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# Late Prehistoric Lithic Economies in the Prairie Peninsula: a Comparison of Oneota and Langford in Southern Wisconsin and Northern Illinois

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LATE PREHISTORIC LITHIC ECONOMIES IN THE PRAIRIE PENINSULA:  
A COMPARISON OF ONEOTA AND LANGFORD IN SOUTHERN WISCONSIN AND  
NORTHERN ILLINOIS

by

Stephen W. Wilson

A Thesis Submitted in  
Partial Fulfillment of the  
Requirements for the Degree of

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at

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## ABSTRACT

### LATE PREHISTORIC LITHIC ECONOMIES IN THE PRAIRIE PENINSULA: A COMPARISON OF ONEOTA AND LANGFORD IN SOUTHERN WISCONSIN AND NORTHERN ILLINOIS

by

Stephen W. Wilson

The University of Wisconsin-Milwaukee, 2016  
Under the Supervision of Robert J. Jeske PhD

This thesis is an examination of the environmental settlement patterns and the organization of lithic technology surrounding Upper Mississippian groups in Southeastern Wisconsin and Northern Illinois. The sites investigated in this study are the Washington Irving (11K52) and Koshkonong Creek Village (47JE379) habitation sites, contemporaneous creekside Langford and Oneota sites located approximately 90 kilometers apart. A two-kilometer catchment of Washington Irving is compared to that of the Koshkonong Creek Village to clarify the nature of environmental variation in Langford and Oneota settlement patterns and increase our understanding of Upper Mississippian horticulturalist lifeways. Lithic tool and mass debitage analyses use an assemblage-based approach to understand the lithic economies at each site, accounting for procurement and manufacturing strategies and assemblage diversity and complexity.

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# CHAPTER 1

## INTRODUCTION

The Oneota and Langford cultural traditions are aspects of the Upper Mississippian pattern of the Late Prehistoric period in the Eastern Woodlands. While Langford has been used to describe a geographically well-defined archaeological culture in Northeastern Illinois, the term Oneota has often been used to describe a larger archaeological culture with much variation that extends across several states in the Midwest of the United States and Canada (Griffin 1960a; Hall 1962; McKern 1942; Overstreet 1995, 1997). However, localities with a distinct Oneota assemblage have been established across Wisconsin (Overstreet 1997). The Lake Koshkonong locality is the concern of the investigation into the Oneota archaeological culture in this study.

### **Research Goals**

The Washington Irving (11K52) and Koshkonong Creek Village (47JE379) sites (Figure 1.1) will serve as study sites for the research into Langford and Oneota village environments, lithic manufacture and tool use. Both village sites are situated within creek environments and are contemporaneous, making the sites ideal for a comparative analysis. The focus of this thesis is the relationship between local environment and the lithic assemblages at late prehistoric archaeological sites. A central aspect of the lithic analysis is based on understanding the lithic economies employed by Langford and Oneota inhabitants within their local environments. However, the focus of this thesis will also be to examine the way in which site location influences the organization of lithic technology for Late Prehistoric groups.

### *Settlement Locations*

The first part of this thesis is a description of the environmental contexts of the Washington Irving and the Koshkonong Creek Village sites. However, the methods used in this

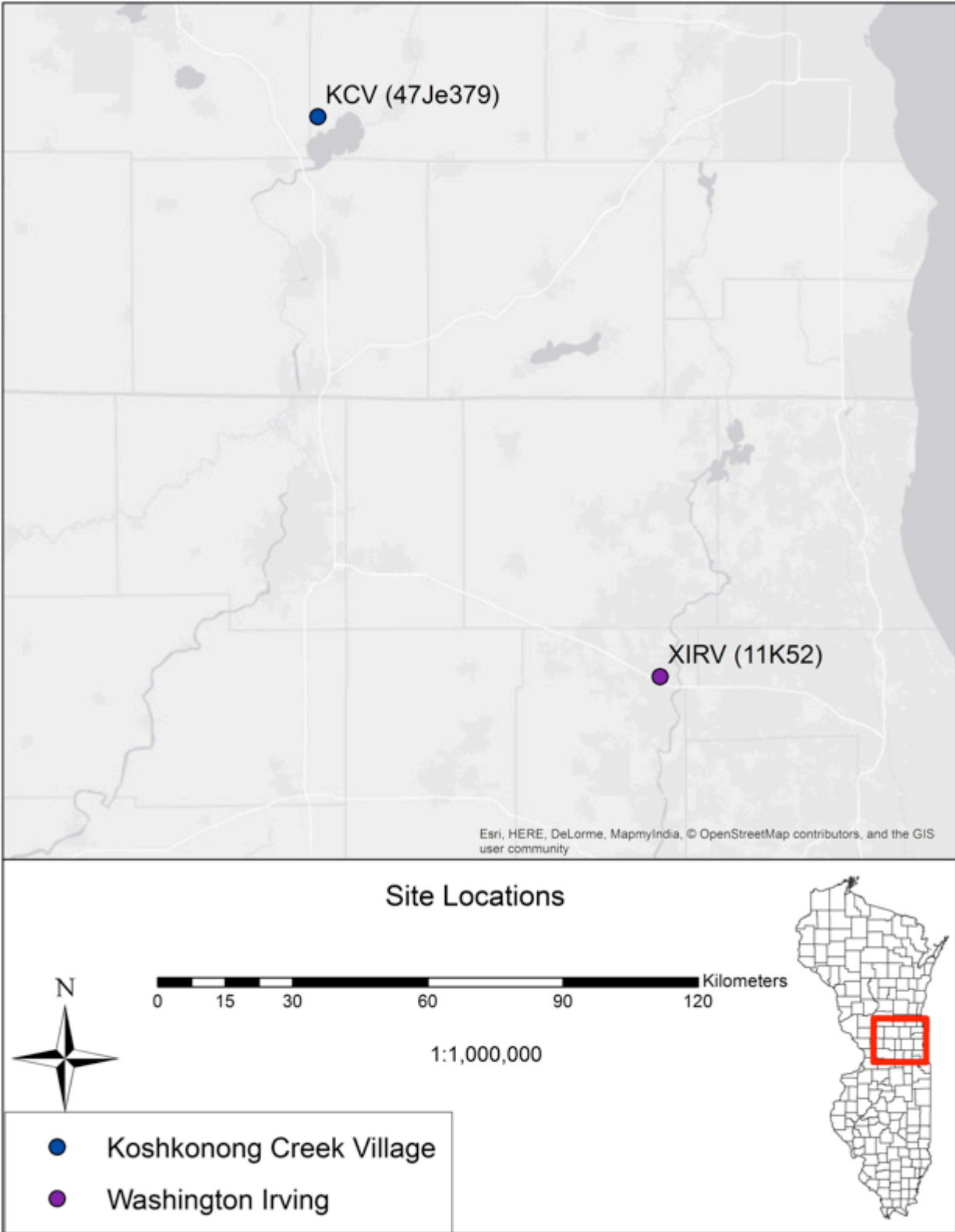


Figure 1.1: Location of the Washington Irving and Koshkonong Creek Village sites in Northeastern Illinois and Southeastern Wisconsin.

thesis differ from previous examinations of Oneota and Langford settlement patterns (e.g., Bird 1997; Jeske 1990; Overstreet 1976, 1978; Rodell 1983; Sasso 1989). A model was created of the environmental setting around the Washington Irving site using GIS to manipulate variables such as the agricultural potential of the land, the composition of environmental zones and the subsequent ecotone areas (after Edwards 2010). The purpose of modeling the site was to update Hunter's (2002) model at a two-kilometer radius and contextualize the site location. A catchment analysis allows for quantifiable variables to be the basis for an examination of settlement patterns and the surrounding environment.

A model of the Koshkonong Creek Village site was previously constructed by Edwards (2010) and is used in this thesis to describe the site's location. Additionally, a descriptive comparative catchment analysis was conducted with the purpose of comparing the sites locations. Specifically, the catchment analyses will be used to answer several research questions (after Edwards 2010:14): What were the environmental contexts of the sites? Were the sites located with access to sufficient arable land?

### *Lithic Assemblages*

The second part of this thesis investigates the lithic economies and stone tool assemblages at the Koshkonong Creek Village and Washington Irving sites. The macroscopic analysis of the lithic assemblages from the study sites includes a mass analysis of the debitage and an individual analysis of the lithic tools. The assemblages investigated in this thesis are from the 2012 and 2014 field seasons at KCV and from the 1984 and 1985 field seasons at Washington Irving. Both assemblages consist of lithic artifacts recovered from excavated contexts, including features and the plow zone. The nature of each lithic assemblage is discussed with the following questions in mind: What raw materials were site occupants using to

manufacture stone tools? What is the quality of the raw material used? Were the raw materials heat altered before being flaked? What stages of stone tool production were happening at the sites? All of these questions regarding the production of stone tools are vital to understanding the lithic economy of the inhabitants of KCV and Washington Irving and can be answered using an assemblage-based methodology. Through a comparison of the lithic assemblages from KCV and Washington Irving, we can further understand the cultural variations of Upper Mississippian groups like Oneota and Langford. Is the lithic technology at KCV similar to that at Washington Irving? Are there interregional differences in the economic choices groups make regarding stone tool production?

### **Thesis Organization**

Chapter Two is a discussion of the cultural history of the Oneota and Langford traditions and a review of the literature surrounding the Upper Mississippian groups. Chapter Three is a discussion of the methods and methodology surrounding the catchment analysis of the study sites. The origins of catchment analysis are discussed, as well as optimal foraging theory, the theoretical framework in which catchment studies are grounded. Additionally, the definition of vegetation types, adapted from Goldstein and Kind (1983), and the methods of reconstructing the prehistoric vegetation of the catchment area are discussed.

Chapter Four is a description of the study sites. Archaeological investigations, excavation and prior research at the sites are discussed. Finally, the site locations are described using the two-kilometer catchments modeled in GIS. The environmental model of KCV was adapted from Edwards' (2010) thesis. Chapter Five is the descriptive catchment analysis of the two sites. The environmental zones, ecotones and arable land of the sites are compared as to attempt to better understand Oneota and Langford site settlement behaviors. Non-economical factors such as site

elevations and distances to important resources are also described and discussed. A resource pull analysis (Jochim 1978) was conducted to characterize the economical areas that influence site placement.

Chapter Six is a discussion of the theoretical perspectives and methods framing the macroscopic analysis of the lithic assemblages. The organization of technology approach highlights many aspects of Upper Mississippian lifeways that may otherwise be obscured. Additionally, the assemblage-based schema and methods of data collection for this thesis are outlined (see Jeske 2014 for lithic recording schema). Chapter Seven is dedicated to describing the lithic tools and debitage from each site.

Chapter Eight is a comparative approach that examines the differences between the lithic tool and debitage assemblages at the study sites. Several aspects of the assemblages are investigated, such as raw material procurement and modification, lithic tool form, morphology and use, the proportion of lithic debitage to tools and the organization of lithic economies within an environmental context.

Finally, Chapter Nine is the summary and conclusions of the research presented in this thesis. Broader impacts of the research are discussed and avenues for future research are suggested.

## CHAPTER 2

### ONEOTA AND LANGFORD ARCHAEOLOGICAL TRADITIONS

The Oneota and Langford traditions are regional expressions of Upper Mississippian culture that are at least partially contemporaneous (Jeske 1989b, 2003; Lurie 1992). Many scholars have debated the origins of both traditions in the past without complete agreement (cf. Boszhardt 1998, 2004; Brown et al. 1967; Emerson 1999; Fowler 1952; Gibbon 1982, 1986; Griffin 1960a, 1960b; Hall 1962, 1986; Henning 1995; Jeske 1989b, 1992b; Markman 1991; Overstreet 1997, 2009; Theler and Boszhardt 2000, 2006). This section briefly explores the discussions that scholars have had regarding the relationship of Upper and Middle Mississippian culture groups and the transition of Woodland and Mississippian patterns.

#### **Upper Mississippian Pattern**

The name Upper Mississippian was first used by McKern (1931:386) to refer to a particular ceramic style typical of the Grand River material culture in Wisconsin and named after the portion of the river flowing between Wisconsin, Minnesota and Iowa. However, Gibbon (1970:281) suggested that the term “Upper Mississippian” was used by McKern to denote a likely center of the cultural tradition rather than define its geographical boundaries. The term Upper Mississippian is used to include several defined archaeological cultures, such as Oneota, Fort Ancient, Fisher and Langford traditions (Hall 1962, 1986).

#### *Origin of Upper Mississippian Lifeways*

An early interpretation by Griffin (1960a, 1960b:26) suggested the changing climate around A.D. 1200 may have been a catalyst for an Old Village Mississippian migration and a

shift of complex Middle Mississippian lifeways to Upper Mississippian lifeways. Upper and Middle Mississippians were once considered to be related; however, Hall (1962:5-6) argued that Upper Mississippian groups lacked certain characteristics, such as temple mounds or diverse art forms, that are distinctive of Middle Mississippian groups. While Hall (1986:365-366) suggested Upper and Middle Mississippian groups share numerous characteristics suggestive of contact and interaction, or even a shared ancestry, he acknowledged that the term Upper Mississippian was outdated and implied that those groups are more closely related to Middle Mississippian cultures or to each other than to the Woodland archaeological cultures.

Conversely, many scholars have postulated that Upper Mississippian groups derived from Late Woodland societies rather than Middle Mississippians (Boszhardt 2004; Egan-Bruhy 2014; Gibbon 1972, 1980; Jeske 1989b, 1992b; Richards and Jeske 2002; Theler and Boszhardt 2006). Jeske (1989b, 1992b) hypothesized that an Upper Mississippian cultural transformation occurred as a result of Late Woodland horticultural practices alongside a shift in social relations between large and small neighboring groups. Jeske wrote:

As Late Woodland groups in the Mississippi and lower Illinois valleys developed Mississippian lifeways, coalescing into a larger and more complex political and social units, the northern groups would quite likely have been marginalized. The nature of interactions between northern and southern groups is unknown, but the differences in population sizes would have left the northern groups at a disadvantage in any economic and social interaction [Jeske 1992b:65].

Upper Mississippian societies are often marked by localized occupations with large portions of the landscape marked without occupation (Emerson 1999; Richards and Jeske 2002). While Jeske (1992b:62) argued that structure of Upper Mississippian groups into separated localities may have been due to strategies of maintaining social boundaries and an ethnic identity, Emerson (1999:37) suggested the presence of distinct buffer zones or “no-man's lands”



between contemporaneous groups suggests the presence of warfare and violence among Mississippian groups. Jeske (1999b) also argued for a World Systems perspective where the threat of military coercion may have been part of a multidimensional relationship between Middle and Upper Mississippian groups.

### *Oneota and Langford*

Oneota and Langford are contemporaneous, neighboring Upper Mississippian traditions (Jeske 1989b). Several scholars have argued that Oneota and Langford traditions can easily be identified and distinguished by their distinct ceramic assemblages (Brown et al. 1967; Jeske 2000:287). Conversely, some archaeologists have argued that Langford and Oneota ceramic assemblages may not suggest distinct cultural groups. Berres (2001) suggested Oneota and Langford groups should be considered as one single Upper Mississippian tradition, as pottery from both Langford and Oneota sites contain motifs indicative of Oneota culture only, suggesting the Langford tradition is simply a phase of the Oneota tradition (Berres 2001:141). However, Jeske (2003a:179) rejected Berres' conclusions and suggested Langford and Fisher phase Oneota ceramics were not designed, manufactured, and used by a single, unified cultural entity. To support his case, Jeske argued four points:

The lack of Fisher ceramics from the Fox, Des Plaines, and DuPage River valleys, and from upland sites in northern Illinois, indicates some form of territorial boundary maintenance. Not only were Fisher and Langford ceramics used by people who maintained some form of spatial discreteness, these people followed different subsistence and settlement strategies. In addition, there is evidence that differential technologies were utilized to exploit their environments (Jeske 1989b). Finally, the scant radiocarbon data for Fisher sites indicates that Langford and Fisher are not exactly coeval, although they certainly overlap in age [Jeske 2003a:179].

Furthermore, Jeske (2003a:179) suggested the presence of Langford sherds at Oneota sites and shell-tempered sherds at Langford sites on the margins of the Langford territory

indicates some form of cultural interaction between the two cultural groups. In support of this conclusion, Schneider (2014) also noted the Lake Koshkonong locality has strong association to groups in northern Illinois. The Crescent Bay Hunt Club, Koshkonong Creek Village and Schmeling sites have yielded several Fisher ware vessels commonly found in northern Illinois.

While Emerson (1999) argued that Langford exhibited a higher level of hierarchical organization than Wisconsin Oneota groups, Foley-Winkler (2011) concluded Langford and Oneota burial practices suggest an egalitarian socio-political organization despite a significant amount of variation among sites. While Langford mound burials are more common than among Oneota groups, there are known Oneota mounds located in south-central Wisconsin, and at the Fisher site in northern Illinois (Langford 1927). Non-mound burials are also common in Oneota sites, such as sites in the Lake Koshkonong Locality, and are found at several Langford sites such as the Zimmerman and Washington Irving sites (Brown 1961; Jeske 2000).

Likewise, Emerson (1999), Foley-Winkler (2011) and Jeske (2000, 2003a) also suggest that violence was a significant part of Langford tradition lifeways. Foley-Winkler concluded that violence is present more frequently at Langford sites than Oneota sites. Further, she suggested violence may have been more localized and restricted when compared to Oneota sites in the Central Illinois valley such as Norris Farms #36 (see Milner et al. 1991). Other recent research regarding the stress adaptations of both Langford and Oneota (e.g., Emerson et al. 2010; Edwards and Jeske 2015; McTavish 2014, 2015) suggest that these groups were under significant physical and social stress.

It is evident that Langford has been widely accepted as a distinct cultural tradition in the archaeological literature surrounding Upper Mississippian research (see Brown et al. 1967; Faulkner 1973; Fowler 1952; Griffin 1946; Jeske 1989b, 1990, 2000; 2003a; Lurie 1992). The

remainder of this chapter is a further discussion of the Oneota and Langford traditions separately within an Upper Mississippian framework.

### **Oneota Cultural Tradition**

People of the Oneota tradition occupied much of the Midwest for seven or eight centuries. Compared to other Oneota traditions, the southeastern Wisconsin Oneota tradition is one of the longest-lived Oneota regional continuities (Hall 1962:108) and spans the course of 600-800 years (Boszhardt 2004; Overstreet 1997). The term Oneota was first used by Charles R. Keyes (1929) to describe the culture associated with archaeological sites in Iowa:

A very distinctive culture that occupied solidly the valley of the Upper Iowa River valley...is unidentified at this time and is called for the present the Oneota, after the old name of the river where it remains the most continuous [Keyes 1929:140].

Keyes (1929:141) originally distinguished Oneota tradition from other groups by their use of shell-tempered, unpolished ceramics, small triangular bifaces and simple flake scrapers. He also noted that Oneota sites are often situated open on high river terraces or wide prairie bluffs.

#### *Oneota in the Archaeological Record*

Often regarded as a “pottery culture” (Gibbon 1982, 1986), Oneota artifacts are most recognizable in the archaeological record by their distinct ceramic style (Hall 1962; Overstreet 1997). Gibbon (1986:319-321) described typical Oneota pottery vessels as globular jars with wide mouths and flaring rims that were often decorated. The clay was smoothed with a paddle and tempered with mussel shell before firing, differing from Woodland style pottery, which is often decorated with cord wrapping. However, there are regional differences among Oneota

pottery types, such as Grand River, Lake Winnebago, Orr, and Carcajou, mostly commonly varying in shoulder decoration or the addition of grit temper with shell.

Common Oneota chipped stone tools are small triangular projectile points, scrapers, knives, drills and perforators (Gibbon 1986). Expedient stone tools and unrefined bifacial tools are common, likely to be more efficient with the fair and poor quality local raw material (Sterner 2012). However, Gibbon (1986:328) acknowledged that a stone tool assemblage is not diagnostic of an Oneota occupation, as many prehistoric groups in the Midwest used small triangular projectile points, scrapers and other tools.

Apart from tempering clay for pottery, shell was used for various tools and ornaments, such as spoons, hoes, scrapers, fish lures, and pendants. Copper tools and ornaments such as beads and pendants are commonly found at Oneota villages, but in low frequencies (Gibbon 1986).

Early Oneota settlements are often described as including several different house types, such as wigwams, rectangular, and pit houses, with longhouses adopted after A.D. 1400 (Hollinger 1995; Overstreet 1997). Benches were often built around the inside walls of house with a fireplace set in the middle of the floor (Gibbon 1986). However, Moss (2010) concluded that longhouse structures were a significant part of the architecture at the Crescent Bay Hunt Club site, and at this time, it appears that they date between A.D. 1200-1400.

Pits have been observed in basin, bell-shaped, and cylindrical forms and were often used for food storage. Garbage such as broken pottery vessels and animal bone was often thrown into the pits after they had been used for storage (Gibbon 1986). While not common during early Oneota occupations, Overstreet (1997) noted that the construction of palisades became more

common among Oneota groups as time went on. However, recent reevaluation of several Oneota sites at Lake Koshkonong call into question evidence for palisades (Schneider 2015).

Oneota cemeteries in southeastern Wisconsin are generally characterized by non-mound burials (Birmingham and Eisenberg 2000; Foley-Winkler 2004, 2011). However, mounds have been associated with several Grand River phase Oneota sites (Foley-Winkler 2011; Overstreet 1997). John A. Jeske (1927) reported numerous mounds at the Walker-Hooper site, while Overstreet (1981) reported burials at the Pipe site within a small knoll, either natural or modified. There are several examples of Oneota mound burials in Illinois, such as the Fisher site (Langford 1927), a Fisher Phase Oneota site, and the Norris Farms #36 (Milner et al. 1991), a Bold Counselor Phase Oneota site. Oneota burial practices were commonly placed on their backs in an extended position, but evidence of bundle burials, semi-seated and semi-flexed positions have also been observed. Individual burials are most common; children are occasionally found with adults in the same burial (Foley-Winkler 2004, 2011). Pottery vessels, projectile points, shell spoons, pipes and other artifacts have been recovered from burial contexts (Gibbon 1986).

### *Oneota on the Landscape*

Oneota groups relied on agricultural practices, such as growing corn, squash, and other less important crops (Brown 1982; Gibbon 1986). In a comparative analysis of Late Prehistoric Upper Great Lakes populations, Egan-Bruhy (2014:67) suggested that Oneota groups placed less importance on maize and squash than Middle Mississippian groups, but favored the exploitation of wild rice as well as nuts, acorn and barnyard grass.

Overstreet (1978) suggested that Oneota sites are often situated on fine sandy loams and other soils that are ideal for horticulture; Jeske (1989b) further noted that Oneota groups

commonly placed sites near mature floodplains with regularly inundated soils. Hunting, fishing, trapping and the gathering of wild plants and mussels were also important subsistence practices (Gibbon 1986). Edwards (2010) and Rodell (1984) concluded that Oneota sites in the Lake Koshkonong locality were all located in the vicinity of some form of aquatic environment. Such a site location allowed site occupants to exploit wetland resources while reducing pursuit time, yet remain nearby savannas for hunting upland game.

### *Wisconsin Oneota Localities*

Overstreet (1978, 1997) originally defined seven distinct localities of Oneota habitation sites around Wisconsin. However, Schneider (2015) indicates that two additional localities are now recognized, one near the Waupaca River and potentially another one in northeastern Wisconsin (also see Overstreet 2009). Wisconsin Oneota localities encompass a large portion of the state, with significant areas across the landscape without occupation, separating these localities (Emerson 1999; Richards and Jeske 2002). The La Crosse and Lake Pepin localities are situated in western Wisconsin along the Mississippi River valley. The remaining localities are located in eastern Wisconsin and include the Green Bay, Wolf River, North Lakes, Middle Fox River Passageway, Grand River, and the Lake Koshkonong localities (Figure 2.1).

### *Wisconsin Oneota Chronology*

The temporal boundaries of the Oneota tradition are controversial (cf. Boszhardt 2004; Overstreet 1995:33) but are circa A.D. 1050 to 1650 (Schneider 2015). In 1962, Hall introduced a temporal system based on three horizons to distinguish varying Oneota traditions. These periods are named the Emergent, Developmental, and Classic horizons. Overstreet (1978, 1997) later expanded on Hall's framework to include a fourth horizon, named the Historic horizon.

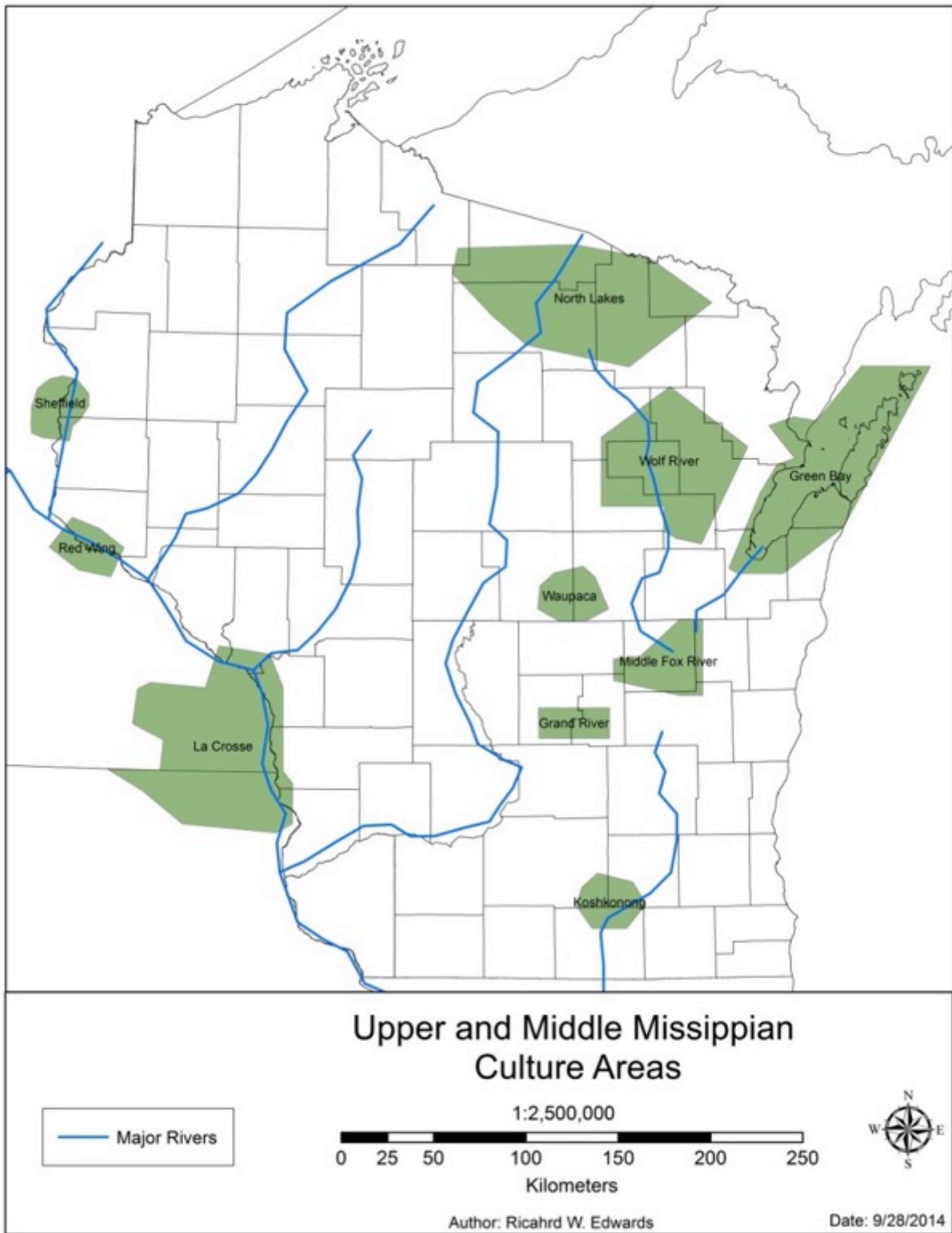


Figure 2.1 Localities of Wisconsin Oneota occupations (map by Edwards).

However, some scholars advocate that distinct temporal horizons often imply an association between groups within the divisions, and often hinder the ability to recognize the variation in material culture between sites and between localities (Hart and Brumbach 2003:747).

Overstreet (1995, 1997) suggested several criteria to be adequate evidence to distinguish the Emergent horizon, ranging from circa A.D. 950 to 1150, to later Oneota occupation horizons. Such criteria include the frequency of undecorated ceramics, pit house structures, and the low frequency of end scrapers. The Developmental horizon, ranging from circa A.D. 1150 to 1350, has been distinguished from the Emergent horizon by an increase in the decoration on pottery, such as trailed or punctate shoulder designs, as well as the addition of wigwam architecture and evidence of bipolar stone tool manufacturing.

By the Classic horizon, ranging A.D. 1350 to 1650, undecorated vessels are rare and bone tools such as bison scapula hoes become more ubiquitous. Lithic technology exhibits the exploitation of poor quality raw material as well as a higher frequency of end scrapers to triangular points (Overstreet 1995). Research of the Historic horizon, post-A.D. 1650, involves the suggestion of an association between the Oneota with the historic Winnebago (or Ho-Chunk); however, this conclusion is unclear and has been debated by scholars (see Green 1993; Griffin 1960a; Hall 1995; Overstreet 1995; Richards 1993, 2003).

#### *Origin of Wisconsin Oneota*

Overstreet (1997) identified two models for the origin of Oneota tradition in Wisconsin: an *in situ* development model and a migration model. The *in situ* development, or transformation model, assumes that local Late Woodland people adopted new sedentary life-ways centered on the increased agricultural use of corn. Conversely, the migration model does not directly connect



Late Woodland and Oneota cultures but rather suggests people who were already in possession of a corn-based agricultural life-way became more sedentary in village type communities.

Many scholars have concluded that Oneota in southeastern Wisconsin emerged as a fully recognizable complex and does not coincide with a migration model, although the topic has been debated thoroughly (see Boszhardt 1998, 2004; Gibbon 1982, 1986, 1986; Griffin 1960a; Hall 1962, 1986; Henning 1995; Jeske 1992b; Overstreet 1997, 2009; Theler and Boszhardt 2000, 2006). Scholars in opposition of the *in situ* model proposed the lack of evidence of interaction between Woodland and Oneota population suggests a migration and replacement model (Overstreet 1995). However, others have argued a fully developed Oneota tradition must have been developed before A.D. 950, and the lack of evidence for any such occupation suggests a Woodland population transition (Boszhardt 2004:23).

### **Langford Cultural Tradition**

The Langford tradition is a regional expression of Upper Mississippian that emerged circa A.D. 1100 to 1450, and is mainly restricted to the upper Illinois River valley and its tributaries (Birmingham 1975; Emerson 1999; Foley-Winkler 2011; Hunter 2002; Jeske 1989b; 1990; 2000).

There has been much scholarship on Langford tradition within the past several decades. Initial investigations had shown a linear distribution of Langford sites, such as the Gentleman Farm (Brown et al. 1967), Fisher (Langford 1927; Griffin 1946), Robinson Reserve (Fowler 1952), and Zimmerman sites (Brown 1961), located exclusively along the Illinois and Des Plaines rivers. After early discussions of Langford site locations and radiocarbon dates (Jeske 1989b, 1990; Jeske and Hart 1988), Bird (1997:56) noted that more recent archaeological research has 1) expanded the geographical boundaries of the Langford tradition occupation, 2)

added sites located on upland environmental settings, 3) increased understanding of the duration of the tradition with radiocarbon dating, and 4) allowed for the reconstruction of subsistence practices with the recovery of floral and faunal remains from flotation.

James Brown (1961:75) was the first to use the term “Langford” as a descriptor for an archaeological tradition. Prior to that, Langford was used to describe the ceramic style recovered from the Fisher site (11WI5), named and defined in John W. Griffin’s (1946:13-25) Master’s thesis. The analysis describes the ceramic assemblage from the multicomponent Fisher site, and subsequently defined and named the grit tempered ceramic series in honor of George Langford, the first archaeologist to excavate the site. Langford (1927:158) visited the site intermittently beginning in 1898 and made his first “close external examination” in 1912. Langford reported that the ceramics were a mixture of decorated and undecorated, with temper being both shell- and grit. Most vessels were globular in form with sharp necks and low rims. John W. Griffin noted that grit-tempered Langford ceramics were decorated less often than the shell-tempered Fisher ceramics from the site.

#### *Langford in the Archaeological Record*

While Langford pottery is distinctive from Fisher and Oneota ware by the use of a mafic grit temper (see Faulkner 1972; Hunter 2002; Jeske 1989b, 1990; Lurie 1992), many scholars have noted that Langford ceramics are otherwise very similar to Oneota pottery. Vessels are commonly globular in shape with surface treatment that varies from cordmarked to smooth or smoothed-over cordmarked. Rims are often undecorated but examples of notched rims have been observed, and shoulder decorations are often of trailing or chevron designs (Jeske 1989b).

While Jeske (1989b:109) suggested that Langford and Oneota lithic assemblages are largely identical in terms of typology, the assemblage-based analysis produced in this thesis provides a better understanding of the lithic economies of each group. Langford is often characterized by a lithic economy of small triangular point manufacture and bipolar reduction (Jeske 2000:265). Other common lithic tools include stemmed and generalized bifaces (including crude humpback bifaces), bifacial drills, unifacial scrapers and utilized flakes (Fowler 1952; Jeske 1989b, 1990; Lurie 1992).

Bipolar reduction seems to have been an important part of Midwestern lithic technology, and was used to produce of blanks from small nodules and recycle increasingly scarce raw material (Binford and Quimby 1963; Goodyear 1993; Jeske 1992a; Jeske and Lurie 1993; LeBlanc 1992; Shott 1989). Scholars (e.g., Jeske 1992a; Shott 1999) noted that the morphological descriptions of lithic pieces should not imply a fixed category of function or meaning. Following a long-standing discussion in Upper Mississippian literature concerning humpbacked artifacts (cf. Brown 1967; Munson and Munson 1972), Jeske (1992a) argued that rather than define humpbacks as a functional type, they should be seen as the product of bipolar blank production with a low degree of refinement that results in a fairly crude bifacial tool. Munson and Munson (1972:35) argued that humpbacks were a form of knife separate from triangular points, and astutely observed that humpbacks were not recovered from Middle Mississippian sites to the south nor Oneota sites to the north of the Langford-Huber region of northern Illinois. They tentatively suggested a cultural tradition explanation for this distribution. Jeske noted that a lack of discrete characteristics to differentiate humpback from Madison bifaces suggests no real distinction between the two types, and suggests that the distribution of

the form has more to do with raw material package size than function or cultural traditions (Figure 2.2).

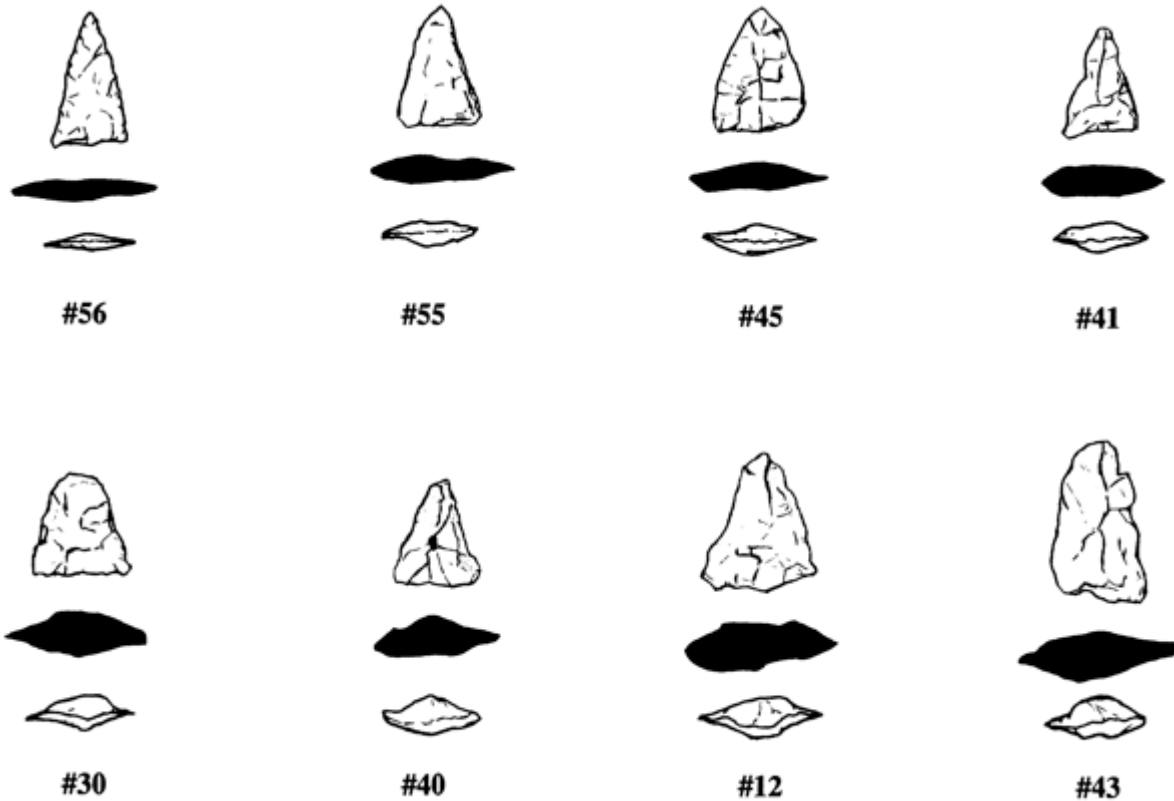


Figure 2.2 A continuum of triangular bifaces from Washington Irving, from refined Madison points (upper left) to crude humpback bifaces (lower right) (adapted from Jeske 1992a).

Floral and faunal assemblages suggest an economy of horticultural practices as well as hunting, fishing and gathering of wild plants. Based on preliminary evidence, Emerson et al. (2005) suggested that Langford groups engaged heavily in maize agriculture, similar to that of Middle Mississippian groups in the American Bottom. However, while maize has been recovered fairly ubiquitously across Langford sites, the extent of the contribution of maize to the diet is ambiguous as its remains are found in low densities (Jeske 2000). Evidence suggests maize was supplemented by hunting and gathering of wild plants such as hickory nuts, wild fruits, with little

evidence for the use of Eastern Agricultural Complex plants present at Oneota and Middle Mississippian sites (Egan-Bruhy 2014). It has been suggested “maize was probably a dietary supplement in the Langford diet, augmenting a generalized hunting-gathering economy focused on wetland resources” (Jeske 1990:225). Bioarchaeological research at the Material Service Quarry site, a Langford site in the Upper Illinois River Valley, however, suggests that Langford maize consumption was comparable to that of populations in the American Bottom (Emerson et al. 2010).

McTavish (2014, 2015) reported that the Washington Irving site and other Langford sites show patterns of local resource acquisition with an emphasis on large upland mammal hunting as well as substantial bone processing. A variety of bone, shell and antler tools have been recovered at Langford sites. Awls, needles, projectile points, pressure flakers, pendants and ear-spools are common Langford tools made of bone, shell and antler. While elk or bison scapula hoes are common bone tools recovered from Oneota sites, they have not been discovered in Langford contexts; Jeske (1990, 2000) proposed the utilization of digging sticks and the lack of scapula hoes may suggest a divergence in the agricultural practices between Oneota and Langford groups.

### *Langford Mortuary Patterns*

Langford sites are characterized by mound and non-mound burials (Foley-Winkler 2011, Jeske, Foley-Winkler et al. 2003). While the absence of mounds is a common characteristic of Oneota burials in southeastern Wisconsin, some Langford sites exhibit mound burials, such as the Robinson Reserve (Fowler 1952; Lurie 1992), Gentleman Farm (Brown et al. 1967), and Material Service Quarry sites (Bareis 1965). However, there are several village sites that do not

contain mound burials, such as the Zimmerman (Brown 1961) and Washington Irving (Jeske 1990, 2000).

### *Langford Landscapes*

Langford land use was complex, and included multiseasonal villages, small camps, and burial sites. Based on data from across northern Illinois and northwest Indiana (e.g., Craig and Galloy 1996; Emerson 1999; Faulkner 1972; Jeske 1990; Lurie 1992; Markman 1991; Michalik 1982), Jeske (2000) stated:

The organization of settlements seems to have been somewhat hierarchical, with large, semi-permanent (or perhaps permanent) villages of 2-5 ha in the larger valleys (e.g., Fisher, Plum Island, Zimmerman); smaller, seasonally occupied sites of ½ - 2 ha found in smaller valleys and adjacent uplands (e.g., Robinson Reserve, Cooke, Reeves); and very small (circa 100-300 m<sup>2</sup>) special activity or extractive camps arc found in marginal, inter-fluvial upland environments (e.g., Kuzwon, Kuzteau, Gazebo). Washington Irving is somewhat of an exception, in that it is a 4 ha site located on a small creek, approximately 2 km from a major river [Jeske 2000:265].

### *Langford Spatial Boundaries and “Localities”*

The Langford tradition is essentially spatially confined to northern Illinois (Jeske 1990, 2000; Lurie 1992), although some Langford outliers extend into Indiana, east Central Illinois, and southeastern Wisconsin. Faulkner (1972:58,122) investigated and identified Langford in the archaeological record at several sites in northwestern Indiana based on the Langford ware ceramics; however, the sherds were recovered in the context of Fisher and Huber occupations. Similarly, a Langford occupation was identified along the Milwaukee River in Milwaukee County in Wisconsin based on Langford Plain and Langford Trilled vessels recovered from the site (Gregory et al. 2000). Brown et al. (1967:36) noted that a single Langford ware sherd was recovered from the Aztalan site, a Middle Mississippian occupation, while Hall (1962:70,92-93)

noted that several Langford grit tempered sherds that account for one or two vessels were recovered from the Carcajou Point site along Lake Koshkonong, a multicomponent site (see Jeske, Hunter et al. 2003).

Bird (1997:132-142) outlined six distinct localities in the Lower Lake Michigan area. She notes that these localities were designed to establish a framework for consistency in the presentation of archaeological data. Additionally, Bird defined 12 tentative phase designations across the six localities. The phases were attempts to outline patterns of settlement systems, architecture, mortuary practices, ceramics types and lithic technology. However, similar to her temporal designations, Bird (1997:135) herself noted that locality designations are limited by the lack of data and quality of data from radiocarbon dates.

### *Langford Chronology*

The Langford tradition is a regional expression of Upper Mississippian that emerged circa A.D. 1000-1100 until circa A.D. 1400-1450, (Birmingham 1975; Jeske 2000), although the majority of Langford sites date in the range of A.D. 1200 to 1350 (Emerson 1999; Jeske 1989b, 2000). Along with localities, Bird (1997:134-135) proposed a horizon model of the Upper Mississippian Langford sequence. Using a tri-modal distribution of calibrated radiocarbon dates from Langford ceramics, she divided the Langford tradition into three “horizons”: Early Langford from A.D. 973 through 1034, Middle Langford from A.D. 1110 through 1357, and Late Langford from A.D. 1426 to 1504.

However, Jeske (2000) cautioned against creating discrete temporal phases based on the current Langford ceramic data, as there is no clear evidence for a strong connection between chronology, space and ceramic types within the Langford tradition. He also further argued it is

currently “premature to attempt a formal division of Langford into archaeological phases” (Jeske 2000:268). It has been argued that many more radiocarbon dates from well-controlled archaeological contexts will be required to develop a robust Langford chronology in Northern Illinois (Emerson et al. 2005; Jeske 2003a).

### *Origin of Langford*

As with the Oneota tradition, many scholars have suggested that the Langford tradition emerged *in situ* from preceding Late Woodland groups in the region (Brown et al. 1967; Fowler 1952; Jeske 1989b, 1990, 1992b; Markman 1991). However, Emerson (1999) noted that there has been no agreement on how the transformation occurred.

As with the Woodland-Mississippian transition hypothesis, scholars have suggested Langford may have originated from a lack of integration with other surrounding groups. Conversely, other scholars have interpreted Langford groups as descendants of the Middle Mississippian culture, either from a migration of peoples or a transmission of cultural beliefs and lifeways (Emerson 1999). Considering the difference between Oneota and Langford pottery, Jeske (1989b, 1992b) suggested that the grit/shell tempered dichotomy began when Late Woodland groups came into contact with Middle Mississippian and nearby Oneota groups, and subsequently integrated into a larger Oneota group in northern Illinois. Additionally, he suggested that:

Other groups in the more remote, smaller river valleys such as the Fox and Des Plaines were more isolated and were not completely enculturated in broader Oneota traditions. Those groups retained traditional grit temper even while employing many Oneota style attributes in their ceramics. The retention of grit temper by Langford groups is seen as a stylistic marker, reflecting a level of sociocultural integration, and not as a strictly functional aspect of ceramic technology [Jeske 1989b:115].



It has been suggested that Langford groups were living on a constricted landscape, as their asymmetrical interaction with neighboring Middle Mississippians would have prompted increased levels of violence and increased territorial boundedness (Emerson 1999:12). However, it is very clear that Langford groups were separate from neighboring groups such as Oneota and Middle Mississippians, but maintained a degree of interaction with these groups (Jeske 1989b, 1992b, 2003a).

## CHAPTER 3

### CATCHMENT ANALYSIS METHODS AND METHODOLOGY

For the research in this thesis, the Washington Irving site was modeled using Geographic Information Systems (GIS) to update the previous model of the site (see Hunter 2002). Hunt (1992:306) acknowledged that the use of GIS, over traditional forms of catchment analysis, allows for the creation of complex and manageable models of the landscape associated with archaeological sites and is enhanced by the data management capabilities of the GIS software.

The examination of the Washington Irving site settlement and the comparison of settlement patterns of Langford and Oneota Upper Mississippian traditions are based on an optimal foraging theory framework. Optimal foraging theory originates from economic, biological, and ecological concepts and has often been modified for archaeological research to better understand how environmental context effects human behavior (Jochim 1976, 1983; Smith and Winterhalder 1981). The goal of many optimal foraging studies has been to identify the composition of faunal assemblages to reconstruct the available resource base of prehistoric groups; however, some studies have emphasized the underlying bases for economic decision-making (Keene 1981:7). The catchment analysis presented in this thesis is grounded in an economic-based optimal foraging framework. In this section, the literature surrounding optimal foraging theory in an archaeological context will be briefly discussed (also see Jochim 1976; Keene 1981; Moore and Keene 1983; Winterhalder and Smith 1981).

#### **Optimal Foraging Theory**

Early archaeological research in optimal foraging studies often made connections between animal behavior and human behavior to understand foraging strategies among

prehistoric groups (Keene 1983). Jochim's (1976) research on prehistoric groups has been regarded as an important foundation for understanding resource exploitation, settlement location, and demographic organization among foragers based on the behavioral and distributional characteristics of available resources (Keene 1981:8).

Optimal foraging models have attempted to create hypotheses regarding the optimal strategies for particular situations in three areas: optimal diet, optimal group size, and optimal foraging space (Keene 1983; Winterhalder 1981). In many optimal foraging studies, understanding behavior within an optimization framework requires a currency or cost-benefit measure that is important to the goals of an organism or group. Keene (1981:9) suggested that the correct currency to employ in optimal foraging studies is the net rate of energy intake over time, often defined as efficiency. However, Jochim (1983:160) acknowledged that viewing efficiency isolated from other factors is not sufficient for optimization models, as groups often seek to achieve several simultaneous goals that are equally significant and possibly conflicting. While efficiency has been a central focus of many optimal foraging models, additional influences, such as nutrients, technological maintenance costs, costs of information gathering, non-food yields, risk, and social factors have been thoroughly studied (Jochim 1988).

Linear program modeling commonly used in economics, ecology and other fields, has also been used in anthropological optimal foraging studies. Keene (1981:14) defines linear programming as a "plan" or "schedule of activities" that best fulfills the specific goal of a group among all feasible alternatives. Linear programming can be a detailed way to understand population settlements and resource exploitation as well as predict the time of year and the extent to which particular resources were exploited. Conversely, Winterhalder (1981:13) suggested that the potential use of optimal foraging studies in anthropology requires generality, and argued that

models based on realism and generality are often comparative. He noted that it is necessary to “simplify complex adaptive systems so that they retain essential and interesting (i.e., nontrivial) features, but at the same time become analytically tractable” (Winterhalder 1981:18). Linear programming modeling is beyond the scope of this research, as it requires additional data collection regarding the costs, values, and availability of each resource (Keene 1981:24-39).

For the purposes of this thesis as a comparative study between Langford and Oneota traditions, Winterhalder’s (1981) advocacy for generality has been followed while economic efficiency (minimizing effort while maximizing productivity) is assumed to be the main factor of settlement location. It can be assumed that Upper Mississippian diet was economically feasible and relatively efficient within cultural and environmental constraints (after Edwards 2010:51; also see Jochim 1976:6-7). Christenson (1982) distinguished economy and efficiency, defining economy as the management of resources and efficiency as the rate of energy input to output over time. Given the constraints on the procurement of raw materials from the environment placed on Upper Mississippian horticulturalists, the assumption of economic efficiency can be used to study Oneota and Langford groups.

Under these assumptions, Edwards (2010; after Jochim 1976) suggested Upper Mississippian settlements would need to be situated in locations that allowed for the exploitation of local resources efficiently. Considering the resource availability throughout northern Illinois and southeastern Wisconsin, he suggested optimally-placed settlements would be located near combined resource areas, such as wetlands near arable land, but also near forest ecotones for optimizing the chance of successful hunting as well as access to fuel. An optimal foraging model of economic efficiency provides the theoretical framework for resource exploitation and

settlement location within the catchment areas around the Washington Irving and Koshkonong Creek Village sites.

### **Catchment Analysis**

The concept of a catchment developed from the analogy of an area drained by a river, and continued as a term to suggest “an area which supplies one particular component of the site record” (Vita-Finzi 1978:25). In an archaeological context, the identification of site exploitation territory is the main utility of catchment analysis. However, it has been acknowledged that catchment analyses can be used to compare sites. Jarman et al. (1973) wrote:

Site catchment analysis has been found useful in comparing the location of sites. Where several contemporaneous sites are available it is instructive to see whether their territories have resources or properties in common, or indeed whether any sites or groups of sites can be considered economically complimentary to each other [Jarman et al. 1973:63].

In early attempts to understand such catchment areas, scholars initially emphasized the distance around a site; however, time soon became an important aspect of catchment as scholars noted that uneven and broken landscape produce boundaries that do not conform to the previously utilized circular shape based on distance (Roper 1979; Vita-Finzi 1978). In terms of economy, Vita-Finzi and Higgs (1970) recognized that the area nearest the site would be most utilized, while exploitation of resources decreases as the distance from a site increases. They wrote:

Other things being equal, distance from the site has a bearing on this: the further the area is from the site, the less it is likely to be exploited, and the less rewarding is its exploitation (unless it is peculiarly productive) since the energy consumed in movement to and from the site will tend to cancel out that derived from the resource. Beyond a certain distance the area is unlikely to be exploited from the site at all: in terms of the technology available at the time, its exploitation becomes uneconomic. [Vita-Finzi and Higgs 1970:7]

Hunter (2002:59-60) acknowledged that terrain, natural obstructions and enriched methods of travel (such as canoes on a waterway) allow for the exploitation of resources to be accessed more complexly than by pedestrian travel time. Such consideration would suggest that catchment analysis to require an amorphous boundary around the site rather than a circular one (e.g., Gallagher and Stevenson 1982). However, Hunter, along with several other scholars (see Edwards 2010; Michalik 1982; Roper 1979; Tiffany 1982; Vita-Finzi and Higgs 1970), argued that simpler circular catchment areas are sufficient. Michalik (1982:40) noted that a circular catchment is a heuristic device, as it “does not represent the actual catchment of a site” and should not be taken as an exact representation of all economic activities that took place at the site. Hunt (1992) also discussed the shortcomings of site catchment analyses, questioning the accuracy of identifying ecosystems and the true shape of a group’s procurement pattern.

While a non-circular catchment may provide a more realistic approximation of the natural boundaries of sites and site exploitation areas, circular catchments have been chosen for previous catchment analyses of Upper Mississippian sites (see Edwards 2012; Hunter 2002; Michalik 1982). In an effort to understand the utilization of resources around a site economically, Vita-Finzi and Higgs (1970) were the first to employ a series of concentric rings to create a catchment for their study area. At each ring, the proportion of resources utilized was reduced, so within the first catchment ring, resources were 100 percent utilized while 50 percent were utilized in the second, larger catchment ring.

In their research, both Michalik (1982) and Hunter (2002) implemented a single ring one-mile radius, as it was assumed that a one-mile catchment was a sufficient area to provide adequate information on the environmental factors affecting the site. Other scholars have implemented larger circular catchment areas. Roper (1979:121) suggested that hunter-gatherer

and forager populations utilize a distance of 10 kilometers from basecamp settlements, while agriculturalists do not normally travel very far from their fields. Similarly, Kelly's (1995:144) Marginal-Value Theorem suggests that forager populations at base camp typically inhabit the area until an effective foraging area of approximately six kilometers is exhausted. Recently, Stencil (2015) produced a catchment analysis of the Finch site (47JE902), a multicomponent prehistoric site situated southeast of Lake Koshkonong; as his research was focused on the foraging behaviors of the earlier prehistoric populations living at the site, Stencil utilized a 10-kilometer catchment area.

As horticultural practices that include foraging and gathering are important aspects of this study regarding Upper Mississippian populations, a smaller two-kilometer catchment area was used. Following the methods of these previous scholars, this analysis has employed a circular catchment, as it facilitates comparisons among sites and is optimal in determining the vegetation distribution around a site. As the catchment model of the Koshkonong Creek Village site (created by Edwards 2010) is used to compare with the catchment area of the Washington Irving site, a double catchment of one-kilometer and two-kilometer areas was implemented.

Alongside a catchment analysis, a resource pull analysis was conducted within the one- and two-kilometer catchment areas surround the sites. The use of double catchments of one- and two-kilometer areas is based on Jochim's (1976:50) idea of resource pull. He suggested that an uneven distribution of resources and their effect on settlement distributions are important considerations when conducting a spatial analysis. The more resources that can be accessed most economically will exhibit a pull on human settlements, and those resources will attract inhabitants to establish settlements nearby. Edwards (2010) further suggested that a site would be placed in the best location to exploit the widest variety of high pull resources. When the idea

of resource pull is applied to a catchment analysis, we should expect the smaller catchments (once kilometer in this study) to have a disproportionate amount of the high pull resources compared to a larger catchment (two kilometers).

### **Vegetation Zones**

Hunter (2002) used soil types outlined from a soil survey map (see Goddard 1979) to delineate the boundaries of four vegetation zones around the Washington Irving site: woodland, prairie, wet prairie and wetland (methods after Michalik 1982; Tiffany 1982). However, the definitions of vegetation types used in this study are the same used by Edwards (2010) in his study of the Oneota Lake Koshkonong locality, and were also used by ARG (1985:19-32) and Jeske (1999:31-34), adapted from Goldstein and Kind (1983). For this catchment analysis, I have utilized five main types of vegetation zones to characterize the environment around the site: forest, prairie, savanna, wetland and aquatic.

#### *Forest*

Forest vegetation has often been defined as an area that is at least 50 percent covered under a tree canopy (ARG 1985). Forest areas would have provided valuable faunal resources to prehistoric populations, such as rabbits, squirrel, deer and elk (Goldstein and Kind 1983), as well as nuts and fruit from fruit-bearing trees (Jeske 1999a).

While Goldstein and Kind (1983:29) outlines several types of forested vegetation zones, they argued that various forest area “tend to blend into each other and division are largely arbitrary.” Similarly, Jeske (1999a) suggested that the resources found in the several types of forest areas are very similar and only require viewing them as a single zone for understanding resource potential.



## *Prairie*

A prairie landscape is defined as grassland with less than one tree per acre (ARG 1985). Goldstein and Kind (1983) indicate prairie as the least economically productive of their vegetation zones. However, Jeske (1999) suggests that may not be the case for this region. Prairies would have provided ragweed, goosefoot, sunflower, amaranths, and sumpweed, as well as rabbits, grouse, deer and bison, coyote and elk, particularly on the edges of prairie/forest or prairie/savanna environments (Jeske 1999a:31-32)

In her catchment analysis of the Washington Irving site, Hunter (2002) noted that the site was located around a wet prairie, or grassland that is seasonally wet. As with forest areas, Jeske (1999a:30) argues that wet prairies and dry prairies can be viewed as one larger type, as the vegetation and resource potential for the two are comparable. However, wet prairies are considered wetland environments in this study (after Edwards 2010:66).

The environment around the site is not clearly identified. Based on the GLO plat map (Milburn 1840), Washington Irving could have been located on a prairie; however, the surveyor's field notes suggest the site was located on an oak savanna. White (1994) noted that savanna and prairie were often synonymous terms in early literature by Illinois surveyors. As per the GLO field notes, this study has suggested the site to be situated in an oak savanna.

## *Savanna/Oak Opening*

A savanna, also called an oak opening, oak savanna or oak barren, is defined as an area with at least one tree per acre but less than 50 percent of acreage under tree canopy (Curtis 1959; cited in Jeske 1999a). An oak opening would have made ideal farmland for Oneota groups, as the soil would have not had a prairie-like thick roots, making cultivation easier (Jeske 1999a; Moran

1980). Furthermore, diffuse tree coverage of a savanna could be easily cleared, unlike in a forested area, making for a more ideal place for horticulture (Goldstein and Kind 1989; Jeske 1999a). Apart from farming, an oak opening environment would have provided valuable resources to inhabitants. Food bearing plants in savannas include a wide variety of seed and fruit bearing species, while faunal resources would have included deer, elk, turkey, rabbits and squirrels (Goldstein and Kind 1983:31; Jeske 1999a:32).

### *Wetland*

Wetlands are defined as areas that are under water for all or a significant part of the year (Jeske 1999a). Goldstein and Kind (1982:21) suggested four types of wetland zones: lowland hardwoods, swamp conifers, grassland swamps and marshes. However, scholars have noted the difficulties interpreting wetlands based on GLO maps and field notes, as all types are often referred to as either swamps or marshes, and are poorly delineated (Goldstein and Kind 1983; Jeske 1999a). For this study all of the various bottomland vegetation zones are categorized as a single wetland zone (after Edwards 2010; Jeske 1999a). Fauna found within the wetlands include animals associated with upland habitats (e.g., deer), but also include aquatic and semi-aquatic animals (e.g., fish, muskrat, turtles). Plant resources such as sumpweed and wild rice would have been very abundant in wetland area (Jeske 1999a:37).

### *Aquatic*

In this study, an aquatic environmental zone includes open water areas, such as lakes, rivers and creeks (after Edwards 2010). The only aquatic environment within the 2-kilometer catchment of Washington Irving is Jelkes Creek. Aquatic zones would have provided several types of resources, such a variety of fish and aquatic mammals (e.g. beavers and muskrats), as

well as larger upland animals in search for water. While Jeske (1999a:33) lumped wetland and aquatic environmental areas into a single zone, Edwards (2010:66-67) separated wetland and aquatic zones because of the different resources availability and transportation potential. As the catchment area of the Washington Irving site with the Koshkonong Creek Village are the focus of this comparative study, Edwards methods are followed, and Jelkes creek is considered an aquatic environment zone separate from wetlands.

### **Reconstructing the Prehistoric Vegetation**

The reconstruction of the prehistoric environment for this catchment analysis involve several datasets, such as General Land Office (GLO) survey maps and field notes (Milburn 1840; Reede 1842) as well as soil survey descriptions and maps (Goddard 1979; Hopkins et al. 1917). Using GLO survey maps and field notes to reconstruct the presettlement vegetation of an area is a commonly accepted method that has been utilized since 1907 (Keene 1981:51); however, they must be used with caution and placed in the context of the surveyor's mission and available technology (Bourdo 1956; Jeske 1988; King 1978; Wood 1976). Soil survey data has been used in conjunction with GLO data in more recent Upper Mississippian research (see Edwards 2010; Goldstein and Kind 1983; Hunter 2002; Michalik 1982; Tiffany 1982).

The Kane County soil surveys from the 1979 and 2004 publications utilize “soil series” to describe the soils throughout the county (see Goddard 1979, Deniger 2004). First published in 1937, the Soil Survey Manual outlines and defines “soil series”, a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material, and “soil types”, a subdivision of the soil series based on the texture of the subsurface soil (Clark 1957:179-181). While Edwards (2010) used the USDA Soil Series Descriptions (Staff, n.d.) to understand the original native vegetation of the catchment

areas around Lake Koshkonong, the soil survey conducted in 1917 (see Hopkins et al. 1917) for Kane County, Illinois predates the United States Soil Survey and Classification system and does not utilize soil series. Rather, the soil classification schema simply identifies a soil type by texture and color throughout a soil profile and describes the soils drainage capabilities. Soils were categorized into four soil classes: Upland Timber soils, Upland Prairie soils, Terrace soils and Swamp/Bottomland soils.

The 1917 soil survey was used to recreate the vegetation of the catchment area, as it is the earliest known soil survey of the area and does not include any disturbed soil areas due to urbanization like more recent surveys (see Goddard 1979; Deniger 2004). The soil survey describes the site to be situated on terrace soils, defined as soils that often occur along streams and formed during glacial melting. Ice would carry and deposit large amounts of gravel or sand along their courses, with finer material later deposited to form the present topsoil (Hopkins et. al 1917:38). The site and its surroundings are located on a “brown silt loam over gravel” type soils, described as one of the best terrace soil types with practically perfect drainage and ideal for agriculture. However, Moran (1980:9) notes that the terrace and bottomland type soil classifications used are of a geological construct and could represent prairie, savanna, forest or wetland prehistoric vegetation. Consequently, the environmental zones on terrace and bottomland soils types were reconstructed from GLO maps and field notes.

Moran (1980:10) also suggested that the wooded areas to the west of the Fox River may actually be better described as oak savanna rather than hardwood forest or “timber”, as noted by GLO surveyor’s maps. Unlike the plat map, the GLO surveyor’s field notes indicate that trees may have covered less than 50 percent of the landscape, suggesting a savanna environment. Moran (1980:68) hypothesized that some savannas are actually the degraded remnants of forests;

he further noted that that savanna environments are commonly found on forest soils, which suggests a forest with a higher density and diversity of tree species persisted long enough to produce a forest soil profile before being reduced by landscape fires.

Hunter's (2002:74) model of the environment surrounding the Washington Irving site is similar to the model in this thesis; however, there are several distinctions. First, Hunter's model of the environment surrounding Washington Irving suggests the site is situated in woodland, with forest and savanna environmental zones not differentiated. However, based on the descriptions of the terrace soils present within the two-kilometer catchment area and the GLO surveyor's field notes, the prehistoric landscape has been interpreted to be a savanna. This discrepancy can most likely be attributed to the schema used by Hunter to classify separate vegetation zones. In this study, the environmental zone in which the site is located has been categorized as oak opening.

Second, Hunter (2002:74) suggested the site was located adjacent to a wet prairie. As noted previously, wet prairie type environmental zones have been classified as a wetland zones (Edwards 2010; Jeske 1999a). Categorized by Hopkins et al. (1917:44) as a bottomland "black mixed loam", the soil that lies directly west of the site is a very fertile soil that drains well. It is likely that Hunter's classification of wet prairie is correct. However, for the purposes this study, it has been categorized as a wetland.

## **Geographic Information Systems/Science Methodology**

### *Environmental Zones*

GLO plat maps for the Dundee and Elgin townships in Kane County, Illinois (Milburn 1840; Reede 1842) were georeferenced in ArcGIS and the soil survey map (Hopkins et al. 1917) was digitized into polygon features. After the soil data were symbolized to represent the

vegetation based on the survey notes, these two sources were used in conjunction with the GLO survey notes to produce a model of prehistoric vegetation zones.

The soil based vegetation map and the original GLO maps were compared on every section line. Some sections are based on vegetation records from the GLO surveyor's maps and notes and others are based on soil survey data. Jeske (1999a:33) recognizes the variable detail in documentation by GLO surveyors within and around vegetation areas, such as openings within forest boundaries and open edges around wetlands. When the recorded vegetation by the surveyor matched the vegetation type from the soil survey, soil data were used because it is more precise. If there were discrepancies between the two, the GLO vegetation types were used because the vegetation was actually observed on the section line and recorded by a surveyor, reducing accuracy issues with soil data. When the two vegetation maps did not line up, they were manually merged by moving points, merging, clipping, etc. in ArcGIS (methods after Edwards 2010).

For the interior of sections, data from the soil based vegetation map were used, as surveying techniques did not require surveyors to deviate from a section line. As such, there are no notes for the interior of sections and many small areas of vegetation were likely missed and not documented (Edwards 2010; Jeske 1999a; Moran 1980). As swamp and marsh bottomlands were incompletely documented by GLO maps and field notes, the soil data were used exclusively to determine wetland vegetation in the catchment area, on section lines and in the interior of sections. The only wetland zones in the catchment area are "peat loams", described as occupying "low, swampy areas that have an almost constant supply of water" (Hopkins et al. 1917:41).

## *Ecotones*

After the environmental zones of the catchment area were created from the GLO survey and soil survey data, ecotones were created. An ecotone has been defined as “a transition between two or more diverse communities...a junction zone or tension belt which may have considerable linear extent but is narrower than the adjoining community areas” (Odum 1959:278). Ecotones are important to understanding human-land relationships as they are typically more productive and contain more biodiversity than the individual communities that compose them, although how much more is dependent upon multiple factors (cf. Fitting 1966; Ghiselin 1977; Lachavanne and Juge 1997; Risser 1995; Schiemer and Zalewski 1991).

In ArcGIS, the ecozones features were first converted from polygons to lines, and 250-meter polygons buffers were generated to model the ecotone areas around environmental zone boundaries. Several of the Extract and Overlay toolsets in the Analysis ArcToolbox were used to create the ecotones. Clip, intersect, union and erase tools were used to manipulate the features to model the intersecting ecotones of the catchment area (after Edwards 2010).

## *Agricultural Potential*

Along with ecozones and ecotones, a model of the agricultural potential was also created of the two-kilometer catchment area. Agricultural potential was determined to be good, fair or poor. The agricultural potential of the catchment area was modeled by assessing three criteria: soil quality, soil drainage, and slope (Edwards 2010).

Soil qualities including loams and silts were considered to be the best soil types for tilling, as well as loamy sands, silty loams, sandy loams, and silty sands. Soils that were primarily a clay component are considered poor for cultivation. Prairie environments were

immediately discounted as potential area for cultivation because of the extensive root systems of prairie soils (after Edwards 2010:73-74). The majority of soils in the catchment area are silty loams, with some wetland areas of deep peat soils (Hopkins et al. 1917).

The soil surveyors also assessed the drainage capabilities of soil types (see Hopkins et al. 1917). Soils classified as well drained or moderately well drained were considered good for agriculture. Those that were classified as somewhat poorly drained were considered fair. Certain soils were determined to excessively drain and were considered poor for agriculture; if the soils drain too quickly, plants are not likely to get enough water for cultivation (Edwards 2010:74).

The 1979 soil survey data were used in conjunction with the 1917 survey to model the slope of the catchment area for determining agricultural potential. This survey was used for several reasons. The 1979 dataset contains slope information that the 1917 soil survey does not contain, and also contains fewer areas of disturbed soil than more recent surveys (Deniger 2004).

While the survey has disturbed soil areas due to urbanization that makes vegetation reconstruction difficult, the slope of the landscape for the majority of the catchment area could be modeled. The majority of disturbed soils were small areas encompassed by larger areas of uniform slope; these areas were assumed to have a similar slope as the directly surrounding area and feature classes were created accordingly. Areas classified as zero to six percent slope were rated as good, and six to twelve percent slope were rated as fair. Areas with greater than twelve percent slope were considered to be too steep for plant cultivation (after Edwards 2010). Once the slope of the area was modeled, all three criteria of agricultural potential were considered for creating the agricultural potential model.

#### *Resource Pull*

Based on Jochim's (1976) assumptions of uneven distribution of resources and their



effect on settlement patterns, a resource pull analysis was conducted. The entire two-kilometer catchment area was given a score based on the economic potential of the environmental zone, the agricultural productivity, and the number of ecotones present. Regarding the economic potential of resource zones, savannas and wetlands scored a four, creeks and lakes scored a two, and prairie scored a one. The number of environmental zones within an ecotone determined its resulting score. The highest possible score for an ecotone was four, and the least possible was zero (methods after Edwards 2010).

Within ArcGIS, resource pull areas were determined using the Union Overlay tool in ArcToolbox. By using Union Overlay, a new shapefile was produced from the three input features (ecozones, ecotones, and agricultural potential), with all of their attributes saved into the shapefiles four new attribute fields. Using the variable coding schema, the field calculator tool was used to add the scores into a single resource pull score. The lowest possible score was one, and a maximum possible score was twelve. After totaling the variable scores into single resource pull score, a map was symbolized and exported.

#### *Modeling the Koshkonong Creek Village Environment*

The methods of modeling the prehistoric environment surrounding the Washington Irving site were derived from Edwards' (2010) reconstruction of the environment around the Oneota sites in the Lake Koshkonong Locality. Excluding the minor differences in methods previously outlined throughout this chapter, the methods outlined in this chapter are congruent with those used by Edwards to recreate the environment surrounding the Koshkonong Creek Village. The maps of KCV produced in the previous chapter were created using the respective GLO plat maps and field notes (Burnham 1836; Land 2005; Miller 1833) and soil survey data (Glocker 1979; Staff, n.d.) from Jefferson County, Wisconsin. For a comprehensive description of the

reconstruction of the prehistoric environment at KCV, see Edwards (2010).

## **Expectations**

Jeske (1990:224) suggested that Langford site placement is related to a combination of variables that include the efficient exploitation of multiple ecozones and the availability of tillable soils and hardwoods for fuel and construction material. As such, we can expect the Washington Irving site to be placed around several environments with access to wooded resources and arable land.

In her comparison of the Crescent Bay Hunt Club site with Washington Irving, Hunter (2002:96) demonstrated that Oneota and Langford groups “preferred two different microenvironments at the edge of the prairie peninsula.” Likewise, other scholars have previously suggested that Langford groups cultivated drier terrace soils near upland resources while Oneota typically settled on alluvial or marsh soils (Jeske 1989b; Lurie 1992). However, Keyes (1929:141) originally noted that Oneota sites are often located on river terraces or wide prairies, while Sasso (1989:250) suggested that Oneota village sites in the La Crosse locality were commonly situated on well-drained terraces. While we can expect the site location and the surrounding landscape around Washington Irving to reflect this pattern, the main goal of this the comparative catchment analysis is to examine the idea that the two Upper Mississippian groups preferred different environmental settings, and if so, how they differed.

While Hunter’s (2002) research focused on the difference between Langford and Oneota site placements, the focus of this study is to understand the environments of seemingly similar occupied areas. Hunter (2002:88) previously suggested that Washington Irving was situated on a landscape with more optimal growing conditions for corn than the Crescent Bay Hunt Club;

However, Edwards (2010) suggested that the environment around the Koshkonong Creek Village site would have had significantly more arable land than the area surrounding the Crescent Bay Hunt Club site. Based on these previous environmental analyses, it is expected that KCV and Washington Irving had plenty of arable land.

## CHAPTER 4

### THE STUDY SITES

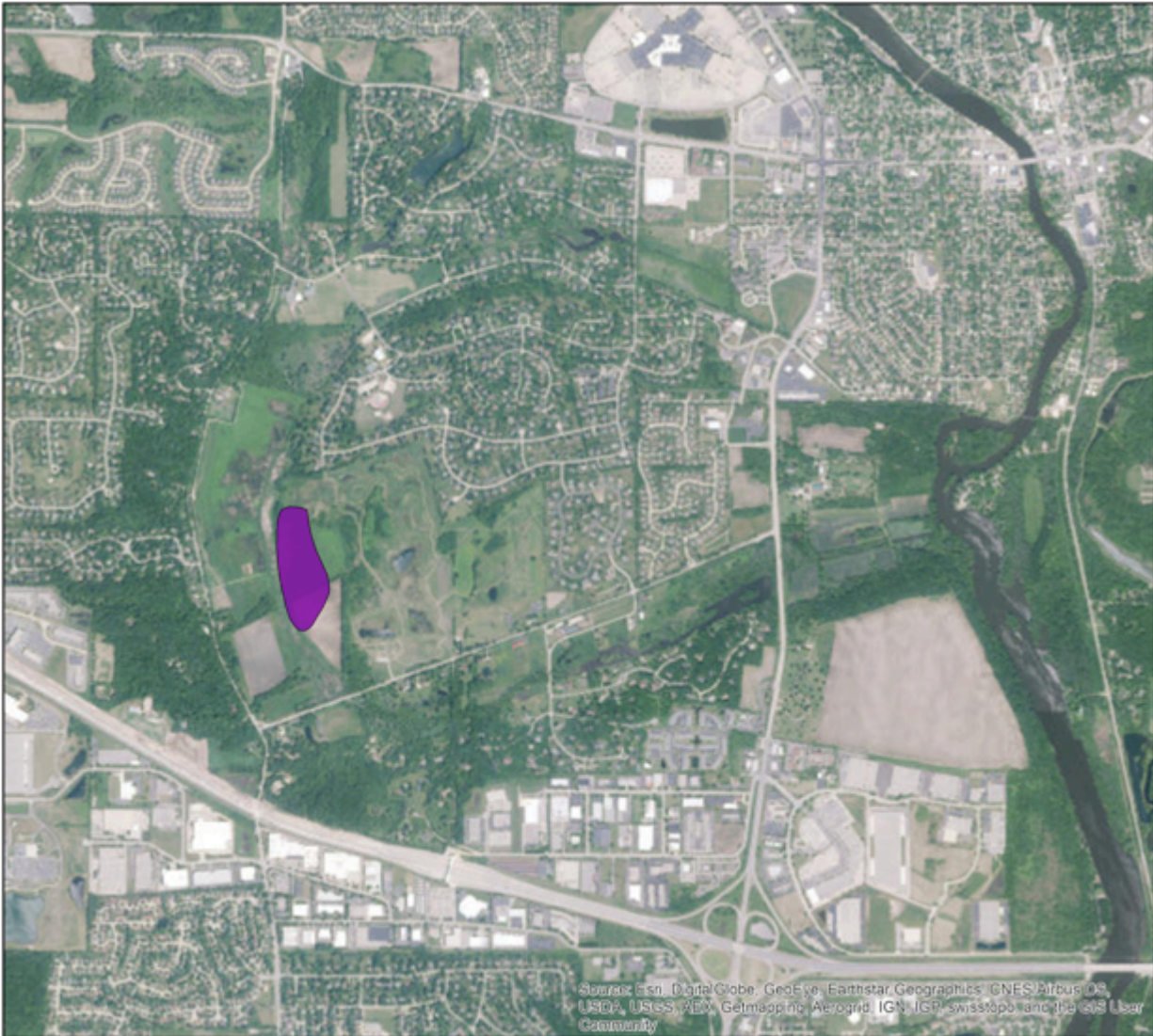
The following chapter provides a discussion of the Washington Irving and Koshkonong Creek Village sites. These are not the only Langford and Oneota sites within the area; however, the sites have been chosen for this study because their similar locations along a creek environment allows for comparison between Langford and Oneota habitation sites in the northern Illinois and southeastern Wisconsin region. Following a summary of the previous excavations and research conducted at each site, a full environmental description generated from the models created in ArcGIS will be discussed.

#### **The Washington Irving Site (11K52)**

The Washington Irving site is a Langford village habitation site located in northeastern Illinois in the Fox River valley along Jelkes Creek, a tributary of the Fox River (Figure 4.1). The earliest documentation of the site was during the early 19th century (see Bird 1989; Jeske 1990). In 1823, Captain Stephen Long was the first to document the site. Upon crossing the Fox River and discovering the site, the expedition:

...discovered a number of mounds, which appear to have been arranged with a certain degree of regularity. Of these we counted twenty-seven. They vary from one to four feet and a half in height, and from fifteen to twenty-five in length; their breadth is not proportioned to their length, as it seldom exceeds six to eight feet. They are placed at unequal distances, which average about 20 yards, and are chiefly upon the brow of the hill; but some of them stand at a greater distance back. Their form appears to have been originally oval; and the slight depression in the ground observed sometimes on both sides of the mound, seems to indicate has been raised by means of earth collected in its immediate vicinity [Keating 1824:179-180].

Stephen H. Long's expedition notes indicate a slightly different description of the discovery. He wrote of no less than 26 mounds situated upon a rising ground about 250 yards



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus OS, USDA, USGS, AeroGRID, IGN, IGP, swisstopo, and the GIS User Community

### The Washington Irving Site 11K52



0 0.5 1 2 3 4 Kilometers

1:32,000



Figure 4.1 Location of the Washington Irving site in Kane County, Illinois.





### *Archaeological Investigations at Washington Irving*

In 1983, a walkover survey was conducted of the Washington Irving site by the Elgin Community College field school. Seven artifact concentration areas were identified, consisting of mostly lithic debris and tools, as well as pottery sherds and plow shatter. Several field schools from the Fox Valley Campus of the Center for American Archaeology also conducted a total surface pick-up survey of the area (Jeske 2000). Based on the initial surveys of the field, Jeske (1990, 1992a) suggested what Long termed “mounds” were actually collapsed late prehistoric earthlodges.

In 1984, field school crews from Elgin Community College as well as Judson College and Harper College returned to conduct excavation in the areas of largest artifact concentration. A total of 38 2-x-2-m units were excavated and indicated a significant Langford occupation. While there was little cultural material below the plowzone, 12 features and four postmolds were discovered. Of the 12 features, 11 of them were excavated and all of them were interpreted as pits or hearths. In 1985, the same field schools returned to the site for further excavation to focus on the cluster of features that were initially interpreted as household units discovered during the previous field season. John Doershuk and April Sievert supervised excavations at the site under the overall direction of Robert Jeske (1990). A large block was opened to identify the possible house floor of the earth lodge. In total, an additional 26 2-x-2-m units were dug with 21 features and postmolds excavated (Jeske 2000, Figures 4.3 and 4.4).

In 1993, a final survey was conducted at Washington Irving and confirmed the original site boundaries laid out a decade prior. The Icabod site was discovered only 240 meters west of the Washington Irving site; however, further research has not been conducted there. Botanical

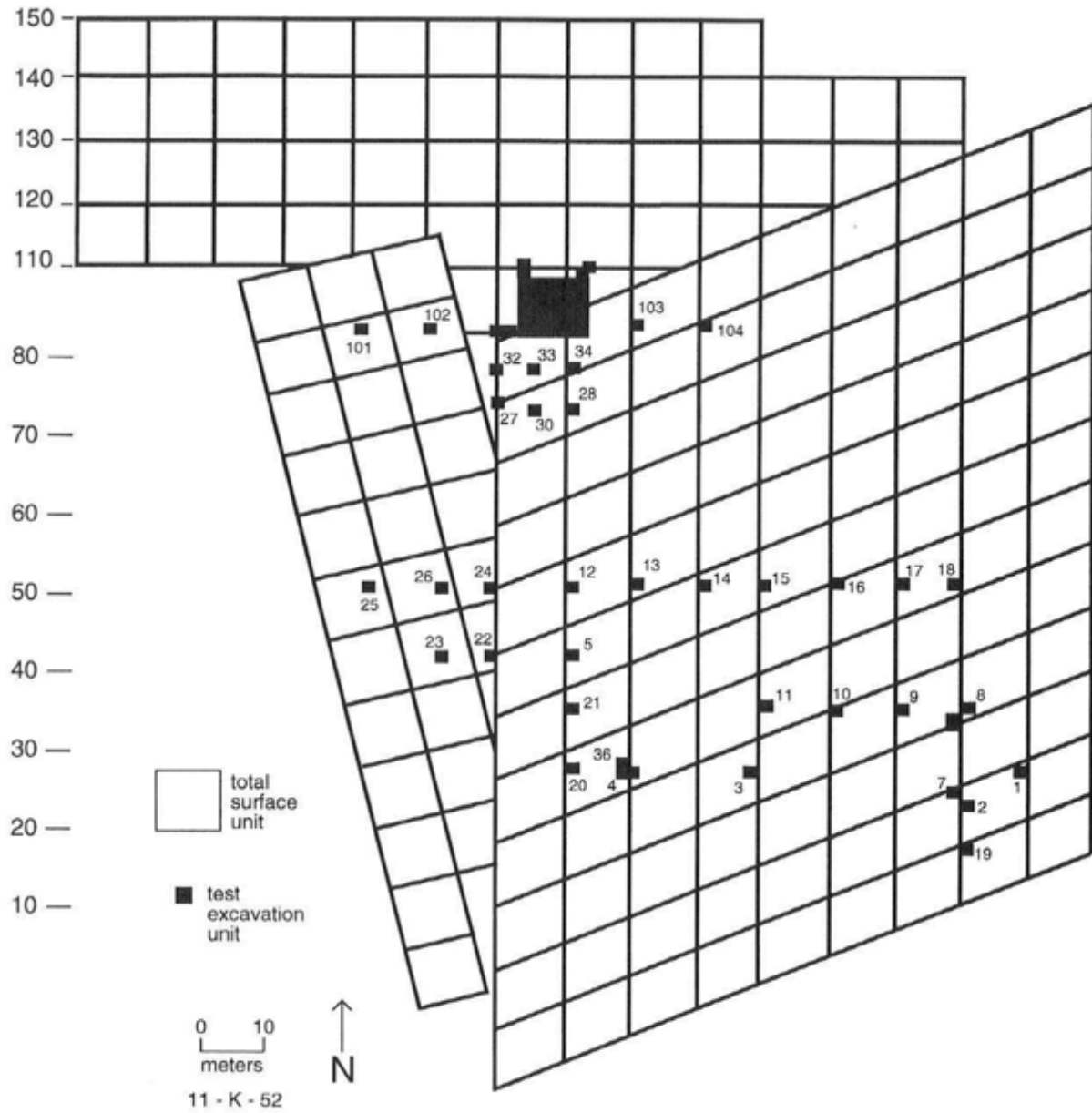


Figure 4.3 Location of 1984 and 1985 excavation units and total surface pickup units (after Jeske 2000:276).

remains, archaeozoological data, feature distribution, and the presence of earth lodges suggest the site was an extensive horticultural village, possibly occupied year-round (Bird 1997; Egan 1985; Jeske 1990, 2000; Lurie 1992; Yerkes 1985).



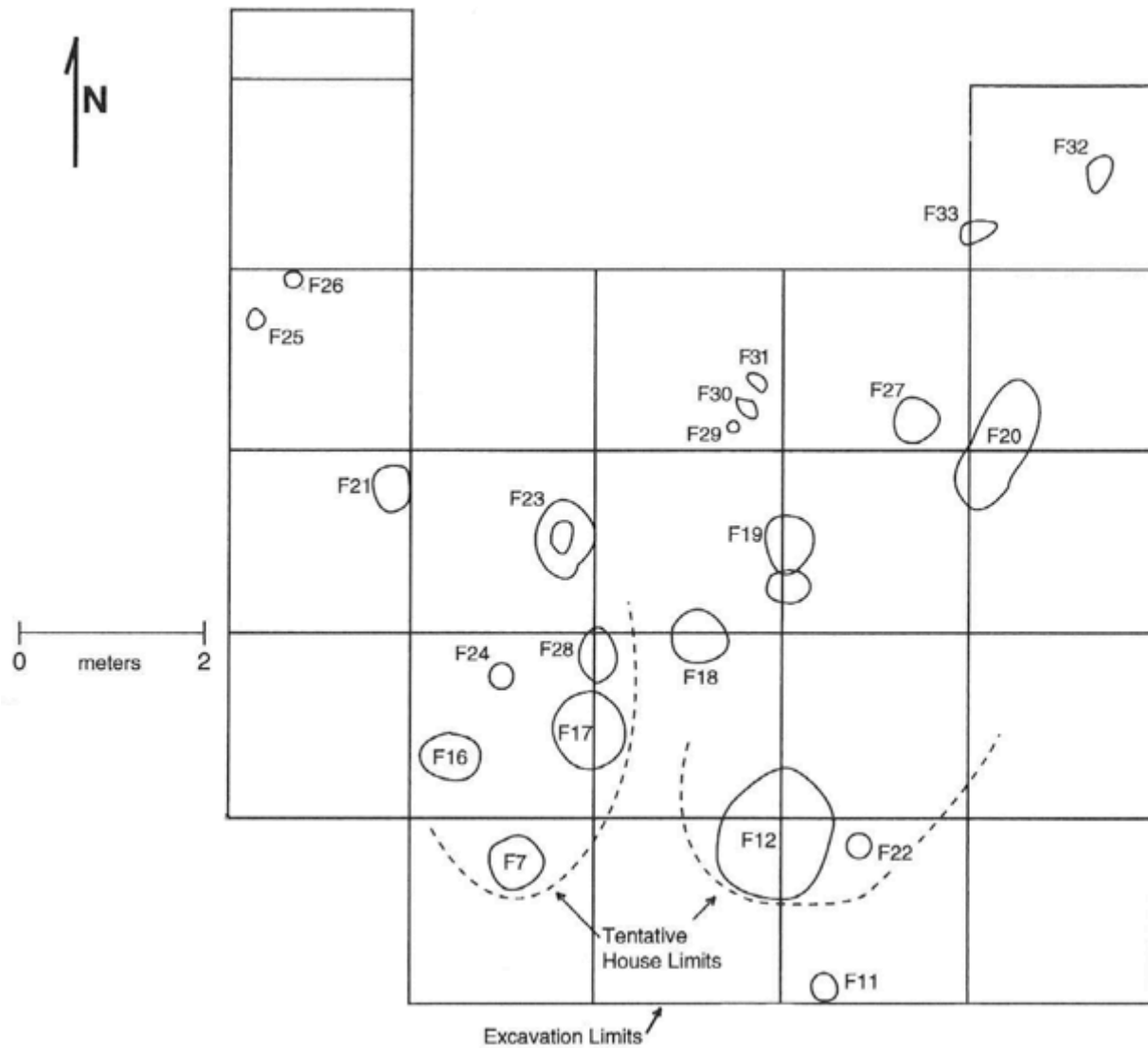


Figure 4.4. Planview of block excavation units and features at the Washington Irving site, 1985 field season (after Jeske 2000).

*Previous Research at Washington Irving*

To date, thirteen radiocarbon dates have been taken from the Washington Irving site. Five radiocarbon dates from wood charcoal suggest an occupation circa A.D. 1260 to A.D. 1450 (Table 4.1; see Jeske 1990; calibrations from Stuiver and Reimer 1986). However, more recent

**Table 4.1. Radiocarbon Dates from the Washington Irving site (derived from Stuiver and Reimer 1986).**

Material	<sup>14</sup> C age	±	Calibrated 1 sigma	%	Calibrated 2 sigma	%	Reference	Lab #
Wood Charcoal	440	70	1412-1516 1596-1618	.87 .13	1328-1341 1395-1640	.02 .98	Jeske 1990	Beta 12587
Wood Charcoal	710	70	1225- 1232 1244-1313 1357-1388	.04 .70 .26	1189-1405	1	Jeske 1990	ISGS 1444
Wood Charcoal	720	70	1223-1305 1363-1385	.83 .17	1169-1175 1181-1399	.01 .99	Jeske 1990	ISGS 1437
Wood Charcoal	420	70	1423-1521 1578-1582 1591-1620	.78 .02 .20	1407-1642	1	Jeske 1990	Beta 12588
Wood Charcoal	710	60	1252-1310 1360-1387	.74 .26	1213-1398	1	Jeske 1990	Beta 19885
Maize	650	20	1291-1306 1363-1385	.4 .6	1284-1318 1352-1390	.44 .56	Richards and Jeske 2015	ISGS A1205
Maize	655	25	1288-1306 1363-1385	.46 .54	1281-1320 1350-1391	.47 .53	Richards and Jeske 2015	ISGS A1201
Nutshell	670	25	1283-1302 1367-1382	.60 .40	1277-1315 1356-1389	.57 .42	Richards and Jeske 2015	ISGS A1206
Nutshell	800	20	1224-1256	1	1212-1269	1	Richards and Jeske 2015	ISGS A1202
Nutshell	810	25	1218-1256	1	1182-1269	1	Richards and Jeske 2015	ISGS A1204
Residue, Langford Plain	880	20	1155-1209	1	1049-1084 1124-1136 1150-1217	.19 .03 .78	Richards and Jeske 2015	ISGS A1080
Residue, Langford Plain	1005	20	998-1003 1012-1031	.09 .91	988-1041 1108-1116	.98 .02	Richards and Jeske 2015	ISGS A1081

radiocarbon dates suggest an earlier and longer occupation between A.D. 1000 and A.D. 1400 (Richards and Jeske 2015).

While the site was heavily disturbed by many years of plowing, Jeske (2000) determined features uncovered during the 1984 and 1985 field seasons to be portions of two subterranean house floors. While most of the cultural material recovered comes from the plowzone, a fraction

of the cultural assemblage was recovered from feature contexts. Virtually all of the ceramic assemblage recovered from excavation has been confidently assigned as Langford ceramics (Jeske 2000:279). The lithic assemblage suggests a generalized economy of inexpensive raw materials and bipolar reduction (Jeske 1990, 2000). While the lithic assemblage was preliminarily discussed by Jeske (1990, 2000), Chapter 7 of this thesis will be an in-depth discussion of the macroscopic analysis of lithics at Washington Irving.

Maize was ubiquitous at the site; other plant remains include cucurbits and American lotus well as other floral material such as wild rice, goosefoot and a variety of seeds and nuts that suggest extensive resource exploitation (Egan 1985; Jeske 2000). Hunter (2002) suggested a wide-ranging faunal resource base; about half of the faunal assemblage consisted of mammal resources, while fish composed approximately a quarter of the assemblage, with the remainder of the assemblage composed mostly of reptile and bird resources (by NISP) (Hunter 2002; Yerkes 1985).

### *Early Survey of the Area*

The General Land Office (GLO) Survey for the state of Illinois began as early as 1804 and was completed by 1856 (Hutchison 1988:246). By the time of European settlement in northeastern Illinois circa 1820, the landscape consisted of prairie, oak-dominated savanna and eastern deciduous forests. Along with Milburn (1840), Moran (1980) and Jeske (2000), ecologists Bowles and McBride (2003) reconstructed the pre-European settlement composition of vegetation and landscape patterns using the original maps and vegetation notes from the U. S. Public Land Survey of Kane County. They concluded that the mixed prairie and timber vegetation pattern in northeastern Illinois began to develop during the hottest and driest part of

the Holocene (around 6,000 and 8,000 years ago) when fires and prevailing winds would have eliminated timber in fire-prone areas of the landscape (Bowles and McBride 2003:7). While landscape fire processes may have been a significant factor in shaping the pre-European settlement vegetation patterns of northeastern Illinois (Bowles and McBride 2003:10), Edwards (2010:66) similarly noted many scholars suggest fires, both natural and cultural in origin, were important for creating and maintaining a prairie landscape in southeastern Wisconsin and around Lake Koshkonong (see Goldstein and Kind 1983; Theler and Boszhardt 2006).

The U.S. General Land Office map of the area, dated 1838, simply shows the site as being a cluster of 27 ancient mounds, located about 250 yards west of the Fox River along Jelkes Creek (Milburn 1840). Jeske (2000:271) suggested that the creek is an old meander scar of the Fox River that was probably cut off from the main channel of the river within the last 7,000 to 10,000 years. The Upper Mississippian settlement at Washington Irving would have been situated along the smaller creek rather than a larger river. The site is depicted on the GLO map as located on a prairie landscape, surrounded by timber. However, the GLO surveyor's field notes suggest that the site is located in an oak savanna.

The earliest known soil survey of Kane County, Illinois was published in 1917. According to the introductory note within the report, the survey and publication was designed to provide "a discussion of important fundamental principles to help the farmer and landowner better understand the meaning of the soil fertility invoice for the lands in which he is interested" (Hopkins et. al 1917) (Figure 4.5).

Over a half-century after the first soil survey publication, a Kane County soil survey was released by the U.S. Department of Agricultural. The 1979 soil survey was prepared for various



Figure 4.5: Map of early soil survey in the vicinity of the Washington Irving site (Hopkins et al. 1917).

uses and “land-planning programs”, such as soil management practices, land use, conservation and development (Goddard 1979:ix), and provided a more detailed and comprehensive soil information. The survey was updated further a quarter-century later by a more extensive soil survey designed to update the preceding survey to provide “additional soil information and larger maps which show the soils in greater detail” (Deniger 2004:13).

As the most recent soil surveys have a large amount of soil disturbance, the model of the prehistoric environmental zones and subsequent catchment analysis of the Washington Irving site was created using the earliest survey available (see Hopkins et al. 1917). The remainder of this chapter will further discuss environmental surroundings and resource potential of the Washington Irving site based on a one- and two-kilometer catchment modeled of the site. Methodology regarding the modeling of environment has been previously outlined in Chapter Three.

### **Description of the Washington Irving Site Location**

#### *Environmental Zones*

The Washington Irving site is located in a savanna environment. Approximately 83% of the one-kilometer catchment area is savanna, with a slightly lower proportion (77%) accounting for the larger two-kilometer catchment (Figure 4.6, Table 4.2). The site entire site is located on a savanna landscape as well as a wetland environment; based on GLO notes, it is likely that the wetland environment around the site was a seasonally wet-prairie type environment.

**Table 4.2. Environmental Zones within Washington Irving Catchments.**

Washington Irving	Savanna	Prairie	Wetland	Lake	Creek	Total
<b>1 km - Total Area (m<sup>2</sup>)</b>	2,620,388	0	507,799	0	11,392	<b>3,139,579</b>
<b>1 km - Proportion</b>	83%	0%	16%	0%	<1%	<b>100%</b>
<b>2 km - Total Area (m<sup>2</sup>)</b>	9,694,211	1,144,574	1,641,318	0	71,378	<b>12,551,481</b>
<b>2 km - Proportion</b>	77%	9%	13%	0%	1%	<b>100%</b>

Over tripling in size at the larger catchment, wetland environments account for 16% of the one-kilometer catchment area and 13% of the two-kilometer catchment area. Wetland areas are located along the creek and to the northeast of the site, as well as dispersed to the south and west of the site by nearby prairie environments. Prairies represent 9% of the



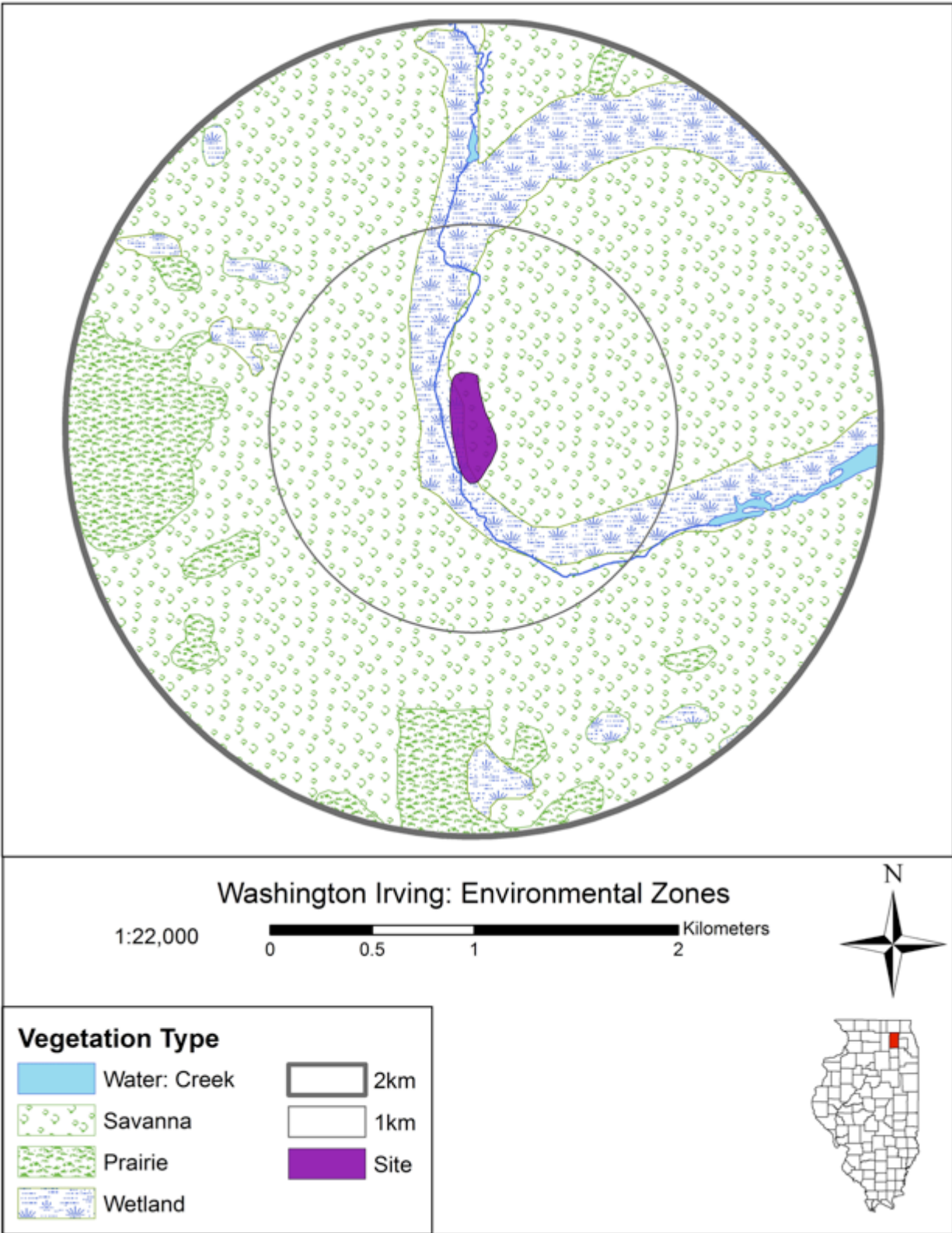


Figure 4.6 Map of the environmental zones around the Washington Irving site.

two-kilometer catchment area around the site; however, there are no prairie environments located within the one-kilometer catchment. Jelkes Creek represents less than 1% of the site around the one-kilometer catchment, and only 1% of the two-kilometer catchment area.

*Ecotones*

While primarily surrounded by savanna environments, the Washington Irving site is situated in a diverse community of ecotones (Figure 4.7, Table 4.3). The site is located entirely within a water/wetland/savanna ecotone and represents 39% of the one-kilometer catchment area, the highest represented ecotone.

**Table 4.3. Ecotones within Washington Irving Catchments.**

Washington Irving	Water/Wetland	Water/Prairie
<b>1 km - Area of Ecotones (m<sup>2</sup>)</b>	0	0
<b>1 km - Proportion of Catchment</b>	0%	0%
<b>2 km - Area of Ecotones (m<sup>2</sup>)</b>	10,822	0
<b>2 km - Proportion of Catchment</b>	<1%	0%
	Water/Savanna	Wetland/Prairie
<b>1 km - Area of Ecotones (m<sup>2</sup>)</b>	14,598	0
<b>1 km - Proportion of Catchment</b>	<1%	0%
<b>2 km - Area of Ecotones (m<sup>2</sup>)</b>	45,590	0
<b>2 km - Proportion of Catchment</b>	<1%	0%
	Wetland/Savanna	Prairie/Savanna
<b>1 km - Area of Ecotones (m<sup>2</sup>)</b>	576,859	16,239
<b>1 km - Proportion of Catchment</b>	18%	1%
<b>2 km - Area of Ecotones (m<sup>2</sup>)</b>	2,288,049	2,213,717
<b>2 km - Proportion of Catchment</b>	18%	18%
	Water/Wetland/Prairie	Water/Wetland/Savanna
<b>1 km - Area of Ecotones (m<sup>2</sup>)</b>	0	1,208,883
<b>1 km - Proportion of Catchment</b>	0%	39%
<b>2 km - Area of Ecotones (m<sup>2</sup>)</b>	0	2,518,605
<b>2 km - Proportion of Catchment</b>	0%	20%
	Water/Prairie/Savanna	Wetland/Prairie/Savanna
<b>1 km - Area of Ecotones (m<sup>2</sup>)</b>	0	6,023
<b>1 km - Proportion of Catchment</b>	0%	<1%
<b>2 km - Area of Ecotones (m<sup>2</sup>)</b>	0	1,607,870
<b>2 km - Proportion of Catchment</b>	0%	13%
	Water/Wetland/ Prairie/Savanna	TOTAL
<b>1 km - Area of Ecotones (m<sup>2</sup>)</b>	0	1,822,602
<b>1 km - Proportion of Catchment</b>	0%	58%
<b>2 km - Area of Ecotones (m<sup>2</sup>)</b>	2,160	8,686,813
<b>2 km - Proportion of Catchment</b>	<1%	69%



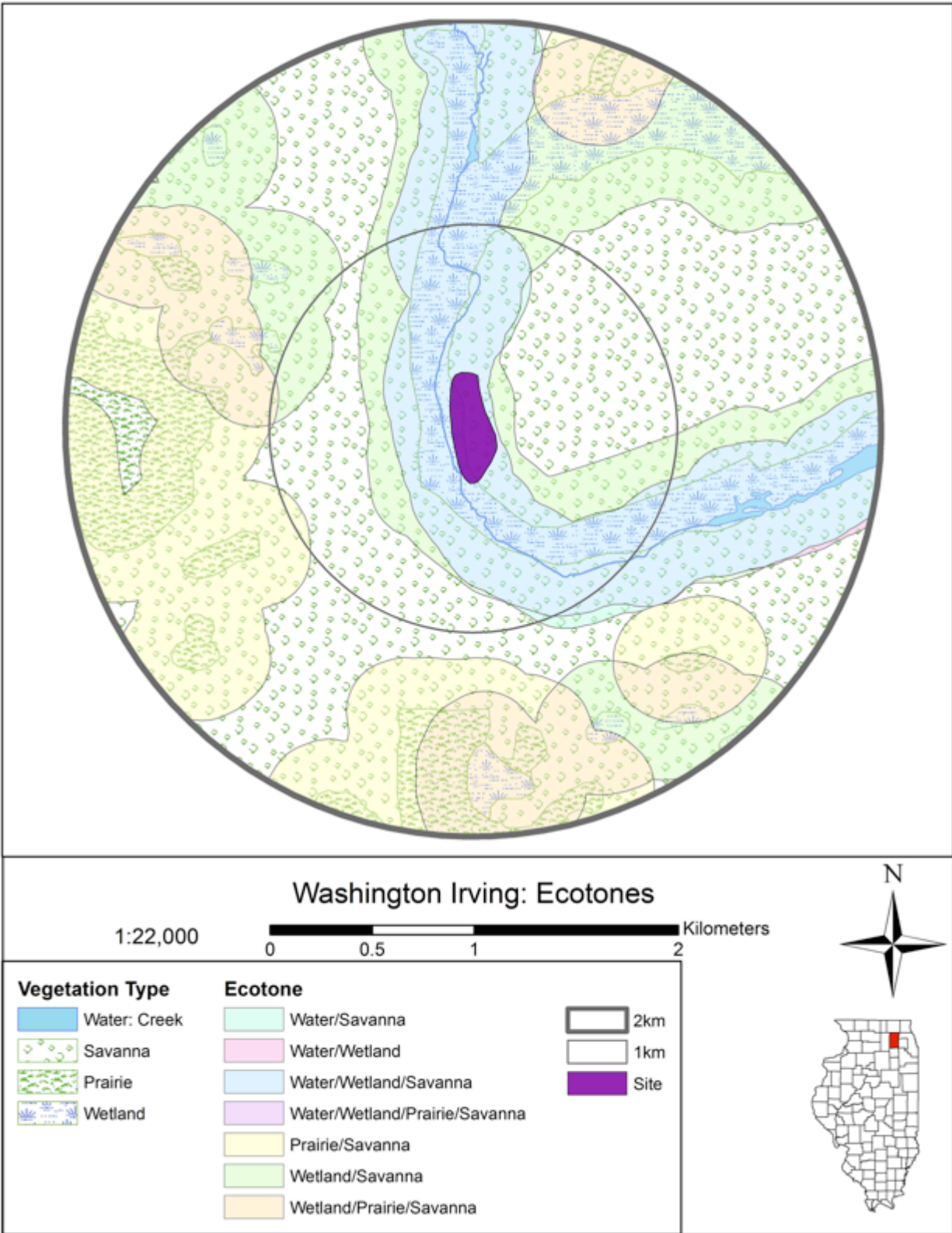


Figure 4.7 Map of the ecotones near the Washington Irving site.

Wetland/savanna ecotones represent 18% of the one-kilometer catchment area.

Water/savanna and wetland/prairie savanna ecotones each represent less than 1% of ecotone areas, while there are no water/wetland ecotones. The absence of water/wetland ecotones is due to the overlap of the savanna components within the catchment area, as Jelkes Creek runs through a wetland area, which is directly surrounded by savanna within the 250-meter ecotone buffer and is characterized within the larger water/wetland/savanna ecotone.

The one- and two-kilometer catchment areas are similar but differ in the proportions of ecotones. The water/wetland/savanna and wetland/savanna ecotones continue to represent the highest proportion of ecotones (20% and 18% respectively) over the two-kilometers area; however, prairie/savanna and wetland/prairie ecotones account for a higher proportion (18% and 13% respectively) than exhibited by the smaller catchment. Water/wetland, water/savanna and water/wetland/prairie savanna ecotones account for very low proportions (less than 1% each) of the two-kilometer catchment, while water/prairie, wetland/prairie, water/wetland/prairie and water/prairie/savanna ecotones do not exist within the one- and two-kilometer catchment areas.

#### *Agricultural Potential*

Washington Irving was settled near a large amount of arable land (Figure 4.8, Table 4.4). Within the one-kilometer catchment, over half (60%) of the land would have been arable, while 50% was good quality, and 10% was fair quality. Within the two-kilometer catchment area, 63% of the land would have had a potential for agriculture, more than quadrupling the amount of arable land within the one-kilometer catchment. The majority of arable land is located to the east of the site, as well as west and south across Jelkes Creek away from the wetland environments.

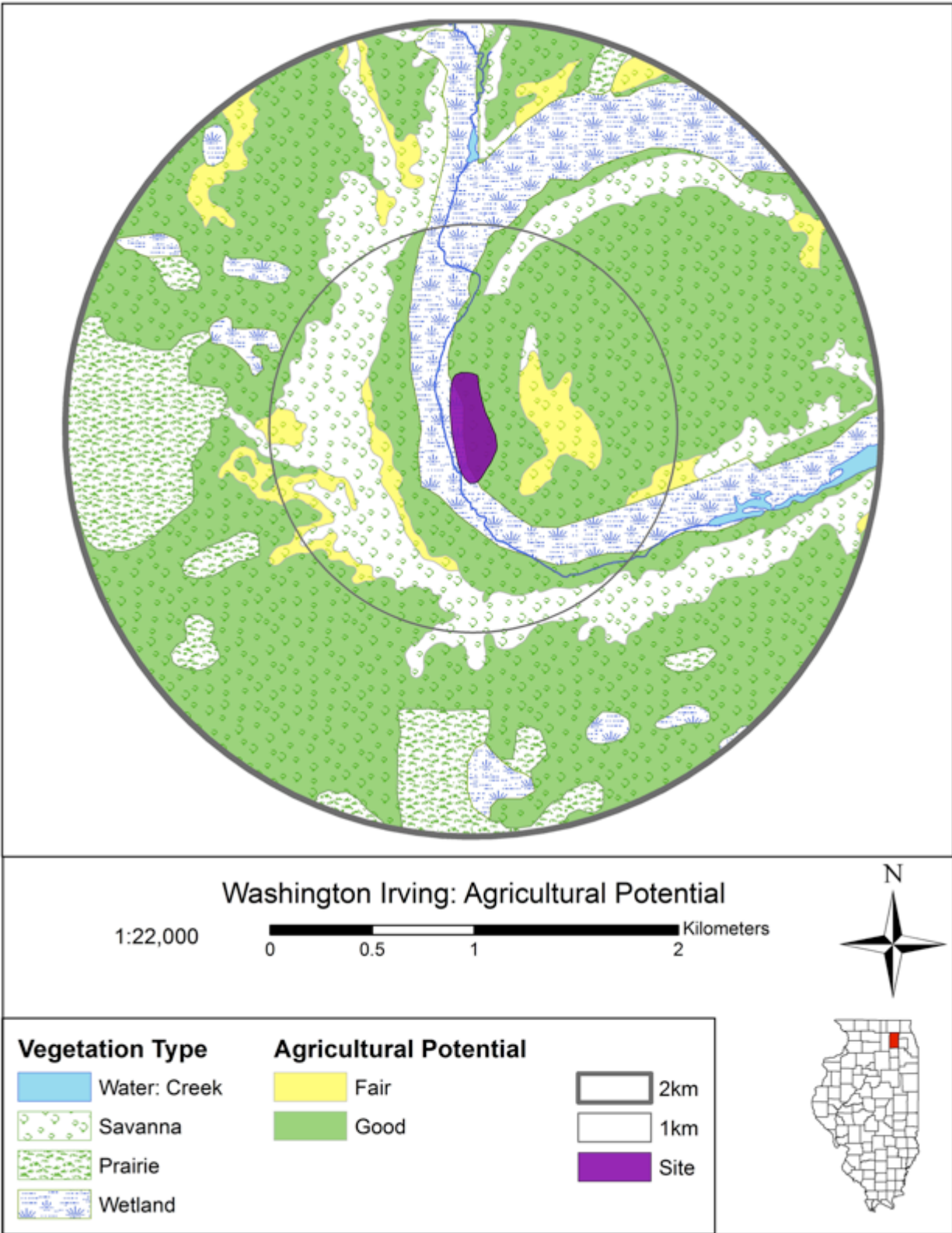


Figure 4.8 Map of the arable land surrounding the Washington Irving site.

Washington Irving	Good	Fair	Total Arable	Poor
<b>1 km - Total Area (m<sup>2</sup>)</b>	1,572,137	307,587	1,879,724	1,259,855
<b>1 km - Proportion</b>	50%	10%	60%	40%
<b>2 km - Total Area (m<sup>2</sup>)</b>	7,264,841	626,647	7,891,488	4,659,993
<b>2 km - Proportion</b>	58%	5%	63%	37%

### **The Koshkonong Creek Village Site (47JE379)**

The Koshkonong Creek Village site is a prehistoric Oneota site located on a modern farm near Lake Koshkonong in Jefferson County in southeastern Wisconsin (Figure 4.9). Located along the shores of Lake Koshkonong and the Rock River (Overstreet 1997:253), KCV is one of several Oneota habitation site located in the Lake Koshkonong locality. It was first documented in the early twentieth century by amateur archaeologists Stout and Skavlem (1908:95-96), who described it as a “small village site”, located approximately 500 feet of the Hemphill farm. Their discoveries at the site included various ceramic potsherds, points, axes and celts, and various other artifacts. Skeletal remains of two individuals were uncovered at the site by an agricultural plow. They also found several concentrated areas containing mussel shells that were interpreted as refuse pits and other areas containing burnt lithic material that were interpreted as hearths.

In addition to the village site, Stout and Skavlem (1908) report several mounds associated with the site. They noted:

Close to the village site on the W. D. Hemphill farm (E ½, S. E. ¼ Sec. 7) were two conical mounds. These are now nearly leveled. In one Mr. Hemphill found the skeletons of two children. To the east on the adjoining farm was once a conical mound and about a quarter of a mile further to the east are traces of another. [Stout and Skavlem 1908:58]

Along with the conical mounds located near the village, they also mention two other mound groups not associated with KCV that are removed from the current boundaries of the site.



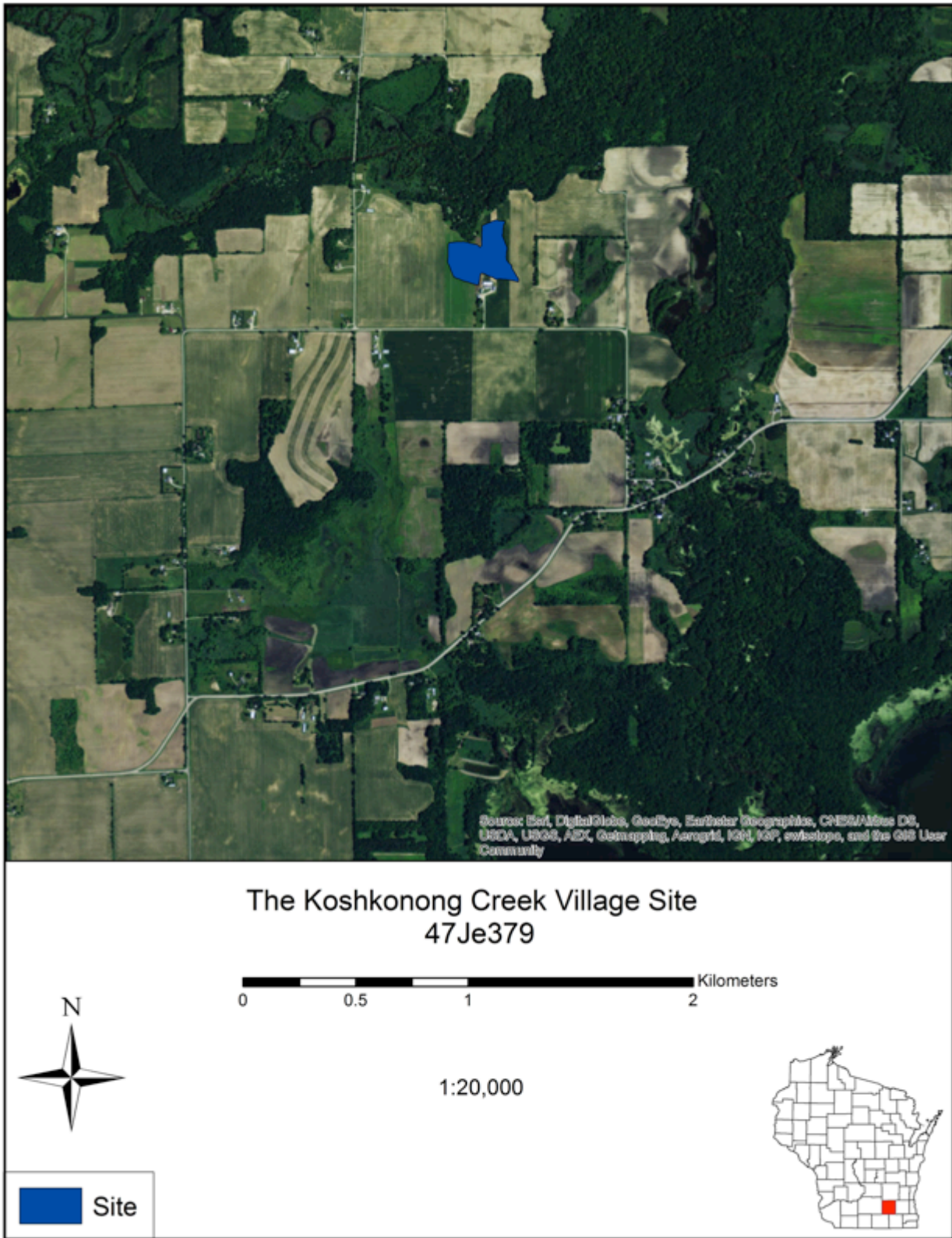


Figure 4.9 Location of the Koshkonong Creek Village site in Jefferson County, Wisconsin (after Edwards 2010).

They wrote of one isolated, well-preserved linear mound west of the village, and three nearly leveled linear mounds north of the creek (Stout and Skavlem 1908:58).

*Archaeological Investigations at the Koshkonong Creek Village*

In 1986, the University of Wisconsin-Milwaukee conducted a survey at the site as part of the Lake Koshkonong Survey (Musil 1987). Musil recorded the Koshkonong Creek village site outlined by Stout and Skavlem (1908) on the Weisensel farm and subsequently renamed the site Twin Knolls. In her survey, she identified three artifact concentration areas and established site boundaries that cover approximately nine and a half acres.

UW-Milwaukee returned to KCV in 2008 as a field school to conduct a walkover survey of the site. It was determined that the site boundaries extend further than previously established during the initial survey, covering 13 acres. Two artifact concentration areas were delineated that overlap two of the original concentrations that Musil recorded and 459 artifacts were recovered (Cowell et al. 2008).

During the 2010 field season, the UW-Milwaukee field school returned to KCV to conduct additional pedestrian surveys as well as the first subsurface excavation. The artifacts uncovered from the 2010 field season support the previous interpretations of the site boundaries and concentrations from the 2008 field survey. Along with some historic artifacts, 686 prehistoric artifacts were recovered from the 2010 survey, with 163 recovered from pedestrian survey and 523 from the 68 shovel tests excavated. Based on the findings from shovel testing, three 2-x-2-m test excavation units were excavated. A total of 214 prehistoric artifacts—mostly lithics—were recovered from the test excavations with no features uncovered (Pater et al. 2010).

In 2012, UW-Milwaukee returned to the site to exclusively focus on the concentration areas defined during the surveys of 1986 and 2008 and excavated 40 square meters within the

Oneota component of the site. Ten 2-x-2-m units were excavated in a block to identify features beneath the plow zone. A total of 48 features were excavated, comprising 37 postmolds, four basins, two cylindrical pits, two shallow basins, a wall-trench, a heavily disturbed hearth, and a large post or small pit. A single feature, possibly a small pit, was not excavated because of its location, extending under a back dirt pile. All excavated features were bisected by a trench to expose a profile and the remainder of the feature fill was collected for flotation. The pattern of postmolds indicate at least one, but potentially two, house structures within the excavated area (Edwards and Spott 2012).

In 2014, UW-Milwaukee returned to KCV for further survey and excavation. The 2014 KCV pedestrian survey covered approximately 12 acres of agricultural fields at the site and produced 103 lithic tools and 265 pieces of debitage in several concentration areas east of the 2012 and 2014 excavation areas (Ahlrichs et al. 2014). Excavation units were placed southeast of the 2012 excavation units with the goal of locating the southern portion of the long house discovered during the previous field season. A total of 45 m<sup>2</sup> were excavated with 14 features and over 60 postmolds uncovered, including part of the eastern wall of the previously discovered longhouse and segments of two other possible structures, as well as several small basins and large cylindrical pits, initially thought to be refuse pits. As with the 2012 excavation, features were photographed, mapped and bisected, with half of the soil matrix collected for flotation (Edwards 2014).

#### *Previous Research at KCV*

To date, only two radiocarbon dates are available for the site (Table 4.5). The first sample was from residue on the inside of a Grand River Plain rim sherd and dates to calibrated A.D. 990-1045 at two sigmas (Edwards and Spott 2012). The second radiocarbon date was from

**Table 4.5. Radiocarbon Dates from the Koshkonong Creek Village Site (Edwards and Spott 2012; Edwards, personal communication).**

Material	<sup>14</sup> C age	±	Calibrated 1 sigma	%	Calibrated 2 sigma	%	Lab #
Residue, Grand River	1000	20	999-1002	.06	989-1104	.92	ISGS A2272
			1013-1035	.94	1099-1119	.07	
					1142-1146	.01	
Residue, Busseyville	605	20	1307-1328	.41	1299-1370	.78	ISGS A2320
			1341-1363	.41	1380-1403	.21	
			1385-1395	.17			

residue on a smoothed over Busseyville Grooved Paddle Trailed sherd. The most probable two sigma calibrated date is circa A.D. 1300 -1370 (p=0.78) with a smaller probability of A.D. 1380-1405 (p=0.21) (Edwards, personal communication). From the two radiocarbon dates from the site, the time of occupation aligns with the dates from the nearby Schmeling and the Crescent Bay Hunt Club sites (Edwards 2014) and support previously tentative dates for the site (Cowell et al. 2008; Musil 1987).

In a preliminary analysis of the lithic assemblages from the 1986, 2008 and 2010 field seasons, Doyle (2012) concluded that stone tools from KCV appear to resemble an Upper Mississippian tool economy based on speed and efficiency, manufacturing tools with free-hand and bipolar techniques with fair and poor quality materials. Carpiaux and Edwards (2014) conducted a preliminary analysis of the 2012 ceramic assemblage and concluded that the assemblage fits well into the expectation of a Lake Koshkonong Oneota site, although they advocate for additional analysis with a larger sample size. Edwards and Spott (2012) provided a preliminary feature analysis of the site and outlined the ceramic, faunal, and copper assemblages from excavation at the site.

Relatively little research has been completed on the Koshkonong Creek Village site compared to other Oneota sites around Lake Koshkonong (but see Carpiaux and Edwards 2014;



Cowell et al. 2008; Doyle 2012; Edwards 2010, 2014; Edwards and Spott 2012; Edwards and McTavish 2012; McTavish and Edwards 2014; Musil 1987; Pater et al. 2010; Van de Par et al. 2015). Recently, the Crescent Bay Hunt Club has been a major focus of research in the Lake Koshkonong locality. Master's theses, doctoral dissertations and other academic works by Edwards (2010), Foley-Winkler (2004, 2011), Hunter (2002), Jeske (2003, editor), Jeske et al. (2006), Moss (2010), Olsen (2003), and Sterner (2012) provide descriptions of Oneota settlement patterns, mortuary practices, lithic economies and subsistence practices.

#### *Early Survey of the Area*

Survey for the state of Wisconsin was conducted between 1832 and 1866 (Wisconsin Board of Commissioners of Public Land 2005). Miller in 1833 and Burnham, Mullett and Brink throughout 1835 and 1836 surveyed the sections within the townships to the northwest of Lake Koshkonong (Burnham 1836; Miller 1833). The nearly leveled mounds associated with the Koshkonong Creek Village site (Stout and Skavlem 1908:58) are not noted on the GLO plat map or sketch maps (Figure 4.10).

Based on General Land Office survey notes, Robert Finley (1976) produced a map of the original vegetation cover for the entire state of Wisconsin at a 1:500,000 scale (Figure 4.11). This vegetation map has been used in previous research regarding Oneota settlement and subsistence patterns (see Rodell 1983). However, in a comparison of the map produced by Finley and the GLO plat map produced by Burnham (1836), Edwards (2010) showed that the map created by Finley is not suitable for the reconstruction of environmental zones and boundaries because of its small scale. Finley failed to record Koshkonong Creek as well as several other wetland features and misrepresented the forest boundaries around the region compared to the areas that are found on the GLO map. Edwards acknowledged that the differences between the

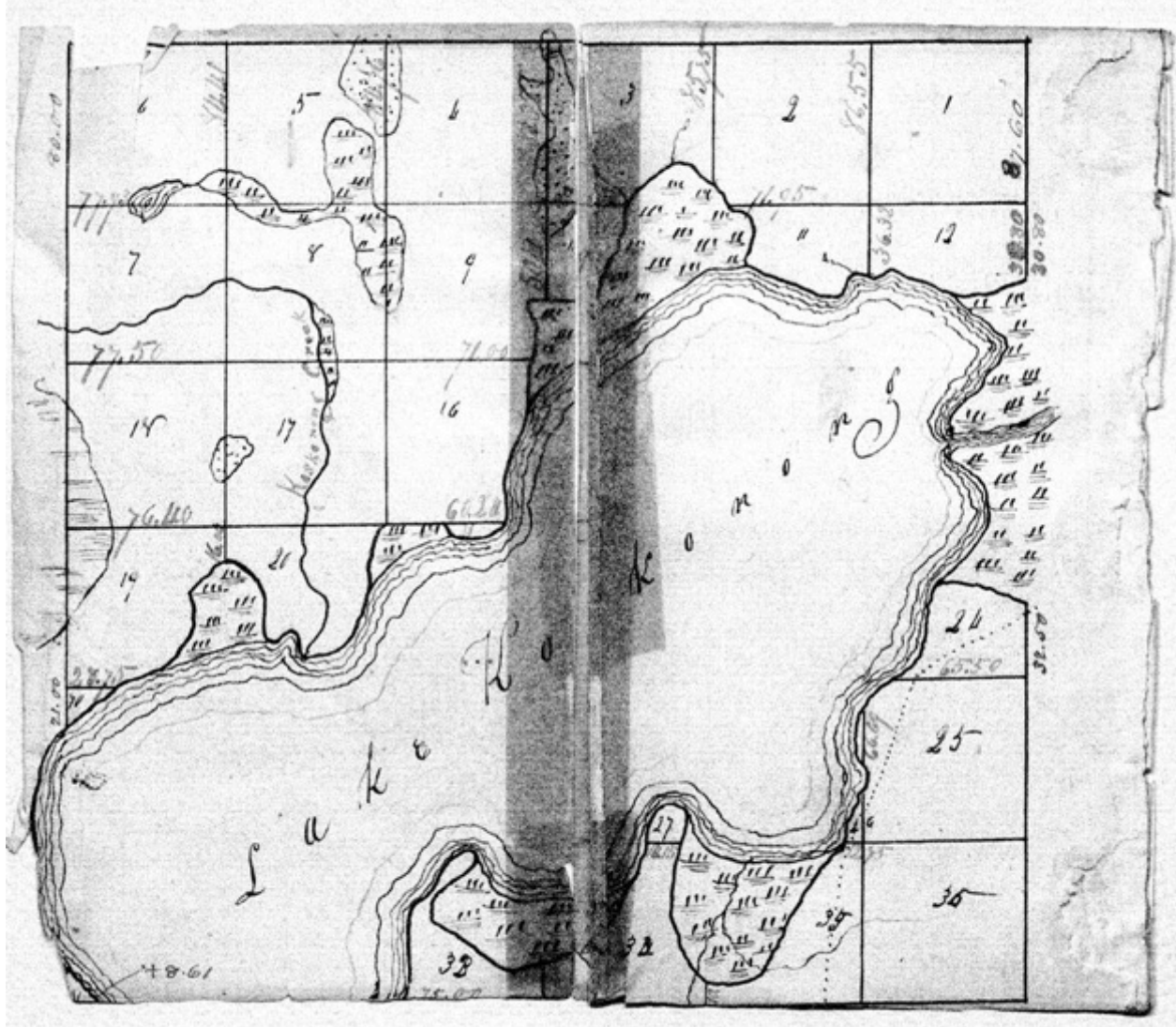


Figure 4.10 GLO sketch map of Lake Koshkonong and Koshkonong Creek (Burnham 1836)

soil survey maps and GLO maps may be due in part to the nature of the GLO survey and its lack of data from the interior of the sections.

Along with other Oneota sites in the Lake Koshkonong locality, Edwards (2010) successfully created a model of the environmental zones around the Koshkonong Creek Village using a combination of GLO maps and survey notes and soil survey data (see Burnham 1836; Glocker 1979; Miller 1833).

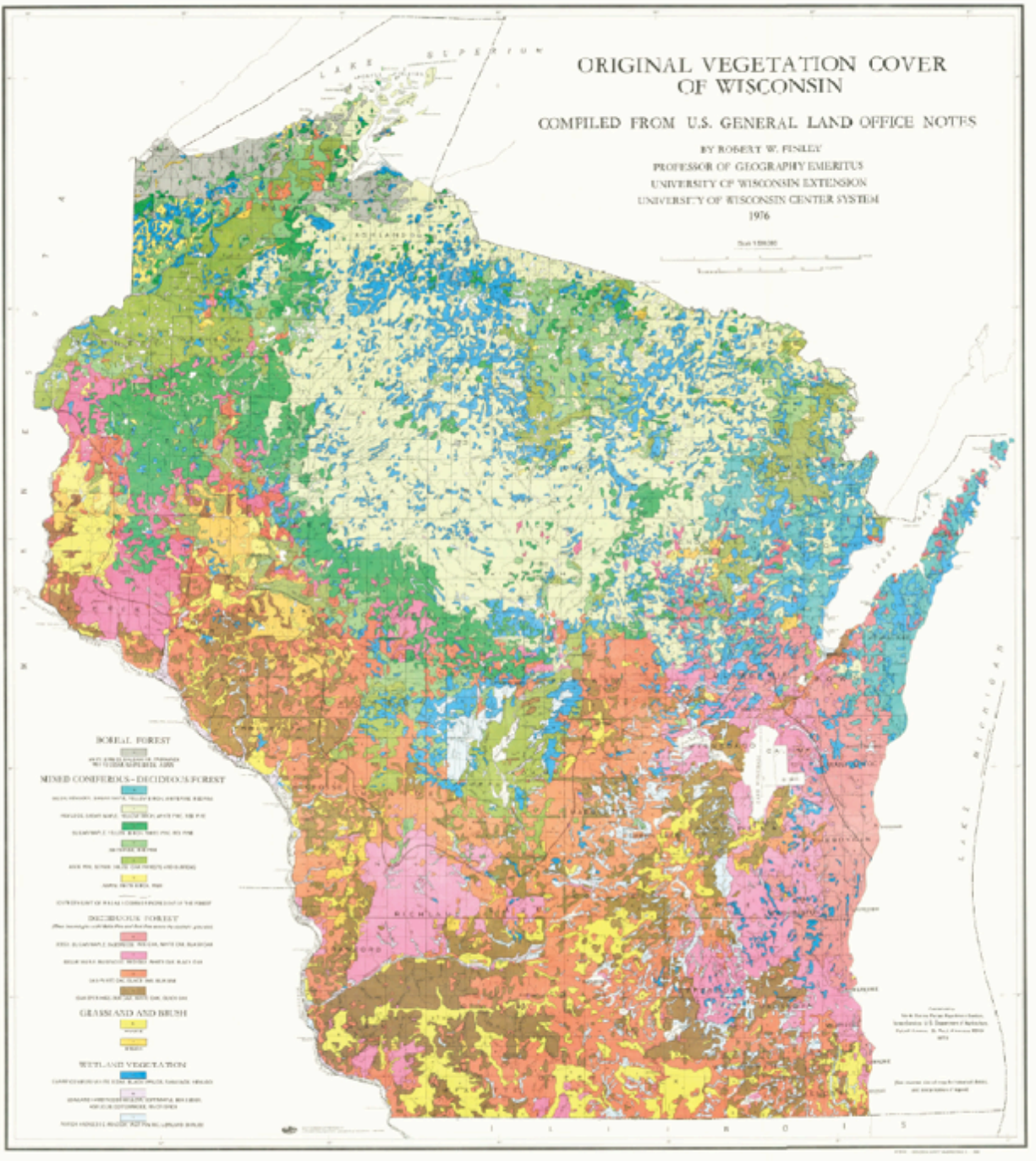


Figure 4.11: Original vegetation cover for the state of Wisconsin based on GLO notes (Finley 1976).

## Description of the Koshkonong Creek Village Site Location

### *Environmental Zones*

Savanna environments largely dominate the site area (Figure 4.12, Table 4.6). Savanna accounts for 84% of the two-kilometer catchment area, with a slightly higher proportion (88%) accounting for the one-kilometer catchment. The entire site is located within a savanna environment. Wetland environments are the second most common, accounting for 12% of the two-kilometer catchment area, mainly located along the creek as well as to the north and northeast of the site. Prairie environments, as well as the creek itself, account for the remainder of the environmental zones. Prairie represents 6% of the one-kilometer catchment, but is only represented by 2% of the two-kilometer catchment. The creek represents 2% of the site around both one- and two-kilometer catchment areas (Edwards 2010).

**Table 4.6. Environmental Zones within Koshkonong Creek Village Catchments (after Edwards 2010).**

KCV	Savanna	Prairie	Wetland	Lake	Creek	Total
<b>1 km - Total Area (m<sup>2</sup>)</b>	2,747,716	199,414	118,405	0	74,598	3,140,132
<b>1 km - Proportion</b>	88%	6%	4%	0%	2%	100%
<b>2 km - Total Area (m<sup>2</sup>)</b>	10,488,508	310,649	1,469,804	0	290,070	12,559,033
<b>2 km - Proportion</b>	84%	2%	12%	0%	2%	100%

### *Ecotones*

The Koshkonong Creek Village is located within a diverse environment. There are four different ecotone areas located within the sites boundaries, and the site is surrounded by a variety of other ecotones (Figure 4.13, Table 4.7). Prairie/savanna and water/wetland/prairie/savanna ecotones represent the largest proportion of ecotones (15% and 14% respectively) within the one-kilometer catchment. The remaining wetland/savanna, water/wetland/savanna, water/prairie/savanna water/savanna and water/wetland/savanna ecotones represent similar proportions (7, 8, 9, 10 and 11%, respectively) (Edwards 2010).



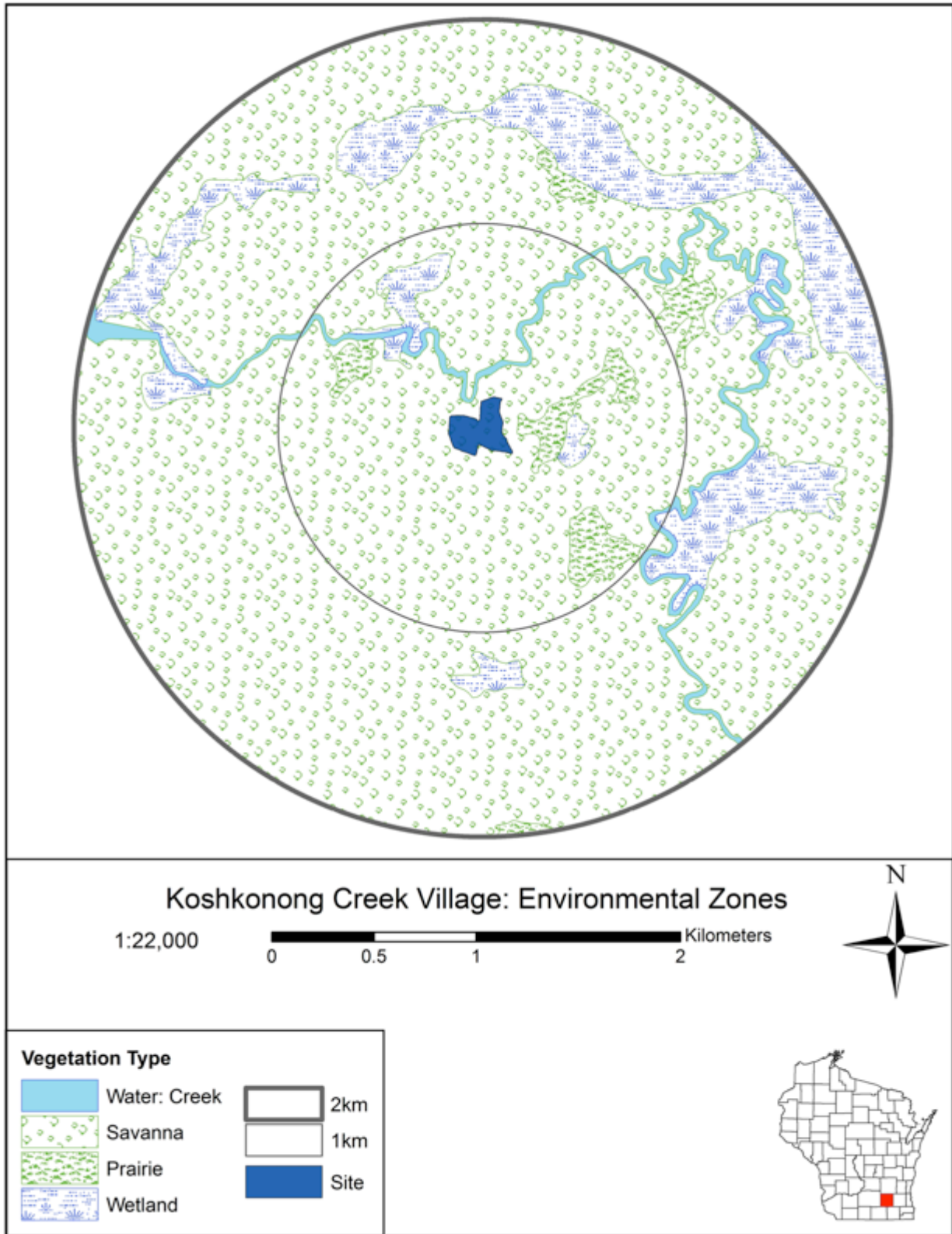


Figure 4.12 Map of the environmental zones around the Koshkonong Creek Village site (after Edwards 2010).

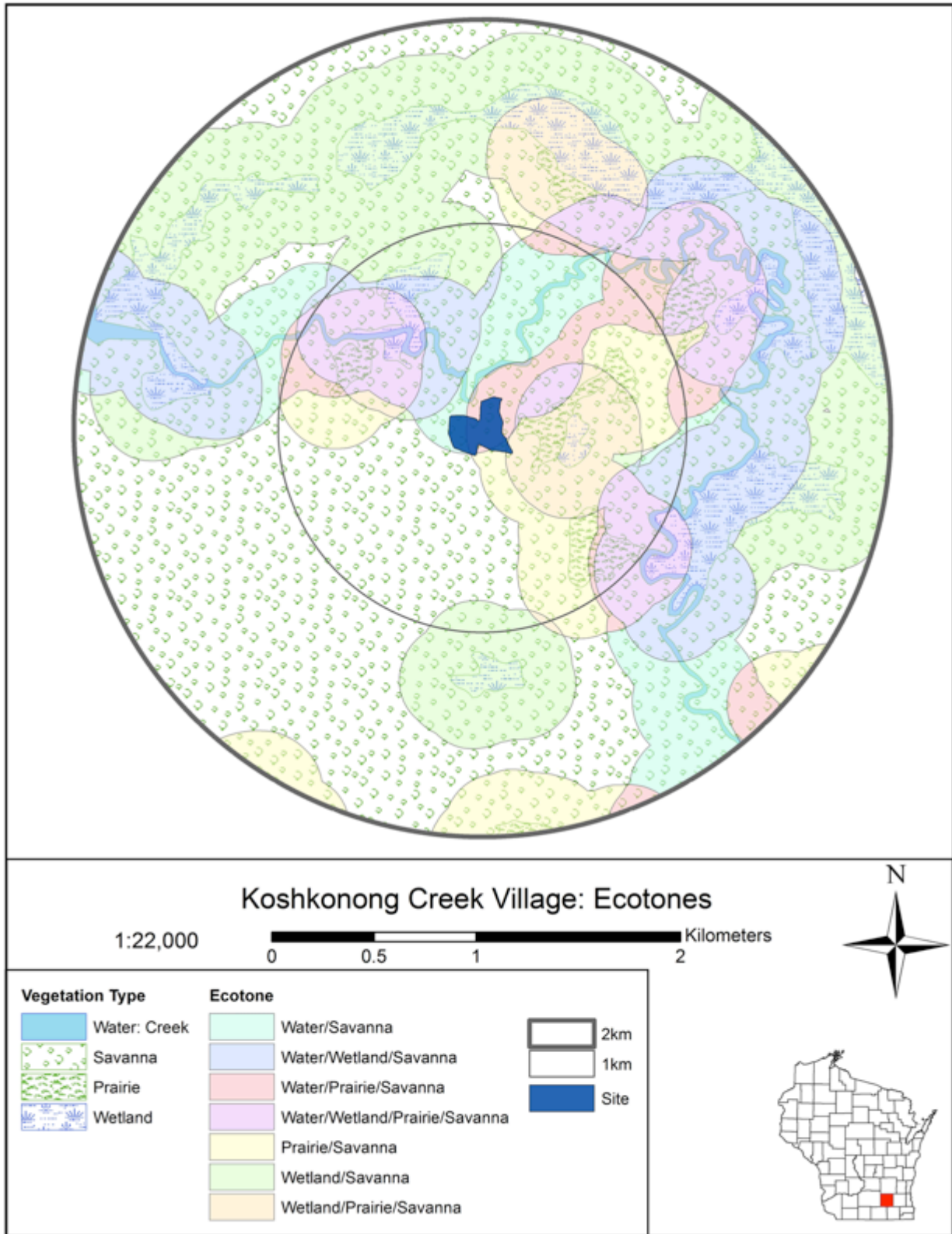


Figure 4.13 Map of the ecotones near the Koshkonong Creek Village site (after Edwards 2010).

**Table 4.7 Ecotones within Koshkonong Creek Village Catchments (after Edwards 2010).**

KCV	Water/Wetland	Water/Prairie
1 km - Area of Ecotones (m <sup>2</sup> )	0	0
1 km - Proportion of Catchment	0%	0%
2 km - Area of Ecotones (m <sup>2</sup> )	0	0
2 km - Proportion of Catchment	0%	0%
	Water/Savanna	Wetland/Prairie
1 km - Area of Ecotones (m <sup>2</sup> )	313,785	0
1 km - Proportion of Catchment	10%	0%
2 km - Area of Ecotones (m <sup>2</sup> )	814,405	0
2 km - Proportion of Catchment	6%	0%
	Wetland/Savanna	Prairie/Savanna
1 km - Area of Ecotones (m <sup>2</sup> )	218,730	479,604
1 km - Proportion of Catchment	7%	15%
2 km - Area of Ecotones (m <sup>2</sup> )	3,119,603	911,210
2 km - Proportion of Catchment	25%	7%
	Water/Wetland/Prairie	Water/Wetland/Savanna
1 km - Area of Ecotones (m <sup>2</sup> )	0	248,729
1 km - Proportion of Catchment	0%	8%
2 km - Area of Ecotones (m <sup>2</sup> )	0	1,844,493
2 km - Proportion of Catchment	0%	15%
	Water/Prairie/Savanna	Wetland/Prairie/Savanna
1 km - Area of Ecotones (m <sup>2</sup> )	292,450	334,703
1 km - Proportion of Catchment	9%	11%
2 km - Area of Ecotones (m <sup>2</sup> )	497,942	657,542
2 km - Proportion of Catchment	4%	5%
	Water/Wetland/ Prairie/Savanna	TOTAL
1 km - Area of Ecotones (m <sup>2</sup> )	451,359	2,339,360
1 km - Proportion of Catchment	14%	74%
2 km - Area of Ecotones (m <sup>2</sup> )	1,029,228	8,874,423
2 km - Proportion of Catchment	8%	71%

Within the two-kilometer catchment, wetland/savanna ecotones are most common (25%), with water/wetland/savanna ecotones accounting for 15% of the catchment area. Collectively, ecotones represent 74% of the one-kilometer catchment and 71% of the two-kilometer catchment. Edwards (2010:108) suggested the winding nature of Koshkonong Creek lengthened the transitional boundaries between environmental zones, resulting in more ecotone coverage.

#### *Agricultural Potential*

The Koshkonong Creek Village was settled near a large amount of land with the potential for agriculture (Figure 4.14, Table 4.8). Within the one-kilometer catchment, over two-thirds

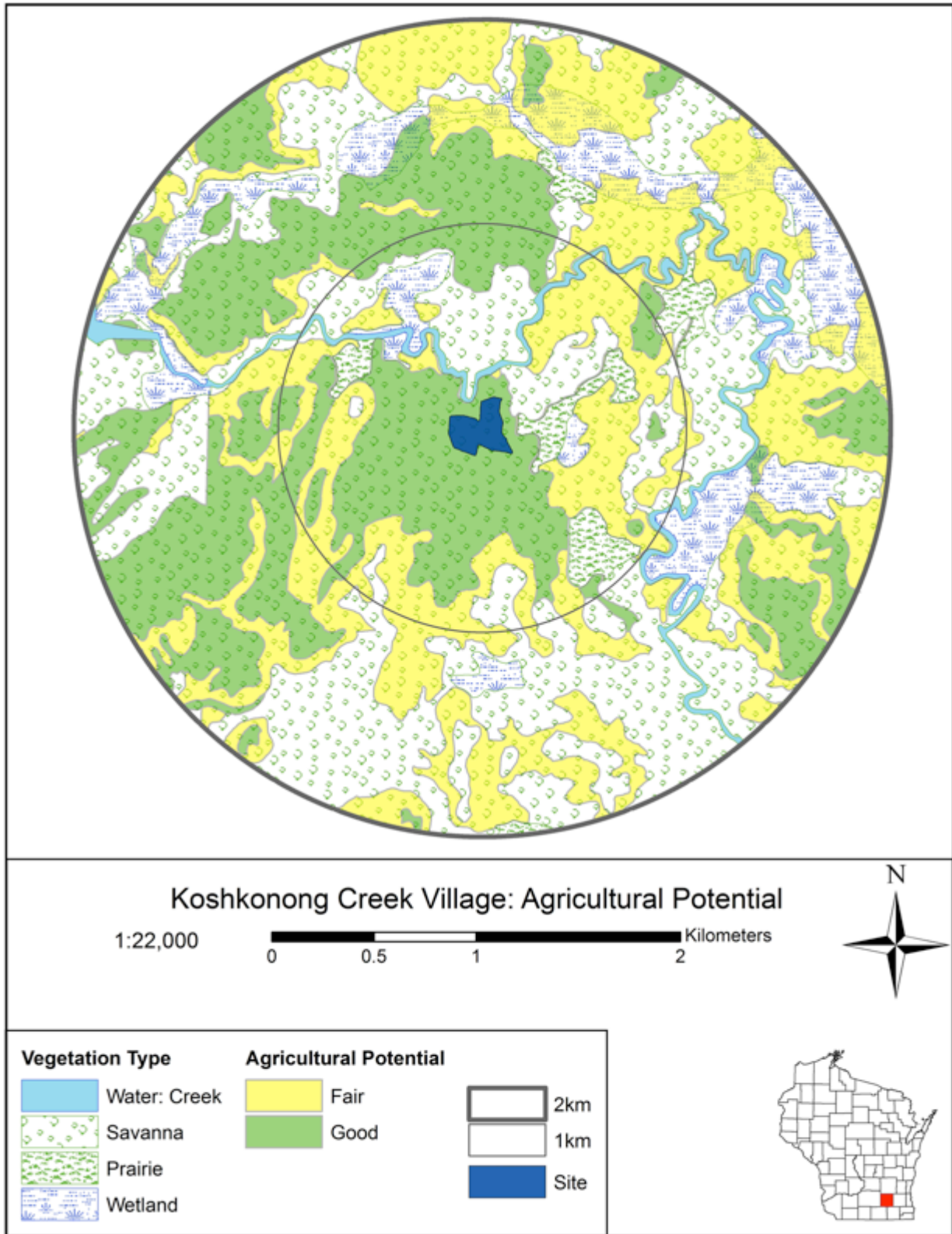


Figure 4.14 Map of the arable land surrounding the Koshkonong Creek Village site (after Edwards 2010).



(68%) of the land would have been arable, with 37% being of good quality, and 31% being of fair quality. Within the two-kilometer catchment area, over half of the landscape (58%) would have had a potential for agriculture, more than doubling the amount of arable land than within the one-kilometer catchment. Unlike at a one kilometer, there is a higher proportion of fair quality arable land (31%) than that of good quality (27%) at the two-kilometer catchment. Arable land is primarily to the south and southwest of the site, as well as north across Koshkonong Creek (Edwards 2010).

KCV	Good	Fair	Total Arable	Poor
<b>1 km - Total Area (m<sup>2</sup>)</b>	1,169,905	963,659	2,133,564	1,006,569
<b>1 km - Proportion</b>	37%	31%	68%	32%
<b>2 km - Total Area (m<sup>2</sup>)</b>	3,406,921	3,926,079	7,333,000	5,227,530
<b>2 km - Proportion</b>	27%	31%	58%	42%

## CHAPTER 5

### DISCUSSION OF THE CATCHMENT ANALYSIS

At first glance, the Washington Irving and Koshkonong Creek Village sites appear to be located in similar environments. These basic similarities were the basis for the initial research questions proposed in this thesis. Research questions regarding the Langford and Oneota occupations and settlement patterns include: 1) What were the environmental settings of the Washington Irving and Koshkonong Creek Village sites? 2) Were they situated in similar environmental contexts? 3) Are the sites situated in a location with plenty of agricultural potential? 4) How do the sites and their locations fit into our current understanding of Oneota, Langford, and Upper Mississippian settlement patterns?

The environmental settings of each site were previously discussed in Chapter Four. To answer the remaining questions, this chapter will be a discussion of the catchment analysis produced from the data generated from the models of the Washington Irving and Koshkonong Creek Village sites (Figures 5.1 and 5.2). These figures combine the data presented in Figures 4.6, 4.7, and 4.8, and 4.12, 4.13, and 4.14, respectively. By comparing the proportions of environmental zones of the one- and two-kilometer catchment areas, a better understanding of the site's environmental similarities can be gained. In an investigation of the ecotones around the one- and two-kilometer catchment areas, the economic potential of the environments around each site can be examined.

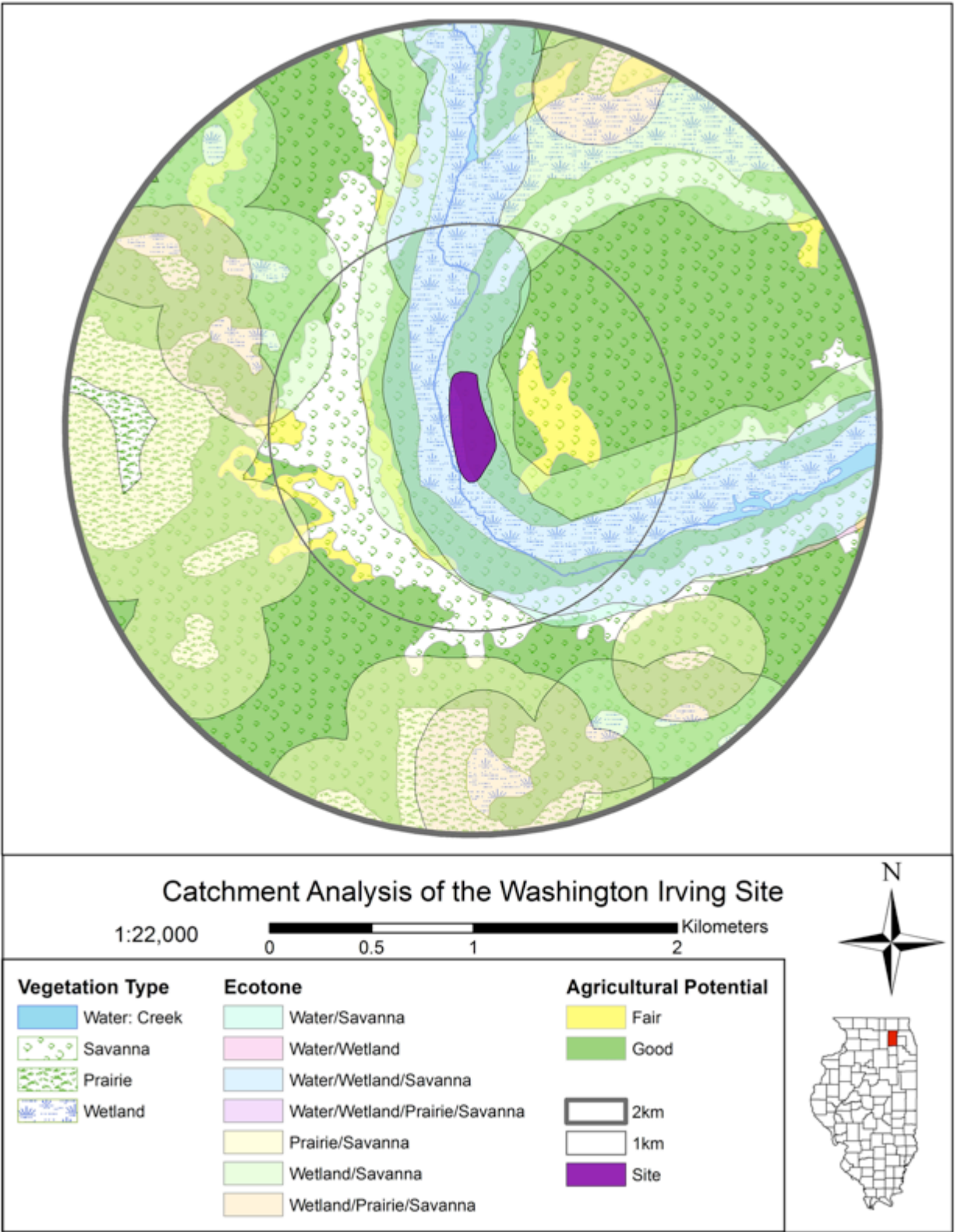


Figure 5.1: Map result of the Washington Irving catchment analysis.

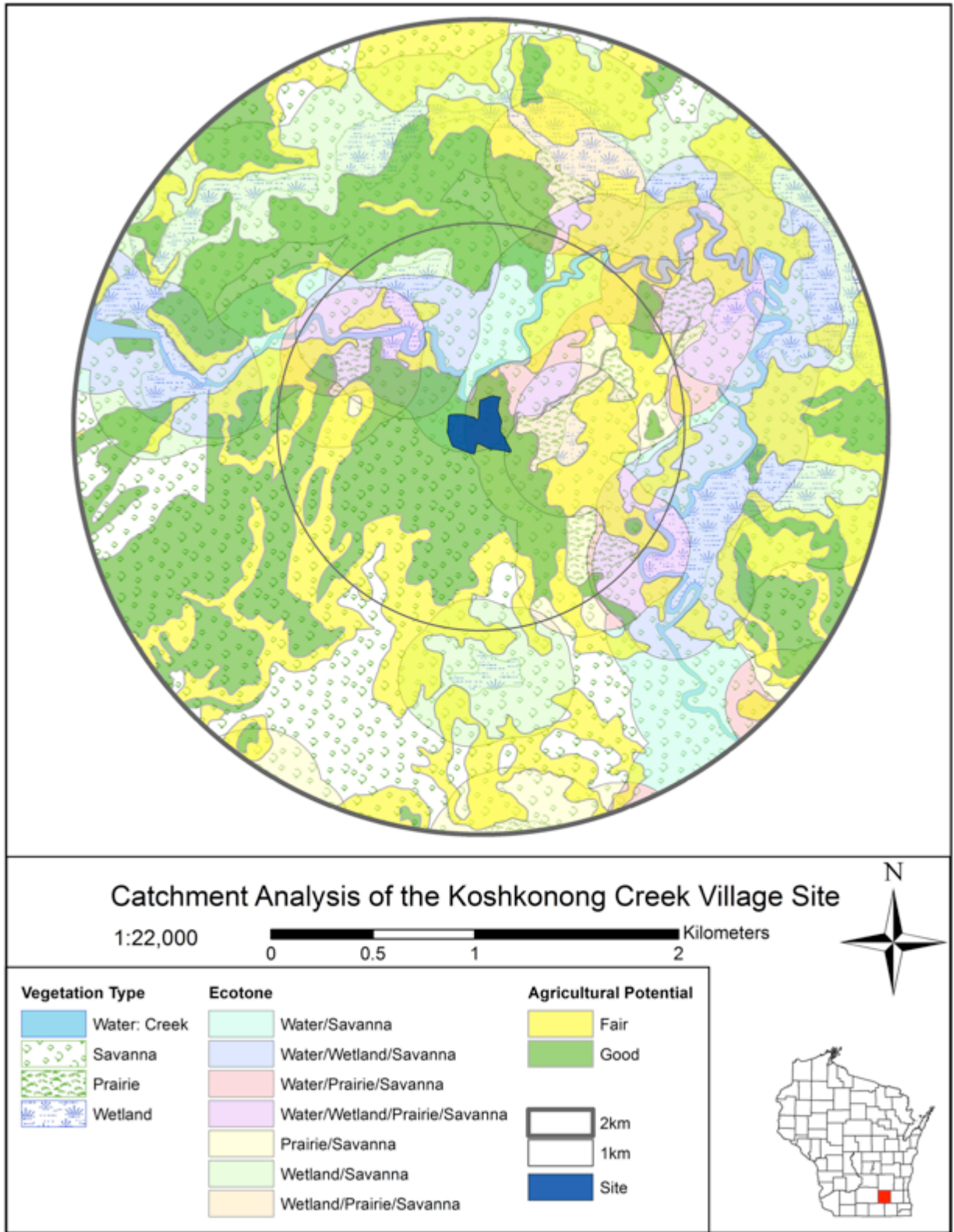


Figure 5.2: Map result of the Koshkonong Creek Village catchment analysis (after Edwards 2010).

## **Catchment Analysis**

### *Environmental Zones*

From an examination of the relative proportions of the environmental zones surrounding the sites, it appears that the sites are situated in comparable settings with little variation among them (Figures 5.3 and 5.4). KCV is surrounded by far more savanna than the other sites in the Lake Koshkonong locality (Edwards 2010). The Washington Irving site exhibits similar proportions of environmental zones to KCV, particularly wetland and savanna zones.

Within the one-kilometer catchment, the sites show similarly high proportions of savanna ecozones, representing 82% of Washington Irving's catchment area and 88% of the Koshkonong Creek Village one-kilometer catchment. However, the sites also suggest some variation within a one-kilometer catchment. While a prairie landscape represents 6% of the ecozone within one kilometer of KCV, there is no prairie ecozone situated within a kilometer of Washington Irving. Conversely, a wetland ecozone represents 16% of Washington Irving's one-kilometer catchment area, while 4% of the one-kilometer catchment around KCV is represented by wetland.

Within the two-kilometer catchment area, the sites also appear to be located in similar environments and suggest less variation than the within the one-kilometer catchment area. Washington Irving and KCV are situated near of 13% and 12% proportion of wetland ecozones, respectively. However, KCV is situated near a slightly higher proportion of savanna (84%) than at Washington Irving (77%). Conversely, Washington Irving is situated near a higher proportion of prairie (9%) than KCV (2%).

The similar proportions of wetland zones at two kilometers suggest the inhabitants would have had similar access to wetland and upland resources. Because of KCV's more inland

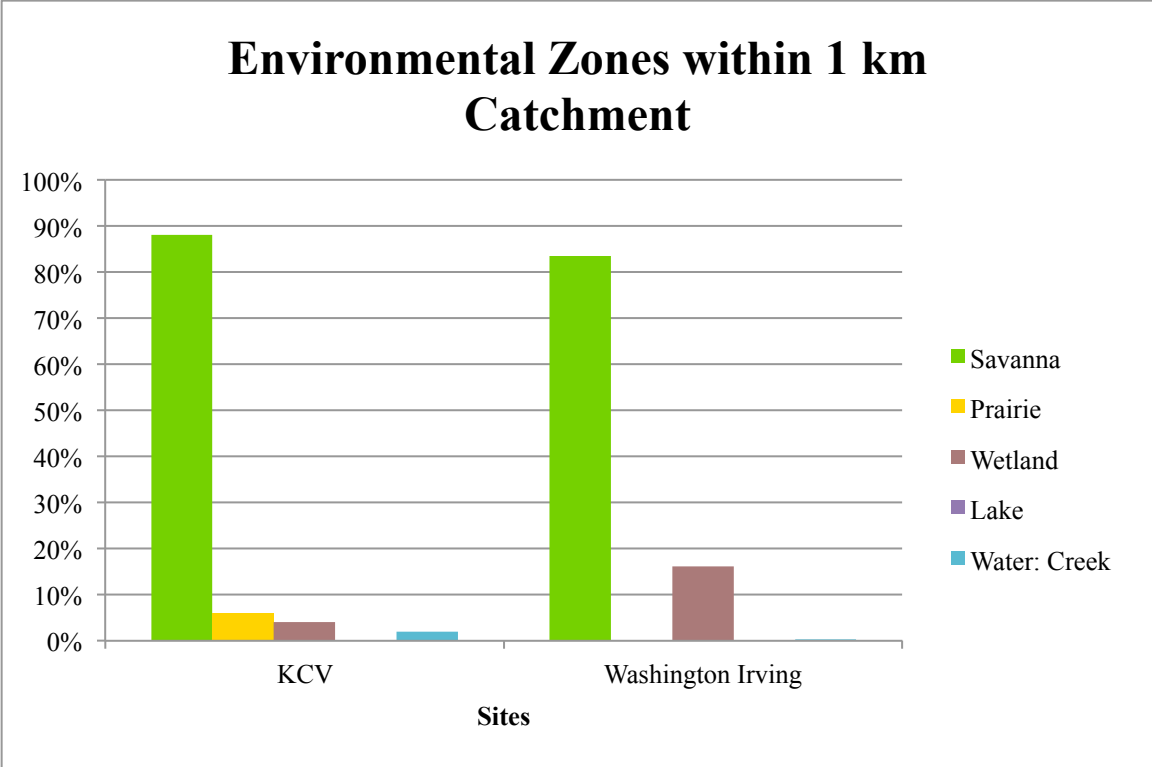


Figure 5.3 Comparison of Environmental Zones at 1 kilometer.

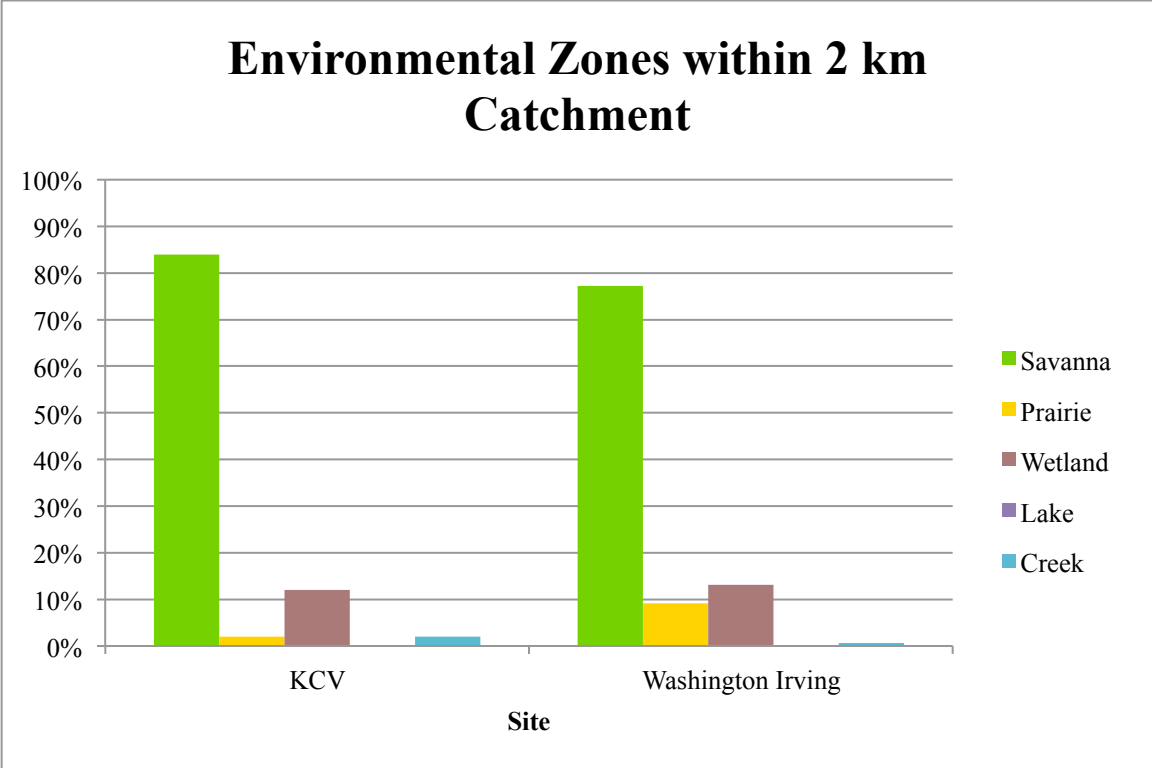


Figure 5.4 Comparison of Environmental Zones at 2 kilometers.

location, Edwards (2010) hypothesized that Koshkonong Creek Village site inhabitants may have exploited a higher degree of upland and riverine resources than inhabitants of site located nearer to Lake Koshkonong. However, given the environmental similarities between Washington Irving and KCV, it can be hypothesized that an analysis of faunal and floral assemblages could indicate many similarities in subsistence practices.

### *Ecotones*

Both sites appear to be situated around comparable locations regarding their surrounding ecotone areas (Figures 5.5 and 5.6). However, there is variation among ecotone composition and proportions that distinguish the two site locations, primarily within the one-kilometer catchment area. Within one-kilometer, the sites suggest different proportions of ecotone coverage as well as the composition of environments within ecotones. While 58% of the one-kilometer catchment around Washington Irving is represented by ecotones, ecotone areas cover 74% of the one-kilometer catchment around KCV. The most distinct difference between the two sites is the ecotone composition within the one-kilometer catchment area. While KCV has a fairly even distribution of proportions over the ecotone areas, the Washington Irving site's one-kilometer catchment area has a large proportion of water/wetland/savanna ecotone (39%) followed by wetland/savanna ecotone (18%) with a very low proportion of other ecotones represented; conversely, a water/wetland/savanna ecotone (8%) and wetland/savanna ecotone (7%) exhibit notably lower proportions within KCV's one-kilometer catchment. A prairie/savanna ecotone accounts for 15% of the one-kilometer catchment around KCV, while the same ecotone only represents 1% of the one-kilometer area around Washington Irving. Both water/prairie/savanna (9%) and wetland/prairie/savanna (11%) ecotones are represented at KCV's one-kilometer area, but these ecotone areas do not occur at Washington Irving's one-kilometer catchment.

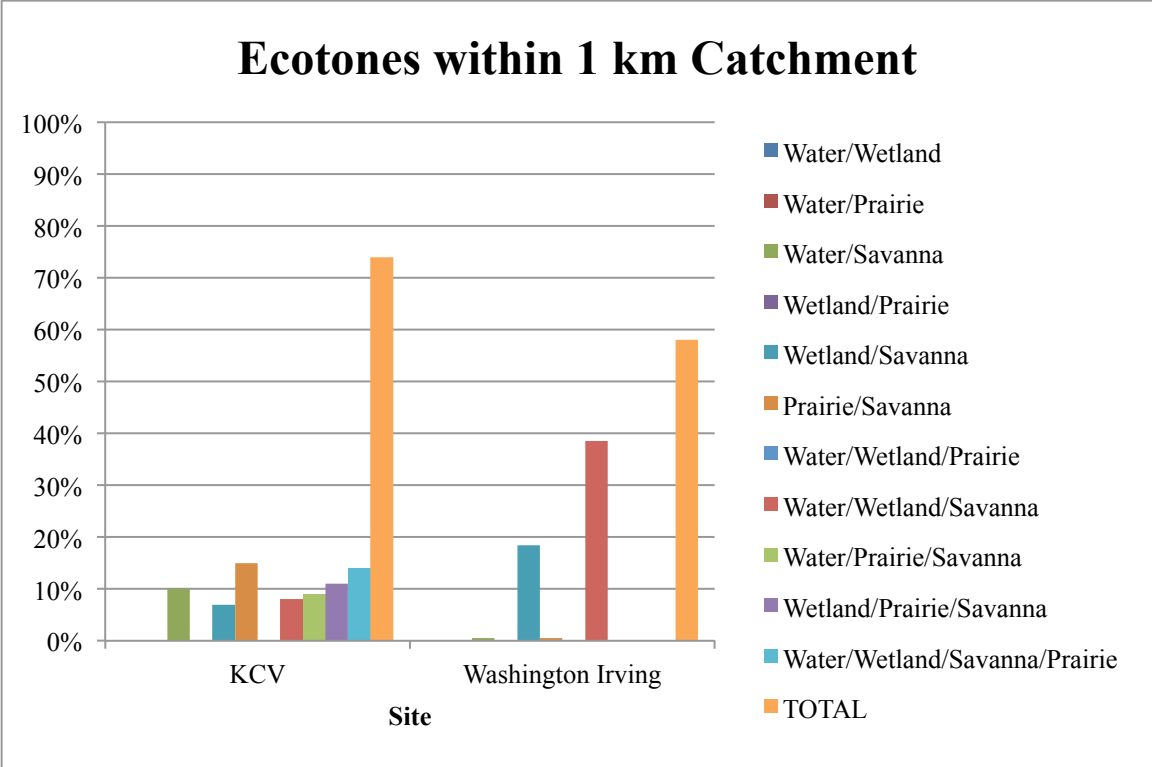


Figure 5.5 Comparison of ecotone proportions at 1 kilometer.

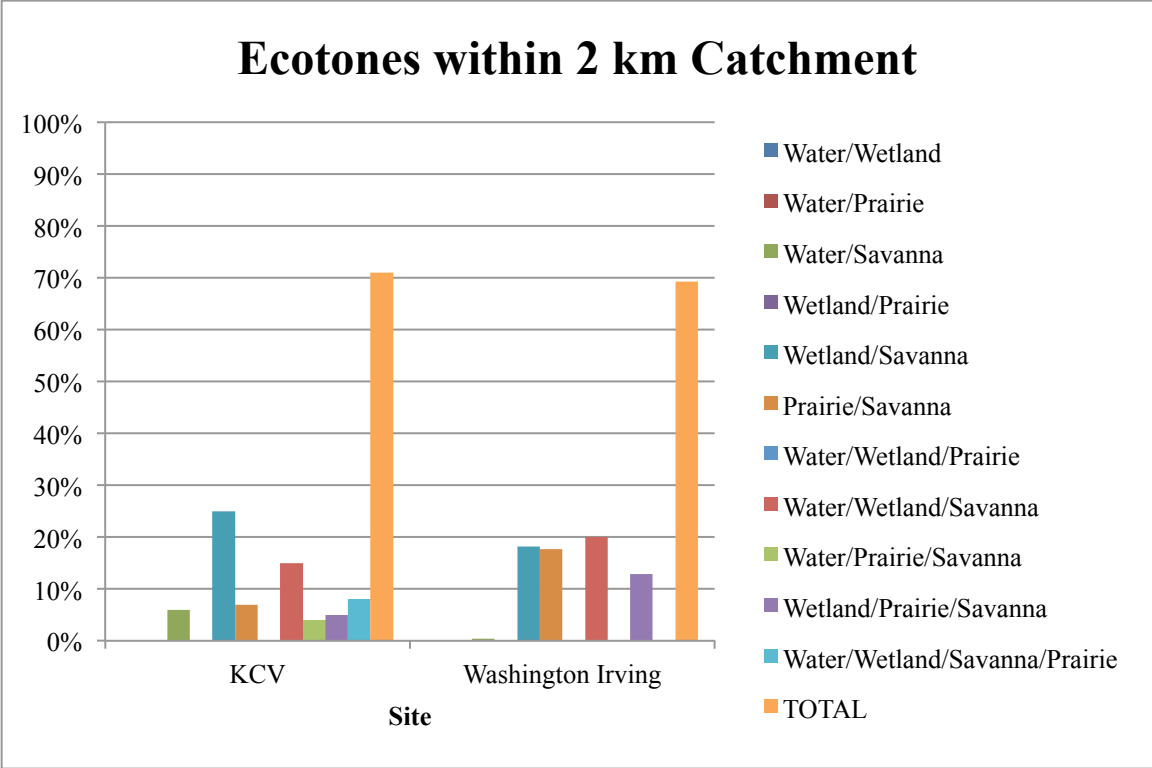


Figure 5.6 Comparison of ecotone proportions at 2 kilometers.



At two kilometers, the sites exhibit a similar proportion of overall ecotone coverage. Around Washington Irving, ecotone areas cover 69% of the area, while 71% of the area around KCV is represented by ecotones. Unlike the differences within the one-kilometer catchment area, Washington Irving and KCV appear to exhibit similar proportion of several ecotones within the two-kilometer catchment. The areas surrounding the sites were primarily wetland/savanna and water/wetland/savanna ecotones, collectively covering 38% and 40% of sites catchment areas, respectively.

However, similar to the one-kilometer catchment area, there are some differences in the ecotone composition that make up the two-kilometer catchment areas of each site. Approximately 18% of Washington Irving's two-kilometer catchment is a prairie/savanna ecotone, while the same ecotone only accounts of 7% of KCV's two-kilometer area. Similarly, a higher proportion of wetland/prairie/savanna ecotone represents Washington Irving's two-kilometer catchment than is represented within KCV's catchment (13% compared to 5%). Conversely, a higher proportion of the wetland/savanna ecotone is represented at KCV than is represented within Washington Irving's two-kilometer area (25% and 18%, respectively). Within KCV's catchment, the water/savanna and water/wetland/savanna/prairie ecotones represent 6% and 8% of the total area, respectively, while the same ecotones proportions to the total two-kilometer catchment within Washington Irving are less than 1%. The water/prairie/savanna ecotone composed 4% of KCV's two-kilometer catchment, but does not exist within either of Washington Irving's catchments.

While these aspects differentiate the ecotone distribution between the two sites, the total area of ecotone coverage around both two-kilometer catchment areas is similar; 69% of Washington Irving's catchment area is represented by ecotones, while 71% of KCV's catchment

area is represented by ecotones. The discrepancy in ecotone proportions between the two sites are likely due to the overlapping of two ecotones that share a similar environmental zone (e.g. water/savanna ecotone overlapping a water/wetland ecotone); where there are higher proportions of three-zone ecotones within Washington Irving's catchment, two- and four-zone ecotones are represented in a higher proportion within KCV's catchment. In sum, the ecotone context of the sites indicates convergence rather than divergence.

### *Agricultural Potential*

To understand the agricultural potential around Washington Irving and the Koshkonong Creek Village sites, the proportions of arable land at the sites were investigated. At both sites, a difference was observed in the amount arable land rated good and fair between one- and two-kilometer catchment areas (Figures 5.7 and 5.8). The amount of total arable land accounts for good and fair soil types, while poor soils were not deemed arable. Within the one-kilometer catchment area, the Washington Irving site had a substantial 50% of the catchment area considered good, with 10% deemed fair for a total of 60% arable land and 40% deemed poor. While the Koshkonong Creek Village site had less soil classified as good in quality (37%), fair soils accounted for 30% of the land, forming a combined 68% of total arable land, with 32% deemed poor.

Within the two-kilometer catchment areas, the sites suggest similar proportions of total arable and poor quality land areas. Washington Irving exhibited a slightly higher proportion of arable to non-arable land, with 63% of the two-kilometer surrounding area considered arable, and the remaining 37% deemed non-arable. Likewise, KCV exhibited 57% or arable land to 43% non-arable land. However, the most notable difference between the agricultural potential of the sites within two-kilometers is the proportions of good and fair quality soils. Washington Irving

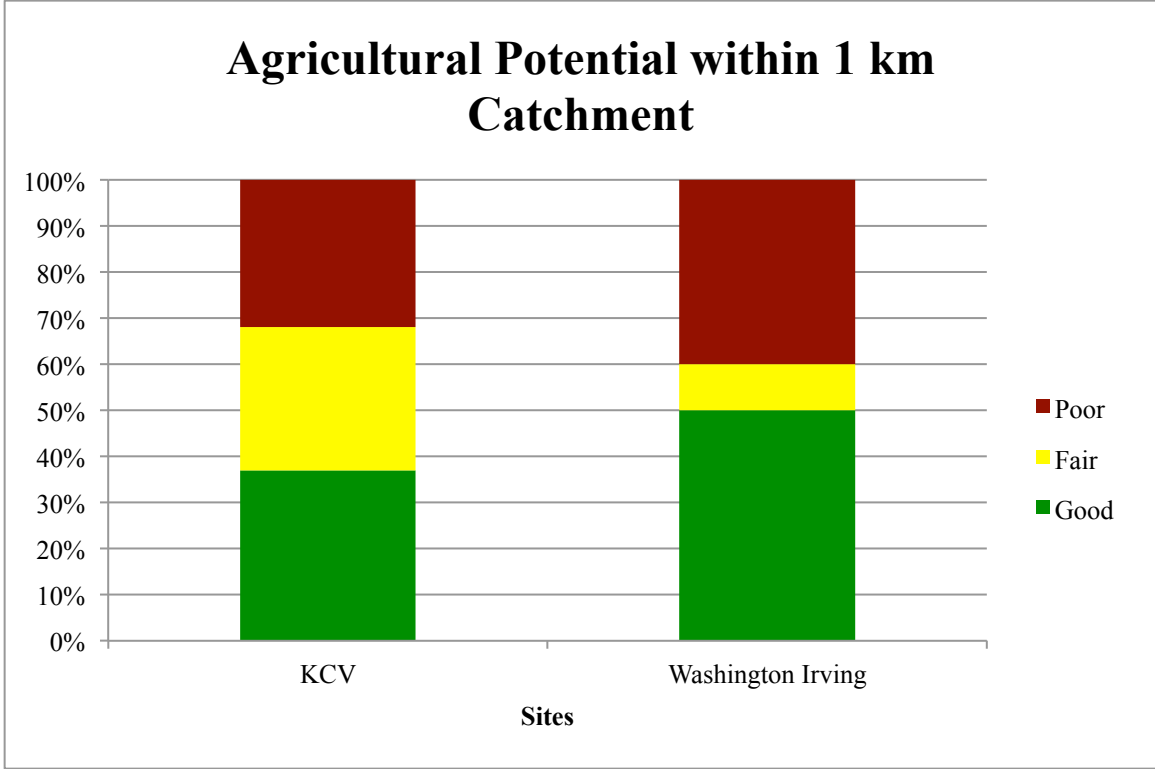


Figure 5.7 Comparison of arable land at 1 kilometer.

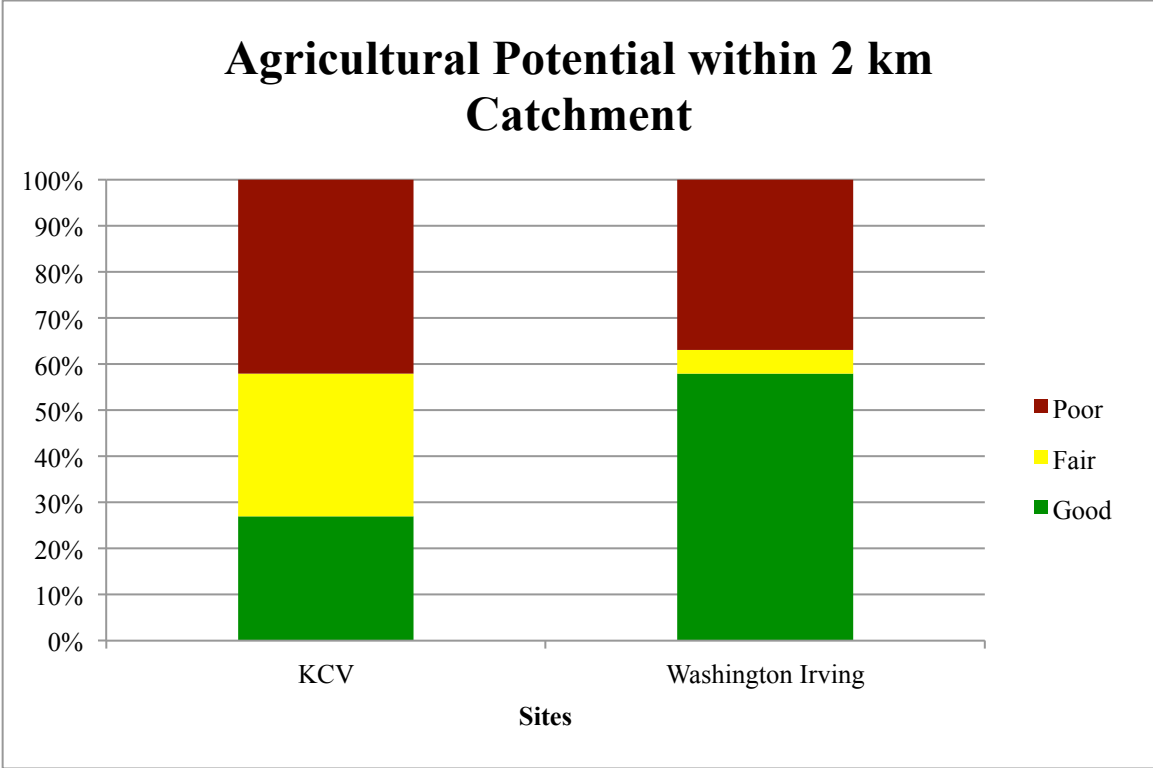


Figure 5.8 Comparison of arable land at 2 kilometers.

has far more good quality soils (58%) than is available around KCV (27%); however fair quality land surrounding the Washington Irving site (5%) was notably lower than the proportions observed at KCV (31%).

While the proportion of arable to non-arable land seems generally similar and consistent between the sites, what do the proportions of good and fair quality soils indicate about site settlement patterns? Edwards (2010:131) argued that a much higher proportion of good quality soil within the one-kilometer catchment area indicates a site was strategically placed near high quality arable land. He proposed that isolated areas of good quality land would have been actively sought out and settled to take advantage of its agricultural potential (although a resource pull analysis may be more representative of an economical site location and is discussed later in this chapter). While this concept applies to KCV, the same pattern does not emerge at Washington Irving. The amount of good and fair arable land that surrounds KCV increases from 58% to 68% between the two- and one-kilometer catchment areas; conversely, more good and fair quality land was present at the two-kilometer radius of the Washington Irving site (63%) than at the one-kilometer catchment (60%). However, as soil draining capabilities were not as strictly notated in the early survey used to model the Washington Irving site, it may not be appropriate to compare good and fair quality arable land between the sites; rather, for this particular comparative analysis, it may be more accurate to simply compare arable and non-arable land.

The higher proportion of wetlands within the one-kilometer catchment area of Washington Irving is likely the main factor for a lower proportion of arable land. While the wetland soils were deemed to have no agricultural potential because of their poor drainage, they would have had provided access to other valuable resources at a close distance to the site.

The large proportion of arable land surrounding both sites suggests that both sites would have had enough potential to sustain a horticulturalist lifeway. While bioarchaeological evidence suggests that Langford people engaged in similar levels of maize consumption as “agriculturalist Mississippians” of the American Bottom (Emerson et al. 2005:100), inhabitants at KCV and other Koshkonong Oneota sites also had adequate arable land to effectively grow maize (Edwards 2010). Flannery (2009:92) argued that a Mesoamerican village with approximately 80 hectares of arable land would have been enough to grow and feed 350 people on a diet primarily of maize. More relevantly, Schroeder (1999) indicates that the average yield for historic Native American maize agriculture in Eastern North America was approximately 19 bushels of corn (approximately 630kg) per acre. She also indicated historic Native American households on average tended gardens of approximately 0.6 acres in size, which would have yielded each family nearly 380kg or 1,592,200 calories worth of maize each year. Assuming a daily caloric need of 2000 calories per person per day, each family plot would provide a family of four with approximately 55% of their necessary food intake (Jeske, personal communication, 2016). Since arable land around both Washington Irving and KCV within the one-kilometer catchment totals circa 500 acres, both sites easily had enough arable land to sustain several hundred occupants.

### **Non-economic Factors**

While environmental zones, ecotones and arable land is the main focus of this catchment analysis, several other factors are worth investigating. Edwards (2010; citing Jochim 1976) recognized the significance of comparing the elevation of a site and distances from sites to economically important environmental features as they influence the habitability of an area. He wrote:

Settlements must be placed in areas that satisfy the physical needs of the residents while also conforming to non-economic needs of the culture. It is outside the scope of this

project to examine most non-economic factors of settlement placement, however, it is important to consider the elevation of a site and the nature of the soils around it. While not necessarily economic in nature, these factors deal directly with the habitability of an area and cannot be ignored when considering factors that determine settlement placement [Edwards 2010:133].

The following section will be a discussion of these factors, such as site elevation and surround elevations, as well as distance to well-drained soils, water sources and ecotones.

*Elevation*

Apart from environmental zones, ecotones and arable land, several distance-based variables were also considered. Using the USGS topographic maps of the Busseyville and Elgin Quadrangles, the elevations of the sites were determined, both at the boundaries, with the average of the highest and lowest elevations, and at the centroid of the sites (Figures 5.9 and 5.10, Table 5.1). Using both data are important, as the highest and lowest can help show the variation in elevation, while the centroid elevation measurement may be a more accurate representation due to modern erosion around the site boundaries (after Edwards 2010).

**Table 5.1 Elevations of the sites.**

Site	Feet		Meters		Average		Centroid	
	Highest	Lowest	Highest	Lowest	Feet	Meters	Feet	Meters
<b>Washington Irving</b>	750	736	229	224	743	226	745	227
<b>Koshkonong Creek Village</b>	820	800	250	244	810	247	810	247

Both the Washington Irving and Koshkonong Creek Village sites are situated on high ground adjacent to a creek environment. As Edwards (2010) suggested about KCV, Washington Irving also appears to be situated on high ground that would give site inhabitants some protection from flooding. Koshkonong Creek is approximately 10 meters below the centroid of the KCV, while Washington Irving is similarly situated approximately 5 to 10 meters above Jelkes Creek.

The Washington Irving site is situated on an upland terrace, surrounded by higher ground

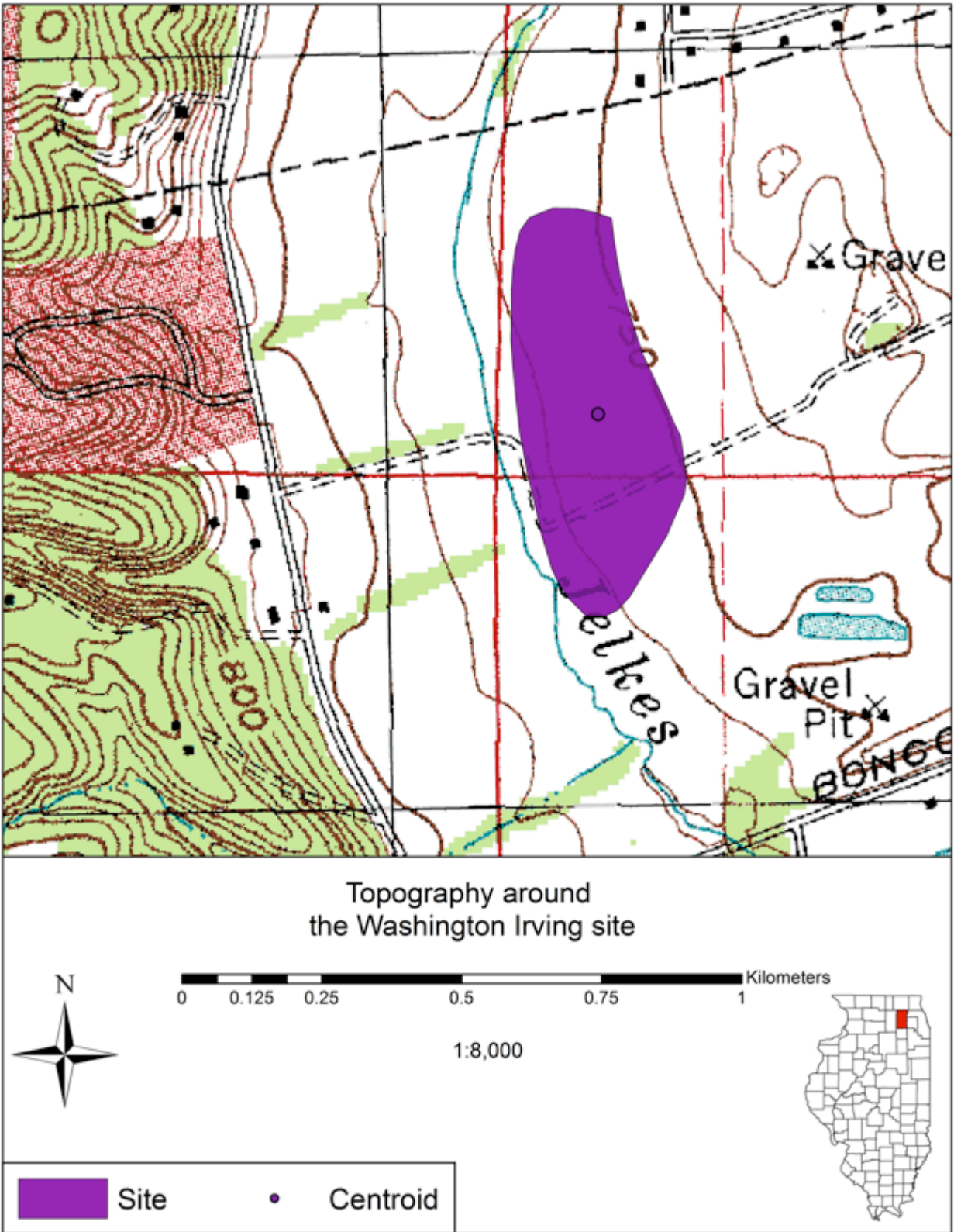


Figure 5.9 Topography of the land surrounding Washington Irving.

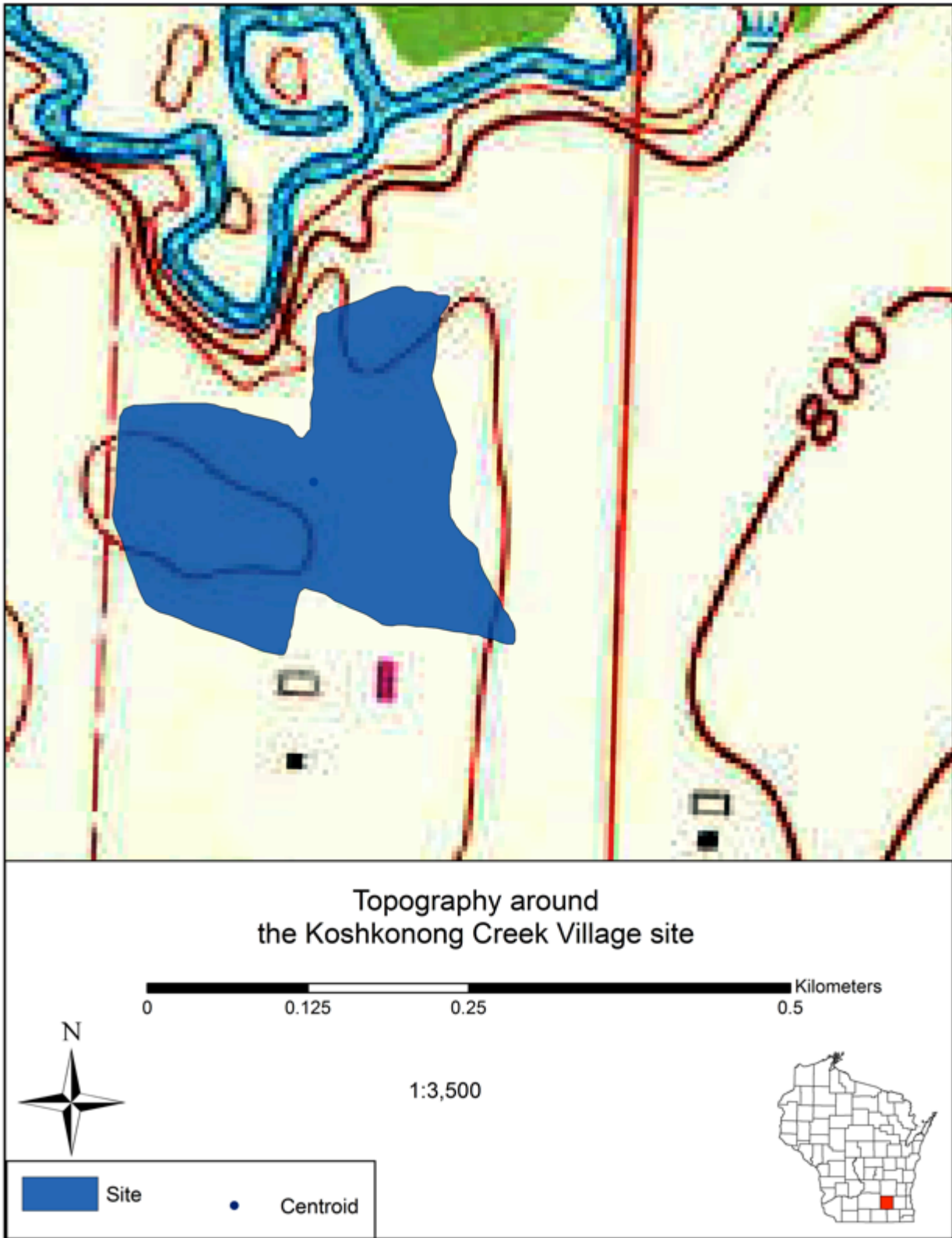


Figure 5.10 Topography of the land surrounding the Koshkonong Creek Village.



that rises approximately 15 meters to the east of the site and at least 40 meters west of Jelkes Creek. Similarly, there is higher ground that rises over 15 meters above the site to the west of KCV. Interestingly, the Crescent Bay Hunt Club site is also situated on an approximate 8-meter slope that crests 700 to 800 meters to the west, while the Schmeling site is on nearly 15-meter slope that crests one kilometer to the west. Carcajou Point is located on a more modest 5-meter slope that crests one kilometer to the northwest. The degree to which these site locations were designed to protect from western winds is an interesting question compared to how they enhance a defensive position, as the sites are fairly well concealed from enemies.

*Distance to Well-Drained Soils*

Both Washington Irving and KCV are located on well-drained or moderately well drained soil (Table 5.2). As the sites were located at relatively high elevations, it is therefore not likely that the sites would have remained wet long after a rain or flooding episode. Apart from the well-drained and moderately well drained soils on which the sites are located, the sites are within a close proximity to arable land with good and fair drainage. Jochim (1976) noted that settling on a well-drained area would have been vital for the comfort and health of the site inhabitants, as living and sleeping on dry land would have been a central consideration.

<b>Table 5.2. Distance to Important Resources (in meters).</b>		
Resources	Washington Irving	Koshkonong Creek Village
<b>River/Lake</b>	2775	3044
<b>Creek</b>	139	134
<b>Wetland</b>	48	400
<b>Ecotone</b>	0	0
<b>Well-Drained Soil</b>	0	0

*Distance to Water Sources*

As water is an important resource to all prehistoric groups, site distance to water is an important variable to consider in examining site location. There are two primary sources of water

within the catchment areas of Washington Irving and KCV: Jelkes Creek and Koshkonong Creek, respectively, and the various wetlands ecozones that surround the sites. Both sites are located directly adjacent to creeks, both located about an eighth of a kilometer away from Jelkes and Koshkonong Creeks. However, the sites are somewhat removed from major bodies of waters. Jelkes Creek is a tributary of the Fox River, which is located less than three linear kilometers away from the Washington Irving site. Similarly, KCV is located approximately three linear kilometers away from Lake Koshkonong.

#### *Distance to Ecotone*

Both sites were situated within close proximity to multiple ecotone areas. The centroid of the Koshkonong Creek Village is located in a water/prairie/savanna ecotone, while the boundary of the site overlaps with several other ecotones. The entirety of the Washington Irving site boundary is located within a water/wetland/savanna ecotone. While situated in different ecotones, this suggests that inhabitants of both Washington Irving and KCV were very well positioned to exploit the various resources of the diverse ecotones around the sites.

#### **Resource Pull Analysis**

This resource pull analysis was designed to determine areas that had the strongest economic pull within the one- and two-kilometer catchment areas at both KCV and Washington Irving (after Edwards 2010; Jochim 1976). Resource pull scores were tallied from three categories at any given location with values attributed to the productivity of the environmental zones present, the number of environmental zones within an ecotone and the quality of arable land (Table 5.3).

**Table 5.3 Description of values for resource pull analysis variables (after Edwards 2010).**

Variables	Productivity Scores				
	0	1	2	3	4
<b>Environmental Ecotones</b>	n/a	Prairie	Water	n/a	Savanna/Wetland
<b>Arable Land</b>	0 Ecozones	1 Ecozone	2 Ecozones	3 Ecozones	4 Ecozones
	Non-Arable	n/a	Fair	n/a	Good

For the purposes of this analysis, Values 9 through 12 are considered high pull, while five through eight are considered medium pull; as a score of one is not a possible in this schema, scores two through four are considered low resource pull. From an economic perspective, it can be expected that high score resource pull zones would be located in higher proportions within a one-kilometer catchment, suggesting the sites were placed near the richest areas for resource and agricultural potential (Edwards 2010). The resource pull zones of both study sites were examined at one- and two-kilometer catchment areas (Figures 5.11, 5.12, 5.13, 5.14; Tables 5.4 and 5.5).

**Table 5.4 Resource Pull Analysis Score Distribution (Proportion of 1 km Catchment).**

	Low			Medium				High				Total
	2	3	4	5	6	7	8	9	10	11	12	
<b>Washington Irving</b>	0%	0%	15%	0%	13%	19%	23%	0%	11%	19%	0%	<b>100%</b>
<b>Koshkonong Creek Village</b>	0%	2%	6%	3%	22%	7%	33%	5%	16%	5%	2%	<b>100%</b>

**Table 5.5 Resource Pull Analysis Score Distribution (Proportion of 2 km Catchment).**

	Low			Medium				High				Total
	2	3	4	5	6	7	8	9	10	11	12	
<b>Washington Irving</b>	1%	6%	9%	1%	9%	15%	24%	1%	21%	14%	0%	<b>100%</b>
<b>Koshkonong Creek Village</b>	0%	1%	9%	2%	25%	10%	28%	8%	13%	4%	1%	<b>100%</b>

A comparison of the proportions of high pull zones suggests that resource pull area proportions are similar within the one- and two-kilometer catchment radii. However, there is some variation. The Washington Irving site exhibits very similar proportions (15%) of low pull

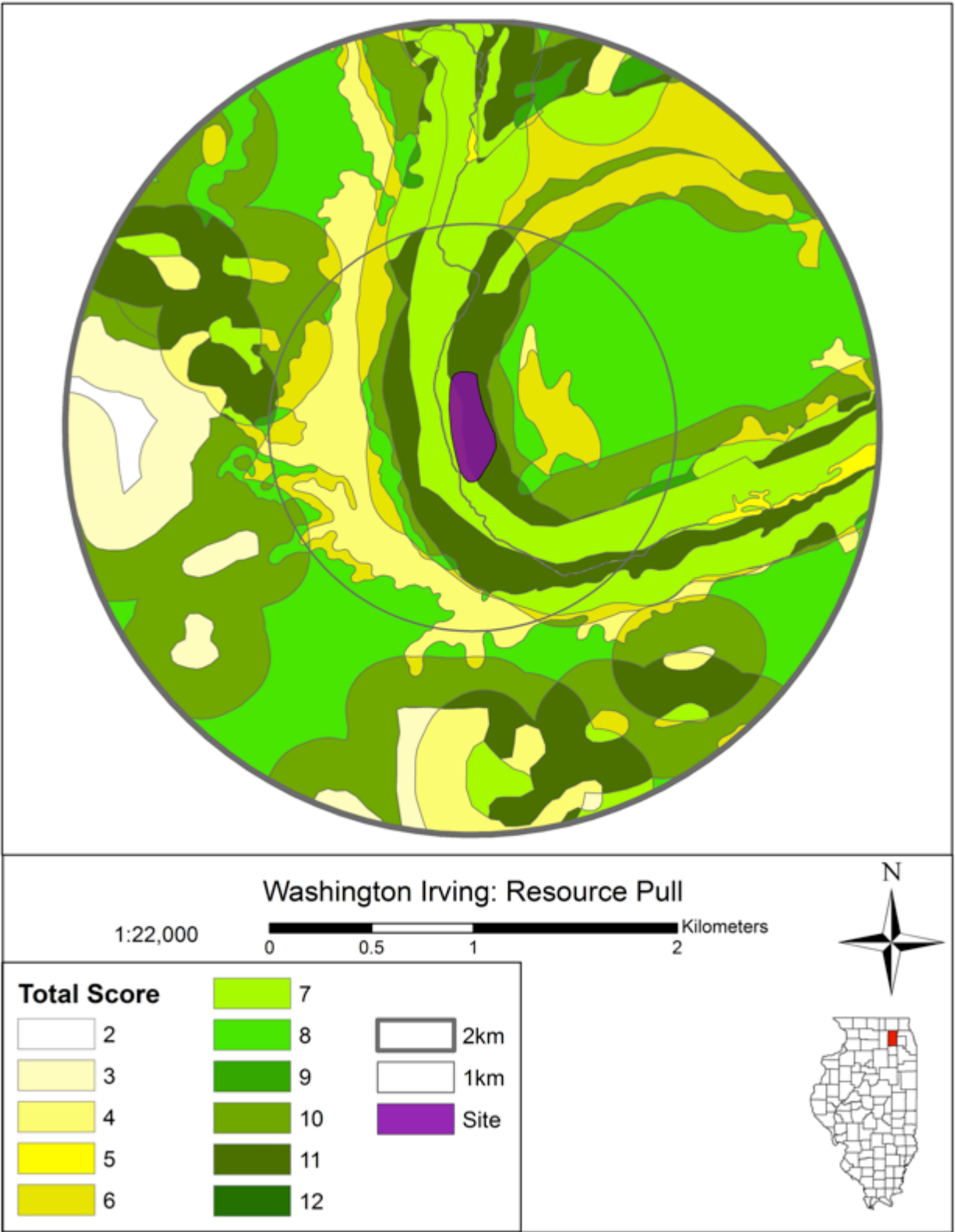


Figure 5.11 Map result of the Washington Irving resource pull analysis.

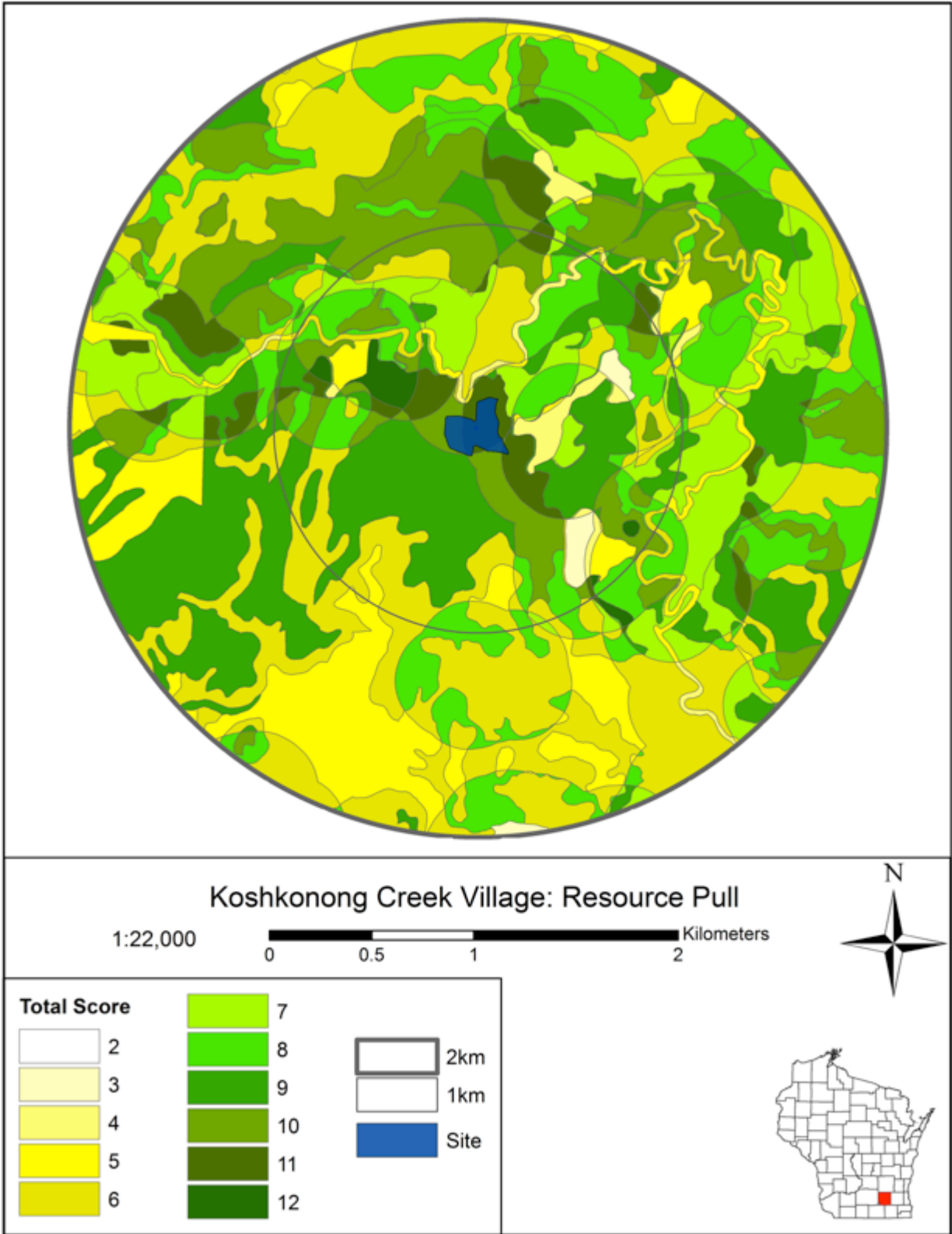


Figure 5.12: Map result of the Koshkonong Creek Village resource pull analysis (after Edwards 2010).

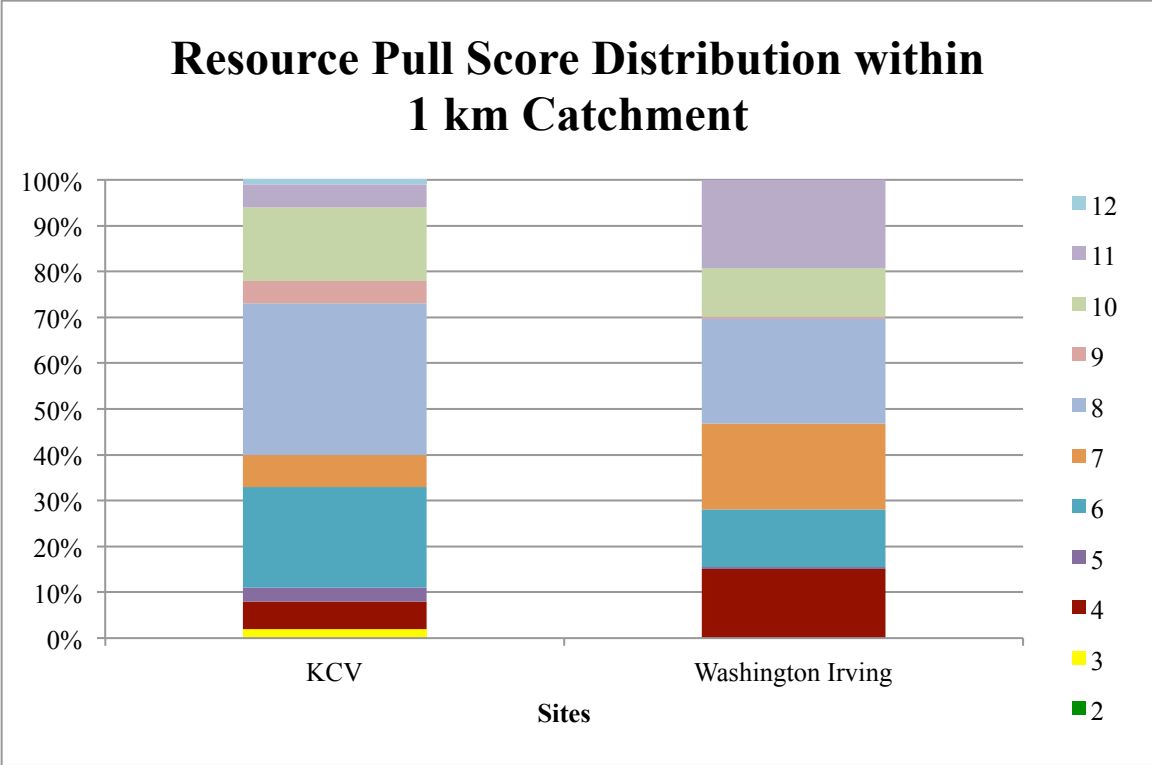


Figure 5.13: Proportion of Resource Pull Scores at 1 kilometer.

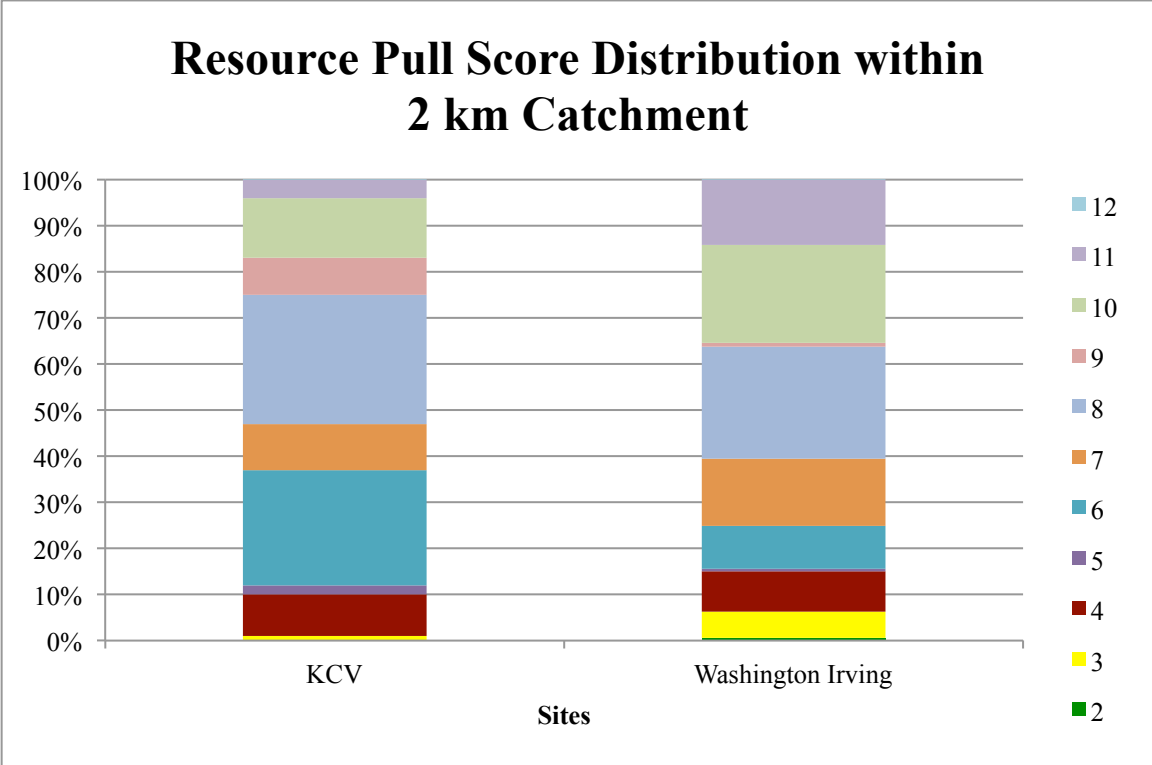


Figure 5.14: Proportion of Resource Pull Scores at 2 kilometers.

areas between one- and two-kilometer catchments. Similarly, 7% of the one-kilometer catchment area around KCV has low pull, and rises to 10% within the entire two-kilometer catchment.

Within a one-kilometer radius, the high pull areas represent 28% of KCV’s total area, and decreases 26% within the two-kilometer radius. However, while KCV follows the expectation that high pull areas are represented in higher proportions within the one-kilometer catchment than at two kilometers, the Washington Irving site exhibits a higher proportion of high pull areas within the two-kilometer catchment (36%) than at one-kilometer (30%).

Edwards (2010) initially hypothesized that the lack of a distinct pattern may be caused by the small amount of high pull resource zones altogether. Following Edwards (2010), the total area ranked as each score at one kilometer was investigated as a proportion of the total area within two kilometers with the same score (Table 5.6).

**Table 5.6 Resource Pull Analysis Score - Distribution of Resources as proportion of 2 km.**

1 km Proportion of Whole	Low			Medium				High			
	2	3	4	5	6	7	8	9	10	11	12
<b>Washington Irving</b>	0%	0%	43%	16%	34%	32%	24%	15%	13%	34%	0%
<b>Koshkonong Creek Village</b>	n/a	80%	17%	29%	23%	16%	29%	16%	30%	33%	87%

A majority of high value resource zones with scores 11 and 12 are located within the one-kilometer catchment. High pull scores of 11 and 12 at KCV are represented in proportions (33% and 87% respectively) that support the initial expectation. While score 12 areas do not exist within one kilometer of Washington Irving and are poorly represented within two kilometers at Washington Irving (only 1610 m<sup>2</sup>), fully 34% of score 11 areas are located within the one-kilometer catchment. The result of this investigation supports the expectation that high score resource pull zones should be located in higher proportions within a one-kilometer catchment.

Overall, this catchment analysis supports the hypothesis that the Washington Irving and Koshkonong Creek Village sites appear to have been located similarly near rich areas for resource extraction with access to wetland, upland and creek resources while remaining in close proximity to a sufficient amount of arable land.

### **Summary and Discussion**

The investigation of environmental zones and arable land around the catchment areas revealed that the Oneota and Langford occupants at the sites would have had access to many diverse resources as well as the potential to engage in substantial agricultural practices. The purpose of investigating the ecotones surrounding the sites' catchment areas was to determine the economic potential that would have been accessible to the site inhabitants. However, with seven different ecotones, the issue is quite complex and there is no way to determine if one ecotone is more economically important than others (after Edwards 2010:128). Nonetheless, the analyses suggest that the two sites exhibit similar ecotone proportions within the two-kilometer catchment area.

This study was not designed to demonstrate that site locations were specifically chosen compared to other potential locations; rather, it is a simple characterization of the site locations according to a set of environmental variables. A formal statistical analysis (such as a weighted Log Ratio Analysis, or wLRA) was not conducted for the comparative analysis of the study sites. The purpose of creating the catchment model of the Washington Irving site was to update Hunter's (2002) model at a two-kilometer radius and contextualize the site location. The current model serves as a validation of the earlier one-mile catchment model. However, this study suggests that Hunter's (2002:96) argument that Oneota and Langford groups "preferred two different microenvironments at the edge of the prairie peninsula" is not necessarily correct.



However, we should expect that particular conclusion since KCV was chosen for study because it is a locational outlier compared to other Oneota sites at the Koshkonong Locality. In effect, the work here does not invalidate Hunter's argument in general, but it does caution us that site placement models must be nuanced and contextualized.

### *Lithic Economies in an Environmental Context*

The previous chapters have been dedicated to creating a detailed view of the Washington Irving and Koshkonong Creek Village site environments. The following chapters in this thesis are the descriptions and analysis of the lithic tool and debitage assemblages from the sites. Environment and lithic technology, particularly raw material procurement, are fundamentally connected within a larger site settlement pattern and economy. The assemblage-based lithic tool and debitage analyses presented in the following chapters allow for a discussion regarding the organization of technology and lithic economics of the site occupants. It has been argued that energetic efficiency is the most optimal solution for a group when there are constraints on raw materials within a cultural-environment (Jeske 1992a; Torrence 1989b; discussed in-depth in the following chapter). The economic strategies surrounding stone tool manufacture can be better understood based on our understanding of those constraints.

While this comparative catchment analysis allows for the contextualization of resource availability and utilization, subsistence practices and lithic economies cannot be directly equated. Brose (1978:97) noted that "the relationship between stone tool industries and subsistence activities cannot be explained simply in terms of the available lithic sources or the [specialized or general] economy practiced at any specific site." Nonetheless, the subsistence economy inferred from the floral and faunal record at both sites allows us to make hypotheses about the need for

particular adaptations of lithic economy employed at the sites. In this case, the preliminary faunal analyses from both sites suggest stress adaptation practices. The presence of deer remains under two years of age at KCV (Van de Par et al. 2015) and a high degree of bone processing at Washington Irving (McTavish 2014) both suggest dietary stress possibly due to resource exhaustion.

Jeske (2003b) suggested violence and the maintenance of social and political relationships require energy that often lessens the amount of time and energy budgeted for material procurement and tool manufacture. Further, Jeske (2011) noted:

The optimal mix [of resource use] will change depending upon limiting factors, and that change should result in technological variation across space and through time, depending upon the environment. This variation in technology includes not only differences in raw material selection, but the diversity and complexity of tools manufactured and used, the levels of energy expended in manufacturing tools, the intensity of tool use, and tool discard rates [Jeske 2011:6].

The microenvironments of the sites have been observed to be generally similar and suggest site inhabitants had comparable access to upland, wetland and aquatic resources and plenty of arable land. However, this catchment study has not accounted for raw material procurement. Significant differences in lithic procurement and manufacturing strategies would indicate there is a difference in other environmental constraints, such as the quality, availability and accessibility of raw material, as well as stressors from the social and political landscape, which are not directly apparent from the environmental catchment analysis alone.

## CHAPTER 6

### MACROSCOPIC METHODS OF ANALYSIS

Many scholars have argued the way in which a group organizes technology is directly related to settlement patterns, social strategies, the acquisition of food resources and the environment, as well as other activities in a cultural system (Bamforth 1986; Jeske 1989a, 1992a; Ricklis and Cox 1993; Shott 1986; Torrence 1983). The focus of an organization of technology framework is to understand the behaviors surrounding technology, such as stone tool procurement, selection, manufacture, use, maintenance, reuse and discard (Andrefsky 1994; Bamforth 1986; Kelly 1988; Nelson 1991; Shott 1986).

#### **Organization of Technology**

Lewis Binford has been credited as the first archaeologist to implement the concept of technology as a way to understand the variation of behavior across an archaeological assemblage (Nelson 1991). In a study of the technologies used by the Nunamiut in Alaska, Binford (1977:24) concluded that an analysis of a social group's technology can be useful for understanding the "dynamics of behavior" of the group, and further argued that the current approaches for studying the variability of lithic assemblages were in need of "rethinking" (Binford 1979:271).

In his efforts to rethink lithic variability, Binford (1979) introduced viewing stone tools in terms of curation and expediency. Tools that have been curated have been defined as tools made useful for multiple tasks, made with the expectation of future use, maintained through a number of uses, transported from place to place, or recycled for other uses when necessary. Conversely, expedient tools have been defined as tools that are made, used and discarded in a practical or temporary fashion (Bamforth 1986; Binford 1979).

Following up on Binford's (1979) curated and expedient tool dichotomy, Torrence (1983) introduced the idea of a time-stress that shapes the strategies of scheduling different activities based on time constraints. Torrence's framework was intended to derive information from a lithic assemblage in order to predict the effects of time budgeting and further inferring about a groups settlement patterns and mobility. In the archaeological record, she suggested that time-stress could be observed in an assemblage's diversity and complexity. While groups with an increase of time-stress are expected to decrease the diversity and complexity of a tool assemblage, it is expected that decrease in a groups time-stress would exhibit an increase the diversity and complexity of a tool assemblage.

While Torrence's (1983) main focus was on time-stress and mobility, she also recognized that efficiency played a role in the organization of a group's technology. She wrote that when it is expected for a group to maximize their use of time efficiently, one could observe the effect it has on other related behaviors. Bamforth (1986) argued that a group's mobility was not necessarily the main factor in understanding their technological organization. Instead, he proposed that efficient tool procurement, manufacture, and use were critical to understanding many aspects of technological organization. Rather than claiming technology affects the activities performed by a group, Bamforth (1986:39) stressed that technology is organized around the requirements of an activity or activities that causes variation in all aspects of tool manufacture and use.

### *Theoretical Models and Optimization*

While recognizing that mobility may have been an important determinate in the organization of lithic technology among groups (see Binford 1977, 1979; Jeske 1987; Kelly

1988; Lurie 1989; Shott 1986; Torrence 1983), there has also be a focus of understanding other possible determinants of technological organization (see Andrefsky 1994; Bamforth 1986; Bleed 1986; Jeske 1989a, 2003b; Lurie 1989; Kelly 1988). Torrence (1989b) recognized that a range of models with much variation have been implemented by archaeologists to observe an organization of lithic technology. She wrote:

There are major disagreements about both the choice or currency (i.e. what problems are being addressed by or otherwise influence behavior) and whether the function of the tool or the way technology adapts itself to external constraints should have primacy in constructing an optimal model [Torrence 1989b:2].

However, Torrence (1989b) suggested that these different models are worth exploring, as they highlight issues and areas of study where increased attention to theory building is necessary. Ricklis and Cox (1993:444) wrote that lithic efficiency is not constant, but dynamic within a cultural system and fluctuates based on the demands of the overall adaptive behavior of a group. As such, lithic organization should be expected to change when other behavioral aspects of a cultural system changes.

Several archaeologists have stressed that energetic efficiency can often be assumed the most optimal solution when the emphasis is placed on understanding a behavior based on the environmental and time constraints rather than how the currency can be optimized (Nelson 1991:61; Torrence 1989b:2-3). Similarly, Jeske (1987:11) acknowledged that optimization models work best when a highly limiting economic factor is in operation, such as water holes in desert environments or spatially limited raw material outcrops. While mobile groups had previously been the focus on technological study, several scholars had begun to ask questions about less mobile groups and how to view their organization of technology (see Bamforth 1986; Jeske 1989a, 1992a, 2003b; Lurie 1989), and suggested that with less mobility and increased

sedentism, a group would be expected to increase their technological efficiency or become more economical (Jeske 2003b:225).

### *Energy Efficiency, Economy and Technology*

Over the past several decades, archaeologists have frequently used an economic model to explore the organization of technology (see Andrefsky 1994; Bamforth 1986; Jeske 1989a, 1992a; Lurie 1989; Morrow and Jefferies 1989; Torrence 1983, 1989a, 1989b). For groups that have a constraint on raw material resources, an economic model can be used to view the behaviors of a group through their technological organization. Economy is the management of resources and refers to use of raw material; to be more economical means to increase management of raw material with the goal of increased the yield of the resource (Jeske 1987:3). In this framework, a group's organization of technology will be determined by their need to maximize "efficiency" and their "economy" (Jeske 1989a:37).

In similar fashion to Binford (1979) regarding curation and expediency, Jeske (1992a) outlined a dichotomous spectrum of economies that can be expected from a lithic assemblage. A specialized lithic economy is commonly indicated by a more complex and diverse stone tool assemblage, with more evidence efficient activity, such as the resharpening and reuse of tools. Conversely, it can be expected for a generalized lithic economy to show evidence of less energy being put into the procurement and manufacture of tools because of stressors or competing activities. The tools and the debitage from a site will reflect a generalized economy by being a larger assemblage, showing less evidence of the resharpening of tools and consisting primarily of local raw materials.

Bamforth defined efficiency as energy expended as well as the return on the energy expended (1986:39). His efficiency model of technological organization argues that an efficient technological organization allows for all aspects of tool manufacture and use to be completed with a minimum amount of effort. As time and energy are limited resources, it is expected that groups invest in efficient behavior regarding technological activities, such as lithic procurement, and tool manufacture, use and discard (Jeske 2003b:226)

The concepts of efficiency and economy have often been discussed together when regarding the organization of lithic technology. However, following Christenson (1982), Jeske (1987, 1989) made a distinct effort to distinguish the two concepts. He defined “economy” as the management of resources and defined “efficiency” as the ratio of input to output, where a higher output per unit of input represents a higher efficiency. While economy is about raw material, efficiency is about time. Differentiating between economy and efficiency is important because while a certain activity might be efficient for completing a certain task, it may be less economical in terms of utilization of raw material. Sterner (2012:87-88) outlined how bipolar reduction (Figure 6.1) is both economical and efficient, as it efficiently removes several flakes from a core that can later be made into tools while economically recycling exhausted bifaces or small chert cobbles into bipolar flakes and cores. However, not all activities are both economical and efficient.

Using an economic model to study the lithic assemblages of Upper Mississippian horticulturalist groups is beneficial because of their constraints on the procurement of raw materials from the environment. Energetic efficiency is often assumed to be the most optimal solution when there are constraints on raw materials, the environmental and time (Torrence

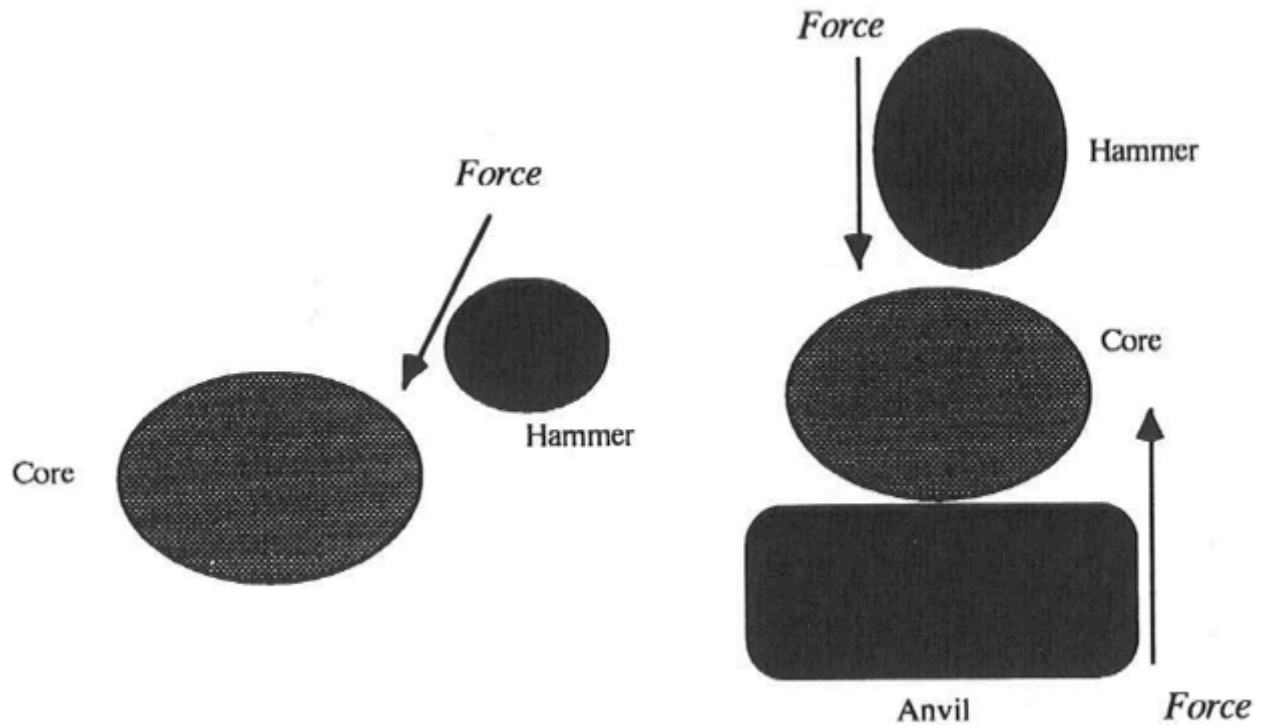


Figure 6.1: Freehand and Bipolar Percussion (after Jeske and Lurie 1993:147).

1989b). Based on that efficiency, the economic strategies regarding stone tool manufacture employed by groups can be better understood.

### **Assemblage-Based Approach**

The methods that connect the theory of an organization of technology approach have often been referred to as an assemblage-based approach (see Blodgett 2004; Jeske 1987; Lurie and Jeske 1990; Park 2004; Sterner 2012; Winkler 2011). The lithic assemblage recovered from a site will reflect the economizing choices that social groups make regarding how time and energy is used in tool production (Jeske 1987:2). By using an assemblage-based approach to view tool production as part of a larger set of cultural activities rather than an isolated activity, we can better understand the economy and economizing behaviors that organized a group's technology (Jeske 2003b; Sterner 2012).



By implementing an organization of technology framework, it allows me to ask questions about the degree of efficiency expended by groups engaged in stone tool manufacture and maintenance (Jeske 1987, 1989a, 1992a, 2003b). The methods adopted from Lurie and Jeske (1990) is rooted in this economic model of viewing stone tool production. The assemblage-based approach will allow me to observe debitage in terms of its economic value rather than simply a byproduct of lithic production (Jeske 2003b).

Many previous lithic analyses that have been produced at the University of Wisconsin-Milwaukee have implemented such an approach (see Ahlrichs et al. 2014; Blodgett 2004; Doyle 2012; Park 2004; Sterner 2012; Winkler 2011). The lithic analysis presented in this thesis will implement a similar organization of technology approach. Based on the lithic assemblages from KCV and Washington Irving sites, the following macroscopic analysis focuses on the understanding the strategies and economizing behaviors implemented by the Oneota and Langford group by observing how they organized their lithic technology.

### **Methods of Data Collection and Analysis**

The lithic assemblages from excavations at KCV and Washington Irving were analyzed using an adapted version of the Lithic Documentation and Schema (Jeske 2014; see Appendices A and B) developed by Lurie and Jeske (1990). There are several advantages to using this recording method. First, the classification variables within the schema allow for information to be gathered regarding the stone tool economy, as well as functional and stylistic information of a lithic assemblage. This is distinctly different from a morpho-functional based typological framework, which often causes incorrect assumptions and misinterpretations about stone tool utilization (Flenniken and Raymond 1986; Jeske 1989a; Odell 1979; Yerkes 1983). Second, the schema was designed for the recovery of the maximum amount of information with the least

input of time and energy, as well as produce datasets that facilitate comparisons among sites (Jeske 2014). The lithic assemblages began with a mass analysis of all lithic debitage, followed by the individual analysis of the tools.

A mass analysis allows for tool production strategies to be interpreted, such the procurement strategies, major reduction techniques, and heat-treatment strategies to improve flaking quality (Andrefsky 2005). Jeske and Lurie's (1990) schema also includes a more detailed individual debitage analysis that allows for every piece to be observed on numerous attributes. However, the collection of data during an individual debitage analysis takes significantly more time (Ahler 1989:85; Odell 2004:121). Conversely, the mass debitage analysis was designed to quickly process large datasets.

#### *Mass Analysis of Lithic Debitage*

The lithic tool and debitage assemblage from the 2012 field season at the Koshkonong Creek Village were previously sorted upon beginning the data collection for this thesis. Various lab volunteers from the University of Wisconsin-Milwaukee sorted the lithics from other artifacts from the 2014 field season after the conclusion of the field school excavations, while the author sorted debitage from tools. The lithic assemblages from the 1984 and 1985 field seasons at Washington Irving were previously sorted and analyzed by the author. The entire lithic tool and debitage assemblage from Washington Irving, including lithics from total surface pickup, plowzone, and excavated and flotation recovery contexts from features have been examined and previously discussed in the literature (see Jeske 1990, 2000). The present analysis of the Washington Irving tool assemblage is designed to be directly comparable to the lithic assemblage from the Koshkonong Creek Village. Since flotation context materials have not been fully processed from KCV, lithics from flotation context from Washington Irving were subject to

sampling; only lithic debitage larger than 12.5mm was examined from Washington Irving, as ½ inch mesh screen was used at the site during excavation. The following methods outline the steps taken to analyze the lithic assemblages from both study sites.

The first step in the analysis of the lithic assemblage was the sorting of tools from the debitage; as the tools and debitage from the 2012 assemblage from KCV and both field seasons at Washington Irving were sorted prior to this study, only the 2014 lithic tool and debitage assemblage from KCV needing sorting. Any lithic piece that showed evidence of modification by chipping, battering, or use-wear was categorized as a tool. Each tool was given a number, placed into artifact bags, labeled with its provenience information, and set aside for an individual analysis.

The debitage from each provenience context was divided into three categories: flake, flake-like, or non-flake. Any piece that exhibited two or more attributes of a flake was categorized as a “flake”. The attributes of a flake include: the presence of a striking platform, a bulb of percussion, ripples/rings of force, or a typical termination type, such as feather, step, or hinge. Any piece that exhibited one and only one of these attributes were categorized as “flake-like”. “Non-flake” pieces, also know as shatter, are those that have none of the attributes of a flake (after Lurie and Jeske 1990).

Once the lithic debitage was sorted into flake, flake-like and non-flake categories, they were further sorted, counted and weighed (in grams) by size grade. The debitage was placed in one of four size grades: less than 8 mm, 8 to 12.5 mm, 12.5 to 25 mm, or greater than 25 mm. The final two variables that were observed and recorded for the debitage groups were the amount of cortex on a piece and the presence of heat alteration (after Jeske 2014). All the data was collected and catalogued in a Microsoft Excel spreadsheet.

By observing and recording these variables, a mass debitage analysis allows for the interpretation of the activities and strategies surrounding the lithic economy at a site. Sorting debitage by size grade and recording the presence of cortex may help characterize the stage of lithic reduction occurring at a site, or at a specific location within a site. As stone tool production is a reductive technology, a high frequency debitage of a smaller size grade suggests later stages of lithic reduction, while a higher frequency of size grade 4 debitage suggests earlier stages of lithic reduction. Similarly, the presence of cortex at a high frequency of debitage can imply initial stages of lithic reduction (Andrefsky 2005; Odell 2004). Recording the presence of heat alteration within the debitage assemblage can further characterize the lithic economy used by the site inhabitants. Evidence of heat alteration indicates a strategy was applied to improve the flaking quality of poor quality raw materials (Kooyman 2000; Rick 1978).

#### *Individual Analysis of Lithic Tools*

Following the mass debitage analysis, an individual analysis of the lithic tools was conducted (see Jeske 2014; Appendix B). The lithic analyses began with recording provenience information as well as metric variables such as length, width, thickness and weight. Weight was not recorded for tools determined to be either broken or incomplete. Other attributes recorded mostly reflect information about the tool regarding manufacture, function and style. Comment categories were used to describe the common morpho-functional tool type associated with a piece as well as any other exceptional feature worthy of notice (after Jeske 2014; Jeske and Lurie 1990).

Several categories regarding tool material were observed and recorded. Raw material types and quality were identified with the use of a comparative collection housed at the UW-Milwaukee Archaeological Research Laboratory, while a manuscript on file at UW-Milwaukee

regarding lithic raw materials from Wisconsin was used to help determine whether raw materials were locally accessible (Winkler et al. 2009). Ferguson and Warren's (1992) article *Chert Resources of Northern Illinois: Discriminant Analysis and an Identification Key* was helpful in determining the raw materials from the Washington Irving assemblage.

The comparative collection was also used to determine the presence or absence of heat treatment. Changes in color, commonly a red, pink or yellow color, and an increase in luster are the most common indicators of heat alteration (Rick 1978:57-58). The amount of cortex observed on the surface of tools was also recorded. Cortex amounts were recorded as 0%, present but less than 50%, between 50% and 100%, and 100% cortical surface.

Categories regarding tool manufacture were also recorded. The basic forms of tools were categorized into several types: edge- or functional-unit only, unifacial, bifacial, multifacial, nonfacial, prismatic blade or bladelet, or unknown. The location of edge modification was also recorded and classified as either unifacial, bifacial, both unifacial and bifacial, or not applicable. Regarding the method of modification, tools categorized as either flaked, battered, both flaked and battered, use-wear only, or not applicable. Regarding bifacial tools only, refinement quality of a tool was classified as crude, medium, refined, cannot determine, while, non-bifacial tools were classified as not applicable. Tool refinement was based on the considerations of flake scar size along tool edges, the regularity of tool outline, and thickness of the bifacial tool.

Characteristics of tool morphology were observed and recorded. The completeness category refers to the completeness of the functional unit of a tool, recorded as broken, whole, cannot determine and not applicable (for fragments without functional units). Conversely, the element present category refers to the entire element of a tool present, not just the functional unit of a tool. Elements present were categorized as including the distal end, mid-section, proximal

end, an indeterminate end section, all elements, or cannot determine. For tools with distal ends present, distal end morphology was further recorded, classified as either blunt, pointed, not applicable (for pieces without distal ends), or cannot determine.

Several variables were recorded regarding the edge of tools. Reworking or reuse, classified as either present, absent or possible, refers to the resharpening to a tool. Rework has been determined by factors such as abrupt changes in tool outline or retouch around a tool edge, or retouch on a broken edge may also be used as indicators of rework. The position of retouch or use of a tool was also recorded as being either on the end, side, end and side or cannot determine, or not applicable for unretouched pieces.

Variables regarding edge configuration were also recorded. The number of edges (up to four edges) and edge angles were recorded as 0 to 45 degrees, 46 to 75 degrees, or greater than 75 degrees, with measurements were taken 5 mm back from the edge of the functional unit. Edge configurations were recorded as smooth, serrated, denticulate, notched, or not applicable. For whole and almost whole tools, the hafting element variable was recorded as present, possible, absent, not applicable, or modified for hafting by thinning and/or grinding the tool base. Tool projections, defined by intentional retouch or by wear on an unretouched area that extends out from the body of the piece, were recorded as present, possible or absent. The modification of projection was recorded as present (having been formed by intentional retouch), absent (having been defined on the basis of wear) or not applicable.

## CHAPTER 7

### DESCRIPTION OF THE LITHIC ASSEMBLAGES

#### The Washington Irving Debitage Assemblage

A total of 1,641 pieces of debris from the Langford component at Washington Irving was subjected to massdebitage analysis. The pieces were divided into size grades 1 through 4 (Jeske 2014; Appendix A):

- Size Grade 1: Less than 8 mm
- Size Grade 2: 8 mm to 12.5 mm
- Size Grade 3: 12.5 mm to 25 mm
- Size Grade 4: Greater than 25 mm

However, for the purpose of comparing the lithic assemblage to that from the Koshkonong Creek Village, size grade 1 and 2debitage recovered from excavation were not included in this study. At the present time, flotation recovery contexts from the excavations at the Koshkonong Creek Village have not been completely processed. Therefore, the lithic assemblage recovered from at Washington Irving was subject to sampling. As ½ inch mesh screens were used to recover materials during excavation, only pieces ofdebitage 12.5mm and large (size grade 3 and 4) were included in this analysis (Table 7.1).

**Table 7.1. Totals and percentages of the Washington Irving lithicdebitage based on size grade.**

Type	n of Pieces	Weight (g)	% of Total	n with Cortex	% with Cortex	% of Total w/ Cortex	n with HT	% with HT	% Total w/ HT
3	1229	1148.2	74.9%	302	24.6%	62.0%	190	15.5%	70.1%
4	412	2487.6	25.1%	185	44.9%	38.0%	81	19.7%	29.9%
<b>Total</b>	1641	3635.8	100%	487	29.7%	100%	271	16.5%	100%

Apart from size grade divisions, thedebitage assemblage was also divided into the flake type categories: Flake, flake-like, and non-flake. Non-flakes or shatter debris were the most

common, with 38% of the pieces (n=622) falling into this category (Table 7.2). Flake and flake-like pieces exhibit similar frequencies in the debitage assemblage, representing approximately 31% (n=512, n=507) of both assemblages. Many of the flake-like pieces were recorded as such because they were missing either platforms or terminations, or did not have other features like rings of force or bulbs of percussion. A majority of the lithic debitage was debris shatter, showing no characteristics of lithic reduction such as a striking platform, bulb or percussion, ripples or discernible termination and was categorized as non-flakes.

**Table 7.2. Totals and percentages of the Washington Irving lithic debitage based on type.**

Type	n of Pieces	Weight (g)	% of Total	n with Cortex	% with Cortex	% of Total w/ Cortex	n with HT	% with HT	% Total w/ HT
Flake	512	407.9	31.2%	104	20.3%	21.4%	84	16.4%	31.0%
Flake-Like	507	730.0	30.9%	136	26.8%	27.9%	82	16.2%	30.3%
Non-Flake	622	2497.9	37.9%	247	39.7%	50.7%	105	16.9%	38.7%
<b>Total</b>	1641	3635.8	100%	487	29.7%	100%	271	16.5%	100%

Nearly 30% (n=487) of the total debitage assemblage showed evidence of cortex remaining of the surface of a piece. Approximately half of size grade 4 debitage (n=185) showed cortex on the surface of the material, while about a quarter of size grade 3 debitage (n=302) had cortex present. This trend is expected. As a piece of lithic material is reduced, there will be less cortex remaining on the debitage as well as the core being worked (Ahler 1989:90; Andrefsky 2005:115; Odell 2004). The presence of heat-altered material represents around 16% of the debitage assemblage regardless of division by debitage type or size grade, indicating that the heat-treatment of raw materials was a strategy used to improve flaking quality (Kooyman 2000:65).

As previously reported (see Jeske 1990, 2000), bipolar reduction and free-hand lithic manufacturing techniques were implemented by the occupants of the Washington Irving site. However, a formal bipolar debitage analysis with blind testing (e.g., Jeske and Lurie 1993) was



beyond the scope of this research. In previous renditions, Jeske's (2014) mass debitage analysis schema included a variable to record number of bipolar pieces per size grade; however, the schema has since abandoned the category. Jeske and Lurie (1993:145) argued that it is not possible to distinguish the two techniques by dividing the debitage assemblage into free-hand and bipolar categories for analysis, as an analyst will likely combine the products of the two techniques. Nonetheless, bipolar cores and tools are present in the lithic tool assemblage and indicate an occurrence of bipolar manufacture. Apart from flake stone tools, several hammerstones were recovered that have pits and striations, suggesting they have been used for bipolar reduction (Jeske 2000).

### **The Washington Irving Tool Assemblage**

The lithic assemblage from the 1984 and 1985 excavations at Washington Irving includes 101 chipped stone tools. Photographs of the tools by morpho-functional type are located in Appendix C (Plates 1-8). The lithic tool and debitage assemblages sampled for this thesis suggests a debitage-to-tool ratio of approximately 16:1. As ½ inch mesh screens were used during excavation, the inclusion of size grade two pieces (8mm to 12.5mm) from flotation to the assemblage sampled in this thesis would result in a debitage-to-tool ratio at Washington Irving that is considerably higher. Hunter (2002:86) reported a debitage-to-tool ratio around 20:1, accounting for approximately 2,400 “analyzable” flakes. However, the tabulation record from the excavations displays approximately 10,000 pieces of debitage recovered, although, a large majority are small, size grade 1 pieces. Using this data, the debitage-to-tool ratio is approximately 100:1. The Washington Irving site exhibits a high debitage-to-tool ratio, yet varies depending on the sampling strategy employed.

### *Raw Material*

The majority of the lithic tool assemblage is composed of Silurian chert (n=74, 73%; Table 7.3). Much of the material is locally available Joliet formation Silurian, accessible in northeastern Illinois throughout natural outcrops along the Des Plains and DuPage Rivers, as well as in the Fox River valley in Kane County (Ferguson and Warren 1992). There is an exposure of Silurian chert on the Fox River approximately 10 km south of the site (Jeske, personal communication, 2016). Kullen (2011) noted that large exposures would have been the main, local source of the material for prehistoric groups in northeastern Illinois. The raw material is nearly white in color and, while not abundantly fossiliferous, contains many more fossils than other Silurian formation cherts (Willman 1973:19-20). Joliet formation Silurian was available from outcrops exposed in ravines, from deposits in streambeds and as inclusions in glacial till (Kullen 2011).

**Table 7.3. Percentage and number of tools by raw material type from Washington Irving.**

<b>Raw Material</b>	<b>n</b>	<b>%</b>
Silurian	74	73.3%
Unknown	22	21.8%
Burlington	3	3.0%
Hixton	1	1.0%
Moline	1	1.0%
<b>TOTAL</b>	<b>101</b>	<b>100%</b>

Tools made from Burlington represented a small proportion of the assemblage (n=3, 3%). Burlington chert varies in color from white, tan and brown, and when heat-treated is often pink, orange or red in color, occasionally exhibiting banding. The Burlington exposure located in west-central Illinois would have provided the most accessible source of the material for southeastern Wisconsin and northern Illinois populations; however, there are also exposures of the material in eastern Missouri and southeastern Iowa (DeRegnaucourt and Georgiady

1998:172-173). Ferguson and Warren (1992:12) note that Burlington commonly has a waxy luster but recognize that dull-lustered Burlington can often resemble Joliet formation chert.

One tool (1%) was made of Hixton Silicified Sandstone, a material of fair to high quality. The only source known is located at Silver Mound in western Wisconsin (Carr and Boszhardt 2010). Silicified stone breaks conchoidally and is brittle enough to be flaked into different shapes with sharp edges (Andrefsky 2009). Likewise, one tool (1%) was made of Moline chert. Originating from northwestern Illinois, Moline is a high quality, glossy raw material (Sterner 2012). One tool of good quality was initially thought to be Knife River, but appears to be similar to some unknown chert types found in the area (Ahlrichs, personal communication, 2015). Knife River chert is distinctively dark brown in color and non-local to the area, with several quarries found along the Knife River valley in several counties in North Dakota (Clayton et al. 1970:282).

In total, approximately three-quarters (n=74) of the lithics from Washington Irving were made of locally available Silurian with only five tools (5%) being of known non-local material (Table 7.4). Likely a local material, the remaining tools (n=22) represent unknown glacial till. If the tools categorized as unknown material are considered local, the proportion of tools made from local material represents an overwhelming majority of the lithic tool assemblage (n=96, 95%).

<b>Material Type</b>	<b>n</b>	<b>%</b>
Local	74	73.3%
Non-Local	5	5.0%
Unknown	22	21.8%
<b>TOTAL</b>	<b>101</b>	<b>100%</b>

The majority of lithic tools from Washington Irving were made from fair quality material (n=75, 74%). Approximately 22% (n=22) of the tools were categorized as being poor quality raw materials. Tools of good quality raw material represent only 4% (n=4) of the assemblage. The frequencies of locally available and fair and poor quality raw materials suggest that little time and energy was spent making traveling or trading for good quality chert (Jeske 1992a).

The amount of tools with some cortex suggests that early stages of lithic reduction were possibly occurring at Washington Irving. Approximately three-quarters of the tools (n=74) had no cortex remaining on the surface while the remaining one-quarter of the tools (n=27) had less than 50% cortex on the tool. No tool had more than 50% on the surface covered with cortex.

As indicated by the debitage assemblage, heat alteration was a strategy employed at Washington Irving to help improve the quality of poor and fair raw materials. Approximately 14% of the assemblage (n=14) showed the presence of heat alteration, with an additional 12% (n=12) possibly having been heat-treated. One tool (1%) was burned and another tool (1%) was too small to determine the presence of heat alteration. The remaining 72% of the tools (n=73) were not thermally altered.

#### *Tool Morphology and Modification*

There were several basic tool forms in the Washington Irving assemblage (Table 7.5). Over half of the tools (55%, n=56) were bifacially modified, with 19% of the tools (n=19) being edge-only and 17% being multifacial (n=17). Only 6% of the tools (n=6) were unifacially modified. Three of the tools were categorized as prismatic blades; Jeske (2000) reported that the full assemblage including tools from survey contained of a small percentage of pseudo-bladelets, which suggests flake reduction from bipolar cores. The frequency of tool forms from this sample

**Table 7.5. Percentage and number of tools in each Basic Form category from Washington Irving.**

<b>Basic Form</b>	<b>n</b>	<b>%</b>
Bifacial	57	56.4%
Unifacial	6	5.9%
Multifacial	17	16.8%
Edge-Only	18	17.8%
Prismatic Blade/Bladelet	3	3.0%
<b>TOTAL</b>	<b>101</b>	<b>100%</b>

of the assemblage is consistent with that of the entire tool assemblage (including TSP recovered artifacts) previously documented by Jeske (2000).

Whole tools, or tools with complete functional unit present, represent just over half of the lithic assemblage from Washington Irving (n=55, 55%). Broken tools, or tools with one or more functional units interrupted by a break, accounts for approximately 37% (n=37) of the assemblage. The remaining nine tools (9%) did not contain functional units were scored as Not Applicable. A majority of tools recovered had all elements present (63%, n=64). These include whole tools as well as cores without functional units. The remaining tools were not complete, with 11 tools (11%) having only the distal end present, 17 tools (17%) having the proximal present, 5 tools (5%) having only the mid-section present, and 3 tools (3%) having an indeterminate end section present.

Regarding the method of tool modification, over one-third of tool assemblage from excavations at the Washington Irving site was modified by flaking (37%, n=37; Table 7.6). Approximately 32% of the assemblage (n=32) was modified by flaking and battering, while 18% of the assemblage (n=18) was modified by battering only. Modification by use-wear only was present on 14% (n=14) of the tools in the assemblage. A higher frequency in battering technique of manufacture may suggest a high degree of bipolar percussion in the manufacture of lithic tools. Jeske (1990:230) suggested that humpback bifaces and triangular bifaces show similar

**Table 7.6. Percentage and number of tools in each Method of Modification category from Washington Irving.**

<b>Method of Modification</b>	<b>n</b>	<b>%</b>
Flaked	37	36.6%
Flaked and Battered	32	31.7%
Battered	18	17.8%
Use-wear Only	14	13.9%
<b>TOTAL</b>	<b>101</b>	<b>100%</b>

evidence of bipolar reduction techniques and differ morphologically based on raw material quality and fracturing during reduction.

Few pieces showed evidence of retouch. While 74 of the tools (73%) did not show any evidence of reuse or retouch, six tools (6%) showed evidence of retouch, and 21 (21%) tools were categorized as possibly being reworked. There were no tools in the assemblage that showed evidence of projections, or the intentional retouch or wear on an unretouched area that extends out from the body of a piece. However, this is also most likely due to sampling bias, as Jeske (2000) noted in his original analysis that a small frequency of bifacial drills that were recovered from the site. While the absence of any evidence of reuse or possible reuse may be due to the lack of ability to recognize it, a low frequency of rework is expected in assemblages that are indicative of a generalized lithic economy that produces crudely refined pieces and expediently made tools (Jeske 1992a).

Of the bifacially modified tools (n=57), a majority of the tools were of either crude refinement (60%, n=34) or medium refinement (25%, n=14). Two tools (4%) were determined to be refined and seven tools (12%) were too small to determine the level of refinement. As with the procurement of raw material, it appears that little time was spent refining tools; rather, the focus was to expediently create (although not necessarily discard) functional tools (Jeske 1992a). However, the frequencies of basic tool forms suggest that while expedient edge-only tools were

part of the lithic economy to inhabitants, some time and energy may have been spent making bifacial tools.

Hafting elements were mainly absent or not applicable among the tools in the assemblage. A total of 11 tools (11%) showed evidence of obvious marked constrictions or notched hafting elements, while 17 tools (17%) showed possible evidence of hafting. These triangular bifacial points had either straight or concave bases with only slight indications of possible hafting elements, and could be defined as Madison points in common point typology. However, contracting-stemmed, expanded-stemmed and side-notched hafting elements are also present.

### **Washington Irving Tools based on Morpho-Functional Categories**

This section is a discussion of the lithic tool assemblage as tool types using a morpho-functional typology (Table 7.7). As the goal of the schema is to produce datasets that facilitate comparisons among sites (Jeske 2014), traditional tool typologies were considered. As noted by Sterner (2012), the use of morpho-functional categories persists in a vast amount of literature and is required to a to be comparable to other lithic tool analyses.

**Table 7.7. The Washington Irving lithic assemblage categorized by a morpho-functional typology.**

<b>Morpho-functional Category</b>	<b>n</b>	<b>%</b>
Unidentified Tool	48	47.5%
Triangular Point	34	33.7%
Multifacial Core	9	8.9%
Scraper	4	4.0%
Knife	3	3.0%
Hafted Bifacial Points	3	3.0%
TOTAL	101	100%

#### *Triangular Points/Madison Points*

Triangular points represent 31% (n=31) of the lithic tool assemblage recovered from excavation at Washington Irving (Table 7.8, Plate 1). Madison points, including humpbacks,

**Table 7.8. Measurements of projectile points from Washington Irving.**

<b>Triangular Point Type</b>	Measurement	n	Mean	SD
Madison Points (excluding humpbacks)	Length (mm)	4	24.5	5.3
	Width (mm)	7	17.2	2.9
	Thickness (mm)	13	4.1	1.5
	Weight (g)	2	3.3	3.5
Humpback	Length (mm)	7	25.2	3.6
	Width (mm)	12	18.1	1.9
	Thickness (mm)	13	7.3	1.6
	Weight (g)	7	2.7	1.7
Unclassified Triangular Bifaces	Length (mm)	3	28.7	3.3
	Width (mm)	4	21.1	4.3
	Thickness (mm)	5	7.3	1.4
	Weight (g)	3	3.5	1.3

represent 84% of all of the triangular projectile points, and account for 26% (n=26) of the entire tool assemblage. All Madison points in the tool assemblage are bifacial in form. Excluding humpbacks, Madison points represent 42% (n=13) of triangular projectile points. Justice (1987:224) defined Madison points as a straight sided or slightly concave isosceles triangular arrowhead, with a range of variation of excurvature at the base. However, for the purposes of this study, triangular points have been separated into Madison and humpback types and discussed separately, as they exhibit several differences. Five of the tools within the projectile point assemblage were categorized as unclassified points (24%). Several of the triangular projectile points could not be categorized because they were broken or crude. However, one of the tools was a refined biface made of Hixton Silicified Sandstone with only the midsection remaining.

#### *Humpback Triangular Bifaces*

Humpback bifaces are crudely manufactured pieces that have many step fractures that result in a hump-like feature on one face of the tool (Jeske 1992a). By definition, many of the humpback triangular points recovered at Washington Irving fall into the ambiguous category of



Madison point. While Jeske (1992a:476) noted there is a lack of distinct characteristics separating humpback from Madison bifaces, they are worth noting separately as they have been identified as being associated with bipolar reduction techniques. A total of 13 humpback triangular points were recovered at the Washington Irving site, also representing 42% of the total triangular point assemblage and half of the Madison point assemblage (Plate 2). An overwhelming majority of the Madison and humpback triangular points were broken; however, a t-test shows the thickness of the two point types are significantly different; on average, more traditional Madison points are approximately three millimeters thinner than humpback triangular points.

In her high-power use-wear analysis of a small sample of humpback bifaces (after Keeley 1980), April Sievert (Hohol 1985) suggested the tools were used for a variety of purposes on a variety of materials. One Madison humpback had polish and striations on the tip, while hafting wear was observed on the basal corners of another. Wood polish was observed on a humpback that appeared to have been used for boring. On one tool, an unidentified weak polish was observed on the highest side of the hump. Due to the course grain and light color of the tools, only one-third of the tools examined showed polish. However, it is possible that more humpback tools were utilized but showed no evidence of wear.

#### *Other Formal Tools*

Several formal bifacial tools were recovered (Table 7.9, Plate 3). Three bifacial tools had distinct hafting elements; one tool was an expanded-stemmed, one tool was a contracting-stemmed, and one was a side-notched. All three tools were broken and could not be categorized into any further point typology.

<b>Formal Bifacial Tools</b>	<b>Measurement</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
Knives	Length (mm)	2	45.9	0.1
	Width (mm)	3	23.1	4.2
	Thickness (mm)	3	8.7	3.0
	Weight (g)	2	9.0	4.0
Unidentified Hafted Bifaces	Length (mm)	0	N/A	N/A
	Width (mm)	1	22.8	N/A
	Thickness (mm)	2	6.0	0.8
	Weight (g)	0	N/A	N/A

Three tools were classified as knives (3%, Plate 4). Each knife exhibited different morphological characteristics. All three tools were bifacial in form; one is a large biface broken near the base, one is a large biface with evidence of resharpening, and one was a possibly a bifacial preform worked into a knife. Only five tools were classified as scrapers, all of which were classified as end and side scrapers (5%; Table 7.10, Plate 5). However, hide-scraping activities can be interpreted from edge-only unidentified tools that show transverse motion use with hide or meat polish. The final three formal tools (3%) appear to be the tip of knives, drills or projectile points, etc. The tools were classified as formal, as they were clearly worked bifacially into a point; however, because they are so incomplete, they could not be identified as any specific tool type.

<b>Scraper Type</b>	<b>Measurement</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
End and Side Scrapers	Length (mm)	5	30.7	8.6
	Width (mm)	5	21.1	5.8
	Thickness (mm)	5	7.4	3.3
	Weight (g)	5	4.7	2.8

### *Bipolar and Free-Hand Cores*

A total of nine cores (9%) were recovered from the tool assemblage (Table 7.11). Of these tools, seven bipolar cores were recovered from the lithic tool assemblage (10%, Plate 6).

**Table 7.11. Measurements of multifacial cores from Washington Irving.**

Multifacial Core Type	Measurement	n	Mean	SD
Bipolar Cores	Length (mm)	7	27.0	6.1
	Width (mm)	7	18.8	5.1
	Thickness (mm)	7	12.0	3.9
	Weight (g)	7	6.3	4.2
Freehand Cores	Length (mm)	2	31.6	7.1
	Width (mm)	2	13.0	2.5
	Thickness (mm)	2	11.5	2.9
	Weight (g)	2	6.2	4.2

The remaining two cores recovered from the lithic tool assemblage did not show any evidence of bipolar reduction (Plate 7). Cores were classified as bipolar if striking platforms were present at both ends of the flake scars present on the core (after Sterner 2012). Crushed platforms and battering are commonly present at both ends of the core due to the nature of bipolar percussion, with multiple strikes of the hammer stone against an anvil (Kooyman 2000:56). Jeske and Lurie (1993) suggested that bipolar reduction is an economizing strategy to reduce poor quality raw material when good quality material is unavailable. There were several multifacial lithic tools that may once have been cores—opposed to flakes or blanks—that appeared to have a utilized edge and were subsequently categorized as unidentified multifacial tools, as their function was not fully apparent.

#### *Unidentified Tools*

A total of 47 lithic tools (47%) from the assemblage did not fit into any of the formal typological categories and were categorized as Unidentified (Table 7.12, Plate 8). Additionally, there were 15 unidentified bifacial tools (32%), eight unidentified multifacial tools (17%) and three unidentified unifacial tools (6%). Of these unidentified tools, nearly half were expedient edge-only tools (n=21, 45%). Three “pseudo-bladelets” (Jeske 2000:279) recovered were considered edge-only tools, as they showed signs of use wear or microflaking and were likely

**Table 7.12. Unidentified tool forms from Washington Irving.**

<b>Modification Type</b>	<b>Measurement</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
Edge-Only	Length (mm)	20	26.8	7.0
	Width (mm)	21	17.5	6.0
	Thickness (mm)	21	6.5	3.4
	Weight (g)	20	3.3	4.0
Bifacial	Length (mm)	8	29.5	4.4
	Width (mm)	9	20.1	5.1
	Thickness (mm)	14	6.9	1.5
	Weight (g)	8	4.4	2.9
Multifacial	Length (mm)	8	26.5	6.1
	Width (mm)	8	19.1	4.9
	Thickness (mm)	8	10.6	4.5
	Weight (g)	8	5.3	4.5
Unifacial	Length (mm)	2	23.0	0.3
	Width (mm)	2	14.8	1.6
	Thickness (mm)	3	6.1	2.7
	Weight (g)	1	2.2	N/A

formed from bipolar cores than prepared blade cores. Absent from the Washington Irving site and other Langford sites, prepared blade cores are the most important factor in distinguishing blade production (Odell 1994). Prepared cores are commonly observed in contexts that include Clovis, Hopewell, Neolithic Mesoamerica, the California Channel Islands, Alaska and the Northwest Coast, as well as large earthwork sites such as Poverty Point and Cahokia (Odell 1994; Parry 1994).

### **Summary of Washington Irving Lithics**

The results of the analysis of the lithic tools recovered from feature and plowzone contexts at Washington Irving support the findings initially reported by Jeske (2000), who noted a similar frequency of tool forms and suggested bipolar reduction as a major form of the site inhabitant's economy. Furthermore, the Washington Irving lithic assemblage exhibits similarities to other Langford sites such as the Robinson Reserve (Lurie 1992:96-99), LaSalle County Home (Jeske 1998:30-45) and Zimmerman sites (Park 2004:157-161) with a prevalence of bipolar

reduction techniques, a moderate production of triangular bifacial tools (including humpback bifaces), and the procurement of fair and poor quality local raw material.

The remainder of this chapter is an in-depth description of the tool and debitage assemblages from the Koshkonong Creek Village. Successively, a comparative analysis of the Washington Irving and Koshkonong Creek Village lithic assemblages are discussed in Chapter 8.

### **The Koshkonong Creek Village Debitage Assemblage**

A total of 681 pieces of debris from the Oneota component at the Koshkonong Creek Village was subjected to mass debitage analysis and were divided into size grades 1 through 4 (Table 7.13). Only lithic pieces recovered from ¼ inch dry screen contexts were subject to analysis, as the majority of the assemblage collected for flotation has not yet been processed or sorted. Over half of the debitage assemblage was size grade 3 (61%, n=414). Size grade 2 and 4 represent 18% (n=119) and 21% (n=144), respectively.

**Table 7.13. Totals and percentages of the KCV lithic debitage based on size grade.**

Type	n of Pieces	Weight (g)	% of Total	n with Cortex	% with Cortex	% of Total w/ Cortex	n with HT	% with HT	% Total w/ HT
1	4	0.5	0.6%	2	50.0%	1.3%	1	25.0%	0.5%
2	119	40.05	17.5%	17	14.3%	10.6%	36	30.3%	18.0%
3	414	358.6	60.8%	85	20.5%	53.1%	125	30.2%	62.5%
4	144	610.4	21.1%	56	38.9%	35.0%	38	26.4%	19.0%
<b>Total</b>	<b>681</b>	<b>1009.5</b>	<b>100%</b>	<b>160</b>	<b>23.5%</b>	<b>100%</b>	<b>200</b>	<b>29.4%</b>	<b>100%</b>

About a quarter of the total debitage assemblage (24%, n=160) showed evidence of cortex remaining on the surface of a piece. Approximately 39% of size grade 4 debitage (n=56) showed cortex on the surface of the material, while about a fifth of size grade 3 debitage (21%, n=85) had cortex present. Size grade 2 pieces showed even less frequency of cortex (14% n=17). Only four pieces of debitage were smaller than 8mm (size grade 1, less than 1%), half of which

had cortex. This is likely due to sampling error. These proportions are expected due to the nature of lithic core reduction. The presence of heat alteration was noted in 29% (n=200) of lithic debitage from KCV. Between size grades 1, 2, 3 and 4, similar proportions of heat treatment represent the debitage assemblage at 25% (n=1), 30% (n=36), 30% (n=125) and 26% (n=38), respectively.

As with the Washington Irving assemblage, the debitage assemblage was also divided into the flake type categories: Flake, flake-like, and non-flake (Table 7.14). Non-flake shatter debris was the most common, with approximately 40% of the pieces (n=269) falling into this category. Flake-like pieces represent 38% (n=256) of the debitage assemblage. The remaining 23% (n=156) of the debitage were categorized as flakes.

**Table 7.14. Totals and percentages of the KCV lithic debitage based on type.**

Type	n of Pieces	Weight (g)	% of Total	n with Cortex	% with Cortex	% of Total w/ Cortex	n with HT	% with HT	% Total w/ HT
Flake	156	60.8	22.9%	19	12.2%	11.9%	49	31.4%	24.5%
Flake-Like	256	196.5	37.6%	45	17.6%	28.1%	82	32.0%	41.0%
Non-Flake	269	752.1	39.5%	96	35.7%	60.0%	69	25.7%	34.5%
<b>Total</b>	<b>681</b>	<b>1009.5</b>	<b>100%</b>	<b>160</b>	<b>23.5%</b>	<b>100%</b>	<b>200</b>	<b>29.4%</b>	<b>100%</b>

Non-flake pieces exhibit the highest proportion of cortex (36%, n=96), while flake-like and flake pieces with cortex are represented in lower proportions, 18% (n=45) and 12.2% (n=19) respectively. Debitage classified as flakes exhibit a higher proportion of heat alteration (37%) than flake-like and non-flake pieces (28% and 27%, respectively).

Chi-square tests show no significant relationship between the debitage type and heat alterations. While a chi-square test suggests a significant relationship between the cortex and debitage type (where cortex is overrepresented in non-flake pieces while flake and flake-like pieces are underrepresented), a phi coefficient of 0.168 suggests a weak association. Chi-square

tests on large samples are not a reliable indicator of statistical significance and require further testing (Drennan 2009:190).

### **The Koshkonong Creek Village Tool Assemblage**

The lithic assemblage from the 2012 and 2014 excavations at the Koshkonong Creek Village includes 93 chipped stone tools. Photographs of the tools by morpho-functional type are located in Appendix C (Plates 9-15). The debitage-to-tool ratio from the assemblage is approximately 7:1. Doyle's (2012) preliminary investigation of lithics recovered from survey at Koshkonong Creek Village exhibited a debitage-to-tool ratio of about 4:1, while Ahlrichs et al. (2014) reported a debitage-to-tool ratio of less than 3:1. These ratios are quite low, likely due to the nature of pedestrian survey; the debitage-to-tool ratio from excavated contexts represents a more comparable sample of debitage to compare to lithic assemblages from other prehistoric sites.

#### *Raw Material*

The majority of the lithic tool assemblage is composed of Galena chert (n=57, 61%; Table 7.15). Galena outcrops are located in south-central and southwestern Wisconsin, south of the Wisconsin River (Rosebrough and Broihahn 2005; Winkler et al. 2009), as well as northwestern Illinois, southeastern Minnesota, and northeastern Iowa. However, Galena has been known to occur as far east as Rock and Jefferson counties in Wisconsin (Winkler et al. 2009). Galena chert is gray in color and abundant with fossils, with a medium-fine to fine in texture and dull luster.

Approximately 16% (n=15) of the tool assemblage was made of local Silurian chert.

**Table 7.15. Percentage and number of tools by raw material type from KCV.**

<b>Raw Material</b>	<b>n</b>	<b>%</b>
Galena	57	61.3%
Silurian	15	16.1%
PDC- Oneota	10	10.8%
Unknown	8	8.6%
Burlington	2	2.2%
Hixton Silicified Sandstone	1	1.1%
<b>TOTAL</b>	<b>93</b>	<b>100%</b>

Unlike the Joliet formation Silurian chert prevalent at the Washington Irving site, Silurian recovered at KCV is a local material of the Niagara formation, found in outcrops in pink color when heat treated, dull and chalky in texture with abundant fossils, and is commonly found in nodular bands in bedrock, streambed deposits and as glacial till (Winkler et al. 2009).

Approximately 11% (n=10) of the tools from KCV were made of Lower Prairie du Chien chert, or Oneota chert. Prairie du Chien chert occurs in two main chert formations, the Oneota and the Shakopee formations. Shakopee is in the upper part of the Prairie du Chien formation, while Oneota is in the lower part of the Prairie du Chien. Oneota formation chert is often mottled, swirled or marbled in appearance, a trait not common in most other cherts in Wisconsin. In the eastern extent of its formation, Prairie du Chien is commonly orange in color, while in the western part of the Prairie du Chien formation can be gray. While difficult to knap, Prairie du Chien often benefits from heat alteration and can become more pinkish in color (Winkler et al. 2009).

Galena, Silurian, and Oneota chert represent locally available raw materials (Table 7.16). The remaining tools made from exotic non-local materials. Burlington represented a small proportion of the assemblage (n=2, 2%). As discussed in the previous section of this chapter, Burlington chert exposures are located in west-central Illinois, eastern Missouri and southeastern Iowa and would not have been a local resource to groups in southeastern Wisconsin



**Table 7.16. Percentage and number of tools made from local vs. non-local raw material from KCV.**

<b>Material Type</b>	<b>n</b>	<b>%</b>
Local	82	88.2%
Non-Local	3	3.2%
Unknown	8	8.6%
TOTAL	93	100%

(DeRegnaucourt and Georgiady 1998). Only one tool (1%) was made of Hixton Silicified Sandstone, also a non-local resource, with the only known location of the material located in western Wisconsin (Carr and Boszhardt 2010).

Nearly 9% (n=8) of tools were made of unknown glacial till chert. If the tools categorized as unknown material are considered local, the proportion of tools made from local material represents an overwhelming majority of the lithic tool assemblage (n=90, 97%).

An overwhelming majority of lithic tools from KCV were made from fair quality material (89%, n=83). Approximately 9% (n=8) of the tools were categorized as being poor quality raw materials. Only two tools were made of good quality raw material (2%), both made of non-local Burlington. It is evident that little time and energy was spent to acquire good quality chert as locally available fair quality raw materials dominate the lithic tool assemblage (after Jeske 1992a).

The amount of tools with some cortex suggests that early stages of lithic reduction were occurring at KCV. About three-quarters of the tools (n=70, 75%) had no cortex remaining on the surface of tools, while the less than one-quarter of the tools (n=21, 23%) had less than 50% cortex on the tool. Only two tools (2%) had more than 50% on the surface covered with cortex.

As suggested by the debitage assemblage, heat treatment was a strategy employed at KCV to help improve the quality of poor and fair raw materials. Approximately half of the lithic

tool assemblage (51%, n=47) showed no evidence of heat treatment. Approximately 34% of the assemblage (n=32) showed the presence of heat alteration, while an additional 13 tools (14%) were categorized as possibly having been heat-treated. Only one tool (1%) was burned.

*Tool Morphology and Modification*

There were four basic forms of tools in the assemblage recovered from KCV (Table 7.17). Over half of the tools (53%, n=49) were edge-only tools. Bifacial and unifacial tools account for 23% (n=21) and 15% (n=14) of the tool assemblage (n=22) respectively. Only 9.7% of the tools (n=9) were multifacial in form. There were no prismatic blades or pseudo-bladelets recovered.

**Table 7.17. Percentage and number of tools in each Basic Form category from KCV.**

<b>Basic Form</b>	<b>n</b>	<b>%</b>
Bifacial	22	23.7%
Unifacial	14	15.1%
Multifacial	9	9.7%
Edge-Only	48	51.6%
TOTAL	93	100%

Regarding the method of tool modification, over half of tool assemblage from KCV was modified by flaking (57%, n=53; Table 7.18). Tools modified by flaking and battering and well as tools modified by use-wear only equally represent 19% of the tool assemblage (n=18). Four tools (4%) were modified by battering only.

**Table 7.18. Percentage and number of tools in each Method of Modification category from KCV.**

<b>Method of Modification</b>	<b>n</b>	<b>%</b>
Flaked	53	57.0%
Flaked and Battered	18	19.4%
Battered	4	4.3%
Use-wear only	18	19.4%
TOTAL	93	100%

Whole tools with complete functional units present represent nearly two-thirds of the lithic assemblage at KCV (n=61, 66%). Broken tools with one or more functional units interrupted by a break accounts for about a quarter of the tool assemblage (26%, n=24). Eight tools (9%) did not contain functional units and were scored as Not Applicable. Three-quarters of the tool recovered (74%, n=69) had all elements present, which include whole tools and cores without functional units. The remaining tools were broken, with eight tools (9%) having only the distal end present, six tools (7%) having the proximal present and six tools (7%) having only the mid-section present. Four tools (4%) were scored as end section present, with the end indistinguishable between distal and proximal.

An overwhelming majority of tools showed no evidence of retouch or reuse. While 85 of the tools (91%) did not show any evidence of reuse, three tools (4%) showed evidence of retouch, and five tools (5%) tools were categorized as possibly being reworked. One of these tools includes a knife reworked from what may have been a scavenged projectile point. No tools in the assemblage showed evidence of projections, or the intentional retouch or wear on an unretouched area that extends out from the body of a piece; however, the base of a drill reworked from a triangular point was recovered. As discussed previously, a low frequency of rework is expected in assemblages that are indicative of generalized lithic economies based on informal and expedient tools made of poor and fair quality raw material (Jeske 1992a).

Hafting elements are not common among tools at the Koshkonong Creek Village. A total of 77 tools (76%) were scored not applicable or as absent of hafting elements. Fourteen tools (14%) showed evidence of obvious hafting elements, marked constrictions or notched hafting elements, while only two tools (2%) showed possible evidence of hafting.

Of the bifacially modified tools (n=25), a majority of the tools were of categorized as having medium refinement (67%, n=14), while five tools (24%) were defined as having crude refinement. Only one tool categorized as refined (5%). Only one bifacial tool was too small and broken to determine the level of refinement. Given these frequencies of medium and crudely refined tools, it appears that the focus of the lithic economy at KCV was to create expedient and functional tools rather than formal tools. However, the presence of basic tool forms such as Madison points also indicates some time and energy may have been spent making unifacial and bifacial tools (Jeske 1992a).

### **Koshkonong Creek Village Tools Based on Morpho-Functional Categories**

As with the Washington Irving tool assemblage, the tools from the Koshkonong Creek Village were also subject to categorization based on a morpho-functional typology (Table 7.19).

**Table 7.19. The KCV lithic assemblage categorized by a morpho-functional typology.**

<b>Morpho-functional Category</b>	<b>n</b>	<b>%</b>
Unidentified Tool	54	58.1%
Triangular Point	23	24.7%
Multifacial Core	8	8.6%
Scraper	5	5.4%
Drill	1	1.1%
Knife	1	1.1%
Unidentified Formal Tool	1	1.1%
<b>TOTAL</b>	<b>93</b>	<b>100%</b>

#### *Triangular Points/Madison Points*

Triangular points represent 26% (n=24) of the lithic tool assemblage recovered from the Koshkonong Creek Village (Table 7.20, Plate 9). Further, Madison points represent all of the triangular projectile points in the tool assemblage. Unlike the lithic tool assemblage at Washington Irving, no humpback triangular bifaces were recovered from KCV. However,

**Table 7.20. Measurements of projectile points from KCV.**

<b>Triangular Point Type</b>	<b>Measurement</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
Madison Points	Length (mm)	9	18.8	3.7
	Width (mm)	12	12.5	1.2
	Thickness (mm)	18	3.3	0.7
	Weight (g)	9	0.6	0.2

Madison points in the KCV tool assemblage were manufactured from several different blanks. Five Madison points (20%) were unifacial in form, while one Madison point was worked as an edge only. The remaining three-quarters of Madison points (75%, n=18) were bifacial in form.

*Other Formal Tools*

Only five tools were classified as scrapers (6%; Table 7.21, Plate 10), three of which were classified as end and side scrapers, while two were end scrapers. Several unidentified expedient flake tools are unifacially worked and may represent scraping activities, although can not be considered scrapers by edge morphology alone. Only one tool was morpho-functionally classified as a knife (1%; Table 7.22, Plate 11). However, as with expedient scrapers, it is likely many of the unidentified edge-only expedient tools show microscopic traces of cutting materials in a longitudinal motion. The knife, made of local Oneota formation Prairie du Chien chert, shows evidence of resharpening on one or more edges. The tool was likely a scavenged Kramer

**Table 7.21. Measurements of scrapers from KCV.**

<b>Scraper Type</b>	<b>Measurement</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
End Scraper	Length (mm)	1	31.6	N/A
	Width (mm)	1	17.8	N/A
	Thickness (mm)	1	6.7	N/A
	Weight (g)	1	4.3	N/A
End and Side Scraper	Length (mm)	3	32.0	6.0
	Width (mm)	3	18.3	4.5
	Thickness (mm)	3	6.9	1.5
	Weight (g)	3	4.3	3.4

**Table 7.22. Measurements of formal bifacial tools from KCV.**

Formal Bifacial Tools	Measurement	n	Mean	SD
Knife	Length (mm)	1	45.9	N/A
	Width (mm)	1	28	N/A
	Thickness (mm)	1	12.1	N/A
	Weight (g)	1	11.8	N/A
Drill	Length (mm)	1	15.8	N/A
	Width (mm)	0	N/A	N/A
	Thickness (mm)	1	3.6	N/A
	Weight (g)	0	N/A	N/A

projectile point, diagnostic of Late Archaic and Early Woodland periods (Justice 1987:184).

Only one tool was classified as a drill (1%; Plate 12), likely reworked from a Madison point.

While the drill bit projection is broken from the base and was not recovered during excavation, the base exhibits marked constricted hafting similar to that of triangular Madison points.

One unknown tool (2%) was bifacially worked and broken, interpreted as the tip of a knife, drill or projectile point, etc. While clearly worked bifacially and formal in type, the tool could not be identified as any specific tool type and was too broken to measure.

#### *Bipolar and Free-Hand Cores*

A total of eight cores (8%) were recovered from the lithic tool assemblage (Table 7.23).

Of these tools, five freehand cores were recovered from the lithic tool assemblage (63%; Plate

**Table 7.23. Measurements of multifacial cores from KCV.**

Multifacial Core Type	Measurement	n	Mean	SD
Freehand Cores	Length (mm)	5	32.1	10.6
	Width (mm)	5	23.4	10.2
	Thickness (mm)	5	15.8	7.9
	Weight (g)	5	13.4	14.9
Bipolar Cores	Length (mm)	3	23.9	6.5
	Width (mm)	3	16.6	6.1
	Thickness (mm)	3	8.2	3.6
	Weight (g)	3	4.8	3.7

12). The remaining three cores recovered from the lithic tool assemblage were bipolar (38%; Plate 14). Evidence of bipolar manufacture consists of crushed platforms and battering both ends of the core due to the nature of bipolar percussion, with multiple strikes of the hammer stone against an anvil (Kooyman 2000:56). As discussed previously, Jeske and Lurie (1993) suggested that bipolar reduction is used to reduce small and poor quality raw material.

### *Unidentified Tools*

A total of 54 lithic tools (58%) from the assemblage did not fit into any formal typological category and were categorized as Unidentified (Table 7.24, Plate 15). Of these tools, an overwhelming majority were expedient edge-only tools (n=45, 83%). Additionally, there were seven unifacially modified unidentified tools (13%). Bifacial and multifacial forms account for one unidentified tool each (n=1, 2%).

**Table 7.24. Unidentified tool forms from KCV.**

<b>Modification Type</b>	<b>Measurement</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
Edge-Only	Length (mm)	42	26.3	8.3
	Width (mm)	43	19.0	5.3
	Thickness (mm)	44	6.1	3.0
	Weight (g)	42	3.4	3.8
Bifacial	Length (mm)	0	N/A	N/A
	Width (mm)	0	N/A	N/A
	Thickness (mm)	1	6.5	N/A
	Weight (g)	0	N/A	N/A
Multifacial	Length (mm)	1	17.5	N/A
	Width (mm)	1	11.8	N/A
	Thickness (mm)	1	5.9	N/A
	Weight (g)	1	1.1	N/A
Unifacial	Length (mm)	4	23.7	3.5
	Width (mm)	4	17.6	2.6
	Thickness (mm)	5	5.0	2.1
	Weight (g)	4	2.5	1.8

### **Summary of KCV Lithic Assemblage**

The results of the Koshkonong Creek Village lithic tool and debitage analysis support the

findings initially reported by other Koshkonong Oneota researchers. Prior research has suggested that expedient flake tools are more prominent in the lithic tool assemblage at KCV. Doyle (2012) and Ahlrichs et al. (2014) reported that the tool assemblage recovered from past field seasons (survey in 1986, 2008, 2010 and 2014, excavation in 2012) exhibit a 3:1 expedient-to-formal tool ratio. Similarly, Sterner (2102) reported an approximately 2:1 expedient-to-formal tool ratio from the 2004 excavations at the Crescent Bay Hunt Club. The frequencies of formal-to-expedient tool forms between the Washington Irving site and the Koshkonong Creek Village will be further discussed in the following chapter.

Further, the assemblages from excavated contexts from two field seasons increases our understanding of the lithic technology at the site. Ahlrichs et al. (2014) suggested that KCV likely had specialized early stage lithic production areas that were not identified in the 2012 excavations; the 2012 excavation area at KCV may be an outlier in terms of lithic production, as there was far less debitage with evidence of heat alteration and cortex remaining on the surface of pieces as suggested by the lithics recovered from survey.

Ahlrichs et al. (2014) predicted that there were likely areas where early stages of tool production occurred, indicated by evidence of heat treatment, bipolar blank production and the initial removal of cortex. This analysis (representing the 2012 and 2014 excavation over a larger area of the site) is a seemingly better representation of the site as a Koshkonong Locality Oneota village, with generally similar frequencies of cortex and heat treated debitage within the assemblage as to the 2004 debitage assemblage from the Crescent Bay Hunt Club (Sterner 2012).



## CHAPTER 8

### COMPARATIVE ANALYSIS OF THE LITHIC ASSEMBLAGES

This chapter is a discussion of the comparative analysis of the lithic assemblages from the study sites and the subsequent interpretation within the context of the sites on the Upper Mississippian landscape. Specifically, comparisons between lithic raw material procurement and modification, lithic tool manufacture and form, and the proportion of lithic debitage to tools are investigated. The comparative analysis was conducted and interpreted using chi-square tests in R using an alpha level of 0.05. As small differences may appear to be statistically significant when the sample size ( $n$ ) becomes large enough, phi coefficients were calculated when testing the debitage assemblages to test the effect size for chi-square tests (Drennan 2009). Based on previous research of Upper Mississippian lithic economies, it is expected that the two lithic assemblages investigated are generally similar and suggestive of an economy based on energetic efficiency, while varying levels of economizing behavior may suggest varying degrees of raw material availability or stress adaptation from the social and political landscape.

Jeske (2003b) outlined several lines of inquiry for his comparison of Late Woodland and Mississippian occupants of the LaSalle County Home site in the Upper Illinois River Valley in northern Illinois. Of the lithic assemblages, Jeske examined several aspects that suggest economizing approaches, such as debitage-to-tool ratios, local vs. non-local raw material utilization, quality of raw materials, intensity of tool use, tool breakage and tool scavenging. While designed to compare groups from different prehistoric periods, these lines of inquiry can provide valuable insight in the study of contemporaneous Upper Mississippian groups. Along with these characteristics, other aspects of the two assemblages are compared, such as frequency

of heat alteration and presence of cortex, method of modification, proportions of tool form and the degree of bifacial refinement. Finally, the sites are compared and interpreted within the context of their respective physical and cultural surroundings.

### **Lithic Raw Material Procurement and Modification**

The distribution of debitage type throughout the Washington Irving and KCV assemblages exhibit statistically similar frequencies (Figure 8.1). For an analogous comparison with Washington Irving, only size grade pieces 3 and 4 from KCV were considered. The relative frequencies of non-flake type pieces from Washington Irving and KCV are statistically similar (38% and 40% respectively). While a chi-square test reports a significant difference in the relative frequencies of flake and flake-like pieces at Washington Irving (31% of each assemblage) and KCV (23% and 37%, respectively), the low phi coefficient (0.061) suggests there is no association between flake types and the significant may be due to the large sample size (Table 8.1). Flake and flake-like pieces are indicative of free hand reduction, while flakes from bipolar reduction are commonly categorized as either flake-like or non-flake (Winkler 2011). The discrepancy in relative frequencies is not very interesting as standardized residuals suggest there is no significant difference in the frequency of non-flakes pieces between the assemblages while flake-like pieces can represent either type of free hand or bipolar reduction.

<b>Table 8.1. Crosstabulation of Debitage Type from the Washington Irving and KCV sites.</b>				
	Flake	Flake-Like	Non-Flake	<b>TOTAL</b>
<b>Washington Irving</b>	512 (31.2%)	507 (30.9%)	622 (37.9%)	<b>1641</b>
<b>Koshkonong Creek Village</b>	154 (22.6%)	236 (34.7%)	291 (42.7%)	<b>681</b>
<b>TOTAL</b>	666 (28.7%)	743 (32.0%)	913 (39.3%)	<b>2322</b>
$\chi^2=17.3498$ , $df=2$ , $p=0.00017$ , $\phi$ coefficient=0.061				

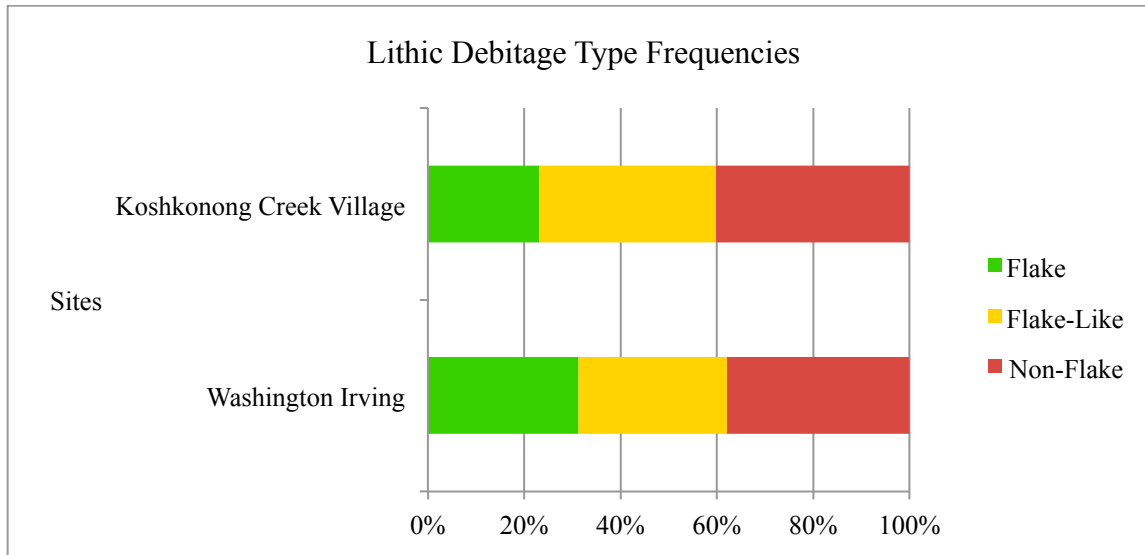


Figure 8.1: Frequencies of lithicdebitage types at the study sites.

### *Presence of Cortex*

The frequencies of cortex remaining on the surface of tools as well as the presence of cortex on pieces ofdebitage are similar between the assemblages (Figure 8.2). Approximately 27% of the Washington Irving tool assemblage represents tools with cortex, while 25% of tools at KCV have cortex (Table 8.2). Similarly, 30% ofdebitage from Washington Irving have cortex, while the frequency of KCVdebitage with evidence of cortex remaining on pieces is 25%. Again, only size grade 3 and 4 pieces ofdebitage from KCV were used in the comparison ofdebitage with the assemblage from Washington Irving to avoid sampling bias. While a chi-square test suggests a statistically different frequency of cortex ondebitage, the phi coefficient is extremely small (0.042) and suggests little or no association (Table 8.3). Similar proportions of cortex on pieces in the tool anddebitage assemblages suggest initial stages of lithic reduction were occurring at the sites (Ahler 1989; Andrefsky 2005; Odell 2004).

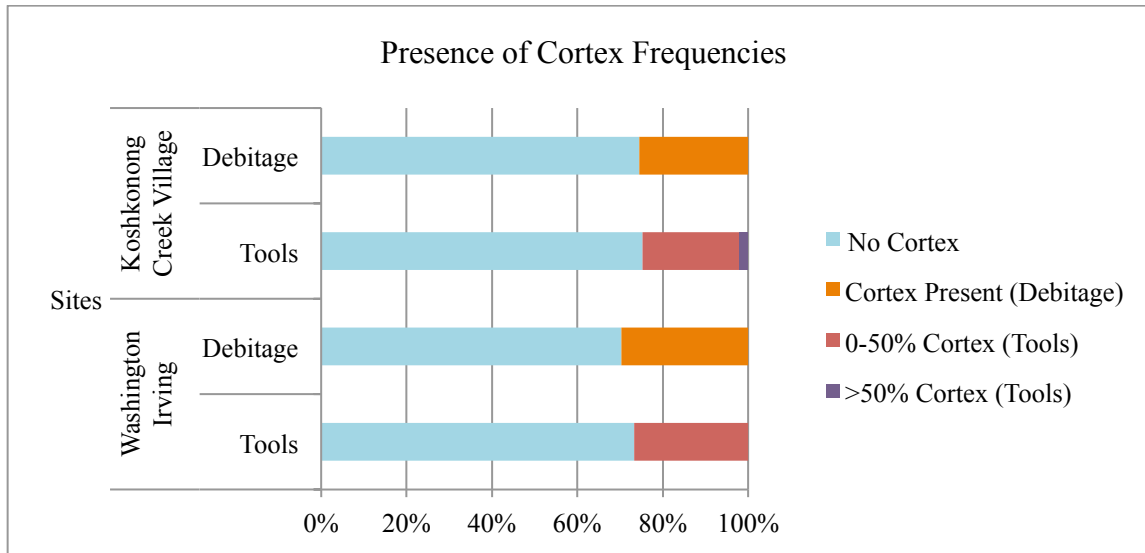


Figure 8.2: Frequencies of cortex present on debitage and tools at the study sites.

	Absent	0-50%	>50%	TOTAL
<b>Washington Irving</b>	74 (73.3%)	27 (26.7%)	0 (0.0%)	<b>101</b>
<b>Koshkonong Creek Village</b>	70 (75.3%)	21 (22.6%)	2 (2.2%)	<b>93</b>
<b>TOTAL</b>	144 (74.2%)	48 (24.7%)	2 (1.0%)	<b>194</b>

$\chi^2=2.602, df=2, p=0.2723$

	Present	Absent	TOTAL
<b>Washington Irving</b>	1154 (70.3%)	487 (29.7%)	<b>1641</b>
<b>Koshkonong Creek Village</b>	417 (74.7%)	141 (25.3%)	<b>558</b>
<b>TOTAL</b>	1571 (71.4%)	628 (28.6%)	<b>2199</b>

$\chi^2=4.4408, df=1, p=0.0464, \text{phi coefficient}=0.042$

### *Evidence of Heat Treatment*

The heat treatment of raw material is an economizing practice utilized by groups at both Washington Irving and the Koshkonong Creek Village and is evident in both the lithic tool and debitage assemblages. Heat treatment often improves flaking quality of poor or fair quality chert (Andrefsky 2005; Kooyman 2000; Rick 1978; Whittaker 1994). Chi-square tests suggest a significantly higher frequency of heat alteration among debitage at KCV than at Washington

Irving (Figure 8.3, Table 8.4), while a medium phi coefficient (0.146) suggests the significance is not simply the result of a large sample size (Drennan 2009). When burned tools are categorized as heat-altered and when heat alteration cannot be determined are omitted (one case), the lithic tool assemblages also suggest more heat treatment at KCV (35%) than at Washington Irving (15%; Table 8.5). Further, if tools that were considered possibly heat-treated are considered as such, the proportion of heat-altered tools at KCV and Washington Irving increases to 50% and 27%, respectively. However, when tools observed as possibly heat-treated are considered as such at Washington Irving but are considered not heat-treated at KCV, the tool assemblages appear statistically similar ( $\chi^2=1.2471$ ,  $df=1$ ,  $p=0.2641$ ).

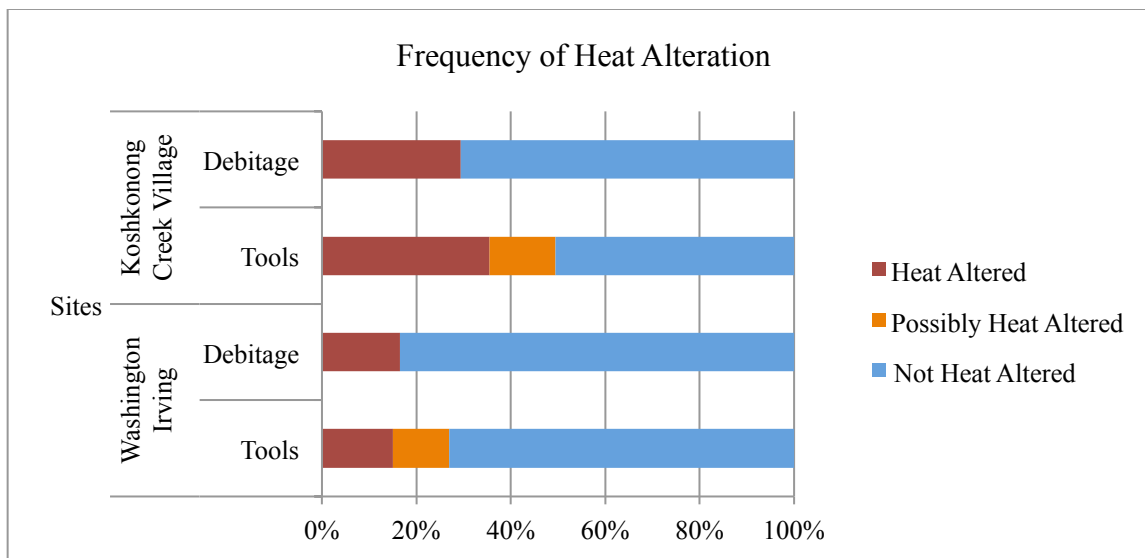


Figure 8.3: Frequencies of heat alteration at the study sites.

	Present	Absent	TOTAL
<b>Washington Irving</b>	271 (16.5%)	1379 (83.5%)	<b>1641</b>
<b>Koshkonong Creek Village</b>	200 (29.4%)	481 (70.6%)	<b>681</b>
<b>TOTAL</b>	471 (20.3%)	1851 (79.9%)	<b>2322</b>
$\chi^2=49.1796$ , $df=1$ , $p=2.34e-12$ , $\phi$ coefficient=0.146			

	Present	Possible	Absent	TOTAL
<b>Washington Irving</b>	15 (15.0%)	12 (12.0%)	73 (73.0%)	<b>100</b>
<b>Koshkonong Creek Village</b>	33 (35.5%)	13 (14.0%)	47 (50.5%)	<b>93</b>
<b>TOTAL</b>	48 (24.8%)	25 (13.0%)	120 (62.2%)	<b>193</b>

$\chi^2=12.1855, df=2, p=0.0023$

*Local vs. Non-Local Raw Material Utilization*

Local raw material utilization is a major part of the lithic economies at the Washington Irving and Koshkonong Creek Village sites (Figure 8.4). Locally available raw materials represent 73% of the tools at Washington Irving and 83% of the KCV tool assemblage; non-local or exotic cherts only represent 5% and 3% of the assemblages, respectively. A chi-square test suggests the relative frequencies between the assemblages are statistically similar (Table 8.6). Further, when one considers the unidentified raw materials as local, locally available raw materials represent an overwhelming majority of tool assemblages at Washington Irving (94%) and KCV (97%). The unknown type cherts are likely locally available pebble cherts (Sterner 2012; Winkler 2011).

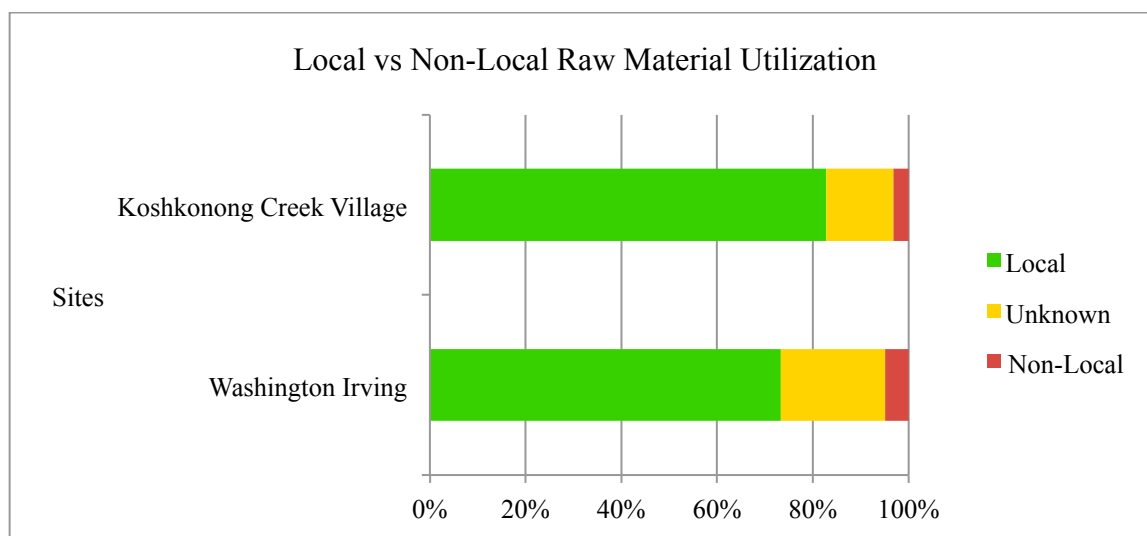


Figure 8.4: Local vs. non-local raw material utilization at the study sites.

**Table 8.6. Crosstabulation of Local v Non-Local Raw Material at Washington Irving and KCV.**

	Local	Non-Local	Unknown	TOTAL
<b>Washington Irving</b>	74 (73.3%)	5 (5.0%)	22 (21.8%)	<b>101</b>
<b>Koshkonong Creek Village</b>	77 (82.8%)	3 (3.2%)	13 (14.0%)	<b>93</b>
<b>TOTAL</b>	151 (77.8%)	8 (4.1%)	35 (18.0%)	<b>194</b>

$\chi^2=2.5483, df=2, p=0.3652$

*Quality of Raw Material*

The expectation that Upper Mississippian groups heavily utilized poor and fair quality raw materials (Jeske 1992a, 2003b) is supported by the lithic tool assemblages recovered from both sites (Figure 8.5). An overwhelming majority of both Washington Irving and KCV are represented by fair quality raw materials (74% and 89%, respectively). While not common, good quality raw materials also represent a similar proportion of both tool assemblages (4% and 2%, respectively). However, there is a significant difference between the frequency of poor and fair quality raw materials (Table 8.7). Poor quality raw materials were recovered at a higher frequency at Washington Irving (22%) than at KCV (9%). This is likely due to the largely poor quality Joliet Formation Silurian chert available to the Washington Irving site inhabitants. Of the 22 tools classified as poor quality, 82% were made of Joliet Silurian (n=18).

**Table 8.7. Crosstabulation of Raw Material Quality from the Washington Irving and KCV sites.**

	Good	Fair	Poor	TOTAL
<b>Washington Irving</b>	4 (4.0%)	75 (74.3%)	22 (21.8%)	<b>101</b>
<b>Koshkonong Creek Village</b>	2 (2.2%)	83 (89.2%)	8 (8.6%)	<b>93</b>
<b>TOTAL</b>	6 (3.1%)	158 (81.4%)	30 (15.5%)	<b>194</b>

$\chi^2=7.2876, df=2, p=0.026$

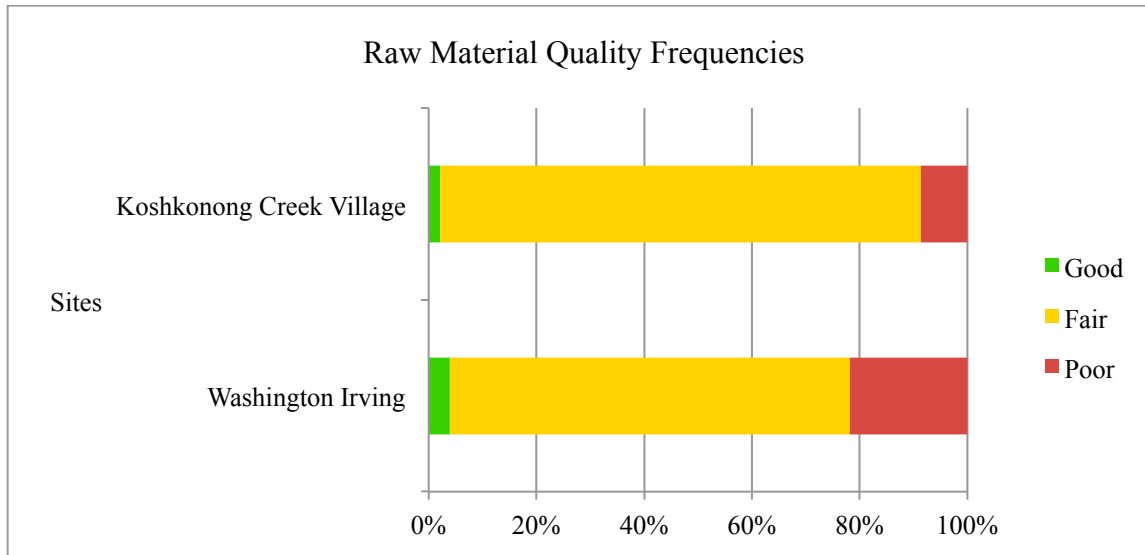


Figure 8.5: Frequencies of raw material quality of tools at the study sites.

### *Method of Modification*

There are some significant differences in the method of modification of tools (Figure 8.6, Table 8.8). Over half of the KCV tool assemblage (56%) was modified by flaking while modification by flaking represents 37% of the tools from Washington Irving. Conversely, 18% of tools at Washington Irving were modified by battering only (without flaking), significantly more than at KCV (4%). Battering suggests pounding or crushing on either the edges of the body of a piece, indicative of bipolar reduction techniques (Lurie and Jeske 1990).

	Flaked	Flaked and Battered	Battered	Use-Wear Only	TOTAL
<b>Washington Irving</b>	37 (36.6%)	32 (31.7%)	18 (17.8%)	14 (13.8%)	<b>101</b>
<b>Koshkonong Creek Village</b>	52 (55.9%)	19 (20.4%)	4 (4.3%)	18 (19.4%)	<b>93</b>
<b>TOTAL</b>	89 (45.9%)	51 (26.2%)	22 (11.3%)	32 (16.5%)	<b>194</b>

$\chi^2=14.946, df=3, p=0.0019$



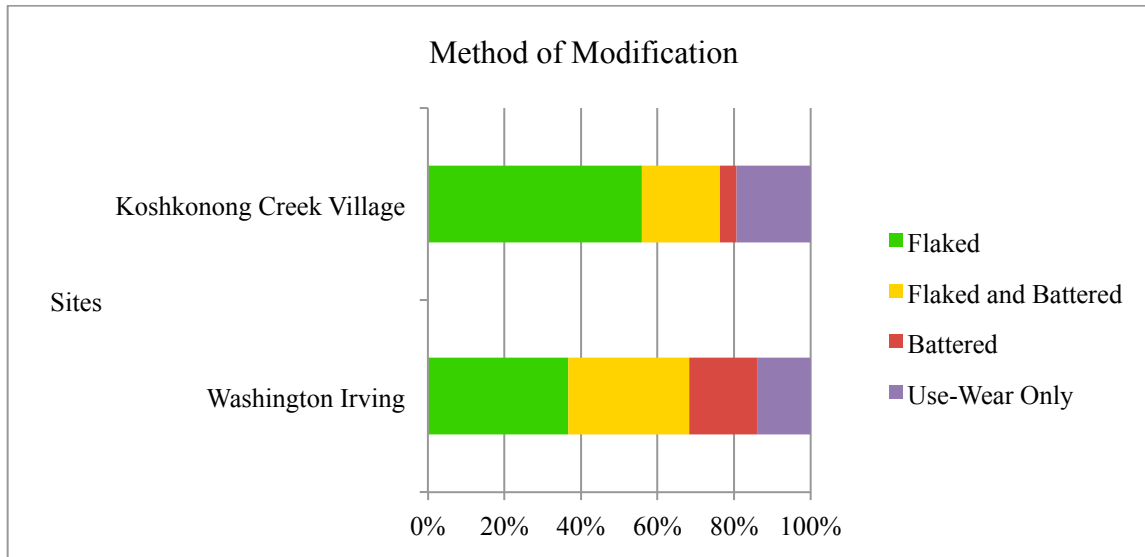


Figure 8.6: Frequencies of manufacturing methods at the study sites.

Approximately 32% of the Washington Irving assemblage was modified by flaking and battering, a slightly higher frequency than reported at KCV (20%). Conversely, modification by use-wear only was more prevalent on tools at KCV (19%) than at Washington Irving (14%). While the frequencies vary between assemblages, a chi-square test suggests the difference in frequencies of modification by flaking and battering and use-wear only are not statistically significant. However, the statistically different frequencies of battering may suggest bipolar reduction may have been more prevalent at Washington Irving, while the statistically different frequencies of flaking suggest more free hand reduction at KCV.

### **Lithic Tool Form, Morphology, Use and Discard**

#### *Bifacial v. Edge-Only Tool Forms*

In the previous chapter, morphological characteristics of the lithic tools from both assemblages were described. When comparing the two assemblages based on the basic forms of tool recovered from the sites, several differences are observed (Figure 8.7). The relative

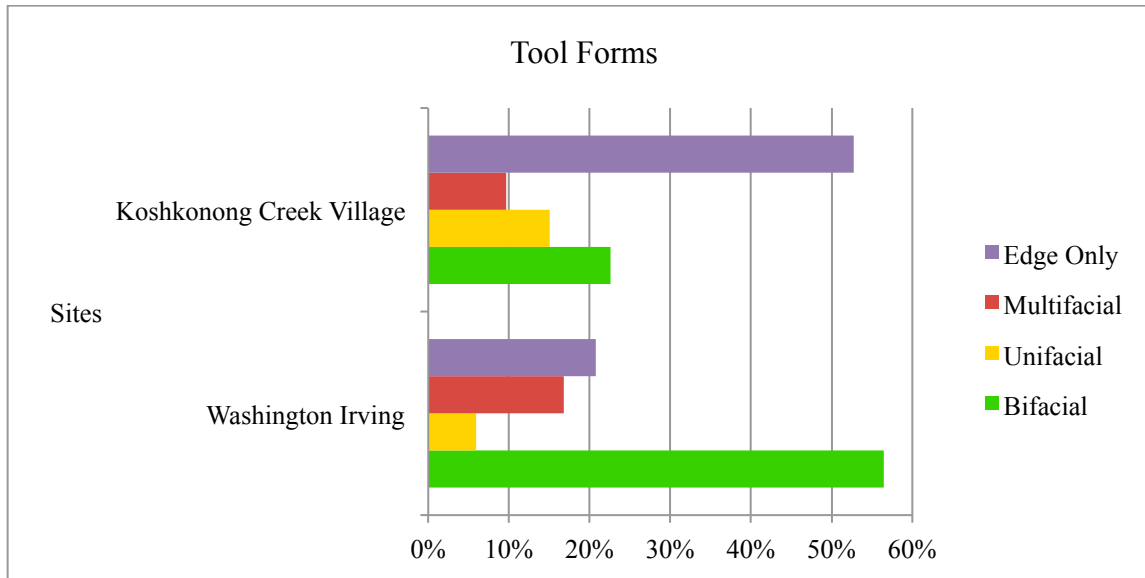


Figure 8.7: Frequencies of tool forms at the study sites.

frequencies of multifacial tools between the assemblages differ but indicate no statistical significance (Table 8.9). However, the proportions of bifacial, unifacial, edge-only tools at the sites are significantly different from each other. While bifacial tools compose 23% of the tool assemblage, the majority of tools recovered at KCV were edge-only in form (53%), suggesting a focus on the efficient manufacture and use of raw materials with the production of expedient flake tools. Conversely, edge-only tools represent 21% of the Washington Irving assemblage. The majority of tools were bifacial in form (56%).

	Bifacial	Unifacial	Multifacial	Edge-Only	TOTAL
<b>Washington Irving</b>	57 (56.4%)	6 (5.9%)	17 (16.8%)	21 (20.8%)	<b>101</b>
<b>Koshkonong Creek Village</b>	21 (22.6%)	14 (15.1%)	9 (9.7%)	49 (52.7%)	<b>93</b>
<b>TOTAL</b>	78 (40.2%)	20 (10.3%)	26 (13.4%)	70 (36.1%)	<b>194</b>

$\chi^2=33.204, df=3, p=2.918e-07$

While the tools at Washington Irving indicate that a higher degree of energy was placed in manufacturing bifaces, many of them are crude in form and may have been expediently

manufactured, particularly evident by the humpback type biface (Hohol 1985; Jeske 1992a). Approximately 60% of bifaces were categorized as crudely refined, with an additional 25% considered medium refined (Figure 8.8). The standardized residuals of a chi-square test suggest the relative proportions of medium and crudely refined bifaces at Washington Irving are significantly different than at KCV (Table 8.10). The relative proportions of refined bifaces appear to be similar.

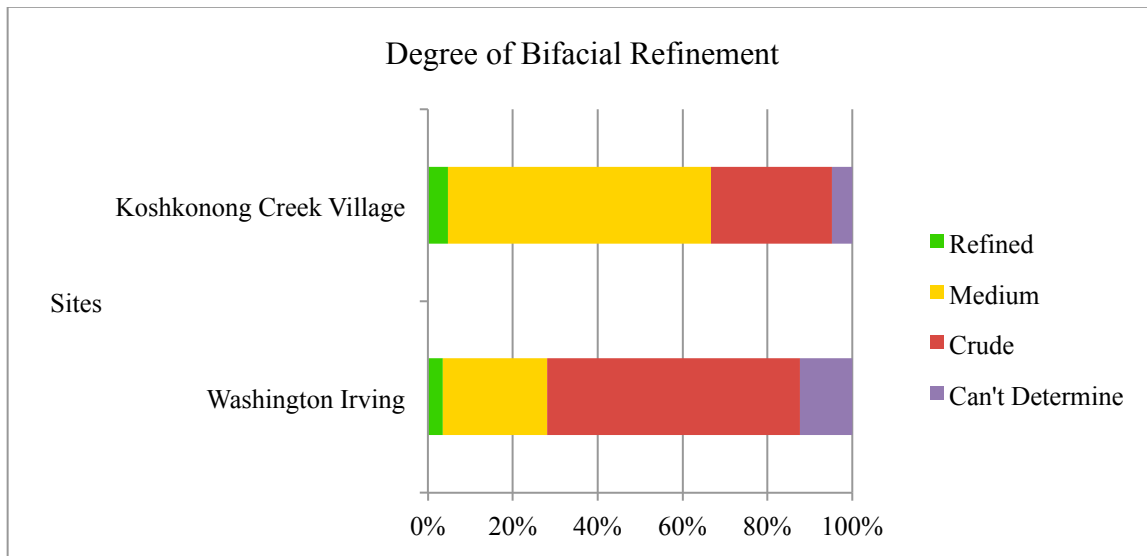


Figure 8.8: Frequencies of the degree of refinement of bifaces at the study sites.

	Refined	Medium	Crude	C/D	TOTAL
<b>Washington Irving</b>	2 (3.5%)	14 (24.6%)	34 (59.6%)	7 (12.3%)	<b>57</b>
<b>Koshkonong Creek Village</b>	1 (4.8%)	13 (61.9%)	6 (28.6%)	1 (4.8%)	<b>21</b>
<b>TOTAL</b>	3 (3.8%)	27 (34.6%)	40 (51.3%)	8 (10.3%)	<b>78</b>
$\chi^2=12.7421$ , $df=3$ , $p=0.0052$					

While bifacial tools dominate the Washington Irving assemblage, a similar frequency of triangular points recovered at both sites. Interestingly, bifacial unidentified tools represent of 32% (n=15) of the unidentified tools at Washington Irving, while only one unidentified tool (2%)

at KCV was bifacially modified. Conversely, edge-only tool forms account for more of the unidentified tools at KCV (83%, n=45) than at Washington Irving (45%, n=21). Kelly (1988) noted the benefits of bifacial tool manufacture:

The 'bifacialness' of some tools gives them the potential to be long use-life tools. A bifacially flaked edge can have a fair amount of cutting power (though less than an unretouched flake of the same material) yet the less acute angle of a biface's edge makes it more durable than an unretouched flake. A completely flaked bifacial tool has a similar microtopography along all its edges; should the tool edge break or become dulled, it can be resharpened relatively easily and continue to be useful. Within limits set by the raw material, a bifacial form simultaneously gives a tool sharpness, durability, and the potential to be resharpened [Kelly 1988:718].

The potential for resharpening and a longer use-life of bifaces may suggest a different degree of expediency in stone tool use and discard.

#### *Expedient vs. Curated Tools*

The concepts of expedient tools, tool curation and the organization of lithic technology have been thoroughly discussed in the Chapter Six. For the purpose of this study, pieces that did not match any formal tool type were considered unidentified expedient tools. Based on the previous definition, 47% of the tools at Washington Irving are considered expedient while 53% are considered formal. At the Koshkonong Creek Village, 58% of tools are expedient while 42% are formal. The proportions of expedient and formal tools support the findings from the lithic assemblage from KCV as well as from the Crescent Bay Hunt Club. Sterner (2012:93) reported that approximately 60% of the tools are expedient, while the remaining 40% were more formal morpho-functional types.

While considered formal by definition, Jeske (1989a, 1992a) argued that humpbacks should be seen as a manufacturing type rather than a morpho-functional type as they are the result of groups efficiently making do with poor quality or scarcely available raw materials for

tool manufacture. Jeske also suggested humpbacks were used efficiently (although not necessarily expediently) as knives, scrapers, projectile points, or for a combination of uses. From this perspective, humpback tools, as well as crude and medium refined Madison points, could be considered expedient in terms of manufacture and curated in terms of use and discard. Kelly (1988) suggested bifaces are less expedient as they allow for more resharpening and can be used as cores. As with curated tools, bifaces may suggest an increase in time-stress due to other scheduling constraints, as they need to be produced well in advance of their use unlike edge-only flake tools (after Torrence 1983:12). Further, Jeske (1992a:476) argued that bifacially formed tools might be more adequate and desirable to groups with extreme constraints on raw material.

Bamforth (1986:49) noted that classifying tools as curated or expedient is often oversimplified and is not extremely useful, as there are different degrees and ways of curating tools. While the comparison of the two lithic tool assemblages suggests a similar level of expediency, a higher frequency of bifaces at Washington Irving indicates an economy based on tool resharpening and reuse to save precious raw material by extending the use-life of tools, indicating more stress and constraints on raw material procurement.

Further, it is interesting that humpbacks are only found at Washington Irving but not at the Koshkonong Creek Village, a pattern that has been acknowledged between Langford and Oneota lithics for several decades. Munson and Munson's (1972) initial hypothesis that humpbacks relate to historic tribal connections is no longer accepted. Further, use-wear analyses of humpbacks and bipolar tools do not suggest the tools are used exclusively as projectile points (Hohol 1985; Jeske and Sterner-Miller 2015). Rather, this study supports Jeske's (1992a) hypothesis that humpbacks are a result of the economical conservation poor quality raw material due to constraints on procurement.

*Intensity of Tool Use*

For the purpose of this study, intense tool use is defined as evidence for extensive or complete use. Jeske (2003b:235) initially expected Mississippian groups to utilize tools more efficiently than Woodland groups by creating more functional units or edges on a tool. In the comparison of the tools from the study sites, the expectation that groups engaged in a similar intensity of tool use is supported. A chi-square test suggests there is no significant difference between the numbers of edges on tools at the sites (Table 8.11). However, while an overall chi-square test suggests the assemblages are similar, the standardized residuals suggest there are significantly more tools with three edges at Washington Irving than at KCV (Figure 8.9).

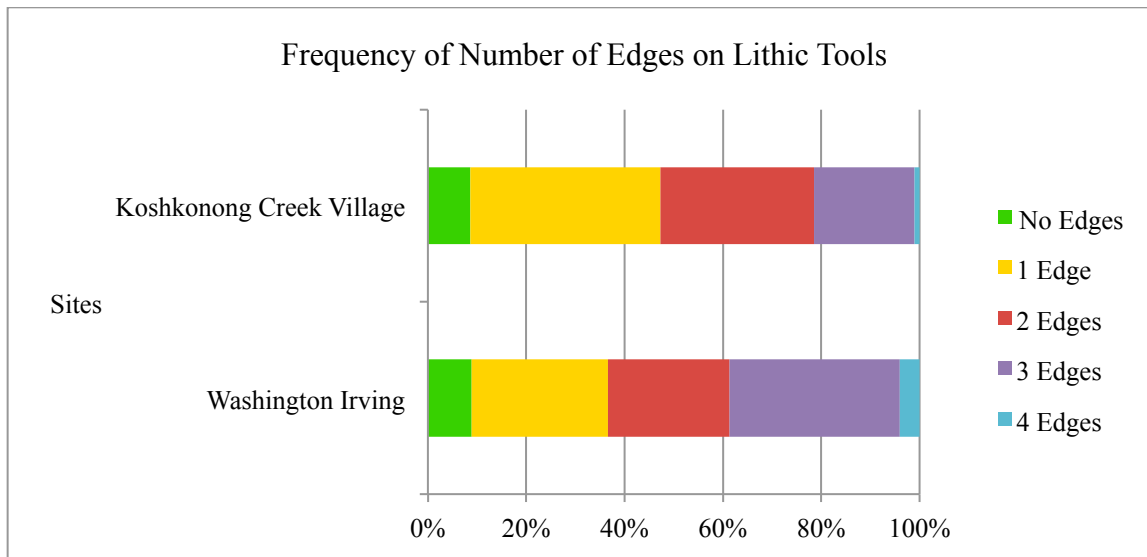


Figure 8.9: Frequencies of number of tool edges on tools at the study sites.

Number of Edges	Zero	One	Two	Three	Four	TOTAL
<b>Washington Irving</b>	9 (8.9%)	28 (27.7%)	25 (24.8%)	35 (34.7%)	4 (4.0%)	<b>101</b>
<b>Koshkonong Creek Village</b>	8 (8.6%)	37 (39.8%)	28 (30.1%)	19 (20.4%)	1 (1.1%)	<b>93</b>
<b>TOTAL</b>	17 (8.8%)	65 (33.5%)	53 (27.3%)	54 (27.8%)	5 (2.6%)	<b>194</b>
$\chi^2=7.6987, df=4, p=0.103$						

The Washington Irving and KCV assemblages exhibit similar frequencies of tools with no functional units or edges (approximately 9% for each assemblage) while a higher proportion of tools at KCV are tools with one or two edges (39% and 31%, respectively) than at Washington Irving (28% and 25%, respectively). Jeske (2003b) acknowledged that a high frequency of tools with more than two edges is likely due to Mississippian tools being hafted more frequently (also see Odell 1994:104). While not initially expected, these findings support Jeske's argument given the higher frequency of bifacial tools at Washington Irving compared to KCV, which exhibits a higher proportion of edge-only flake tools.

*Tool Breakage*

A chi-square test suggests the relative frequencies of broken and whole tools at the sites are similar (Figure 8.10). Excluding tools recorded as N/A, about 40% of tools from Washington Irving were recorded as broken, while broken tools represent approximately 28% of the tool assemblage at KCV (Table 8.12). Jeske (2003b:236) suggested that Woodland groups discarded tools before they are broken or extensively used more often than Mississippian populations. This expectation originates from the concept that Upper Mississippian populations were under more stress and needed to be more economical with the materials that were available to them.

**Table 8.12. Crosstabulation of Tool Completeness from the Washington Irving and KCV sites.**

	Whole	Broken	TOTAL
<b>Washington Irving</b>	55 (59.8%)	37 (40.2%)	<b>92</b>
<b>Koshkonong Creek Village</b>	61 (71.8%)	24 (28.2%)	<b>85</b>
<b>TOTAL</b>	116 (65.5%)	61 (34.5%)	<b>177</b>

$\chi^2=2.303, df=1, p=0.129$

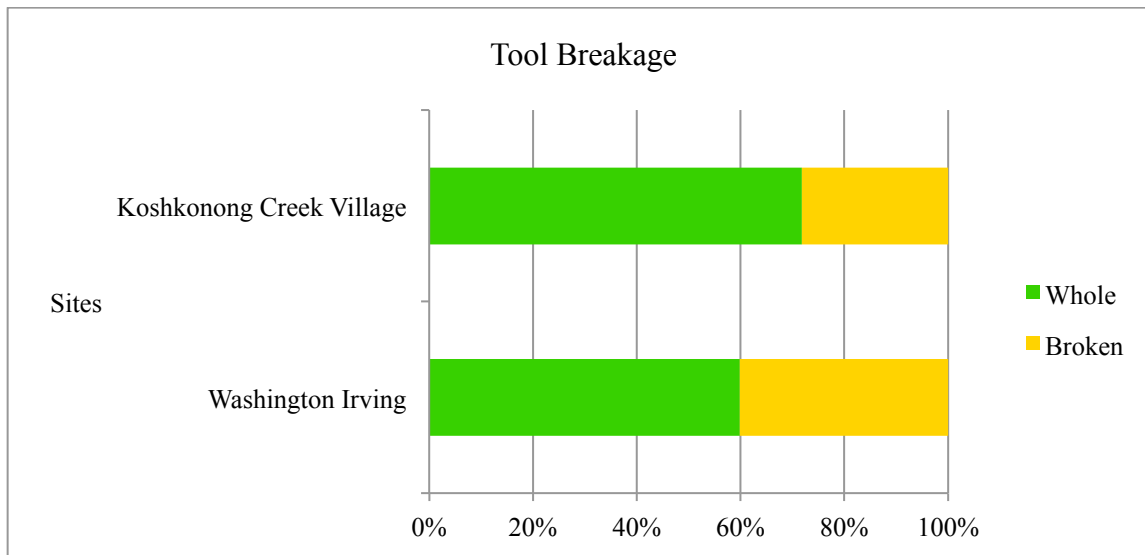


Figure 8.10: Frequencies of tool breakage at the study sites.

Due to the higher frequency of edge-only tools at KCV, less breakage among tools is not necessarily unexpected, as expediently made tools are often discarded expediently. Keeley (1982:803) suggested that tools, especially hafted tools, are only replaced when they become dysfunctional after they are exhausted or broken. This would shape our expectation to assume the Washington Irving site should exhibit a higher proportion of broken tools than at KCV. Again, while the frequency of broken tools is higher at Washington Irving than KCV, a chi-square test indicates there is no significant difference in the relative frequencies of tool breakage.

### *Tool Scavenging*

Only one tool at KCV was interpreted as scavenged. While evidence of rework suggests a knife, the tool may have been a hafted Kramer projectile point, diagnostic of the Late Archaic/Early Woodland period (Justice 1987:184). No whole tools were confidently identified as scavenged at the Washington Irving site; however, three broken bifaces with refined hafting elements (one each of expanded-stemmed, contracting-stemmed, and side-notched hafts) suggests tool scavenging, as refined stemmed bifaces are not ubiquitously recovered at Langford



sites (Jeske 1990b). Lurie (1992:98) also noted the presence of a reworked stemmed biface at the Robinson Reserve site. Jeske (2003b: 236) noted we should expect Mississippian groups to utilize scavenged tools due to the constraints on the procurement of raw material. Despite a small sample of tools, the reuse of scavenged tools appears to be a part of lithic technology at both the Koshkonong Creek Village and Washington Irving sites.

### **Proportion of Lithic Debitage to Tools**

#### *Debitage-to-Tool Ratios*

The debitage-to-tool ratio from Washington Irving assemblage sampled in this thesis is approximately 16:1 (1,641 pieces of debitage and 101 tools). Jeske et al. (2006) reported other Langford sites in northern Illinois to exhibit high debitage-to-tool ratios; the Robinson Reserve and LaSalle County Home sites exhibit ratios of 50:1 and 55:1, respectively, while the Zimmerman site exhibits a much higher 100:1 ratio. However, these ratios are of lithic material from ¼ inch screened contexts (Jeske 1998:8; Jeske and Hart 1988:21; Lurie 1992:95-96). As previously discussed, ½ inch mesh screens were used during excavation and would increase the debitage count for this sample.

The debitage-to-tool ratio from the Koshkonong Creek Village assemblage is approximately 7:1 (681 pieces of debitage and 93 tools). This ratio resembles the findings at the neighboring Crescent Bay Hunt Cub site, exhibiting a low ratio from multiple field seasons. From the 2006 excavations at Crescent Bay, Jeske et al. (2006) report a debitage-to-tool ratio of 17:1, with an excavation strategy of screening only a small sample of plow zone contexts using ¼ inch mesh. Likewise, during excavations in 2002, Jeske et al. (2003:72-74) reported a high debitage-to-tool ratio of approximately 46:1 from screened contexts. However, Gaff (1999:62)

reported a low debitage-to-tool ratio of about 10:1 from ¼ inch screen contexts from excavation at the site in 1998, likely because artifacts were collected from screened backdirt from the 1968 excavations (Jeske, personal communication). Sterner (2012) reports an even lower debitage-to-tool ratio of 5:1 from the 2004 lithic assemblage, accounting for screened plowzone contexts as well as bisected feature contexts, one half being a screened through ¼ inch and the other recovered for flotation.

A low debitage-to-tool ratio is a common pattern that has been reported at the Crescent Bay Hunt Club and is also exhibited at the Koshkonong Creek Village. However, not all Oneota sites exhibit low debitage-to-tool ratios. At the Carcajou Point site in the Lake Koshkonong Locality, Rosebrough and Broihahn (2005:22-26) reported a debitage-to-tool ratio of 48:1 at the Folk Property. Similarly, the Tremaine and Pammel Creek sites in the La Crosse Locality exhibit debitage-to-tool ratios of over 100:1 (O’Gorman 1995; Rodell 1989).

One must be careful of sampling bias when comparing lithic debitage and tools between two assemblages. There is likely some discrepancy in the debitage-to-tool ratios between the sites due to sampling and excavation strategies. However, it is clear that Washington Irving exhibits a higher debitage-to-tool ratio than at KCV. As only pieces of debitage ½ inch (12.5mm) and larger (size grade 3 and 4) were recorded from Washington Irving (exhibiting a 16:1 ratio), the absence of size 2 debitage undoubtedly has an influence on the ratio. Using an analogous sample to eliminate bias can help compare the assemblages. When size grade 2 pieces of debitage are omitted from the sample, the debitage-to-tool ratio from excavations at KCV is 6:1.

When analyzed using an assemblage-based approach, lithic tools and debitage can be observed together to better understand the lithic economies practiced by inhabitants of the sites.

Jeske (2003b) suggested a higher proportion of debitage to tools suggests a higher degree of repair, rework and resharpening of tools was occurring. Jeske's expectation that Mississippian assemblages exhibit a high debitage-to-tool ratio is supported by the Washington Irving lithics. While KCV exhibits a much lower ratio, there is a higher frequency of expedient flake edge-only tools that do not require as much energy to produce compared to bifacial tools that require resharpening. Raw material quality and availability may have an effect on the amount of debitage found in the lithic assemblage (Andrefsky 2004). Further, these differences may be attributed to functional differences of the sites. Additional analysis of the debitage assemblage is needed to address these questions.

### **Lithic Economies in an Environmental Context**

By combining the interpretation of the environmental catchment study with the comparative lithic assemblage analysis, further hypotheses and interpretations can be formulated of the larger Wisconsin Oneota and Langford lifeways in the Upper Midwest. The study sites are situated in similar positions on the landscape. While not "defensive sites" (lacking evidence of defensive structures such as palisades; after Sasso 1989:247-248), the topography of the site areas suggests their locations would have provided the site inhabitants concealment and some protection from surprise attacks, as well as protection from flooding and strong winds. A similar proportion of ecotone coverage, wetland ecozones and agricultural potential at a two-kilometer radius suggest the sites were positioned with similar access to diverse resources. Therefore, it was not expected for the lithic assemblages differ because of constraints from the immediate environment. Rather, differing economizing behaviors in lithic tool procurement, manufacture, use or discard are suggested to be a function of raw material quality, availability and accessibility

(Andrefsky 2004, 2009) as well as other stressors and constraints from the late prehistoric landscape, or a complex combination of both.

Andrefsky (2009:77) acknowledged the complex nature of lithic technological organization, noting “raw material availability, size, and quality have complex influences on different aspects of stone tool technology.” The de-emphasis of formal tool forms and lithics in general in the Late Woodland and Mississippian periods, once a “poorly understood phenomenon” (Jeske 1992a:477-478), has since been considered by many scholars in terms of efficiency, economy and the organization of lithic technology (discussed in Chapter 6). Based on ethnographic and archaeological data, Andrefsky (1994) argued that lithic raw material availability is an important factor in lithic technological organization and in decision making regarding the manufacture various tool types, particularly the production of informal and formal tools. Rather than suggesting it was the cultural preference of the groups to make informal tools, or that toolmakers did not care to make formal tools, Andrefsky (1994:29-30) expected groups with a low abundance of low quality raw material as well as groups with a high abundance of low quality raw material to produce lithic assemblages of primarily informal tools, evident from the assemblages at both study sites.

A higher ratio of debitage-to-tools at Washington Irving than KCV possibly suggests more repair, rework and resharpening on tools (Jeske 2003b). However, the ratio of debitage to tools may also be a function of the raw material availability to groups in their physical and cultural surroundings (after Jeske et al. 2006). The small size of chert nodules and poor quality of raw material available to Washington Irving inhabitants were likely the influence for the production of humpback bifaces, and their utilization further suggests an attempt to conserve raw material (Hohol 1985; Jeske 1992a). As warfare and the maintenance of social and political

relationships require energy that detracts from the amount of time and energy budgeted for raw material procurement and tool manufacture, a higher frequency of crude bifacial tool forms implies more tool curation (after Jeske 1992a; Kelly 1988; Torrence 1983) at Washington Irving than at KCV, suggesting Washington Irving inhabitants were living on a more stressful political landscape and tightening their territorial boundaries (following Emerson 1999; Milner et al. 1991).

## CHAPTER 9

### CONCLUSIONS

The first goal of this thesis was to update Hunter's (2002) catchment model of the Washington Irving site following Edwards (2010) methods from his catchment studies of Oneota sites in the Lake Koshkonong Locality. The subsequent comparative analysis between the Washington Irving and Koshkonong Creek Village sites was to provide a nuanced view of the two environments as well as provide data for further analyses and interpretations of the sites within the Langford and Oneota traditions.

The second goal was to characterize the lithic tool and debitage assemblages from the two study sites using an assemblage-based approach. Further, the two assemblages were subject to a comparative analysis for the purpose of interpreting the variation in the organization of lithic technology that was employed by the Langford and Oneota site inhabitants. This chapter will be an overview of the findings of the catchment and macroscopic lithic analyses as well as the broader impacts of this study and avenues for future research.

#### **Summary and Discussion**

This research has shown the similarities of Oneota and Langford site locations of the Washington Irving and Koshkonong Creek Village sites, contemporaneous creekside villages on the Prairie Peninsula. In her investigation, Hunter (2002:98) suggested that Langford and Oneota populations inhabit and exploit different environments while their lithic technology and economies were similar. While Hunter's research explored the differences of Oneota and Langford settlements based on the lakeside location of the Crescent Bay Hunt Club, this research

compared Washington Irving to KCV, which has similar access to upland, wetland and aquatic resources, and diverse ecotones and plenty of arable land within a two-kilometer radius.

The methods implemented in this analysis adopted from Lurie and Jeske (1990; see Jeske 2014) are closely tied with an economic model of viewing stone tool production. This assemblage-based approach views the debitage in terms of its economic value rather than simply a byproduct of lithic production and reflects the economizing choices that groups make regarding how time and energy is used in tool production (Jeske 1987, 1989a, 2003b). The presence of cortex and the range of debitage size recovered from the sites suggest all stages of lithic reduction were occurring. While only size grade 3 and 4 debitage from Washington Irving were observed because of ½ inch mesh recovery methods, many size grade 2 pieces were recovered from flotation contexts.

The macroscopic analyses of the Washington Irving lithic assemblage and the assemblages from the 2012 and 2014 field seasons at KCV indicate the site inhabitants were utilizing fair and poor quality raw materials that were made of local cherts and glacial till. Many scholars have reported this pattern at other Langford and Oneota sites across Wisconsin and in northern Illinois (Fowler 1952; Hunter 2002; Jeske 1990b, 2000; Lurie 1992; O'Gorman 1993, 1995; Rodell 1989; Rosebrough and Broihahn 2005; Sterner 2012). Bipolar reduction, also common in Oneota and Langford tool assemblages, is often associated with the production of blanks from small raw material packages (Goodyear 1993; Jeske 1992a; Jeske and Lurie 1993) as well as a technique to recycle or conserve raw material.

A similar degree of intensity of tool use and tool breakage, as well as tool scavenging, suggests the efficient use of available raw material. However, a majority of tools at KCV are

edge-only and suggest a lithic economy of expedient tool manufacture and discard while a higher frequency of heat alteration suggests inhabitants tried to improve the flaking quality of raw material. Conversely, Washington Irving inhabitants utilized significantly fewer edge-only tools and more bifacial tool forms, indicating more tool reuse and curation (after Jeske 1992a; Kelly 1998; Torrence 1983). The higher frequency of poor quality raw material, crude bifacial refinement and the use of humpback points also suggests a level of energetic efficiency out of necessity due to the quality of raw material and constraints on procurement (Jeske 1992a). Bradbury (2010) noted the lack of thermal alteration in bipolar assemblages could be related to the emphasis on expedient tool manufacture (although not necessarily expedient discard) and the lack of tool production debris.

### **Broader Impacts**

The results of the comparative catchment and lithic analyses presented in this thesis are beneficial in the discussion of Upper Mississippian lifeways. According to Jeske (1989b, 1990, 2000; 2003a) and other scholars (Brown et al. 1967; Faulkner 1973; Fowler 1952; Griffin 1946; Lurie 1992), Langford represents an ethnically distinct cultural group from Oneota. While culturally distinct, this study has emphasized the physical similarities of the sites located on the Prairie Peninsula with access to similar resources and plenty of arable land. Further, the results of the comparative lithic analysis do not suggest a vastly different stone tool kit, with the exception of humpback bifaces. Rather, the lithics from Washington Irving and KCV suggest differing economizing behaviors were used to get the most out of the fair and poor quality materials available to the groups. While the degree of bifacial and edge-only tools is likely a function of the quality of raw material available to the groups, it may also be a function of stressors and constraints from the social or political landscape. More bifacial tools at Washington



Irving suggest a higher degree of tool curation (after Kelly 1988), further suggesting an increase in time-stress (Torrence 1983:12) and “extreme constraints” on the availability or accessibility of raw material (Jeske 1992a:476).

Many researchers have investigated the differences of Wisconsin Oneota and Langford traditions in the Upper Midwest. Jeske (2000:286) noted the differences in the Washington Irving and Robinson Reserve Langford sites in northern Illinois, suggesting the sites likely represented different functional site types within Langford tradition settlement systems. Similarly, other scholars have accentuated the differences in Oneota lithic economies and settlement and subsistence practices, as well as the social, economic and political interactions in Wisconsin, both intra-locality and inter-locality (see Edwards 2010; Sasso 1989; Schneider 2015; Sterner 2012). Further, Hunter’s (2002) Master’s thesis focused on the comparison of Oneota and Langford in differing environmental settings. However, the focus of this study was to investigate Koshkonong Locality Oneota and Langford traditions with sites situated in similar creekside environments. While not all Langford and Wisconsin Oneota sites share the environmental characteristics exhibited in this research, our understanding of upland positioned creekside Upper Mississippian sites with access to wetland resources and diverse ecotones can be further interpreted and applied to other study sites in the future.

## **Future Research**

### *Further Environmental, Floral and Faunal Studies*

While the focus of the two-kilometer environmental models was to better contextualize the horticultural practices of the site inhabitants, the catchment offers little towards the discussion of raw material procurement practices or the defensibility of territorial boundaries. A

larger catchment study may be able to provide further insight to the site selection behaviors of groups in northeastern Illinois and southeastern Wisconsin. While the catchment model of Washington Irving was used to directly compare with KCV and Lake Koshkonong Oneota sites (see Edwards 2010), more complex catchment models can be designed to more closely integrate economical and environmental factors, such as Verhagen and Whitley's (2012:75) Habitat Model. Similarly, while it is clear that the occupants of both sites heavily utilized local raw materials, a larger lithic resource catchment analysis (e.g. Arakawa 2006) would be an interesting way to analyze the mobility of the two groups and expand our understanding of their nuanced social and political landscapes.

The comparative catchment analysis presented here suggests that the Oneota and Langford groups would have had access to similar resources and comparable agricultural potential. Significant differences in the faunal and floral assemblages at the sites may represent either cultural or social differences between the groups rather than a discrepancy in the availability of resources. Emerson et al. (2005, 2010) suggested that Langford groups engaged heavily in maize agriculture, similar to that of Middle Mississippian groups in the American Bottom. Conversely, Hart (1990:569) suggested the Oneota practiced a mixed horticulturalist economy, with a greater contribution of hunting, fishing and gathering than that of maize cultivation. This pattern has been supported by Hunter's (2002:97) examination of the Washington Irving and Crescent Bay Hunt Club floral assemblages, which suggested a light but ubiquitous distribution of corn and squash at Washington Irving (also see Egan 1985; Jeske 2000) while Crescent Bay inhabitants relied on corn, wild rice and chenopodium in similar proportions. Further flora analysis at KCV will help support or challenge these hypotheses regarding Langford and Oneota subsistence.

A comparative analysis of the faunal assemblages from the sites could help support the argument for differing degrees of stress and conflict adaptation, currently evident from the high degree of bone processing at Washington Irving (McTavish 2014). A preliminary analysis of the faunal assemblage at KCV suggests a higher frequency of deer and elk than at the neighboring Crescent Bay Hunt Club site, while the remains of deer under two years of age suggests dietary stress possibly due to resource exhaustion (Van de Par et al. 2015). However, the frequency and diversity of fish remains suggests that fish was a significant component of their diet. Even with the creek and backwater located nearby, site occupants may have occasionally traveled to Lake Koshkonong for fish, over three kilometers away from the site (Edwards and McTavish 2012). While preliminary faunal data from KCV show a comparable emphasis on mammal and fish (Van der Par et. al 2015), mammals dominate the faunal assemblage at Washington Irving (Hunter 2002). More faunal data from KCV will help in the interpretation of stress adaptation and subsistence practices and further contextualize the site catchment analyses as it relates to local resource acquisition.

#### *Further Lithic Debitage and Tool Analysis*

While the individual tool analysis and mass debitage analysis of this study has provided information on the lithic assemblages from the Washington Irving and Koshkonong Creek Village sites, a full individual analysis of the debitage could provide further information regarding the organization of lithic technologies employed by the groups. An individual debitage analysis approach allows for an extensive examination of every piece of debitage to be observed on many more attributes than that of the mass analysis. Using an individual debitage analysis, categories such as raw material type, the number of dorsal flake scars, platform preparation and platform angle are investigated (see Jeske 2014) and allow for the further interpretation of

specific technological practices such as bifacial thinning, end-scraper resharpening, projectile point notching, and bipolar reduction (Andrefsky 2009:80). A substantial amount of Hixton Silicified Sandstone flakes was recovered in the debitage assemblage at KCV but were not characterized using a mass analysis. By characterizing the debitage based on raw material, a better interpretation of raw material utilization can be formed. Furthermore, a debitage analysis of all size grades from flotation recovery contexts may supply a better representation of debitage to tools at the sites as well as allow for an interpretation of intra-site patterns regarding lithic production areas (Price 1978).

### *Blood Residue Analysis*

Hayden and Kamminga (1979:10) stressed the importance of advancing the field of organic residue analysis from the surface of stone tools as a way to determine tool function. Loy and Dixon (1998:24) acknowledged that blood residue analysis has become increasingly popular within the 1990s and is beneficial in making direct associations with lithic artifacts and subsistence species. Sterner-Miller et al. (2013) suggest that blood residue analysis alongside high- and low-power methods provides supporting evidence for how tools were utilized by prehistoric groups. As human protein residues were found on several projectile points from the Crescent Bay Hunt Club (Sterner-Miller and Jeske 2016), blood residue analyses may also provide supporting evidence for hypotheses about violence among Oneota and Langford groups. However, as blood residue analyses are time intensive and costly, they are not a common aspect of many lithic analyses. A blood residue analysis of the lithic assemblages from KCV and Washington Irving could support evidence from the faunal record regarding subsistence practices and site activities.

### *Microscopic Tool Analysis*

Many scholars argue that microscopic methods in lithic analysis are important in clarifying the role a lithic assemblage, as morphological and typological approaches can be inaccurate in the interpretation of stone tools use (see Flenniken and Raymond 1986; Jeske 1989; Jeske and Sterner-Miller 2015; Odell 1979; Sterner 2012; Yerkes 1983). In his study of the Cahokia microlithic industry, Yerkes (1983) stressed that a tool's morphology does not always represent its function. Using experimental data and high-power magnification, he concluded that unmodified microblades and microcores that resembled burins recovered from Cahokia showed no evidence of edge-wear, suggesting they were not used as tools, while "burin spalls" by morphology were indicated to be used as hafted drill bits to bore holes in shell (Yerkes 1983:508-511).

Similarly, several scholars (Ahler 1971; Flenniken and Raymond 1986; Sterner 2012) have stressed that using the morphology of projectile points to make inferences regarding manufacture and use is neither accurate nor reliable in terms of understanding the tool's function. Using experimental methods, Flenniken and Raymond suggested that one out of every three projectile points change in morphological type due to use and damage over the course of its use-life (1986:613), often leaving no morphological trace of its previous manifestation as a projectile point in the archaeological record.

Apart from simply being a way to describe the activities for which tools were used, Tringham et al. (1974) and Odell (1980) recognized that use-wear analyses are beneficial in the interpretation of other aspects of a societies organizational structure. As the scope of early microwear research was limited to the understanding of the function of tools or the activities that

occurred at a particular site, Tringham et al. (1974:174) stressed that edge-wear research needed to begin to focus on the processes of cultural change; further, they argued that microscopic analyses be “an essential part of *every* lithic analysis” (Tringham et al. 1974:195, emphasis in original). Odell suggested that by “combining functional with technological and formal aspects of lithic remains should increasingly enable us to approach questions of broader anthropological concern” (1980:428). While beyond the scope of this thesis, the use-wear analysis of stone tools from KCV and Washington Irving would be complimentary to the assemblage-based analysis for understanding the strategies of lithic technological organization at the sites.

Microscopic analyses of the tools from Washington Irving, the Koshkonong Creek Village and other Langford and Oneota sites would be beneficial for the further comparison between the two Upper Mississippian groups and would help contextualize the type of tools and activities occurring at the sites. High-power microscopic analyses on a small sample of humpback bifaces from Washington Irving (Hohol 1985) and bipolar tools from the Crescent Bay Hunt Club (Jeske and Sterner-Miller 2015) suggests these crude bifacial and multifacial tools were used for a variety of activities, some with unidentified wear on the humps, and some possible evidence of wear related to hafting. A microscopic analysis of a larger sample of lithic tools from Washington Irving would help benefit the interpretation of lithic technology and economizing behavior occurring at the site. Likewise, an expansion on Jeske and Sterner-Miller’s (2015) microscopic work with lithics from the Crescent Bay Hunt Club (also see Sterner 2012) would be beneficial for the further understanding of Oneota technology around Lake Koshkonong and other Wisconsin localities.

### *Additional Comparative Approaches*

Additional comparisons of lithic assemblages between other Langford tradition sites and sites at other Wisconsin Oneota localities would expand our understanding of lithic organization among Upper Mississippian groups. This study can further help the interpretation of upland village sites with access to wetland resources and diverse ecotones and form hypotheses for further research. Conducting similar catchment analyses for other Langford sites in the Prairie Peninsula as well as sites in other Oneota localities around Wisconsin would be valuable in understanding Upper Mississippian settlement patterns across the Upper Midwest.

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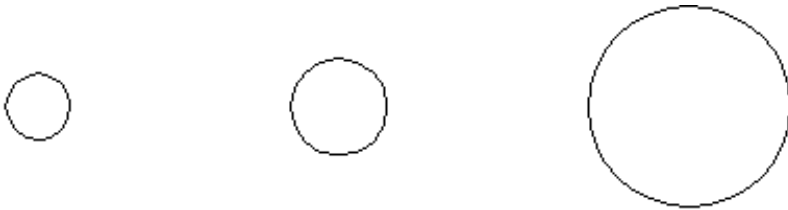
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## APPENDIX A

### Mass Analysis Schema for Debitage (after Jeske 2014; Lurie and Jeske 1990)

- A. Provenience
- B. Additional Provenience
- C. Type
  - 1. Flake
  - 2. Flake-like
  - 3. Non-flake
- D. Size grade
  - 1. Less than 8 mm
  - 2. 8 mm to 12.5 mm
  - 3. 12.5 mm to 25 mm
  - 4. Greater than 25 mm
- E. Count per Size Grade
- F. Weight per Size Grade
- G. Number of Pieces with Cortex per Size Grade
- H. Number of Pieces with heat treatment per Size Grade



Size Grade #1 < 8mm

Size Grade #2 8mm-12.5mm

Size Grade #3 12.5mm-25mm

Size Grade 4 > than 25mm

## APPENDIX B

### Chipped Stone Tool Recording Schema (after Jeske 2014; Lurie and Jeske 1990)

- A. **Provenience:** All artifacts are given a unique number that identifies site and location within the site.
- B. **Catalogue Number:** The catalogue number is an arbitrary number assigned as a short code for the provenience.
- C. **Tool Number:** Each tool is given a unique number within its provenience.
- D. **Raw Material:** Raw material is identified using the comparative collection at the UWM archaeological laboratory. Identification is done by visual comparison, with low power magnification (if necessary) to aid in fossil identification for an excellent resource for northern Illinois cherts (Ferguson and Warren 1992), also see (Winkler, et al. 2009).
  - 1. Unknown
  - 2. Galena Chert
  - 3. Silurian Chert (Niagara Formation)
  - 4. Maquoketa Chert
  - 5. Upper Prairie du Chien Chert (Shakopee Formation, oolitic)
  - 6. Lower Prairie du Chien Chert (Oneota Formation)
  - 7. Platteville Formation Chert
  - 8. Moline Chert Unknown Silicified Sandstone
  - 9. Hixton Silicified Sandstone
  - 10. Burlington Chert
  - 11. Alma Silicified Sandstone
  - 12. Arcadia Ridge Silicified Sandstone
  - 13. Baraboo Quartzite
  - 14. Barron County Quartzite
  - 15. Barron County Pipestone
  - 16. Quartz
  - 17. Rhyolite
  - 18. Basalt
  - 19. Knife River Flint
  - 20.
  - 21. Unknown Quartzite
  - 22.
  - 23. Wyandotte Chert
  - 24. Unknown Chalcedony
  - 25. Flint Ridge Chert
  - 26. Pecatonica Chert
  - 27. Excello Shale
  - 28. Silurian (Joliet Formation)

- 29. Cochrane / Chocolate Chert
- 30.

E. **Raw material quality:** This variable is also defined using comparative samples. Inclusions, fossils, fracture planes, and grain size are used to determine quality.

- 1. Good
- 2. Fair
- 3. Poor
- 4. Can't Determine.
- 5. Not Applicable for non-chert flaked artifacts

F. **Amount of Cortex:** For flake artifacts this variable refers to the percent of the dorsal surface which is covered with cortex or patina. For bifacial and multifacial artifacts the variable refers to the percent of cortex or patina on all surfaces. Patina which has accumulated since the manufacture of the artifact, that is, patination covering flake scars is ignored.

- 1. 0
- 2. <50
- 3. >50, <100
- 4. 100

G. **Heat-Alteration:** This variable is recorded for all artifacts. The criteria used to identify heat-altered chert are taken from (Rick 1978). It should be noted that Rick's experiments were primarily done with Burlington chert, and that his criteria may not apply to all types of chert. In assessing heat-alteration it is necessary to have samples of both the unaltered and altered materials for comparison. Rick's criteria are as follows:

**Luster Contrast.** "On an artifact with flaked surfaces produced both before and after heating, a contrast will appear in the luster of the two surface types. Presence of such a luster contrast is near-certain evidence of heat treatment." (p. 57) This criterion is considered most reliable for scoring Burlington chert.

**Degree of Luster.** An increase in luster is often a result of heat alteration (p. 57).

**Heat Fracture Scars.** These include crazing and pot lid fractures (p. 58).

**Conchoidal Ripples.** Conchoidal ripples are more prominent on heat-altered pieces (p.58).

**Color.** Pink-red coloration was used as an indicator of heat-alteration. Comparative collections are used to indicate the range of variation in non-heat-altered.

Heat-Alteration attributes were scored as follows:

- 1. Heat Treatment Present.
- 2. Heat Treatment Possible.
- 3. Heat Treatment Absent.
- 4. Burned
- 5. Can't Determine

H. **Basic Form:** This variable is recorded for each artifact. Attributes are usually assigned

with 10X magnification. Medium power magnification (40x) is used if use wear is suspected.

1. **Edge or Functional Unit Only.** No attempt has been made to shape the body of the piece, but one or more edges have been retouched and or used. Occasionally a small surface area rather than an edge will be modified through use (usually battering or polish).
  2. **Unifacial.** The body of the piece has been shaped on one side. There must be at least one flake scar which does not originate on the edge on the shaped face. Torrence (personal communication) has suggested the extent of flake scar invasion as an alternate means of assessing body modification.
  3. **Bifacial.** Both faces of the piece have been shaped. There must be at least one flake scar which does not originate on the edge of the piece on both sides of the piece. This flaking usually produces items with lenticular cross-sections.
  4. **Multifacial.** The body of the piece exhibits intentional flake scars creating more than two faces. These pieces often have a blocky appearance. They may or may not have functional units.
  5. **Nonfacial.** These are rounded pieces with no well defined faces or edges. They are usually produced by battering and are often formed through use rather than intentional modification.
  6. **Prismatic Blade or Bladelet.** Flake with parallel edges and at least one ridge running the length of the dorsal surface of the piece. It is usually much longer than it is wide. The piece may or may not show use wear.
  7. **Unknown.** These are fragments that have been flaked or battered on a face of edge, but are too incomplete to assign to any of the above categories.
- I. **Edge Modification:** This variable characterizes the location of retouch or use on an edge. Pieces are considered retouched if: 1.) there are at least three contiguous flake scars or battering 0.5mm or more along the edge of a tool, and 2.) the scars or battering extend more than 1 mm onto the body of the piece. Pieces are considered used when 1.) microflaking, grinding, polishing or rounding extend 0.5mm along an edge, and 2.) modification does not extend beyond 1mm onto the body of the piece. The extent of use on a projection may be less than 0.5mm. Bag wear and shovel or trowel modification scars are usually recognized by their fresh appearance and acute angle to the edge (Knudsen 1973; Odell 1977) Knudson 1973).
1. **Unifacial.** Retouch scars, battering or use appear on one side of an edge or edge segment.
  2. **Bifacial.** Retouch scars or use are on both sides of an edge or edge segment. Modification must occur on both sides of the same edge or edge segment for pieces with more than one edge or edge segment.
  3. **Unifacial and Bifacial.** The piece has more than one edge or edge segment. At least one is unifacially modified and one bifacially modified.
  4. Not Applicable. Pieces without edges are scored not applicable.
- J. **Method of Modification:** Applies to both the edges and bodies of all pieces.
1. **Flaked.** The piece has been intentionally flaked on the body or edge of the piece (See variable J for definition of retouch).

2. **Battered.** An edge or surface has been altered by pounding. It may have been pounded upon or used to pound something else. Pounding will produce flake scars and crushing. When flake scars are not distinct, the alteration is considered battering. Many battered edges have directionality to the remnants of visible flake scars, and it is possible to determine if an edge is unifacially or bifacially modified. Edges formed by battering are often not well defined. There may be a zone of non directional crushing between the sides of an edge. If there are 2mm or less separating directional pounding on both sides of an edge, the edge is considered bifacial; if there are more than 2mm separating directional battering along a segment, the alteration is considered two distinct edges.
  3. **Flaked and battered.** The piece has been altered by both flaking (leaving distinct flake scars) and by battering.
  4. **Use-wear Only.** A functional unit (usually an edge) shows traces of use-microflaking, edge grinding, polishing, or rounding. Microflaking will not extend more than 1mm onto the face of the pieces (See variable J)
  5. **Retouched and used.**
  6. **Not Applicable.** Small problem pieces are scored here.
- K. **Refinement:** This variable applies to pieces scored 3 (bifacial) for Basic Form. Scores for refinement are based on comparison with sample pieces chosen by the author. Size of flake scars along edges, regularity of tool outline and thickness of transverse cross-section were basic criteria for the selection of sample pieces.
1. **Crude.**
  2. **Medium.**
  3. **Refined.**
  4. **Can't Determine.** Pieces are too incomplete to be scored.
  5. **Not Applicable.** Pieces scored something other than 3 for Basic Form.
- L. **Completeness of Functional Unit:** For some studies, particularly functional analysis of tools, the appropriate unit of inquiry is the functional unit rather than the whole tool. This variable records the condition of functional units.
1. **Broken.** One or more functional units on a tool is interrupted by a break.
  2. **Whole.** All functional units are complete. If there are two functional units, one whole and one broken, the piece is scored as broken.
  3. **Can't Determine.** Sometimes a functional unit will end at a break, but the break may not have interrupted the functional unit; i.e., the functional unit was created after the break occurred and is whole. This situation is difficult to determine in practice. This attribute is assigned to questionable pieces.
  4. **Not Applicable.** Fragments without functional units are not scored for this variable.
- M. **Element Present:** This variable focuses on the entire tool. The first three attributes apply to flakes and rectangular-ovoid pieces that have ends. Essentially whole, square pieces, and many small or blocky fragments will be scored as attributes 5, or 4 and 6, respectively.
1. **Distal End.** The distal end of a flake is the termination end, the end opposite the

striking platform and bulb of percussion. For non-flakes the distal end is the working end of the tool if this can be determined. The distal end may contain part of the mid-section.

2. **Mid-Section.** There is no end present.
3. **Proximal End.** The proximal end of a flake is the end that contains the striking platform or bulb of percussion. Hafting elements and butt ends of bifaces are considered proximal ends. Proximal ends may contain part of the mid-section.
4. **End Section.** An end section is present, but it is not possible to determine if it is the distal or proximal end.
5. **All elements Present.** The tool is essentially whole. Small edge sections may be missing, but the entire outline of the piece can be determined without guess work.
6. **Can't Determine.**

N. **Reworking or Reuse:** Tools are often resharpened if an edge becomes dull, or reworked and reused if the tool is broken. Resharpened tools may have remnants of flake scars from the original edge. Tools may become progressively asymmetrical as they are resharpened. Retouch or use on a broken edge and abrupt change in tool outline are also used as indicators of reworking and reuse.

1. **Present.**
2. **Possible.**
3. **Absent.**

O. **Distal End Morphology:** This variable applies only to those pieces with identifiable distal ends (See variable N for definition of distal end).

1. **Blunt.** The major portion of the distal end is perpendicular to an axis drawn through the striking platform and bulb of percussion or perpendicular to the longest axis of the piece if platform and bulb are absent.
2. **Pointed.** Pointed ends may be rounded or acuminate.
3. **Not Applicable.** Pieces without distal ends are scored not applicable.
4. **Can't determine.**

P. **Position of Retouch or Use:** Applies to edge modified only and unifacially modified pieces with modified edges. The tools must be complete enough to determine two axes.

1. **End.** The retouch or use is perpendicular to an axis through the striking platform and bulb of percussion or through the longest axis of the piece if platform and bulb are absent.
2. **Side.** The retouch or use is parallel to an axis drawn through the striking platform and bulb of percussion, or parallel to the longest axis if platform and bulb are not present.
3. **End and Side.** A continuous modified edge is both perpendicular and parallel to the axis. If more than one edge exists, at least one perpendicular and one parallel to the axis.
4. **Can't Determine.**
5. **Not Applicable.** Pieces scored other than 1 or 2 for Basic Form.

Q. **Number of Edges:** Records the number of distinct edges identified on the piece. Each



edge must conform to the definition given in Edge Modification

- R. **Edge Angle:** Edge angles are measured for all edge functional units. Edges on hafting elements are not measured. If only the hafting element is present, no edge angle is recorded. A piece may have more than one edge functional unit. Three measurements are taken for each functional unit and the mode is taken to represent the edge as a whole. Measurements are taken with a goniometer. Measurements are taken 5mm back from the edge, measuring what Knudsen (1973) has termed the production angle. To assign specific locations for each edge measured, the piece is oriented with the long axis vertical and the short axis horizontal. Starting from the top of the piece (the distal end) and moving clockwise around the piece, each edge is given a letter. Up to four distinct edges can be measured on the form. For pieces with more than four edges, a note is made in Comments.
1. **0-45 degrees.**
  2. **46-75 degrees.**
  3. **Greater than 75 degrees.**
  4. **Not Applicable.** Pieces without edges are scored not applicable.
- S. **Edge Configuration:** Edge configuration in plan view is recorded for all edges except edges on hafting elements. Location assignment for each edge on the piece is done exactly the same as in Edge Angle. Thus, Edge Angle A and Edge Configuration A for any piece refer to the same place on the artifact.
1. **Smooth.** There are no regular indentations or projections in plan view.
  2. **Serrated.** There are regular indentations along the edge; the indentations are up to 2mm deep and up to 2mm apart. There must be at least 2 1/2 indentations present.
  3. **Denticulate.** There are regular indentations along the edge; the indentations are greater than 2mm deep and more than 2mm apart. There must be at least 2 1/2 indentations present.
  4. **Notched.** There is a single indentation or a series of non-contiguous indentations on an edge. The indentation(s) must show retouch or use within their boundaries. Notches for hafting are not scored here.
  5. **Not Applicable.** Pieces without edges are scored not applicable.
- T. **Hafting Element:** This variable applies to whole or almost whole pieces (See variable K), and broken pieces with obvious hafting elements.
1. **Present.** Hafting elements are defined by marked constrictions or notches.
  2. **Possible.** Possible hafting elements are defined by slight constrictions, or wear or polish on the lateral margins toward the base. Pieces with suspected hafting elements were examined v microscopically.
  3. **Absent.** There are no indications of hafting.
  4. **Not Applicable.** Fragments without obvious hafting elements are scored not applicable.
  5. **Modification for hafting by thinning and/or grinding the tool base.**
- U. **Projections:** This variable applies to whole pieces, broken pieces with projections. Or projections alone (i.e. broken drill bits). The projections are defined by intentional

retouch or by wear on an unretouched area that extends out from the body of the piece.

1. **Present.**
2. **Absent.**
3. **Not Applicable.** Tool fragments without projections are scored not applicable.

V. **Modification on Projection:** Applies only to pieces with projections (see variable T).

1. **Present.** Projections have been formed by intentional retouch.
2. **Absent.** Projections have been defined on the basis of wear.
3. **Not Applicable.** Pieces without projections are scored not applicable.

The following metric variables are recorded for whole pieces only. Whole pieces are those that were scored 2 for variable J and 5 for variable K. Length, width and thickness were measured to the nearest millimeter.

W. **Length:** The longest axis of the piece regardless of orientation was measured as length.

X. **Width:** The longest axis perpendicular to the long axis was measured as width.

Y. **Thickness:** The greatest axis perpendicular to both length and width was measured as thickness.

Z. **Weight:** Weight was recorded to the nearest gram.

AA. **Comments:** Written comments accompany unusual pieces. The comments have been grouped into six categories.

1. **Thinning Flake.** Thinning flakes are flakes exhibiting dorsal flake scars and some sort of edge preparation. These items are usually products of bifacial manufacture and not in themselves shaped for an intentional use. The platforms often have remnants of bifacial edges or are ground. These bifacial edge remnants are not recorded as a working edge on the thinning flake.
2. **Unusual Raw Material.** Any comment about raw material that is not covered in the main body of the scheme is recorded as a written comment on the original recording forms.
3. **Dubious Artifact.** Flake scars may have been caused by some natural agent, and therefore, the item may not be an artifact.
4. **Unusual Artifact Form, General.** The artifact shape is in some way unique. A written descriptive comment can be found on the original recording sheet.
5. **Unusual Artifact Form, Specific.** The artifact shape is similar to a particular form which is in some way characteristic of the site. A written comment can be found on the original recording sheet.
6. **Association.** The item under consideration is linked to another item. This link may be refitting, items from the same core, or spatial relationship.
7. **More than four edges.** Edge angle and configuration records for these artifacts can be found on the original recording sheet.
8. **Other.**

**BB. Comments 2:** Note for limestone, sandstone, and igneous materials: Heat altered limestone is characterized by a grayish to pink powdery exterior. Pieces are friable and disintegrate into small fragments and powder. Heat altered sandstone and igneous material is often blackened on the surface, giving a smoked appearance. Outer surfaces sometimes exhibit yellow, pink, or red discoloration. Broken surfaces often exhibit crazing similar to heat-cracked chert.

**CC. Projectile Point Type:** List those commonly found in your region. See for example (Justice 1995).

1. Madison.
2. Cahokia.
3. Lowe Flared Base.
4. Snyder.
5. Manker.
6. Adena.
7. Monona.
8. Table Rock.
9. Matanzas.
10. Gainey.
11. Clovis.
12. Unclassified (or Unidentified) Projectile Point.
13. Unclassified lanceolate.
14. Unclassified corner notched.
15. Unclassified side notched.
16. Unclassified stemmed.

APPENDIX C



Plate 1. Triangular Madison point tools from the Washington Irving site



Plate 2. Triangular Humpback point tools from the Washington Irving site



Plate 3. Broken hafted bifacial tools from the Washington Irving site



Plate 4. Knives from the Washington Irving site



Plate 5. Scrapers from the Washington Irving site

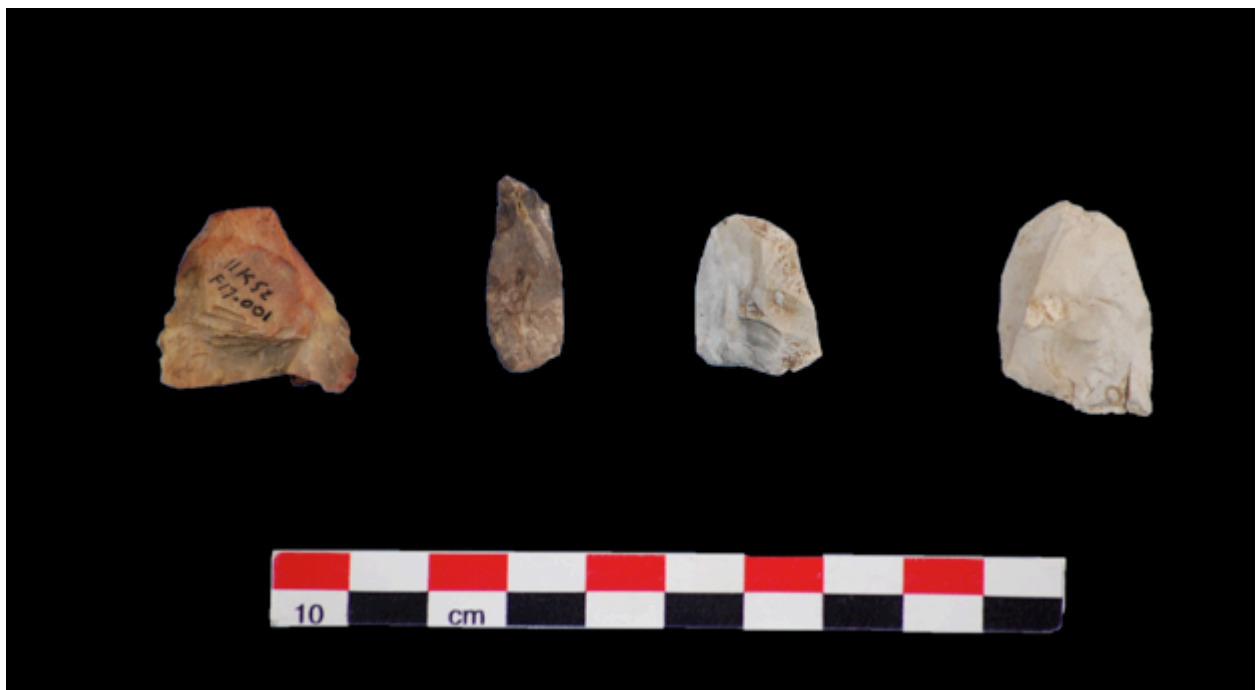


Plate 6. Bipolar cores from the Washington Irving site



Plate 7. Freehand cores from the Washington Irving site



Plate 8. Unidentified tools from the Washington Irving site



Plate 9. Triangular Madison point tools from the Koshkonong Creek Village site



Plate 10. Scrapers from the Koshkonong Creek Village site





Plate 11. Knife from the Koshkonong Creek Village site



Plate 12. Broken drill from the Koshkonong Creek Village site



Plate 13. Freehand cores from the Koshkonong Creek Village site



Plate 14. Bipolar cores from the Koshkonong Creek Village site

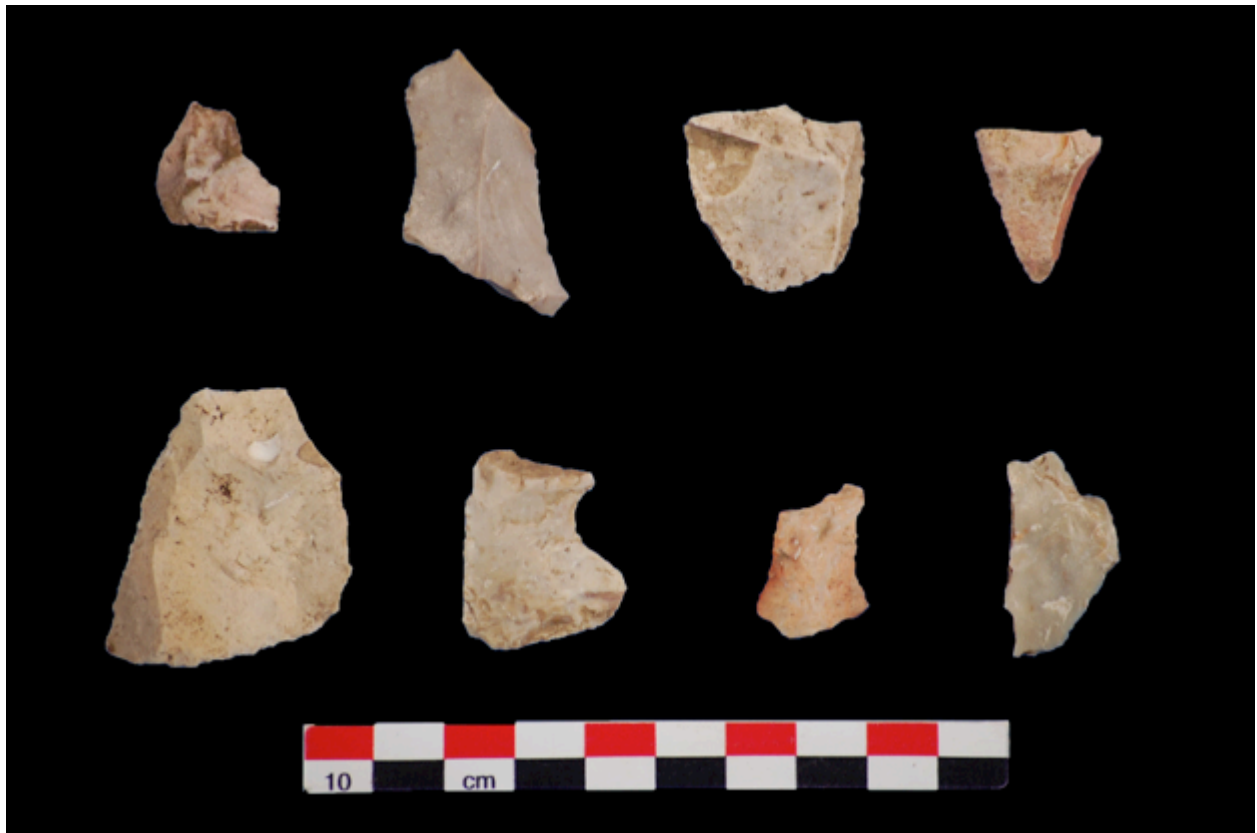


Plate 15. Unidentified tools from the Koshkonong Creek Village site