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Visibility and Intervisibility: A Viewshed Analysis of the Oneota Component of the Lake Koshkonong Locality

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VISIBILITY AND INTERVISIBILITY: A VIEWSHED ANALYSIS OF THE ONEOTA COMPONENT OF THE LAKE KOSHKONONG LOCALITY

by

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ABSTRACT

VISIBILITY AND INTERVISIBILITY: A VIEWSHED ANALYSIS OF THE ONEOTA COMPONENT OF THE LAKE KOSHKONONG LOCALITY
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Under the Supervision of Professor Robert Jeske

This research was conducted to analyze the visual relationship between Oneota village sites, Late Woodland habitations, and mound sites during a period of time that saw all of these groups living contemporaneously on Lake Koshkonong. My research seeks to not only understand what and who Oneota sites could see on the landscape, but also who might have been able to see them. This research adds to the discussion of Lake Koshkonong Oneota relationships with contemporaneous groups during the 11th-15th centuries.

This study focuses on four sites within the Lake Koshkonong Locality that date to the Oneota period: Crescent Bay Hunt Club (47JE904), Schmeling (47JE833), Carcajou Point (47JE002), and Koshkonong Creek Village (47JE379). A viewshed analysis was conducted on these Oneota village sites, as well as all recorded Late Woodland habitations, and Late Woodland mound sites within the locality. The data derived from these analyses were used to answer three research questions 1) What is encompassed and excluded from Oneota site viewsheds?; 2) What is the visual relationship between mounds and Oneota sites?; and, 3) What is the visual relationship between Late Woodland habitations and Oneota sites? High degrees of visibility indicate a close, or at least peaceful, relationship between these sites, while a lack of visibility, or invisibility from one site to another might indicate that one of the groups

could have been attempting to conceal themselves. It is possible that relations with outside groups may have been violent.

The results of this research indicate that 1) Archaeological sites in the study area were placed in environmentally logical places, indicating efficient use of resources;. 2) Oneota sites were placed defensively on the landscape, suggesting some level of intergroup conflict; and, 3) Oneota sites were placed to maintain a viewshed of Late Woodland effigy mound sites, suggesting the persistence of sacred places on the landscape. Further excavation and GIS analysis will need to be done to understand more clearly the relationships among these groups and their relationships with other groups located outside of the Lake Koshkonong locality.

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Chapter 1: Introduction

Research Problem

The vast majority of work done in the Lake Koshkonong locality has been site specific (exceptions include Dillemuth 1999 and Edwards 2010) and comprehensive analysis utilizing raster data has not been published. In the past, viewshed analysis surrounding Lake Koshkonong has been conducted only as a way to analyze what Oneota sites could view and had very narrow goals (McTavish 2016). My research seeks to not only understand what and who Oneota sites could see on the landscape, but also what and who may be viewing them. Lake Koshkonong contains abundant resources and was a prime location for settlements. As such, other archaeological distinct groups such as the Late Woodland Effigy Mound builders (Horicon Phase) and Later Late Woodland groups (Kekoskee Phase) also appear to have occupied areas surrounding the lake at the same time as Oneota groups. The exact chronological and social dynamics between these groups are currently still under-researched. Recent archaeological work shows that interpersonal conflict and violence were a significant part of life (Edwards 2020a:5; Jeske 2020:107–108; Krus et al. 2022:128–129).

A natural consequence of conflict would be an increased desire for the groups experiencing violence to conceal their settlement from others on the landscape. By conducting a viewshed analysis of the entire area surrounding Lake Koshkonong, I created a more holistic understanding of the interrelations among Oneota villages, Effigy mounds, other Woodland mounds, and Late Woodland habitation sites within the Lake Koshkonong region and explore the role visibility played in determining settlement choice for Oneota groups during this period.

Organization of Data

This research incorporates data available from both scholarly sources and the Wisconsin Historic Preservation Database (WHPD). Specifically, mound sites and Late Woodland habitation sites were identified through this database and georeferenced to the project area. However, WHPD records are often incomplete or contain generalized information. For example, a large village site with a long period of occupation such as Crescent Bay Hunt Club (JE-0904) and a short-term campsite like Carlson Knoll (JE-0857) are both labeled as campsite/village despite their variation in size and length of occupation. To that point, mounds sites in WHPD are simply labeled as Effigy, conical, linear, or unknown/other. It is possible that some mounds labeled as conical or linear are Effigy mounds, but this cannot be definitively determined based on the limited information available. Because of this ambiguity, I decided to divide the mound sites into two groups: those constructed in the Woodland period without a definitive Effigy Mound component (Woodland mounds) and those with a definitive Effigy mound component (Effigy mounds).

This ambiguity is present in the extant archaeological data. Salkin (2000) divides the later Late Woodland period of southeast Wisconsin into the Horicon and Kekoskee phases. The Horicon phase (A.D. 700-1200) is defined as sites occupied by groups of mobile hunter-gatherers who constructed low Effigy mounds along streams, rivers, lakes, and wetlands. Their ceramics consisted of grit-tempered, non-collared Madison ceramics often cord wrapped or fabric impressed. The Kekoskee phase (A.D. 800-1300) is defined as sites occupied by groups who lived in villages, used maize agriculture and made grit-tempered collared ceramics such as Aztalan Collared, Point Sauble Collared, and Hahn Cord Impressed. Hunting, fishing, and wild

plants still made up a major portion of their diets. They did not build effigy mounds for their dead. Unfortunately, the WHPD generally did not have enough information available to divide Late Woodland habitation sites into Horicon or Kekoskee phases, so they are treated as a single data set.

There are critiques to the phases division of the later Late Woodland period. Primarily, the phase designations of Horicon and Kekoskee need to be reconsidered due to overlapping radiocarbon dates, settlement location, and ceramic assemblages (Clauter 2012:22). Regardless of the ambiguity in both the temporal and phase designations of the mound sites, what is relevant for my research is that the mounds, whether made by Effigy mound groups or earlier Woodland groups, existed on the landscape before the arrival of Oneota groups to Lake Koshkonong in the twelfth century and represented a non-Oneota population living contemporaneously with Oneota groups in the same restricted geographic area.

Lake Koshkonong

The topography of southeastern Wisconsin owes all of its characteristics to glaciation which moved earth across the landscape, eventually receding and melting into lakes and rivers that are still recognizable today (Figure 1). Lake Koshkonong is one of these waterbodies (Figure 2). A natural impoundment of the Rock River, Lake Koshkonong was initially formed by end moraines which dammed glacial run-off. It was not formally dammed until 1851 (Jeske et al. 2020:10). The glaciated environment of Lake Koshkonong is desirable for both habitation and viewshed analysis. The topography surrounding Lake Koshkonong is a mixture of low-lying marshes and adjacent uplands. The marshes would have supported numerous types of wildlife

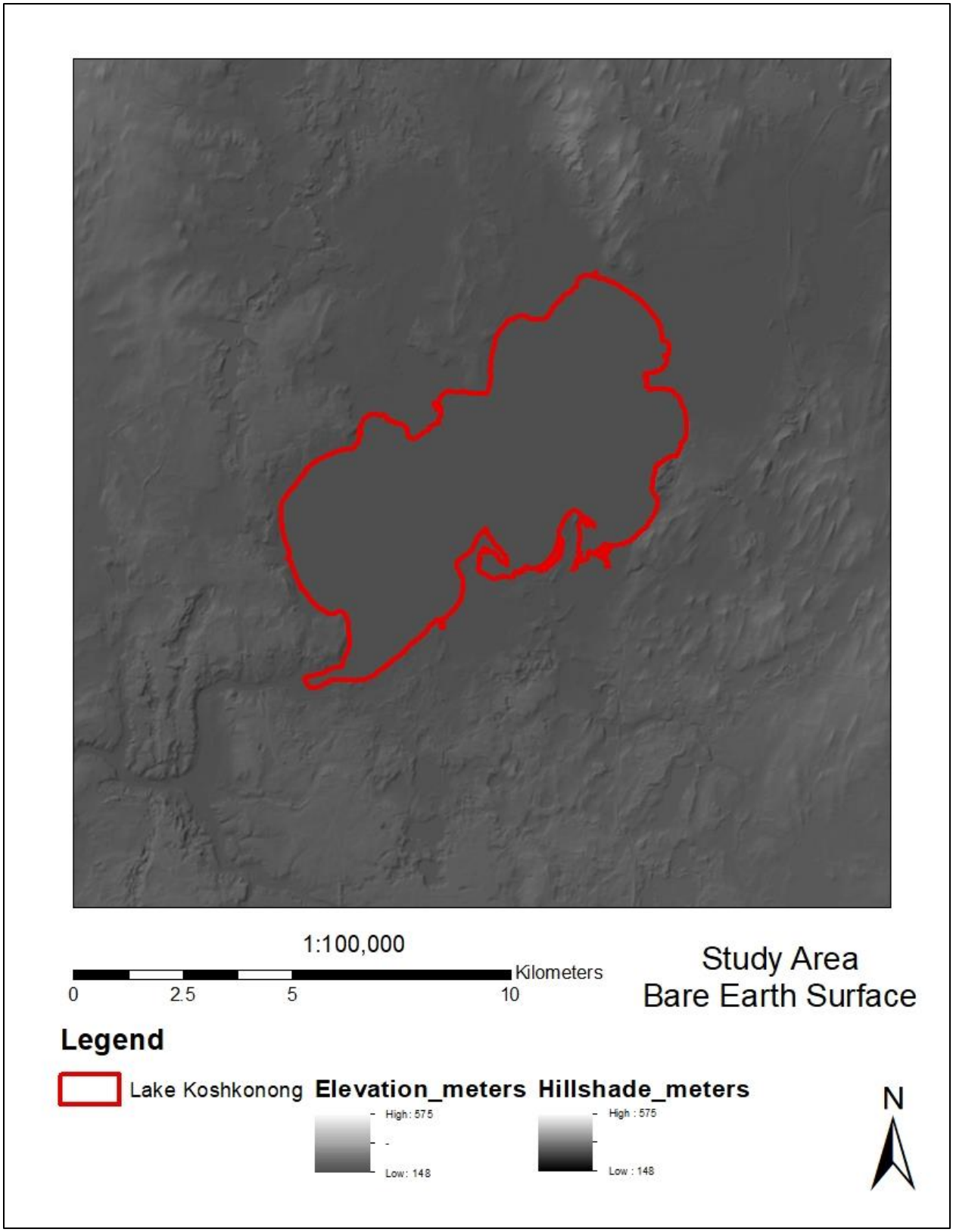

Figure 1. Bare Earth Surface of the Study Area

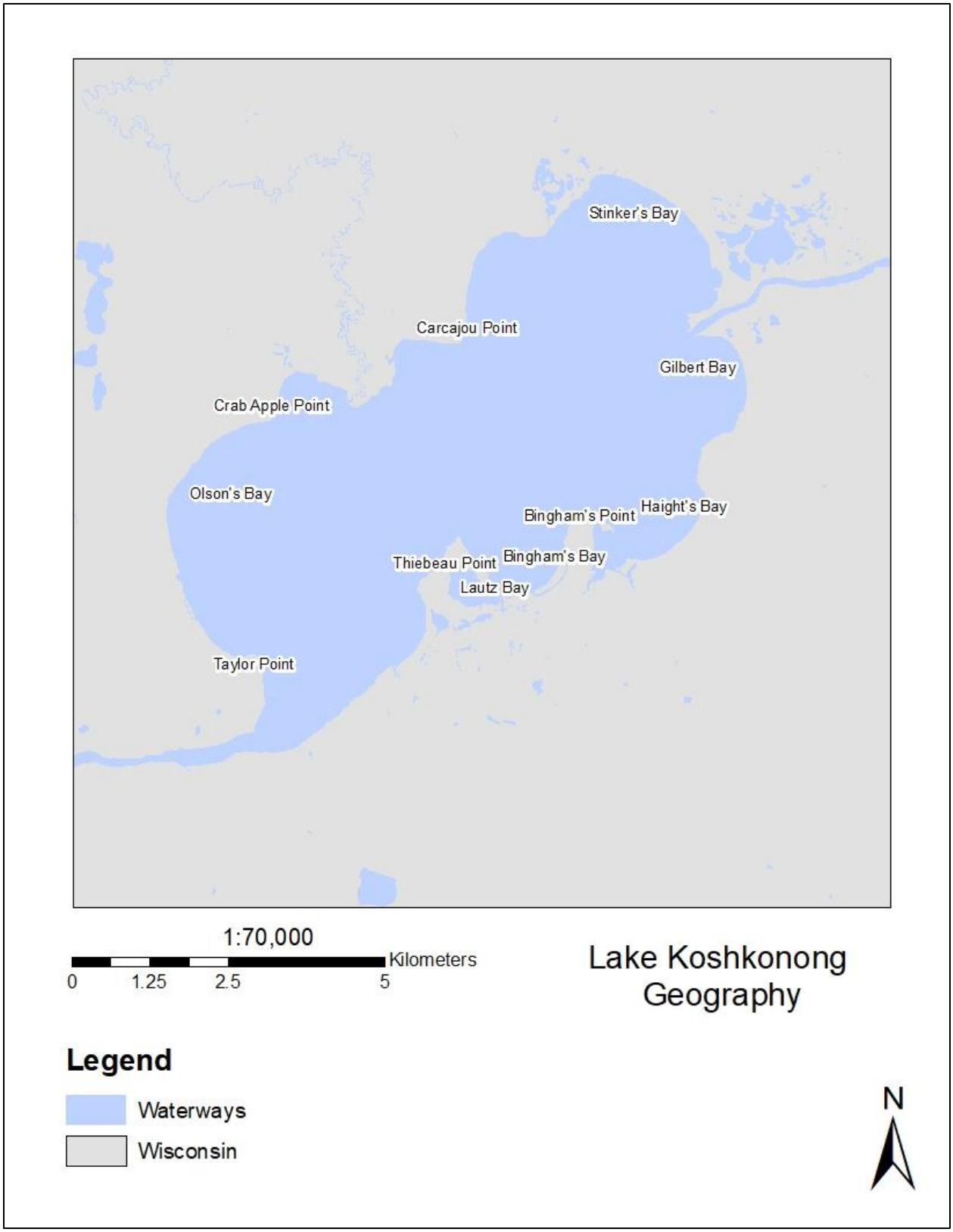

Figure 2. Lake Koshkonong Geographic Place Names

including fish, waterfowl and freshwater mussels while the uplands would have been drier and supported populations of deer, bear, elk and other game (Edwards 2020a; Edwards and McTavish 2012; McTavish 2020). Lake Koshkonong has long been known as a prime location for settlements with the lake being nearly continuously inhabited since the Paleoindian period (Jeske and Winkler 2008; Winkler and Jeske 2010). Visually, the low level of the lake makes it possible to see great distances from certain locales and the rolling hills make it possible to conceal settlements if need be. Additionally, Lake Koshkonong has maintained approximately the same relative size and shape since pre-contact times, making it an ideal location to utilize modern data to answer spatial questions about pre-contact groups.

Lake Koshkonong and the adjacent portions of the Rock River Valley have long been known as a region with a rich occupational history, particularly during the 7th through 15th centuries (Figure 3). The density of these sites inspired some of the earliest archaeological investigations in Wisconsin. Archaeological investigations began in earnest beginning in the mid-19th century and have continued to the present (Hall 1957, 1958, 1962; Jeske 1999, 2001, 2003; Jeske et al. 2002, 2003, 2020; Lapham 1855; Musil 1987, Stout and Skavlem 1908). Due to this history of research, there is a great amount of data available to answer questions regarding placement of sites and their relation to the greater landscape surrounding Lake Koshkonong.

Viewshed Analysis

Viewshed analysis has been utilized in both environmental and archaeological applications for decades. Until computational analysis became standard, viewshed analysis was conducted by hand. While still accurate, it was not efficient as computer algorithms and computations (Gillespie and Clark 1979:647). Early uses of the technique include permitting for

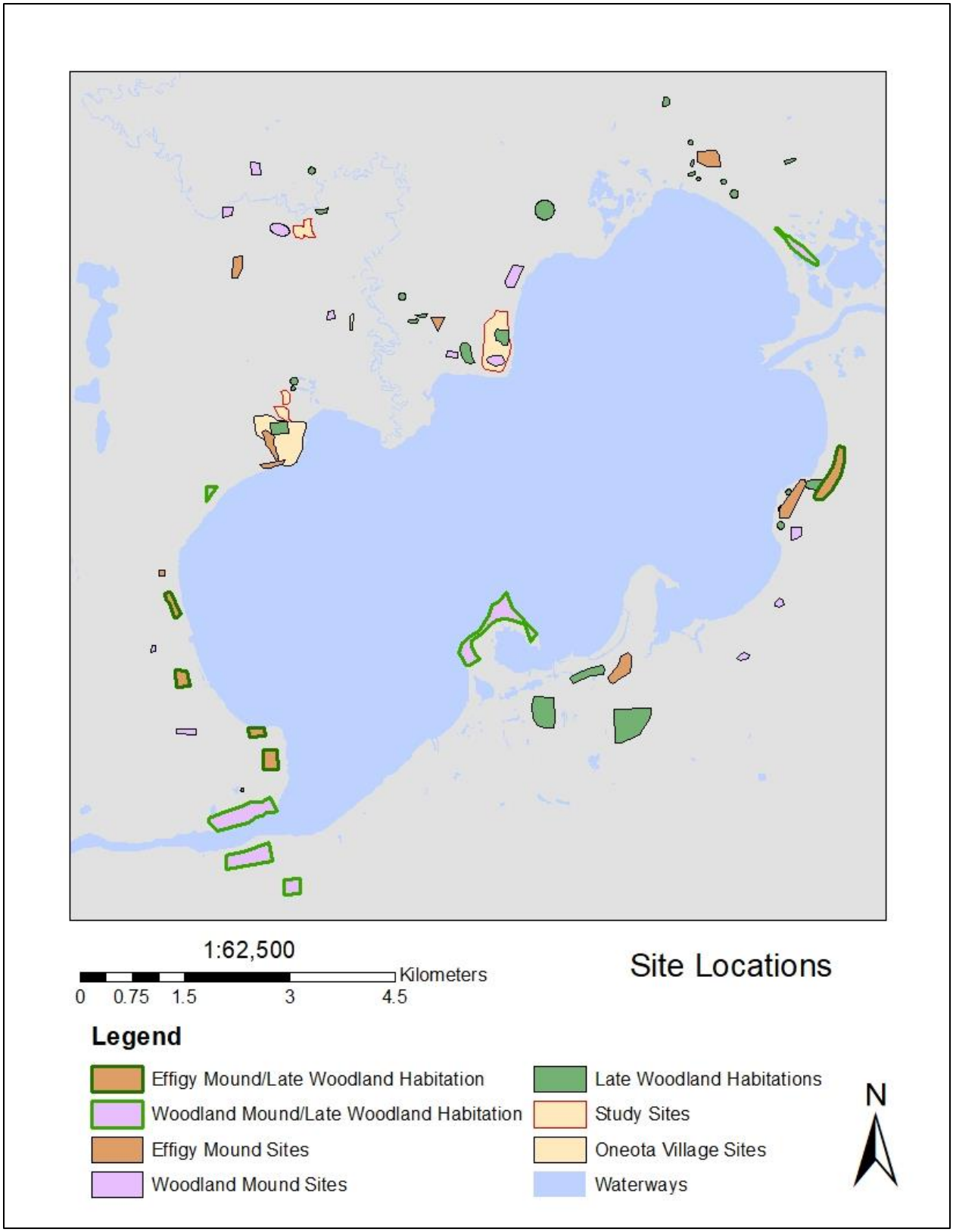

Figure 3. Site Locations within the Study Area

oil and gas developments and by the early 1990's was used to place and manage national parks, monuments, and historic places (Gillespie and Clark 1979; Kvamme 1991:77). By 1995, viewshed analysis was being utilized to understand spatial relationship between Neolithic long borrows in Southern England (Wheatley 1995). Subsequent studies have used this technique to identify settlement patterns and defensibility of village sites (Jones 2006).

More recent applications have focused on the cultural and cosmological significance of visibility rather than strictly focusing on what is physically visible on the landscape (Kim et al. 2020). Additionally, improvements in computational software and an increase in more readily available higher resolution data has resulted in more accessible and accurate geographic information systems (GIS) analysis. Viewshed analysis in general is useful for archaeological applications because the primary data source is elevation data which changes slowly and is relatively static throughout time (Johansson and Lundberg 2016). In comparison to a geologic time scale—which determines elevation, the period of human occupation that North American archaeologists' study is very recent.

It is important to recognize that Viewshed Analysis can only identify if it were possible for individuals at each of the studied locations to view one another. Furthermore, just because sites have intervisibility, it does not necessarily mean that villages were placed specifically to be within this viewshed. The classic caveat that correlation is not causality applies here. Mound sites are situated on high ridges overlooking low-lying areas and therefore have an expansive viewshed that encompasses much of the lake. There is likely a small area in the locality that is not visible from at least one mound site. Multiple factors go into settlement patterns and site placement with visibility to mound groups being one of many considerations. We do not have

any archaeological evidence that can confirm that these viewsheds were intentional or used by the inhabitants of each site. What viewshed analysis can do is inform what is possible to view given the landscape and other factors such as earth curvature and human sight limitations. It is then up to the archaeologist to decipher patterns in these viewsheds in conjunction with other types of data. What is known of each site, its material culture, and history of use can be used to infer the potential relationship between each of the studied sites.

Research Questions

The overall hypothesis for this research is that the visual landscape was a contributing factor in Oneota settlement patterning in the Lake Koshkonong locality during the 11th through 15th centuries. Furthermore, relationships between sites can be discerned by analyzing the spatial and visual patterning between sites within the study area. This hypothesis was evaluated using three research questions:

1) What sites are encompassed and excluded from Oneota village site viewsheds?

2) What is the visual relationship between mounds and Oneota village sites?

3) What is the visual relationship between Late Woodland habitations and Oneota village sites?

The expectation is that patterns of one-way visibility, intervisibility, and invisibility between sites can be interpreted to extrapolate the potential relationships among contemporary groups at surrounding Lake Koshkonong. High degrees of visibility between sites would indicate a visual network of communication and indicate a close relationship between these sites. However, the

nature of that relationship would need to be examined to determine if it was likely positive or negative. A lack of visibility, or invisibility from one site to another would indicate that one of the groups might have been attempting to conceal themselves or relations may have been violent.

Overview of Thesis

Chapter 2 contains an overview of Late Woodland and Oneota culture history within the Midwest, the history of research, as well as the chronology of Wisconsin Oneota. Chapter 3 is an overview of the study sites and background on the Lake Koshkonong locality. Chapter 4 lays out the methodology of my research including a discussion of viewshed analysis, settlement choice, and monumental landscapes. Chapter 5 describes the methods of my research while Chapter 6 discusses the results and Chapter 7 consists of an interpretation of the results. Chapter 8 is the conclusion and discusses the limitations of this study and future research.

Chapter 2: Culture History

Late Woodland

The Woodland Period in Wisconsin is divided into three temporal subdivisions. These divisions are Early Woodland (500 B.C.— A.D. 100), Middle Woodland (A.D 100— A.D 300), and Late Woodland (A.D. 300—A.D. 1250). These divisions represent a gradual transition from mobile hunter-gatherer groups toward a more sedentary lifestyle that incorporated plant cultigens, burial mounds, and pottery (Stevenson et al. 1997).

Woodland Mound Sites

In the Midwest, the first burial mounds, or at least the use of natural knolls and ridges for burials, began to be built as early as the Middle Archaic period (Charles et al. 1988; Ritzenthaler and Quimby 1962). Within the study area, what I have classified as Woodland-style mound sites, date between the Late Archaic and the Late Woodland periods (WHPD 2022). These mound groups consist of conical or oval mounds with the later introduction of linear mounds. The period of mound construction signals the beginning of an archaeologically recognized trend toward sedentism and economic intensification in the form of horticulture (Buikstra and Charles 1999:207). Mounds are artifacts themselves and become part of the landscape once constructed (Dillemuth 1999:99; Kaufmann 2005:25). While part of the static landscape, the human experience of viewing mounds is dynamic, and changes based on the context of the experience and the individual's belief systems and experiences (Dillemuth 1999:100).

Late Woodland Habitation Sites

Late Woodland habitation sites are not restricted to any one part of the Lake Koshkonong locality and are usually seen as two distinct groups falling into an early (circa AD 700-1100) and late (circa AD 900-1200) chronology, with some overlap (Salkin 2000; Stoltman and Christiansen 2000). Early Late Woodland groups in Wisconsin built Effigy mounds and are thought to have been foragers (Mallam 1976; Salkin 2000;). It is during this period that the bow and arrow developed (Stevenson et al. 1997). The introduction and usage of this weapon may be linked to the violence seen at Lake Koshkonong Oneota sites. Later Late Woodland groups are found throughout the Midwest and exhibit regional material culture differences but were maize agriculturalists who buried their dead within villages (Benn 1995; Kelly 2002:36; Salkin 2000; Scarry 2003; Stevenson et al. 1997; Stoltman and Christiansen 2000).

Effigy Mound Sites

During the Late Woodland period, a new type of mound emerged: Effigy mounds (Birmingham and Eisenberg 2000). These earthworks are most notable in the shape of animals, but can also be conical, linear, or other geometric shapes (Kaufmann 2005). They have a restricted range within the Upper Midwest encompassing small portions of eastern Iowa and Minnesota as well as northern Illinois but are primarily concentrated in southern and western Wisconsin (Kelly 2002:4). The placement of Effigy mounds is believed to have many functions and layers of meaning. These functions include perpetuating group identity and renewing social ties, as resource maps, territorial markers, astronomical observatories, or as a representation of their belief system (Birmingham and Eisenberg 2000:127; Clauter 2012:25; Dillemuth 1999:98; Kaufmann 2005:29).

Effigy mound groups were sometimes built around or near earlier conical mounds. These earlier mound groups may have served as "persistent places" and regarded as sacred by the subsequent builders of Effigy mounds who revisited the sites (e,g, Arnold and Murray 2002; Jeske 2006; Richards and Jeske 2002), and the lack of available excavation or remote sensing data for many has led to long estimates of age for these mound groups. Of the mound sites analyzed in this research, all Effigy mound groups also contain conical and/or linear mounds. They are estimated to date between the Middle and Late Woodland periods. Effigy mounds are interpreted to have a unique meaning and imbued with the beliefs and cosmology of the people who constructed them (Hall 1993:41). One of the things that points to the sacred nature of Effigy mounds that differentiates them from both earlier Middle Woodland and later Mississippian mounds is the relative lack of burials (Kaufmann 2005:12). However, when burials do occur, they are often in the center, or "heart" of the mound (Birmingham and Eisenberg 2000:127).

Collared Wares

As cultivated maize became more ubiquitous in Wisconsin, a new style of pottery began to emerge: collared ware (Stevenson et al. 1997:173–175). These pots consisted of grit-tempered vessels with a thick collared rim. The groups that made these vessels lived in long-term settlements that were near large waterbodies and either fortified or located in naturally defensible locations (Richards and Jeske 2002:39; Salkin 2000:530; Stevenson et al. 1997:175). Their subsistence consisted of maize, and squash cultigens in addition to hunting and gathering local resources (Salkin 2000:532). They did not use Eastern Agricultural Complex plants much, but did grow tobacco. Collared Ware sites are widely distributed across the marsh river

landscape of southeast Wisconsin (Goldstein and Richards 1991:200; Richards and Jeske 2002:39; Salkin 2000:536).

Aztalan, while known for its later Mississippian component, was a large Collared Ware Late Woodland village circa AD 900–1000 (Krus et al. 2022:126–127). Aztalan is just one of the many collared ware sites located along the Upper Rock River (Salkin 2000:539), however it is the type site for the most common collared ware style in southeastern Wisconsin: Aztalan Collared. Other collared ware styles include Point Sable Collared, Starved Rock Collared, and Hahn Cord Impressed (Salkin 2000:528).

Oneota

Oneota should not be confused as a single culturally identifiable or ethnic group; rather it is a collection of material cultural traits that are archaeologically identified as related to one another (Edwards 2010:5). These cultural traits are associated with mixed foraging and agricultural/horticultural economies with a reliance on maize, Eastern Agricultural Complex (EAC) plants, and a variety of fauna (Edwards 2020a:14). However, not all Oneota groups have the same material culture signatures (Edwards 2020a; Foley-Winkler 2011; Kreisa 1993; Smith 1978; Hart 1990). Within the classification of Oneota there is a considerable amount of intersite and intrasite variation. Because of this, Oneota culture is typically discussed on a regional level (Edwards 2020a:14). Regional clusters of Oneota sites are known as Localities (Figure 4). In Wisconsin, these localities include La Crosse, Red Wing, Grand River, Wolf River, Waupaca, and Lake Koshkonong (Edwards 2020a:3).

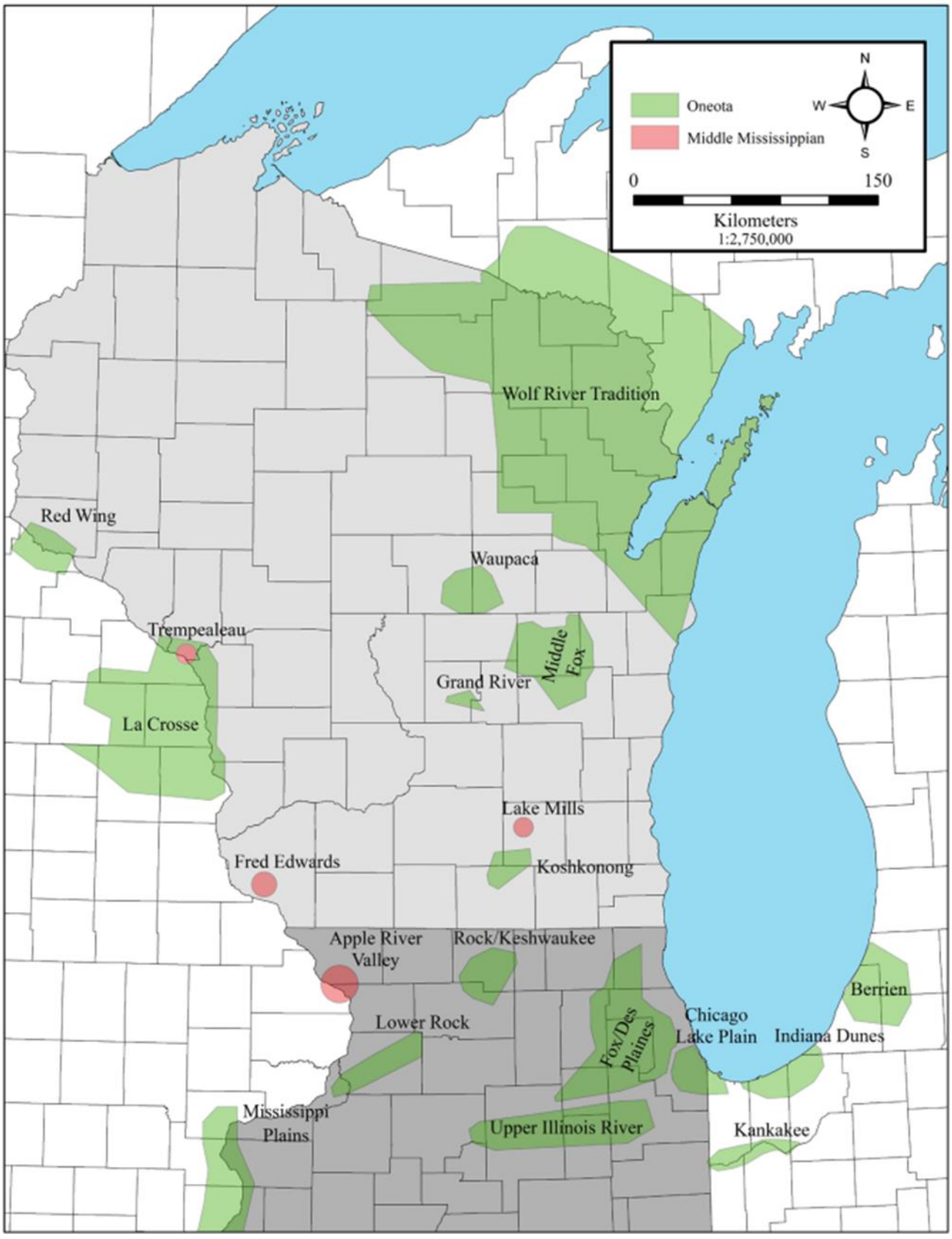

Figure 4. Oneota Localities in Wisconsin; taken from Jeske et al. 2020:3

Oneota is just one of the many groups of material culture, including Langford, Oliver, Fort Ancient, Fisher, Huber, and Berrien, that archaeologists call Upper Mississippian. These seemingly related variations on material culture can be found from modern day Ohio to the plains (Edwards 2020a:13; Jeske 2020:104; Overstreet 1997). Once thought to be part of the same tradition, nearly a century of work on Oneota has amassed a greater understanding of the differentiation of the Upper Mississippian types and regional expressions (Henning 1998; Hollinger and Benn 1998; Tiffany 1997; Benton 2001; Boszhardt 2004; Overstreet 1995). While these groups share commonalities, such as agriculture and some ceramic decorative motifs, adaptational differences to local environments including varying reliance on food sources, and distinctive pottery designs and materials differentiate each group from one another (Jeske 2020:115; Overstreet 1976:255; Smith 1978:480).

Oneota culture was originally defined and named by Charles Keyes and Ellison Orr in the early 1900s. It was named after the Oneota river, now the Upper Iowa River, in northeast Iowa where the first distinctive shell-tempered pottery sherds were found (Keyes 1928, Orr 1900's). Additional work by McKern and Orr in the 1930's and 1940's helped to expand the definition to include material cultural found in Wisconsin (McKern 1931; 1945, Orr 1936). Within the Midwestern Taxonomic Method, Oneota was defined as an Aspect of the Upper Mississippian Phase (McKern 1945). However, it was argued that this method lacked relevancy for Oneota due to site variation over time. In December 1960, the Columbia conference defined Oneota within the Willey and Phillips (1958) model as a tradition composed of Emergent, Developmental, and Classical horizons (Hall 1962).

Oneota Origins

The exact reason for the appearance of Oneota in Wisconsin is still unclear. Two general models of Oneota origins have been proposed: in-situ development (aka transformation model) from either Late Woodland collared ware using groups or Effigy Mound groups (Gibbon 1972; Overstreet 1976; Tiffany 1997) and the migration model of outside groups moving through the Lake Koshkonong Locality and influencing material culture (Overstreet 1997:290). The migration model was initially used with the explanation that Middle Mississippian groups moved northward from Cahokia to Aztalan before transitioning to an Oneota lifeway (Griffin 1960). Others have posited Oneota ceramics represent one or more groups that moved in from the south with a fully developed Oneota culture (Overstreet 1997:290). Both the in-situ and migration models have been shown to be flawed. Using Cahokia as the primary driver of Oneota development is no longer supported by new archaeological evidence (Richards and Jeske 2002:47; Jeske et al. 2020:24–25) and the in-situ model has been shown to have insufficient time for Middle Mississippian groups to influence Late Woodland groups into Oneota (Edwards 2020a:18). Additionally, Middle Mississippian, Late Woodland, Effigy Mound, and Oneota groups have been found to be contemporaneous with one another in the same region (Edwards 2020a:18; Richards and Jeske 2002). This indicates a complex social world where several archaeologically identified groups interacted with one another in geographically confined area.

Lake Koshkonong Locality

Relative to other localities, the people at Lake Koshkonong were isolated from other Oneota groups. Lake Koshkonong is more than 70 kilometers away from the nearest

neighboring locality. Within the Koshkonong locality, Oneota sites were highly clustered on the northwest side of the lake (Jeske et al. 2020:2). Faunal evidence has suggested that Lake Koshkonong had a locality wide economic system with sites having discrete faunal signatures (McTavish 2020). People utilized maize, wild rice, and other Eastern Agricultural Complex plants for subsistence and were more economically and socially independent than other Oneota locality groups. This isolation from other groups and consolidation within their own locality is interpreted as a way to mitigate risk from violence (Jeske 2020:107–116).

Oneota sites first appeared at Lake Koshkonong between AD 1055–1120 and were abandoned between AD 1410–1445. This time span includes circa 45–130 years of overlap between Lake Koshkonong Oneota and Aztalan Middle Mississippian groups (Krus et al. 2022:134). There is no direct evidence of interaction between Lake Koshkonong Oneota with Aztalan, violent or otherwise (Edwards 2020a Krus et al. 2022; Jeske 2020). However, both these groups exhibit characteristics that support a violent landscape throughout this region. Aztalan has the earliest recorded Middle Mississippian palisade with a bastion (Krus et al. 2022:134). The geographic placement of village sites at Lake Koshkonong suggests that they were in defensive locations. Skeletal material from Aztalan and Oneota sites indicate that a high proportion of individuals died from violent interactions (Jeske 2020; Rudolph 2009). This contentious landscape was likely due to Oneota and Mississippians being “minority inhabitants of a region that had been a Late Woodland stronghold since at least AD 600” (Krus et al. 2022:137).

After the abandonment of Lake Koshkonong and other Oneota Wisconsin Localities circa AD 1410–1445, it is unclear to archaeologists what happened to these groups (Krus et al.

2022:136). It has been hypothesized they spread across the upper Midwest and became the ancestors to the historic Ho-Chunk, Ioway, Oto, Missouri, Kansas, Osage, Omaha, and possibly the Dakota (Griffin 1960; Hollinger 1995:141; McKern 1927). While some have tried to associate the land use and life ways of 16th-17th century Oneota sites and the postcontact Siouxan peoples (Dirst 1997:117), it is easier to make this case west of the Mississippi River. Oneota material culture has little in common with what is known of the postcontact indigenous people of Eastern Wisconsin.

This Oneota—Ho-Chunk hypothesis is hindered due to a gap in between the last verified Oneota sites, circa 1450, and the first established Ho-Chunk sites two hundred year later (Dirst 1998:117; Edwards 2020a:24; Hall 1962:102–103; C. Mason 1993; R. Mason 1993). There is little evidence that positively demonstrates a strong relationship between Oneota and Ho-Chunk or European material culture, as there is with Danner and Illini at the Grand Village of the Kaskaskia (Brown 1975) or with Proto-Iroquoian and Iroquoian in the eastern Great Lakes (Snow 1994). Nonetheless, given the highly fluid movement of people across the landscape, it is probable that the many Ho-Chunk people encountered by French explorers and missionaries had ancestors who used Oneota material culture two hundred years prior.

Chapter 3: Lake Koshkonong

Geology

Lake Koshkonong is located in the Eastern Ridges and Lowlands geographic province that was formed due to glacial activity in the Late Pleistocene and Early Holocene (Martin 1916:199; Musil 1987:126). Where glaciers moved across the landscape, the ground was flattened and earth and rock, known as glacial till, were churned up, and moved across the landscape by the enormous weight of the ice. Once the glaciers began receding, the glacial till accumulated at the end of the glaciers became what is known as end moraines. These end moraines help to trap glacial runoff which in turn formed many of the lakes and rivers in southern Wisconsin. This includes Lake Koshkonong, a shallow impoundment of the Rock River that occupies portions of Dane, Rock, and Jefferson Counties (Figure 5) (Jeske et al. 2020:10). Evidence of glaciation is still observable on the landscape and is best visualized in bare earth elevation data (Figure 6). The extent of the glacial lobe and end moraines are present and show the underlying topography without the interference of vegetation.

History of Archaeological Investigation

As a locus of settlement, archaeological investigations have occurred at Lake Koshkonong since the mid-19th century. The first of these was the 1855 survey by Lapham. Primarily focused on mound sites in the area, it also includes a historical account of the depth and vegetation of Lake Koshkonong (Lapham 1855). The next survey was undertaken by Stout and Skavlem in 1908 and focused on the identification of mound and village sites around Lake Koshkonong. Their survey includes the first recorded mention of several mound sites, included in this study: Ogden, Rock River, Tay-E-He-Dah, Taylor House, Fulton, Koshkonong Group,

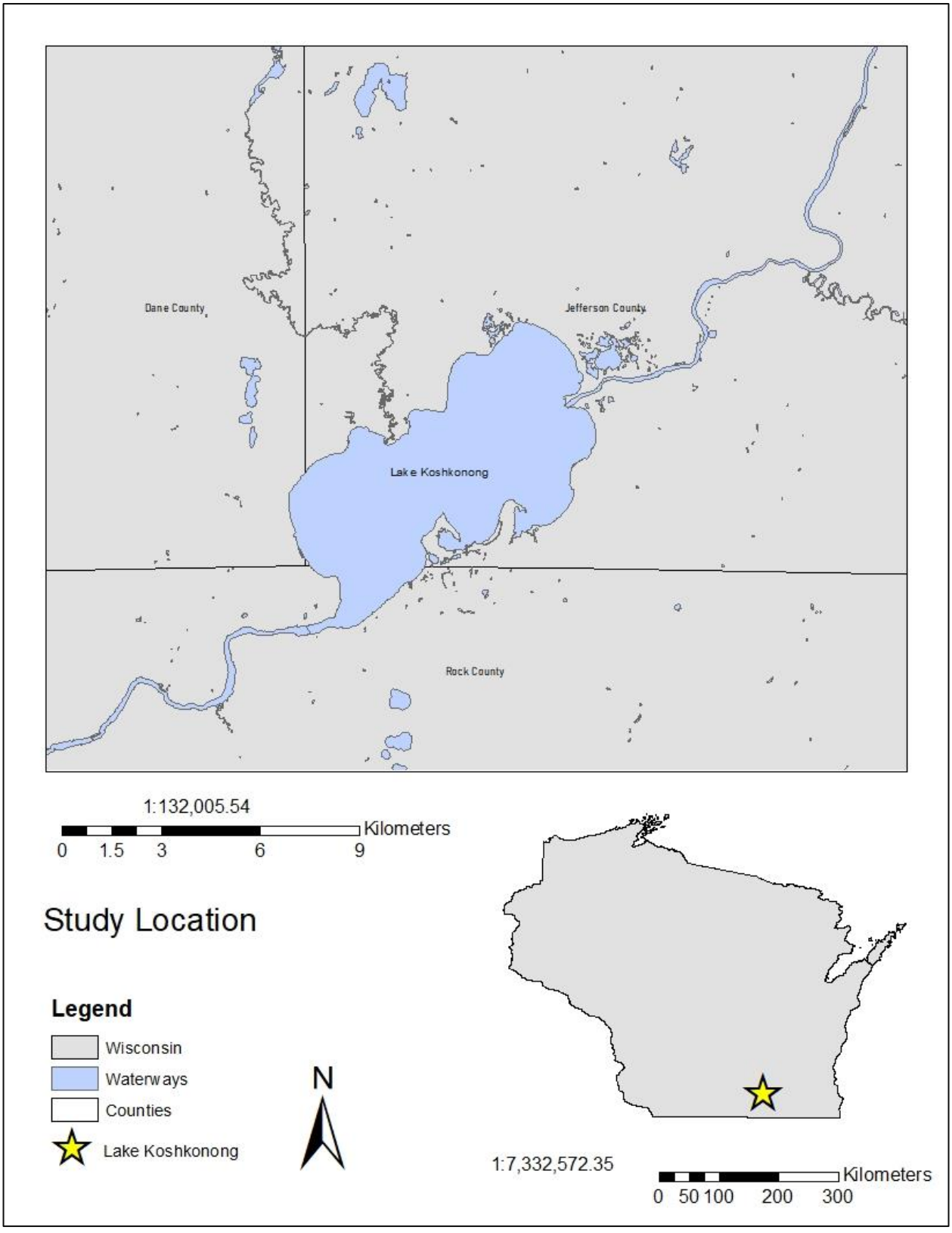

Figure 5. Study Location

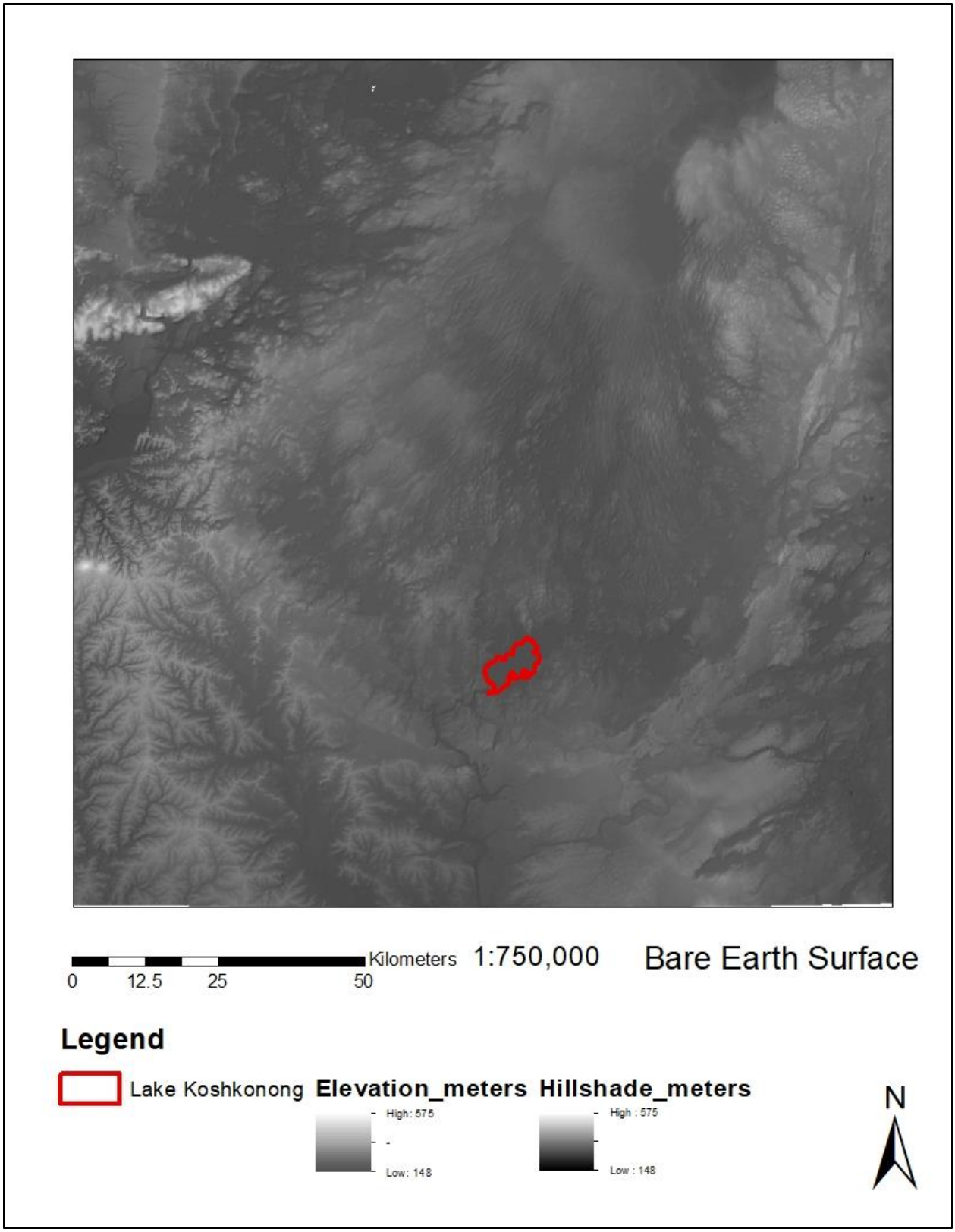

Figure 6. Bare Earth Elevation and Hillshade showing Glacial Moraines

Johnson Group, Noe Springs, North, Rufus Bingham, LeSellier, Kumlien, Koshkonong Creek Mounds, Draves, Skavlem, Loge Bay, Altpeter Group, General Atkinson, Hoard, Fun Hunter's Point, Lookout, Haights Creek, Ira Bingham, and Thiebeau Point (Stout and Skavlem 1908:50–99).

Robert Hall excavated at Carcajou Point between 1955 and 1959 (Hall 1962). Hall's seminal work produced the first Oneota radiocarbon dates in Wisconsin. One small excavation by the University of Wisconsin-Madison and periodic surveys by the University of Wisconsin-Milwaukee occurred throughout the late 20th century. However, the first systematic and continuous excavations of the locality began in 1998, when the University of Wisconsin-Milwaukee began a long-term research program at the Crescent Bay Hunt Club and nearby sites (Jeske et al. 2020:9). This research has resulted in the publication of numerous master's theses, PhD dissertations, conference presentations, and books on the nature of Lake Koshkonong Oneota. Focus on subsistence (Egan-Bruhy 2001; Olsen 2003; Edwards 2010, 2017, 2020; Edwards and McTavish 2012, McTavish 2019, 2020), lithics (Harding 2021; Lambert 2001; Van Beckum and Jeske 2001; Sterner 2012, 2018, 2020; Sterner and Jeske 2017; Wilson 2016), copper (Pozza 2015; 2016; Parkinson 2003), ceramics (Schneider 2015; Schneider and Carpiaux 2020; Kelly 2002; Carpiaux 2018), burials (Foley-Winkler 2004, 2011), viewshed analysis (McTavish 2016; Dillemuth 1999), and others (Edwards and Spott 2012; Moss 2010; Mollet and Jeske 2003; Jeske et al. 2003b; Hunter 2002).

Oneota Component

The occupation of Oneota sites at Lake Koshkonong occurs from the 11th through 15th century (Krus et al. 2022). There are nine sites with known Oneota components located within the Lake

Koshkonong region, six of which are village sites (Figure 7). Village sites are defined as a cluster of permanent settlements with year-round occupation, large food storage and processing areas as well as associated mortuary facilities (Jeske 2020:106). Research has found that Oneota villages were economically independent and linked by kin affiliation (Kreisa 1993:48). Compared to the carrying capacity of the landscape, these village sites were small and underpopulated (Jeske 2020:106–108). Oneota village sites were placed in defensive positions on ridges near steep slopes and in a "D" formation (Jeske 2020:107). This formation would have forced attackers to swing widely while allowing people on the inside of the formation to quickly come to the aid of other village sites.

Evidence of perimortem trauma has been observed in 34% of remains identified dating the Oneota tradition at Lake Koshkonong (Jeske 2020; Jeske et al.2017). In addition to perimortem trauma, some of these skeletons show distinctive markers of poor health, including caries, linear enamel hypoplasia, and abscesses (Krus et al. 2022:126). These skeletal markers indicate that despite living on a fertile landscape, people inhabiting Oneota sites at Lake Koshkonong at least periodically had poor access to these resources and were subject to violent interactions. Understanding that the landscape was potentially hostile is important for inferring reasons for settlement choice and relations between groups living at Lake Koshkonong at this time.

Research Sites

My study will focus on four village sites where a significant amount of work has been carried out, providing the framework for understanding the Oneota component at Lake Koshkonong (Jeske 2020). These sites are Carcajou Point Site (47JE002), Koshkonong Creek

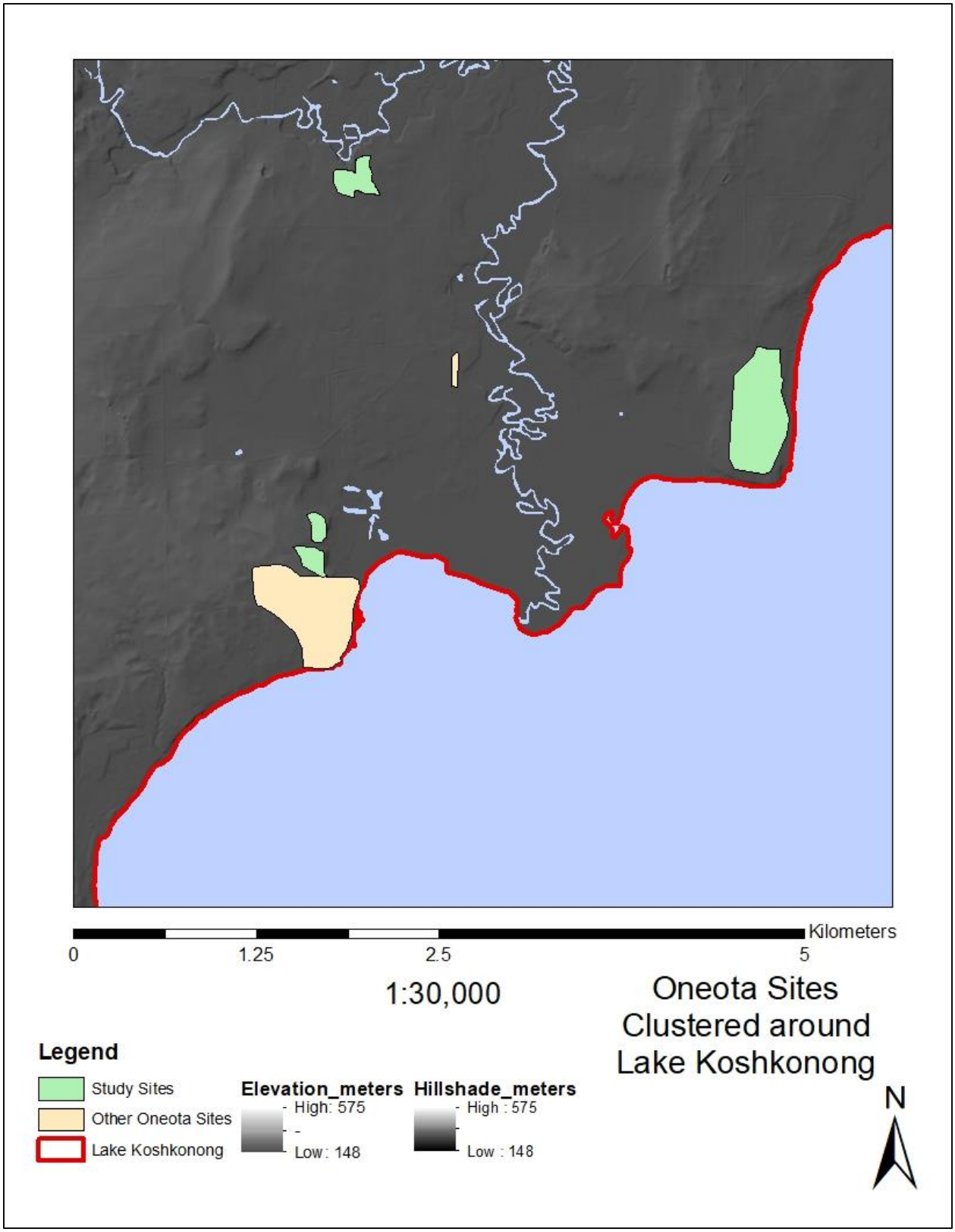

Figure 7. Oneota Sites Clustered on Lake Koshkonong

Village (47JE379), Crescent Bay Hunt Club (47JE904), and Schmeling (47JE833).

The Carcajou Point Site (47JE002)

The Carcajou Point Site (Figure 8) was originally noted in Stout and Skavlem's investigations at Lake Koshkonong (1908:82). This site was excavated by Robert Hall from the University of Wisconsin-Madison between June and November 1957. Originally setting out to locate the historic "White Crow's Village", while some historic artifacts were noted, a much greater amount of Oneota artifacts were observed (Hall 1957, 1962). These investigations became the foundations for the study of Oneota in Wisconsin (Jeske et al. 2020:9); however, a surprising lack of research has occurred at the site since 1959.

Exceptions include survey and excavation by the Southeastern Wisconsin Archaeology Program (SEWAP, later Program in Midwestern Archaeology (PIMA)) in 1984, 1989, 1990, 1998, and 2002 (Brubaker and Goldstein 1990; Jeske et al. 2003a; Richards et al. 1998; Rodell 1983, 1984). Additional excavations were completed for a boat ramp project between 2002-2004 by the Wisconsin Historical Society (Rosebrough and Broihahn 2005). These excavations have strengthened the findings of Hall as well as producing new data from additional feature and unit excavations. Three types of structures have been identified at Carcajou Point including wall trench, rectangular single post, and bent pole wigwams. Identified features consist of post holes, refuse pits, and burials (Hall 1962; Rosebrough and Broihahn 2005:42). These subsequent excavations have produced lithics, ceramics, and faunal evidence that has strengthened Hall's conclusions that Carcajou Point is a year-round permanent settlement with mixed economy subsistence (Hall 1962:32).

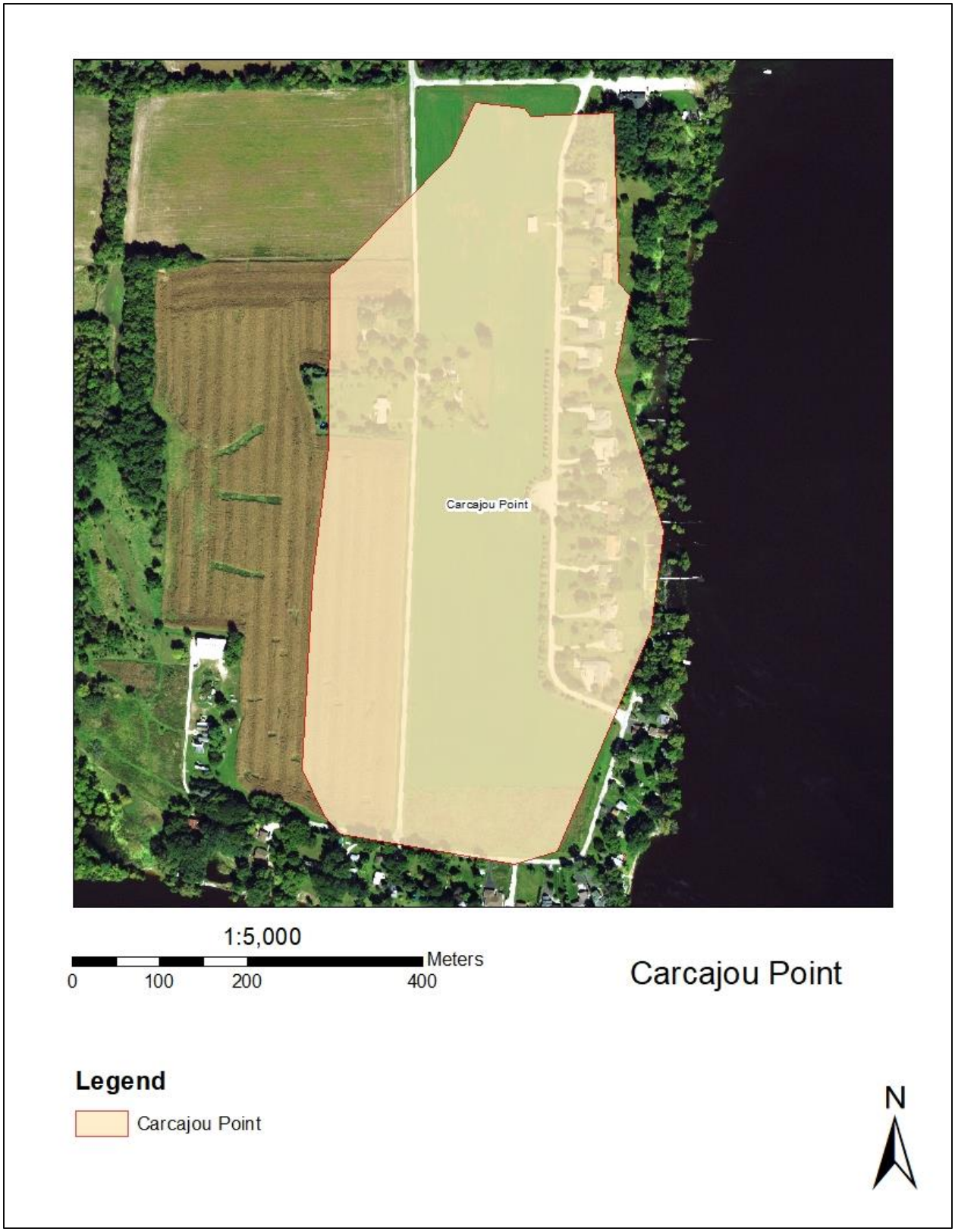

Figure 8. Carcajou Point (47JE002)

Koshkonong Creek Village (47JE379)

First recorded by Stout and Skavlem who described it as a “small village site” (1908:95). The Koshkonong Creek Village (KCV) (Figure 9) is a multicomponent site that encompasses Archaic, Woodland, and Oneota components, but appears to be horizontally stratified, with a large discrete Oneota village occupation. This site has yielded much data regarding structures and two different house structures have been identified at this site, double wall bent pole structures, and rectangular structures. Additionally, mortuary data from the site indicates that not all human mortuary spaces were within clearly defined burial pits and mounds (Jeske et al. 2020:22). Coined as the Twin Knolls site during investigations in the 1980s (Musil 1987), the name has since reverted back to Koshkonong Creek Village. KCV is the only known Oneota village site that is not directly adjacent to Lake Koshkonong (Jeske et al. 2020:21). As such, this site is upland and drier than other Oneota sites in this study (Edwards 2010; Edwards and McTavish 2012:1). Investigations have taken place in 2008, 2010, 2012, 2014, 2016, 2017, and 2021. However, very little of the overall site has been excavated leaving many questions yet to be answered.

The Crescent Bay Hunt Club Site (47JE904)

Located on a limestone ridge overlooking a marshy wetland, the Crescent Bay Hunt Club (CBHC) (Figure 10) is the only single component site in this study (Jeske et al. 2020:14). This site was possibly described by Stout and Skavlem, however it was not referred to by name (1908:80), and could have been referring to the adjacent Schmeling site. The first excavations at CBHC occurred in 1968 when David Baerreis led a field school through the University of Wisconsin-Madison. A formal report of these investigations was never published although an

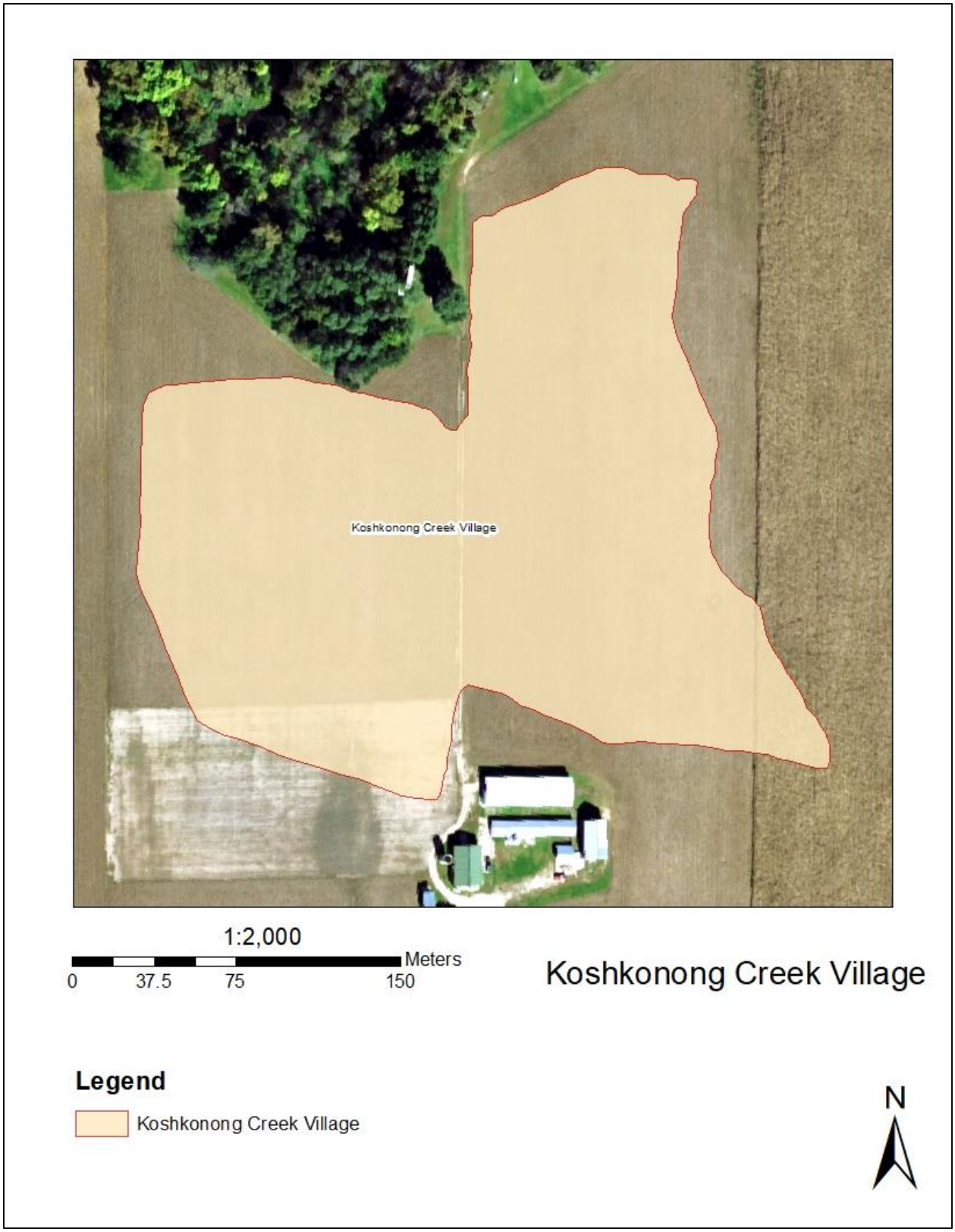

Figure 9. Koshkonong Creek Village (47JE379)

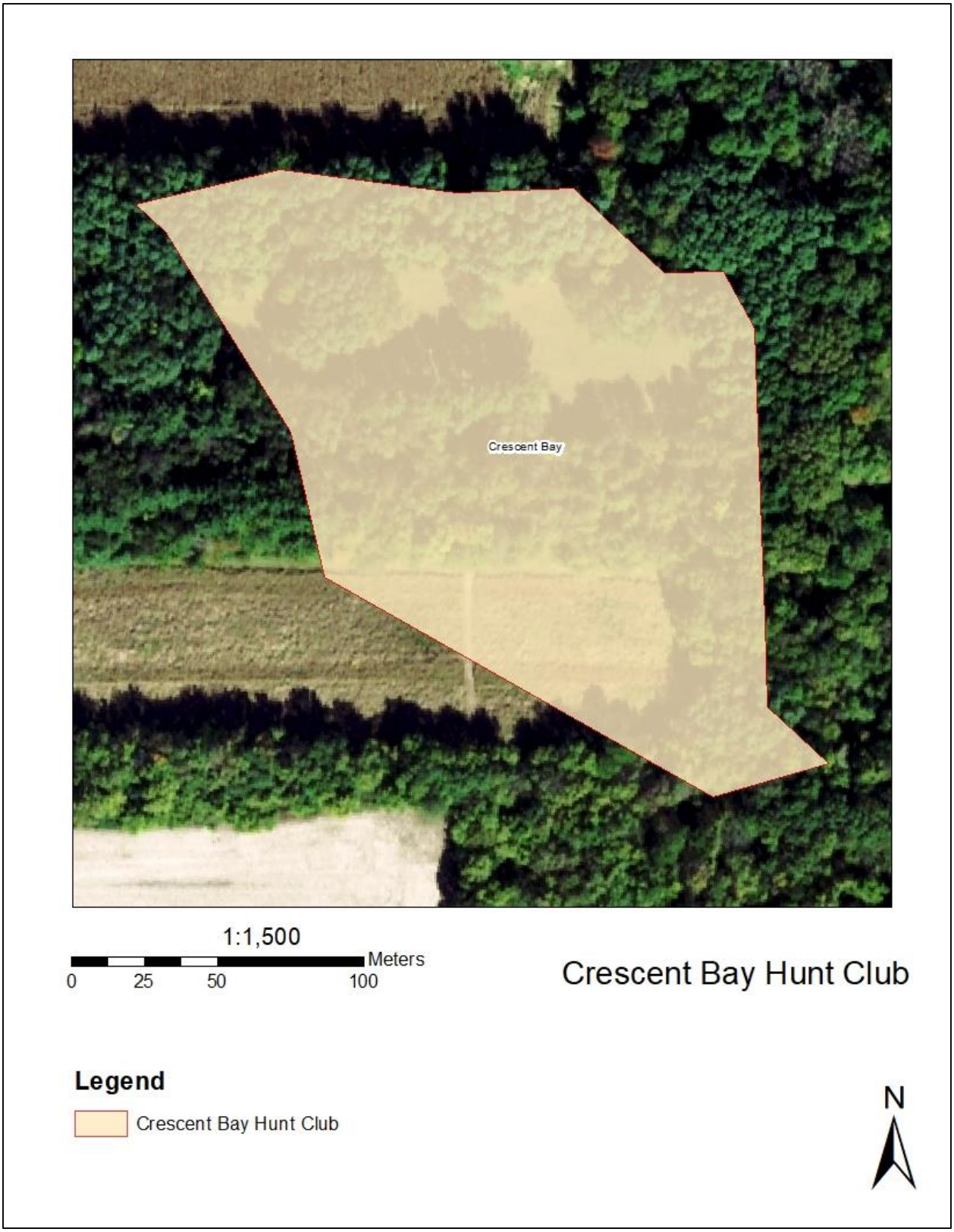

Figure 10. Crescent Bay Hunt Club (47JE904)

unpublished report does exist and at least one master's thesis was published on the resulting materials (Jeske 2020:9). The 1998 University of Wisconsin-Milwaukee field school relocated Baerreis's excavations, including a wigwam type structure mapped in 1968. UWM conducted a total of 10 field school excavations between 1998-2017. This work identified hundreds of features that included post holes, wild rice threshing pits, basins, and wall trenches as well as a palisade (Jeske et al. 2020). Analysis of the material culture has determined that the inhabitants at CBHC occupied it year-round and built three types of structures: bent pole wigwam or gable walled structures, longhouse style structures, and a small semi-subterranean structure. Maize, wild rice, and Chenopodium were domesticated, and a wide array of wild plants utilized. Deer, elk, bison, small mammals, fish, turtles, and mollusks were also consumed. Despite this work, to date only around ten percent of this site has been excavated (Jeske et al. 2020).

The Schmeling Site (47JE833)

Located directly to the north of the CBHC on the same limestone ridge, Schmeling (Figure 11) is separated by a steep natural gorge and spring (Jeske and Winkler 2008). A multicomponent site composed of Paleoindian to Historic period artifacts, the most concentrated area of artifacts is composed of overlapping Middle–Late Woodland and Oneota materials. This site has been interpreted as a village site, but recently it has been suggested to possibly be a ceremonial district for CBHC or the entire locality due to a small concentration of bundle burials and a faunal signature including raptors and aquatic mammals (Foley-Winkler 2008, 2011; Jeske et al. 2020:21; McTavish 2019). Like KCV, Schmeling is horizontally stratified. Much of the site is within a plowed field, which has created a great deal of erosion. Initial investigations demonstrated that the any subsurface features that may have existed within the

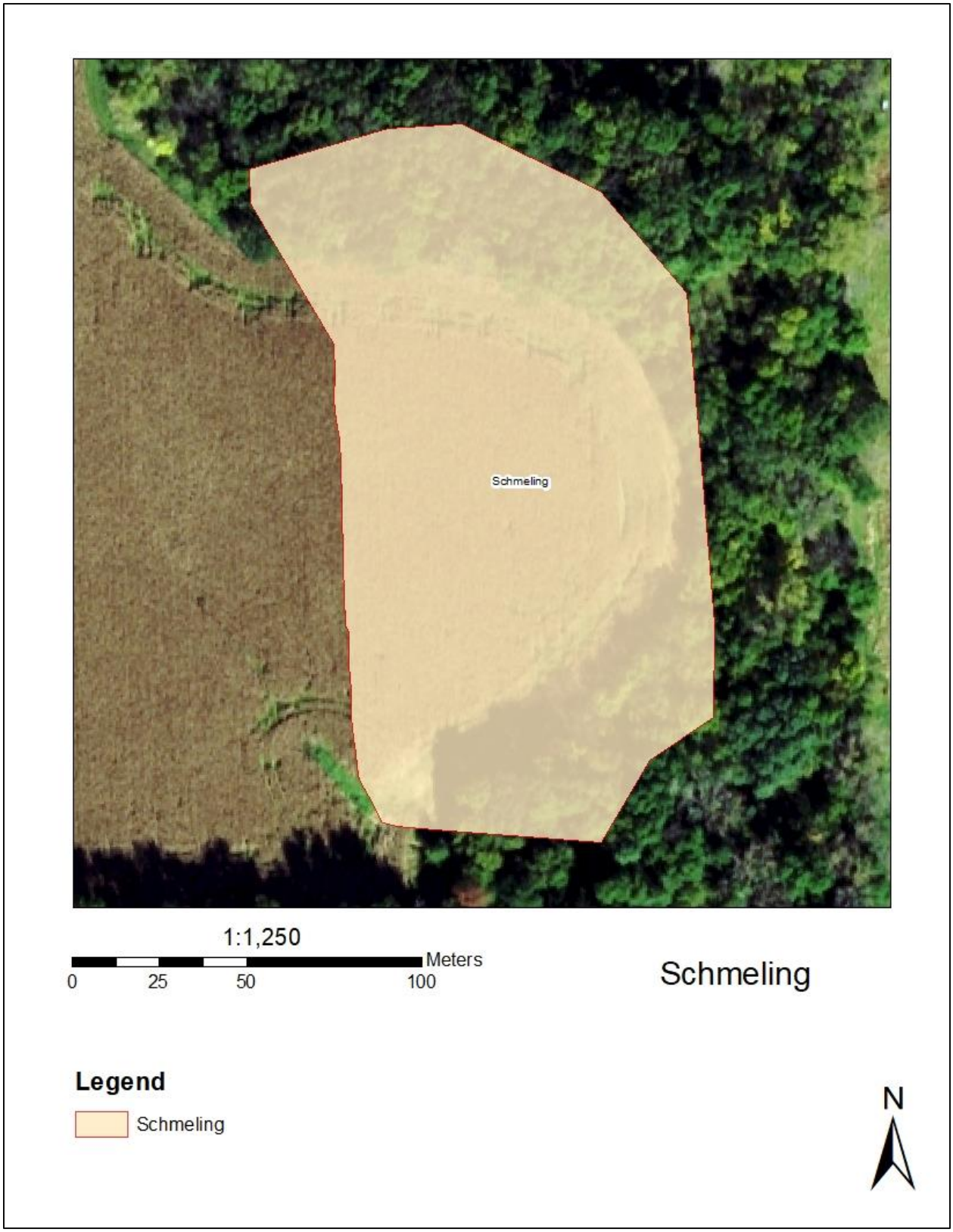

Figure 11. Schmeling Site (47JE833)

agricultural field have been plowed away (Jeske et al. 2020). Therefore, all subsequent excavation units in 2006 and 2008 were concentrated in the wooded area on the north edge of the site in 2006 and 2008. All of the excavated material belongs are associated with the Oneota occupation.

Chapter 4: Methodology

This research was based on the principles of GIS to investigate settlement choice within the Lake Koshkonong locality including proximity and visibility towards mounds. GIS are a powerful tool that can be used for analyzing settlement choice in archaeology (Ebert 2004:335). GIS has been largely associated with mapping capabilities; however, the power of GIS comes not from the ability to visualize and manage spatial data, but in the ability to analyze data to generate and test theory (Ebert 2004:320). Early uses of viewshed analysis for cultural resources consisted of using it to place and manage national parks, monuments, and historic places (Kvamme 1991:77). By 1995, viewshed analysis was being utilized to understand the spatial relationship between Neolithic long borrows in Southern England (Wheatley 1995).

Refinement of the technique and increased capabilities of software has made GIS and viewshed analysis more accessible and efficient for archaeologists in recent years (Ebert 2004; Johansson and Lundberg 2016; Jones 2006; Petrasova et al. 2015; Kim et al. 2020). Visibility is a phenomenon through which humans make sense of space, both cognitively and perceptually (Kim et al. 2020:42). Through the analysis of visibility, not only is physical landscape revealed, but so is the cultural and spiritual landscape of these archaeological sites.

Viewshed Analysis

Viewshed analysis is a GIS technique that employs the use of elevation data to calculate visibility. Elevation data is converted into a raster digital elevation model (DEM) to be used for the calculations. Rasters are made up of cells of which each contain x, y, and z data representing longitude, latitude, and elevation, respectfully. The DEM has been filtered to show the bare earth surface at the time of data collection. Elevation data is useful in archaeological

contexts due to its relatively static nature and slow changes over time. This is most apparent when comparing the geologic and archaeological time scales (Johansson and Lundberg 2016:3). Simply put, the bare earth surface of the study area during precontact times is essentially the same as the bare earth surface of the same area today excluding areas of modern construction and agricultural deflation.

There are several different types of visibility that can be calculated with GIS. The simplest form is line of sight. This form determines if one point is visible from another point, called the observer point (Ebert 2004:329; Jones 2006:525). The second form is viewshed, which is produced by running a program that calculates which raster cells are visible/not visible from an observer point. This is essentially a line-of-sight calculation done in 360 degrees (Ebert 2004:330; Jones 2006:526). The last form of visibility is a cumulative viewshed. This form is determined by layering several viewsheds on top of one another and calculating which areas have the highest visibility (Ebert 2004:329-330; Petrasova et al. 2015:78; Wheatley 1995:2). My research utilizes all three of these techniques to analyze different questions regarding the visible landscape surrounding Lake Koshkonong during the Late Precontact period.

Settlement Choice

Settlement choice in archaeology has been researched using Settlement Ecology. This is the study of how both natural (ecological) and cultural factors influence settlement choice (Birnbaum 2011:6; Jones 2010:1; Jones and Wood 2012:2593). The natural and cultural factors include: access to potable water, raw material access, fuel availability, defensibility, political/social, and even supernatural forces (Jones 2006:533; Jones 2010:1). However, these factors are not a set of rules for the ideal settlement and are simply a system used to

understand how each individual group determined the most important factors when determining where to place their settlement (Birnbaum 2011:6; Jones 2010:10).

One of the factors in determining the settlement ecology of a site is its viewshed of the surrounding landscape. Viewshed plays an important role in describing the visual relationships of places that people lived. From this, archaeologists can infer associations between these places and the environmental and sociopolitical factors that influenced people to inhabit these specific locations (Jones 2006:537). The ability to see someone on the landscape is related to physical closeness, which is associated with social closeness between groups (Kim et al. 2020:10). This relationship is exemplified by Jones (2006), where the settlement choices of Onondaga Iroquois sites are inferred to have been related to visibility, which translated to increased communication between groups. Subsequent studies of the same region have shown how the strong socio-political and signaling networks gradually consolidated over time (Dermarkar et al. 2016; Hart et al. 2016; Hart et al. 2017; Jones 2010; Jones and Wood 2012).

Settlement choice at Lake Koshkonong is defined by the Sasso settlement model (Sasso 1989:240–241). Villages were located on terraces with easy access to arable land and strategically aggregated at locations for trade and travel (Edwards 2020a:136–139; Hollinger 2018:272). Arable land consisted of ridged fields and garden beds—using these agricultural techniques protected against frost damage and extend the growing season while controlling weeds and erosion (Moffat 1979:238; Gallagher and Sasso 1987:148; Gallagher et al. 1985:611; Riley 1987:297–298). Oneota villages were located high on terraces making them defensible, but also increased the sight lines from each of the sites (Edwards 2020a:193). This visibility was

important on a perilous social landscape with evidence of violent interactions (Edwards 2020a, 2020b; Jeske 2020; Jeske et al. 2020; Krus et al. 2022; McTavish 2020).

Monumental Landscapes

Monuments on the landscape are a way in which humans' control and interact with their environment and imbue it with meaning (Howey and Clark 2018:886; Knapp and Ashmore 1999:2). The mounds surrounding Lake Koshkonong are believed to have been ceremonial sites visited a few times a year (Gibbon 1972:167). Lake Koshkonong Effigy mounds have been found to have been re-visited and maintained throughout time. Maintaining the mounds reaffirmed the position and social control of groups, by connecting them to the mounds and thus to the ancestors (Kaufmann 2005:40). Early reports of archaeological features surrounding Lake Koshkonong indicate the spatial relationship between village and mound sites (Brown 1916). While interesting, the meaning of this relationship is not well understood, and many sites are persistent places inhabited many times over many centuries.

Mounds are sacred spaces, both constructed and conceptualized by the groups that built them and utilized them (Knapp and Ashmore 1999:12). The meaning of these sites was constantly fluctuating as the sites were "constructed, utilized, maintained, negotiated, renegotiated meaning and roles of monuments across vast spaces and long periods" (Howey 2012:17). The ongoing maintenance "dramatized the cosmological convictions and reaffirmed relationships" including human bonds and a sense of order and balance in the universe (Mallam 1982). The people using the mound sites manipulated the symbols and rituals for their own purposes such as negotiating both intercommunity and intracommunity relationships (Charles and Buikstra 2002:19–22). While earlier mounds have been theorized to have been a social

demonstration of ensuring the annual cycle would continue the next year (Mallam 1982), as astrological alignments (Eisenburg and Rosebrough 1982), or as a gathering place for dispersed groups of hunter-gatherers (Mallam 1976), the meaning of mounds changed as the groups who used them also changed. Chapman (1995:40) identifies these uses as "Territoriality" and "Tenure" where Territoriality is for communication about the location of individuals in space, while Tenure asserts claims over resources in space. He goes on to assert that as groups became more sedentary, Tenure took on a new meaning. No longer claiming resources on the landscape, Tenure became a claim to the land itself (Chapman 1995:40–41). This sentiment is echoed in the distinction between Middle and Late Woodland mounds. Middle Woodland mounds were oriented towards the family and descendants of the deceased, while Late Woodland mounds shifted their focus toward the larger group (Charles and Buikstra 2002).

There is no direct archaeological evidence that Oneota groups utilized any of the mounds, conical or Effigy, during their occupation of the Lake Koshkonong locality. Burial directions at Carcajou Point and CBHC suggest Oneota groups were burying their dead in prescribed ways, facing particular directions (Foley-Winkler 2004:105). Additionally, copper artifacts found at KCV, CBHC, Schmeling, and Crabapple Point indicate a strong connection between Oneota and cosmological forces (Pozza 2016). Personal adornments such as beads and even a serpent pendant suggest these copper objects were worn close to the body. Archaeologists have long argued that copper had ideological properties and a cosmological connection to the powerful spirits of the underworld (Pozza 2016:25). Some of the same spirits are evoked by effigy mound shapes. The Lake Koshkonong Oneota shared some artifact traits and styles with earlier mound-building groups. It is logical for a group of people who wore

symbols of their beliefs close to their body would want to be close to permanent monuments of this cosmology and take mound sites into account when setting up villages.

Oneota groups that occupied Lake Koshkonong were no doubt aware of the mounds surrounding the lake. Earthen mounds permanently altered the landscape in a way that can be understood across both space and time (Howey 2012:163; Howey and Clark 2018:887). They represent a physical manifestation of the relationship between humans and both the environment and cosmos (Knapp and Ashmore 1999:6). The prepared surface of the base of the mounds represents a liminal surface between the underworld and the upperworld. In this sense, mounds represent "structured messages about a people's cosmological conviction graphically displayed across the landscape" (Mallam 1982:61). Mounds have been interpreted to be an "integrative mechanism" or signifiers of social networks and utilized to strengthen these social groups (Kaufmann 2005:184; Mallam 1982:60).

The mounds themselves may have fallen into disuse by the time the Oneota village sites were established, and the mounds themselves may or may not have been easily visible from Oneota sites. Nevertheless, the prominent placement of mounds would have made them important features on the daily landscape (Charles and Buikstra 2002:14). People give meaning to landscapes and landscapes give meaning to people (Howey 2012:15; Howey and Clark 2018:886; Richards-Rissetto 2017:11). Knowing that the mounds were there, and overlooking the landscape would be enough to trigger feelings of being watched. Kaufman (2005:38) suggests that mounds were built with the intention of looking out over the landscape and the people inhabiting it as a form of social control. The panopticon model, borrowed from Foucault, is a specific example of the belief that mounds were built for the ancestors to look out over the

living (Birmingham and Eisenberg 2001; Buikstra and Charles 1999; Miller 2015:48). This use of Foucault's panoptic model describes "the gaze" of the mounds and the influence that has on human behavior (Kaufmann 2005:38). Knowing that the mounds are present and observing each individual, people maintain or change their behavior to be culturally appropriate. In comparison to other mound types, such as Mississippian or Havana manifestations, Late Woodland Effigy mounds are not massive. However, they maintain a discrete omnipresence on the surface of the Earth and constantly observe those around it (Kaufmann 2005:188).

In this same vein, mounds also represent a physical manifestation of the ancestors (Howey 2012:28; Charles and Buikstra 2002:18–20). Knowing the mounds were there, people may have felt that they were being protected by the watchful eye of the ancestors or held accountable for their actions as the ancestors viewed them. However, mounds are not viewed as individuals, but as a contact point between the sacred and secular—set atop bluffs in a dual liminal space between the earth/sky and valley/uplands (Miller 2015:42–48). Mounds are not sacred because of burials—there are burials in mounds because they are sacred spaces (Bradley 2000; Charles and Buikstra 2022:20; Miller 2015:57). Mounds would be venerated by descendants even without burials (Miller 2015:2).

An example of mound veneration without burials is the Albert's site (47JE887) which is located 18km north of Lake Koshkonong. The site consists of a conical and linear mound on a ridge overlooking the Rock River. The conical mound was tested in 1968. An inconspicuous earthwork of less than 25 cm in height, it shows evidence of highly ritualistic construction. In the center of the mound, a large (19kg) boulder was found on top of a badly burned Havana-style vessel. No signs of mortuary ritual, bones, or grave features were identified within the

mound; however, clay and river gravel were in a layer underneath the vessel, which could point to an association with the Earth diver myth or a corporate affiliation. Radiocarbon dates from the deposits date between the Archaic, 2730 ± 70 B.P., and the Late Woodland, 960 ± 70 B.P. The calibrated ages of these dates, circa 890 B.C. to A.D. 1090, imply occupation and visitation to this persistent place over a long time period (Jeske 2006). While we do not know what the exact meaning of this site was for the people that built and used it, we can infer from the archaeological evidence that the Albert's Site was an important place that people returned to for generations, throughout social and cultural changes that cross archaeologically defined time periods (Jeske 2006:302).

Miller (2015) argues for an interpretation of mounds as a representation of community organization and risk management. The Earthmaker epic, as told by the Ho-Chunk people, tells of when the earth was placed, it constantly spun, and nothing could settle on the surface. Earthmaker then sent down brother water serpents to weigh the earth, but the Earth continued to spin. Earthmaker then scattered rocks on the surface of the Earth, which finally stopped Earth's spinning. The Earth is viewed as just as precarious as it was at the beginning of creation. Miller proposes that "mounds weight on Earth keeping that spot steady and safe" which in turn safeguards against uncertainty (Miller 2015:19–21). A great deal of energy and time went into building and maintaining mounds and can be directly linked to community organization and moral obligation to these sacred places (Knapp and Ashmore 1999:4; Miller 2015:13).

A variation of this epic is the Earth Diver myth. In the beginning the world was nothing but sea. An animal, varying across cultures, dives to the bottom of the sea and returns with a paw full of mud. This mud expands and forms the lands of the earth (Hall 1997:19). Early

excavations in Wisconsin identified the use of dark black, hydric soils taken from marshy and riverine areas and gray-white sands used in the construction of Effigy mounds (Hall 1997:18; Kaufmann 2005:37). Earlier Middle Woodland mounds located near Lake Koshkonong were encased in a dome of white clay while burials in a mound surrounding Lake Mendota in central Dane County had liquid white clay applied to their faces. These burials were drowning victims, believed to have been killed by the horned water serpent (Hall 1997:18–19). Ceremonial soils were also observed in the excavation of the mound at the Albert's Site underneath the burned and crushed Havana style vessel. This symbolic use of soil is believed to be both a connection to the Earth Diver myth as well as tied to the liminal nature of this mound site as a portal to other worlds.

The Potawatomi believed Lake Koshkonong was the home of the feared horned water serpent (Hall 1997:18–19). The horned water serpent (also known as a water spirit or underground water panther) is one of many creatures featured in Effigy mound symbolism. These creatures symbolize the dichotomy of upper world and lower world and are also present in Ho-Chunk clan organization (Kaufmann 2005:36). Water spirits represented the lower world and were the antithesis of the upper world thunderbird (Birmingham and Rosebrough 1982:22–24). Muck soils and white clay were used by mound builders to connect the living world with the water spirits of the lower world as Effigy mounds in thunderbird forms would connect to the upper world. The mounds then form not only a memory of the ancestors, but also connection with other worlds.

Visibility was not the most important factor in placing a settlement, it was simply part of the many competing goals that had to be weighed while also working under the constraints of

the physical environment. Not only would the Oneota be concerned about physical resources like agricultural land, water, or game available close to the settlement, but also with the defensibility of the location as well as its proximity to other groups. Visibility plays a part in both including defensive and cosmological needs. Defensibility is based on both what you can see from your settlement as well as who can see you. Not only would the Oneota be concerned about who was viewing them from habitation sites, but they would also be concerned whether or not they were being viewed by the mound sites. It is my belief that by analyzing the viewshed of both Oneota and surrounding sites, we may be able to glimpse into the reasoning behind settlement patterning during this period.

Chapter 5: Methods

Viewshed analysis was utilized to analyze spatial relationships between 65 sites, including Oneota, Effigy mound, Woodland mound, and Late Woodland habitations within the Lake Koshkonong locality (Table 1). These sites consisted of six Oneota sites (including the four village study sites), eight Effigy mound sites, twelve Woodland mound sites, 28 Late Woodland habitations, and eleven multicomponent sites consisting of five Late Woodland habitation/Effigy mound sites, and six Late Woodland habitation/Woodland mound sites. The goal of this research was to analyze the visual landscape of each Oneota village study site and understand what they could view as well as who could view them within the surrounding landscape. All data used in this research was collected from a variety of public sources, excluding the confidential archaeological site information.

Data

Digital Elevation Model (DEM) rasters, representing the bare surface of Earth, were downloaded from the U.S. Geologic Survey (USGS) website (USGS 2022). I had hoped to utilize LiDAR derived DEMs for this research because of their increased accuracy (1-3.4 meters per pixel), however these data are only available sporadically throughout the United States. The Study Area encompasses portions of Dane, Jefferson, and Rock counties in Wisconsin. The DEM data utilized for this research was derived from topographic maps and had an accuracy of 1/3 arc second or approximately 10 meters for each pixel. The satellite imagery was obtained from National Oceanic and Atmospheric Administration (NOAA) and is part of the National Aerial Imagery Program (NAIP) dating to 2018 (NOAA 2022). Shapefiles for Oneota village sites were provided by Dr. Richard Edwards from the University of Wisconsin-Milwaukee. Shapefiles for

waterways for the state of Wisconsin were downloaded from the Wisconsin Department of Natural Resources (WDNR 2022) and clipped to the Study Area.

Mound site locations were taken from Dillimuth (1999:123). These data were georeferenced to the 2018 NAIP aerial imagery and digitized into shapefiles using on-the-fly digitization. These shapefiles were then cross-referenced against spatial data in the Wisconsin

Table 1. Archaeological Sites included in Study

Site Name	Site Type	Period	Site Number	Burial Number
Johnson Group	Conical, Linear Mounds	Woodland Mound	47DA0039	47BDA0294
Fun Hunter's Point	Conical Mound	Woodland Mound	47JE0031	47BJE0134
Haight Creek Group	Conical Mounds	Woodland Mound	47JE0038	47BJE0137
Lookout Group	Conical, Linear Mounds	Woodland Mound	47JE0039	47BJE0138
Koshkonong Creek Mounds	Linear Mounds	Woodland Mound	47JE0081	47BJE0156
Loge Bay Mound Group	Conical Mounds	Woodland Mound	47JE0085	47BJE0157
Kirby Mound	Conical Mound	Woodland Mound	47JE0088	47BJE0158
Skavlem Mounds	Conical Mounds	Woodland Mound	47JE0114	47BJE0165
Koshkonong Creek A	Linear Mound	Woodland Mound	47JE0380	47BJE0190
Fulton Mound Group	Conical Mounds	Woodland Mound	47RO0042	47BRO0132
Koshkonong Creek Mounds/Twin Knolls Mounds	Conical Mounds	Woodland Mound	–	–
Carcajou Point Mounds	Conical Mounds	Woodland Mound	47JE0002	47BJE0019
Carcajou Point	Village	Oneota	47JE0002	47BJE0119
Crab Apple Point	Village	Oneota	47JE0093	47BJE0160
Koshkonong Creek Village	Village	Oneota	47JE0379	47BJE0263
Purnell	Likely Village	Oneota	47JE0815	–
Schmeling	Village or Cemetery Site	Oneota	47JE0833	47BJE0226
Crescent Bay Hunt Club	Village	Oneota	47JE0904	47BJE0201
Noe Springs Mound Group	Effigy, Conical, Linear Mounds	Late Woodland Habitation/Effigy Mound	47DA0004	47BDA0291
Koshkonong Mound Group	Effigy, Conical, Linear Mounds	Late Woodland Habitation/Effigy Mound	47DA0029	47BDA0292
General Atkinson Mound Group	Effigy, Conical, Linear Mounds	Late Woodland Habitation/Effigy Mound	47JE0003	47BJE0116
Tay-E-He-Dah Group	Effigy, Conical, Linear Mounds	Late Woodland Habitation/Effigy Mound	47RO0092	47BRO0144
Taylor House Mound Group	Effigy, Conical, Linear Mounds	Late Woodland Habitation/Effigy Mound	47RO0181	47BRO0095
Rufus "Bingham" Group	Conical, Linear Mounds	Late Woodland Habitation/Woodland Mound	47JE0096	47BJE0161

Ogden Mound Group	Conical Mounds	Late Woodland Habitation/Woodland Mound	47RO0179	47BRO0093
Ogden Mound Group I	Conical Mounds	Late Woodland Habitation/Woodland Mound	–	–
Thiebeau Point	Campsite/village; Garden; Mound	Late Woodland Habitation/Woodland Mound	47JE0030	47BJE0133
Sake Village	Campsite/village; Mound	Late Woodland Habitation/Woodland Mound	47JE0783	47BJE0192
Cooper's Shores/Rock River Group	Campsite/village; Mound; Burial	Late Woodland Habitation/Woodland Mound	47RO0002	47BRO0113
Shearer Farm I	Campsite/village	Late Woodland Habitation	47JE0775	–
High Ridge	Campsite/village; Burial	Late Woodland Habitation	47JE0785	47BJE0111
South End Site	Campsite/village	Late Woodland Habitation	47JE0786	–
Altpeter I Site	Campsite/village	Late Woodland Habitation	47JE0787	–
Altpeter IV Site	Campsite/village	Late Woodland Habitation	47JE0790	–
Anderson II	Campsite/village	Late Woodland Habitation	47JE0800	–
Zimmerman	Campsite/village	Late Woodland Habitation	47JE0802	–
Carcajou Point III	Campsite/village	Late Woodland Habitation	47JE0812	–
Rainy Knoll Site	Workshop site	Late Woodland Habitation	47JE0821	–
Carlson Site	Campsite/village	Late Woodland Habitation	47JE0826	–
Sake Site	Campsite/village	Late Woodland Habitation	47JE0829	–
Marsden Site	Campsite/village	Late Woodland Habitation	47JE0832	–
Meske Terrace	Campsite/village	Late Woodland Habitation	47JE0835	–
Hunn Farm	Campsite/village; Lithics	Late Woodland Habitation	47JE0838	–
Hershel Plue I	Campsite/village	Late Woodland Habitation	47JE0840	–
Punzel Site	Campsite/village	Late Woodland Habitation	47JE0856	–
Carlson Knoll	Campsite/village	Late Woodland Habitation	47JE0857	–
Carlson Creek II	Campsite/village	Late Woodland Habitation	47JE0860	–
Myrtle Site	Campsite/village	Late Woodland Habitation	47JE0861	–
Finch Site	Campsite/village; Burial	Late Woodland Habitation	47JE0902	47BJE0101
Park Parking	Campsite/village	Late Woodland Habitation	47JE0944	–
W.D. Hoard Site	Campsite/village	Late Woodland Habitation	47JE0945	–
Art Hoard Site	Campsite/village	Late Woodland Habitation	47JE0946	–
–	Campsite/village	Late Woodland Habitation	47JE1002	–
–	Campsite/village	Late Woodland Habitation	47JE1003	–
Van Altena	Campsite/village	Late Woodland Habitation	47RO0241	–
Shearer Farm II	Campsite/village	Late Woodland Habitation	47RO0301/ 47JE0776	–
Malwood I	Campsite/village	Late Woodland Habitation	47RO0303	–
North Mound Group	Effigy, Conical, Linear Mounds	Effigy Mound	47DA0028	47BDA0293
Hoard Mound Group	Effigy, Conical, Linear Mounds	Effigy Mound	47JE0033	47BJE0115

Ira "Bingham Group	Effigy, Conical, Linear Mounds	Effigy Mound	47JE0036	47BJE0136
Altpeter Mound Group	Effigy, Conical, Linear Mounds	Effigy Mound	47JE0079	47BJE0155
Draves Mound Group	Effigy, Conical Mounds	Effigy Mound	47JE0086	47BJE0117
Kumlien Mound Group	Effigy, Conical, Linear Mounds	Effigy Mound	47JE0091	47BJE0159
LeSellier Mound Group I	Effigy, Conical, Linear Mounds	Effigy Mound	–	–
LeSellier Mound Group II	Effigy, Conical, Linear Mounds	Effigy Mound	–	–

Historic Preservation Database (WHPD) records and additional information regarding site number, burial site number, and type of mound site was also obtained from the WHPD. Late Woodland habitations in the Lake Koshkonong vicinity were also identified in the WHPD and georeferenced in ArcMap using the same methods. Because of the lack of consistent or adequate data descriptions in many site descriptions, it is impossible in many cases to distinguish collared ware sites from non-collared ware sites, so all sites identified as Late Woodland in WHPD are used here as one data set.

The location of four mound sites included in Dillemuth's research could not be identified in the WHPD. These were: LeSellier I, LeSellier II, Ogden Mound Group I, and Koshkonong Creek Mounds (Twin Knolls Mounds). These sites were verified using Stout and Skavlem (1908 50; 58; 60; 78). As such, they do not have Smithsonian trinomials. Additionally, Hall 1962 was used to verify the location of the Carcajou Point III (JE-0812) site. All mound sites were divided into two categories: those with an Effigy mound component (Effigy mound sites), and those without, (Woodland mound sites). It is probable that many of these Woodland Mound sites are Effigy mounds, particularly linear mounds. However, with no sure way to distinguish Middle Woodland from Late Woodland conicals, it was decided to make the distinction between definitive Effigy mound sites and non-Effigy Woodland mound sites.

Methods

The first step in viewshed analysis is obtaining a DEM raster of the Study Area. DEM rasters consist of elevation information derived either from light detection and ranging (LiDAR) data or converted from topographic maps. Due to the location of the project area in relation to the spatial location of the DEM rasters, it was necessary to mosaic four DEM files together to obtain a comprehensive set of data that encompassed the entire Study Area. For the purposes of this research, each of the spatial datasets were transformed to the geographic coordinate system GCS_North_American_1983 and datum was NAD_North_American_1983. Using a set projection and coordinate system ensured all subsequent data to be uploaded into ArcMap would have consistent elevation and geospatial data.

The datasets from multiple counties created a challenge when attempting to create data resolution adequate for this research. In particular, when I mosaiced the elevation datasets for the Study area, the edges of these datasets were not perfectly aligned. This mis-match resulted in a small area without elevation data in the southwestern corner of Lake Koshkonong. This absence of data manifests itself as a small black line on the elevation maps. Viewshed rasters are based on this elevation data and this data gap influenced those results. While I could not change the data to incorporate this area, I took this knowledge into account during my interpretation of the data. The absence of data is interpreted by the computer as “0” or very low elevation and resulted in gaps in a majority of the viewsheds generated. I accounted for this gap in my analysis. Fortunately, it was contained within the lake and did not intersect with any mapped sites.

Viewshed Analysis

Viewshed analysis was conducted on all 65 archaeological sites within this study. The mapped locations for all of these sites were in the form of vector polygon shapefiles, however, viewshed analysis can only be conducted on point or line features. It was therefore necessary to convert the polygon site features into representative points. The first attempt at a viewshed analysis began by placing a point feature in the approximate center of each site polygon. I then ran the viewshed analysis for the four Oneota study sites using the *viewshed* tool within the Spatial Analyst toolbox. The "input raster" was the Elevation DEM file. The "input point or polyline observer feature" was the center point feature from each Oneota site. The "output raster" was the completed viewshed and a unique name was given to each viewshed. The remaining inputs, "output above ground level raster", "Z-factor", and "refractivity coefficient" were kept at their defaults. These parameters stayed consistent throughout each viewshed generation. The output resulted in a raster that showed the viewshed from the ground surface and assumed a landscape devoid of vegetation. While it is possible to incorporate vegetation data as well as data regarding palisades and other built structures, that is beyond the scope of this paper. My hope is that this data is a starting point to a more nuanced analysis of visual relationship in the Lake Koshkonong locality.

Analyzing the initial viewsheds, I realized that the center point technique had a flaw in the vector data. Using a single point feature in the middle of each site missed part of that site in the viewshed, which resulted in an inaccurate raster. Enhancing the vector data would ultimately enhance the quality of the output viewshed raster, so I transformed the polygon data into a series of point data using the *feature vertices to points* tool in the Data Management

toolbox. This change yielded a *series* of points at each vertex of the polygon. The final number of vertices for Oneota study sites ranged from 18 to 33; KCV was an outliner with 201 vertices. By deleting redundant points and those located on straight line segments, I pared this down to a more reasonable 46 vertices. The mound sites and Late Woodland habitations were generally smaller and less geometrically complex than Oneota village sites and the number of vertices for these sites ranged from 3 to 15. Each step of this process was done manually, however, in retrospect, the utilization of a model builder would have been more efficient while yielding the same results.

I then ran a viewshed analysis using these series of points. The program automatically combined the viewshed from each point into a collective viewshed for each site which created a problem. Because there were multiple vertices, each was assigned a sequential number in the attribute table connected to the viewshed analysis of each vertex. While the computer was able to recognize that all positive numbers in the raster were visible, it did not recognize that it was all part of the same viewshed. Each point only showed what was visible from that singular vertex, which proved to be a problem when quantifying the data as I could not apply a filter that showed how viewed certain cells were than others. I sought to rectify this by converting each raster into a true binary raster with all visible cells being labeled with a 1 and non-visible cells labeled as 0 (Figure 12). This technique created a way for me to show how often certain raster cells were viewed by particular categories. The break points of the natural jenks are shown in Table 2.

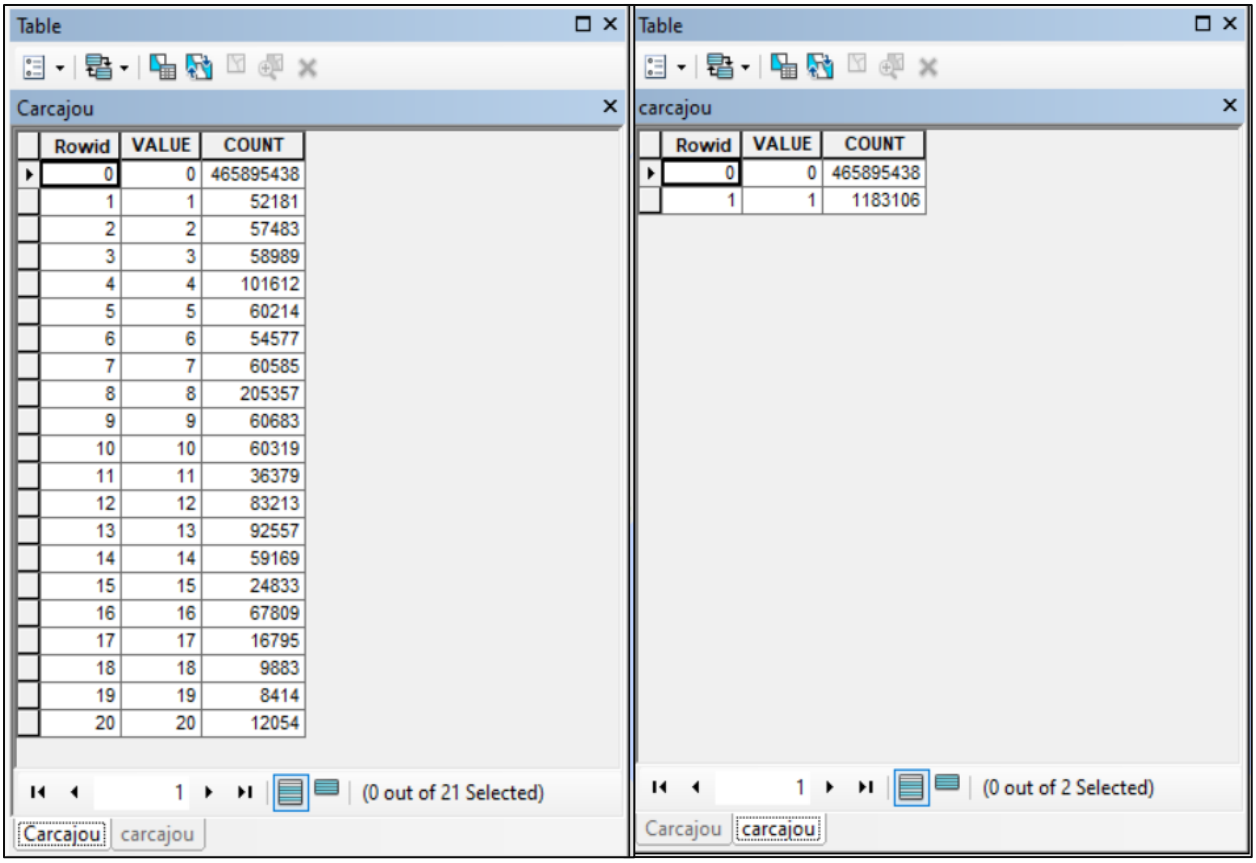

Figure 12. Attribute Table before conditional statement (left) and after (right).

This result was accomplished by using a conditional statement within the raster calculator to translate all cells greater than 1 to be labeled as 1 and was done for all subsets—Oneota village sites, mound sites, and Late Woodland habitations.

Example of the conditional statement: Con("raster_name" > 1,1,"raster_name")

After the binary raster were created, cell statistics were utilized for each subset, and an overlay statistic of sum was used to determine the areas with the highest density of viewsheds for each subset. The densities were then broken into three classes using natural jenks to determine the break points.

Table 2: Generalized Viewshed Divisions by Natural Jenks

Site Category	Division	Number of Sites (#)	Rounded Percentage (%)
Oneota	High Visibility	3-4	50-100
	Medium Visibility	2	25-50
	Low Visibility	1	1-25
	No Visibility	0	0
Late Woodland Habitations	High Visibility	22-37	60-100
	Medium Visibility	11-22	30-60
	Low Visibility	3-11	1-30
	No Visibility	0	0
Woodland Mounds	High Visibility	8-14	60-100
	Medium Visibility	4-8	30-60
	Low Visibility	1-4	1-30
	No Visibility	0	0
Effigy Mounds	High Visibility	9-13	70-100
	Medium Visibility	5-9	40-70
	Low Visibility	1-5	1-40
	No Visibility	0	0

Each of the 65 individual viewsheds from Oneota, Effigy mounds, Woodland mounds, and Late Woodland habitations were analyzed to determine if they were visible from or to Oneota sites. This analysis was done to determine the degree of intervisibility within the Lake Koshkonong site localities. One of the drawbacks of viewshed analysis is that it does not take into account the curvature of the earth and the distance an average human can view across a clear horizon, about 3 miles (ESRI 2019). To correct for this limitation, a 5-kilometer (3.1 mile) buffer surrounding each Oneota site was applied to the viewshed results and any sites that had been determined to be visible but fell outside of this buffer were eliminated from analysis.

Chapter 6: Results

The sample of 65 archaeological sites was analyzed in ArcMap 10.8.1 using methods outlined in Chapter 5. The analysis of the data consisted of two parts. First, the archaeological sites were divided by temporal affiliation into four groups: Oneota, Late Woodland habitation, Effigy mound, and Woodland mound sites. For each group, individual site viewsheds were combined into a heat map to show areas with the greatest concentration of visibility from each temporal group. The outputs included: no visibility, low visibility, medium visibility, and high visibility. The data from each temporal group was divided by Natural Jenks, so the discrepancy in number of sites in each group would not skew the results of the mapping.

The second part of my analysis consisted of determining the intervisibility of the four Oneota village study sites. Both of these data sets were then used to answer my three research questions: 1) What sites are encompassed and excluded from Oneota site viewsheds? 2) What is the visual relationship between mounds and Oneota sites? 3) What is the visual relationship between Late Woodland habitations and Oneota village sites?

Question 1: What sites are encompassed and excluded from Oneota Site Viewsheds?

The general visibility of Oneota sites is much more tightly bound to the center of Lake Koshkonong (Figure 13). This is due to all Oneota sites being located within a small area on the northwest portion of the lake. This sentiment is echoed by Richards and Jeske (2002:39) who describe the Oneota occupation of this region as a "spatially restricted…dense cluster of sites". There is a focus of the central and southeastern portions of Lake Koshkonong, surrounded by bands of medium and low visibility within the boundaries of the lake. However, once the lake shore ends, visibility drops off dramatically, and while some portions in the southern and

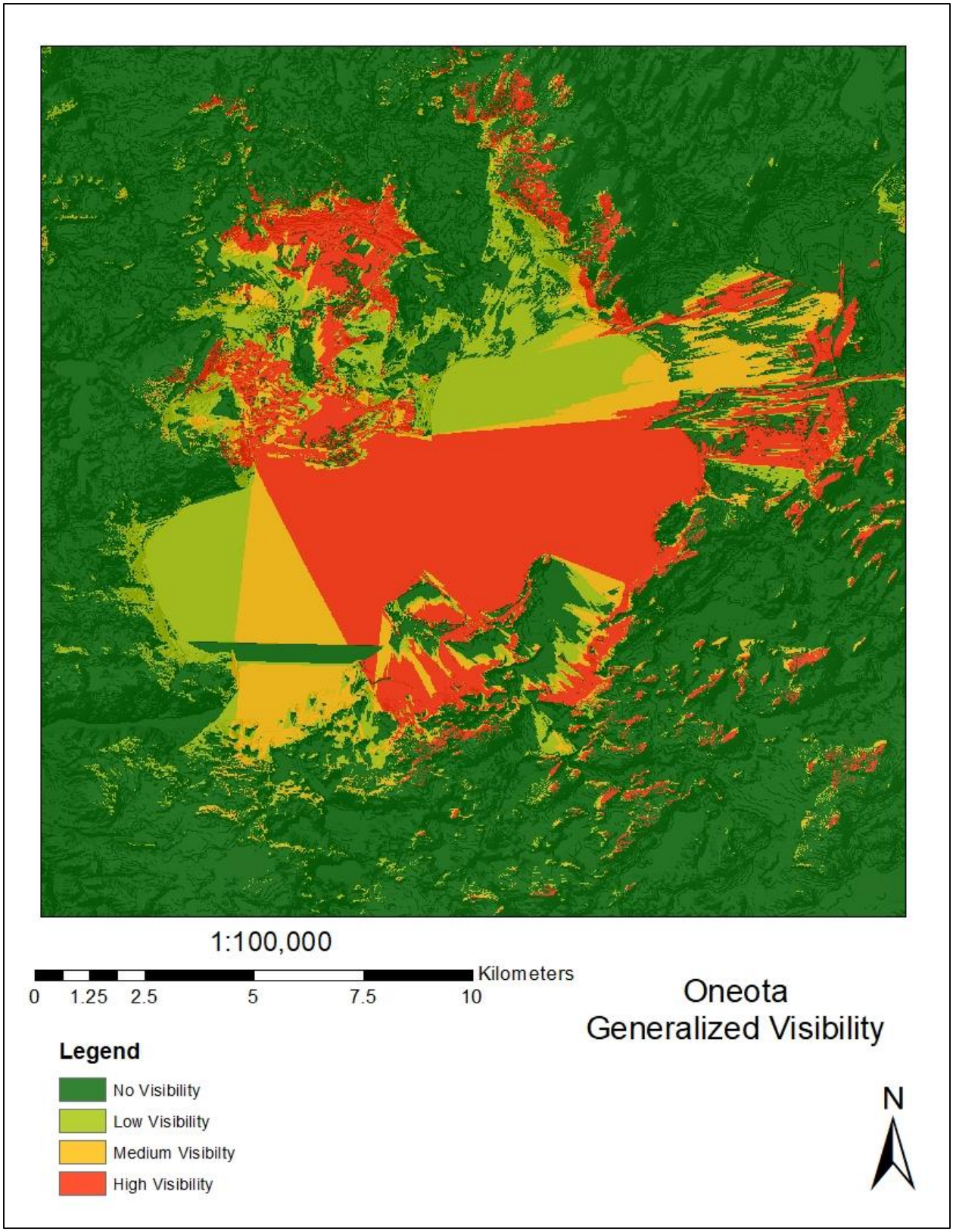

Figure 13. Generalized Oneota Site Visibility

eastern shores have areas of medium and high visibility, the western shore is not visible from any of the Oneota village sites even though they are spatially close. Additionally, the watershed of Koshkonong Creek is nearly all high visibility from Oneota sites as is a ridge to the north of the western bend of the creek. Mud Lake is within a medium visibility of Oneota sites, while ridges to the north and south of Mud Lake have high visibility.

Carcajou Point

Carcajou Point has the largest number of sites located within the 5 km buffer of the project boundary (Figure 14, Table 3), likely due to both its size and proximity to the edge of Lake Koshkonong. Eighty percent of the other Oneota sites are at least partially visible from Carcajou Point. KCV is the only Oneota site that is not visible. Of these four sites, three have reciprocal visibility. The only outlier is Purnell, which can be seen from Carcajou Point, but cannot see Carcajou Point. Four Effigy mound sites are visible from Carcajou Point. These are Altpeter Mound Group, Draves Mounds, Hoard Mound Group, and Ira "Bingham" Mound Group; slightly more than half of the seven Effigy mound sites within the 5 km buffer. These numbers are nearly identical for Woodland mound sites. Nine are located within the buffer and only five are visible Carcajou Point resulting in 55.6% visibility for Woodland mound sites. The group with the greatest number of sites in the study are Late Woodland habitations. There are a total of 25 sites within the 5 km buffer and 19, or 76%, are visible from Carcajou Point. There are also four multi-component sites within the 5 km buffer, one Late Woodland/Effigy mound site, General Atkinson Mound Group, and three Late Woodland/Woodland mound sites, the Rufus "Bingham" Group, Thiebeau Point, and Sake Village. Carcajou Point can view all but the Rufus "Bingham" Group.

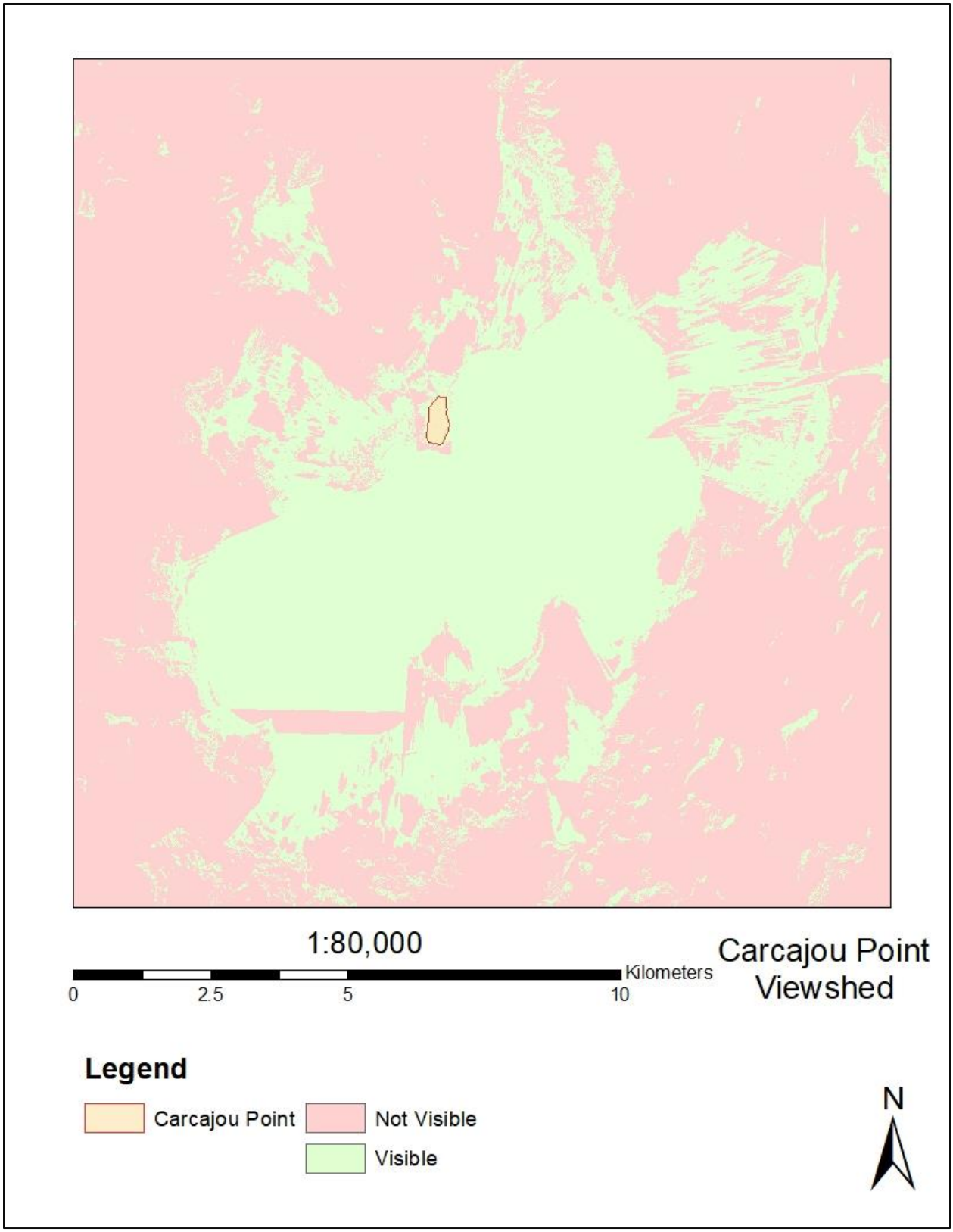

Figure 14. Carcajou Point Viewshed

Table 3. Sites visible to and from Carcajou Point within 5 km Buffer

Site Name	Type	Sites Visible from Carcajou Point	Sites with Visibility of Carcajou Point
Altpeter Mound Group	Effigy Mound	Partial	Full
Draves Mound Group	Effigy Mound	Partial	Partial
Hoard Mound Group	Effigy Mound	Partial	Full
Ira "Bingham" Group	Effigy Mound	Partial	Partial
Kumlien Mounds**	Effigy Mound	Full	Full
Altpeter I Site	Late Woodland Habitation	Full	Partial
Altpeter IV Site	Late Woodland Habitation	Full	Partial
Art Hoard Site	Late Woodland Habitation	None	Full
Carcajou Point III	Late Woodland Habitation	Partial	Partial
Carlson Creek	Late Woodland Habitation	Full	None
Carlson Knoll	Late Woodland Habitation	Partial	None
Carlson Site	Late Woodland Habitation	Partial	None
Hershel Plue I	Late Woodland Habitation	Partial	Partial
High Ridge Site	Late Woodland Habitation	Full	Partial
Hunn Farm	Late Woodland Habitation	Partial	None
Marsden Site	Late Woodland Habitation	Partial	Partial
Meske Terrace	Late Woodland Habitation	Full	Full
Park Parking	Late Woodland Habitation	Partial	Full
Rainy Knoll Site	Late Woodland Habitation	Full	Partial
Sake Site	Late Woodland Habitation	Full	Partial
Shearer Farm I	Late Woodland Habitation	Full	Partial
Shearer Farm II	Late Woodland Habitation	Partial	Partial
South End Site	Late Woodland Habitation	Full	Partial
W.D. Hoard Site	Late Woodland Habitation	Partial	Full
Zimmerman	Late Woodland Habitation	Full	Full
General Atkinson Mound Group	Late Woodland Habitation/ Effigy Mound	Partial	Full
Thiebeau Point	Late Woodland Habitation/ Woodland Mound	Partial	None
Sake Village	Late Woodland Habitation/ Woodland Mound	Partial	Partial
Carcajou Point Mounds	Woodland Mound	Full	Full
Kirby Mound	Woodland Mound	Full	None
Koshkonong Creek Mounds	Woodland Mound	Partial	None
Koshkonong Creek Mounds/Twin Knolls Mounds	Woodland Mound	None	Partial
Loge Bay Mound Group	Woodland Mound	Partial	Partial
Skavlem Mounds	Woodland Mound	Full	None
Crab Apple Point	Oneota	Partial	Partial
Crescent Bay Hunt Club	Oneota	Full	Partial
Purnell	Oneota	Full	None
Schmeling	Oneota	Partial	Partial

*Shading Indicates Reciprocal Visibility

** From 1-meter DEM analysis

Although Carcajou Point has a fairly large viewshed, it is primarily composed of the waters of Lake Koshkonong. Even if we do not take into account the curvature of the earth and the distance decay, on the eastern and western banks Carcajou Point cannot view very far past the shoreline. Interestingly, several Late Woodland habitation/Effigy mound sites are located on the southwestern side of Lake Koshkonong—just out of view of Carcajou Point.

Koshkonong Creek Village

KCV is slightly more isolated on the landscape than the other Oneota village sites. While the other sites had between 36–49 sites within their 5 km buffer, KCV only had 28 (Figure 15, Table 4). All five Oneota sites are within the 5 km buffer and only three of these sites, Crab Apple Point, CBHC, and Schmeling, are visible from KCV. However, all three of these sites have reciprocal visibility. While Carcajou Point and Purnell cannot be seen from KCV, neither can they view Koshkonong Creek Village. Although there are four Effigy mound sites within the 5 km buffer, only one is visible from KCV, Kumlien Mounds. Kumlien will be discussed in more detail below. There are a total of eight Woodland mound sites located within the 5 km buffer of Koshkonong Creek, and 50% are visible from KCV. There are 11 Late Woodland habitations within 5 km of KCV, but only four or 36.4%, can be viewed by KCV. One multicomponent site is within the buffer, the Rufus “Bingham” Group, however it is not visible from KCV.

Because of its differential placement in the upland area further to the north when compared to the other Oneota village sites in this study, the viewshed from KCV is unique. The viewshed encompasses the Koshkonong Creek watershed as it flows east, bends and flows south toward Lake Koshkonong. Due to its placement, the viewshed does not cross over the ridges on either the east or west sides of the Koshkonong Creek watershed and funnels when it

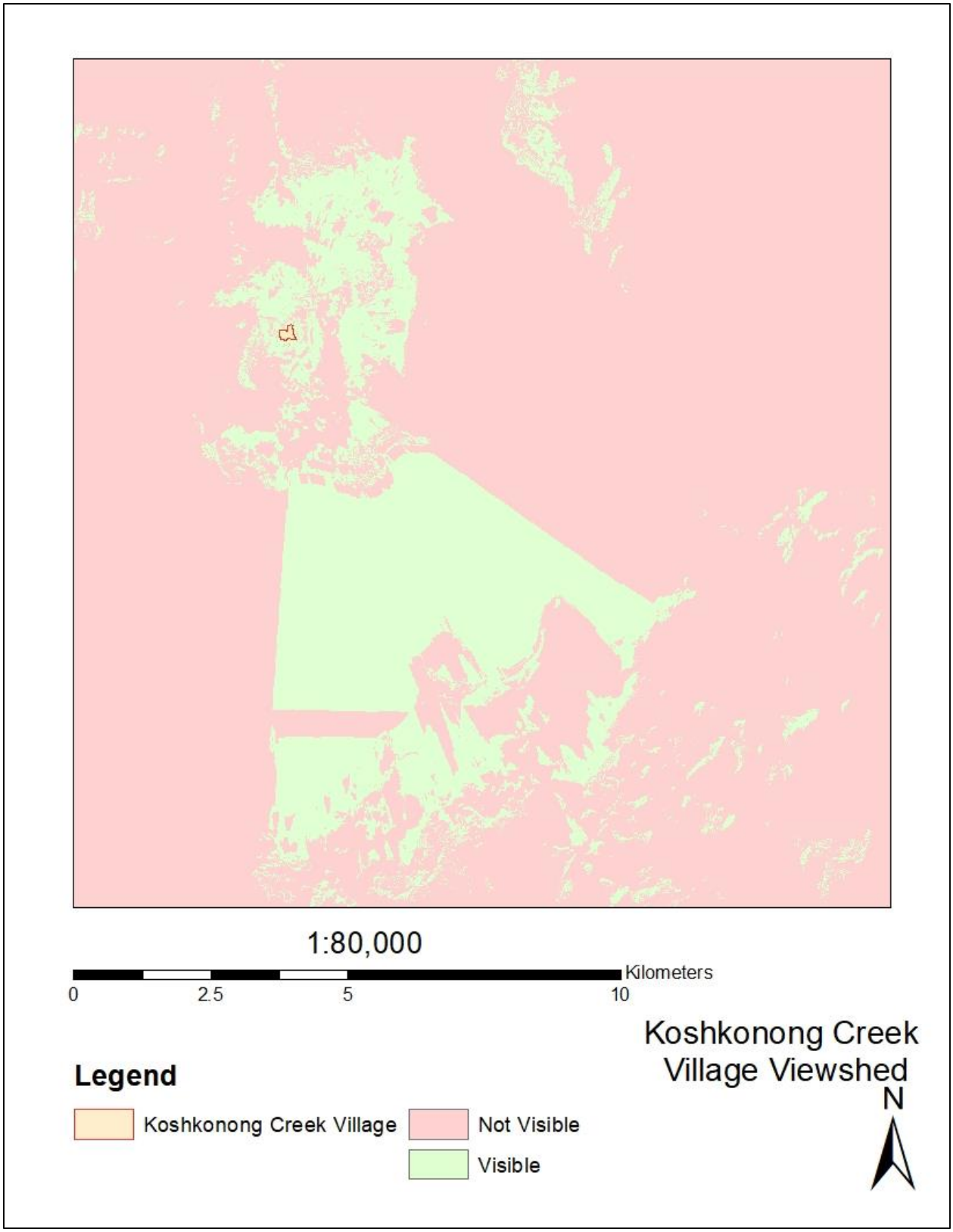

Figure 15. Koshkonong Creek Village Viewshed

reaches the open lake but does not have much visibility of the lake until the earth curves. Due to this placement, most sites within KCV's viewshed are within the upland region as well. It is notable that very few Late Woodland habitations are visible from KCV and the majority of more densely concentrated mound sites located on the east and west banks of Lake Koshkonong are far outside of KCV's viewshed.

Table 4. Sites visible to and from Koshkonong Creek Village within 5 km Buffer

Site Name	Type	Sites Visible from KCV	Sites with Visibility of KCV
Carlson Site	Late Woodland Habitation	Full	Partial
Marsden Site	Late Woodland Habitation	Partial	Partial
Myrtle Site	Late Woodland Habitation	Partial	Full
Punzel Site	Late Woodland Habitation	Partial	Partial
Kirby Mound	Woodland Mound	Partial	None
Koshkonong Creek Mounds	Woodland Mound	Partial	Partial
Koshkonong Creek Mounds/Twin Knolls Mounds	Woodland Mound	Partial	Partial
Skavlem Mounds	Woodland Mound	Partial	None
Crab Apple Point	Oneota	Partial	Partial
Crescent Bay Hunt Club	Oneota	Partial	Partial
Schmeling	Oneota	Partial	Partial
Kumlien Mounds**	Effigy Mound	Full	Full

*Shading Indicates Reciprocal Visibility
** From 1-meter DEM analysis

Kumlien Mound Group

One of the main concerns about the results of this analysis was that it determined that no Effigy mound sites were visible from KCV. However, first-hand accounts of visibility from the site indicate that the mounds are visible from the site (Jeske 2020:107). To analyze this problem, I re-ran the viewshed from KCV utilizing LiDAR derived DEM's and set the height to 5 feet above the ground to account for a human observer. I was specifically looking at the relationship between KCV and Kumlien Mound Group. Because the elevation data was derived from LiDAR, I was able to accurately pinpoint the true location of the Kumlien Mound Group

(Figure 16). I was then able to compare this location with the mapped locations from the WHPD as well as Dillemuth 1999 (Figure 17).

The results indicate that Kumlien Mound Group is visible from KCV despite the results of the initial viewshed analysis. Where my original analysis failed was in the placement of shapefiles. The actual location of Kumlien was on the eastern ridge and the georeferenced shapefile from Dillemuth showed the location of the mound group as being further upland in an adjacent agricultural field. There are several points in the process that may have introduced error. The map from Dillemuth may have been incorrect or did not have enough detail to transfer over without introducing error. Additionally, there is always a small bit of error when choosing control points during georeferencing, however, this is unlikely to have been the culprit in this instance.

The 1-meter DEM produced a viewshed analysis with much smoother and more uniform results. There is less room for interpretation errors when the results are not pixelated because the contours of the 1-meter DEM are more subtle than the 10-meter DEM. When derived from topographic maps, the elevation contours of the 1-meter DEM are less abrupt. In Figure 18, the difference between the amount of area determined to be visible is greatly reduced for the 1-meter DEM and it is much closer to reality. Additionally, the LiDAR derived DEM allowed me to see the location of each of the mounds in the Kumlien mound group and more accurately locate the site boundaries more accurately than the WHPD or Dillemuth. Ultimately, this allowed me to see that Kumlien mounds was visible from all six of the Oneota sites in this study.

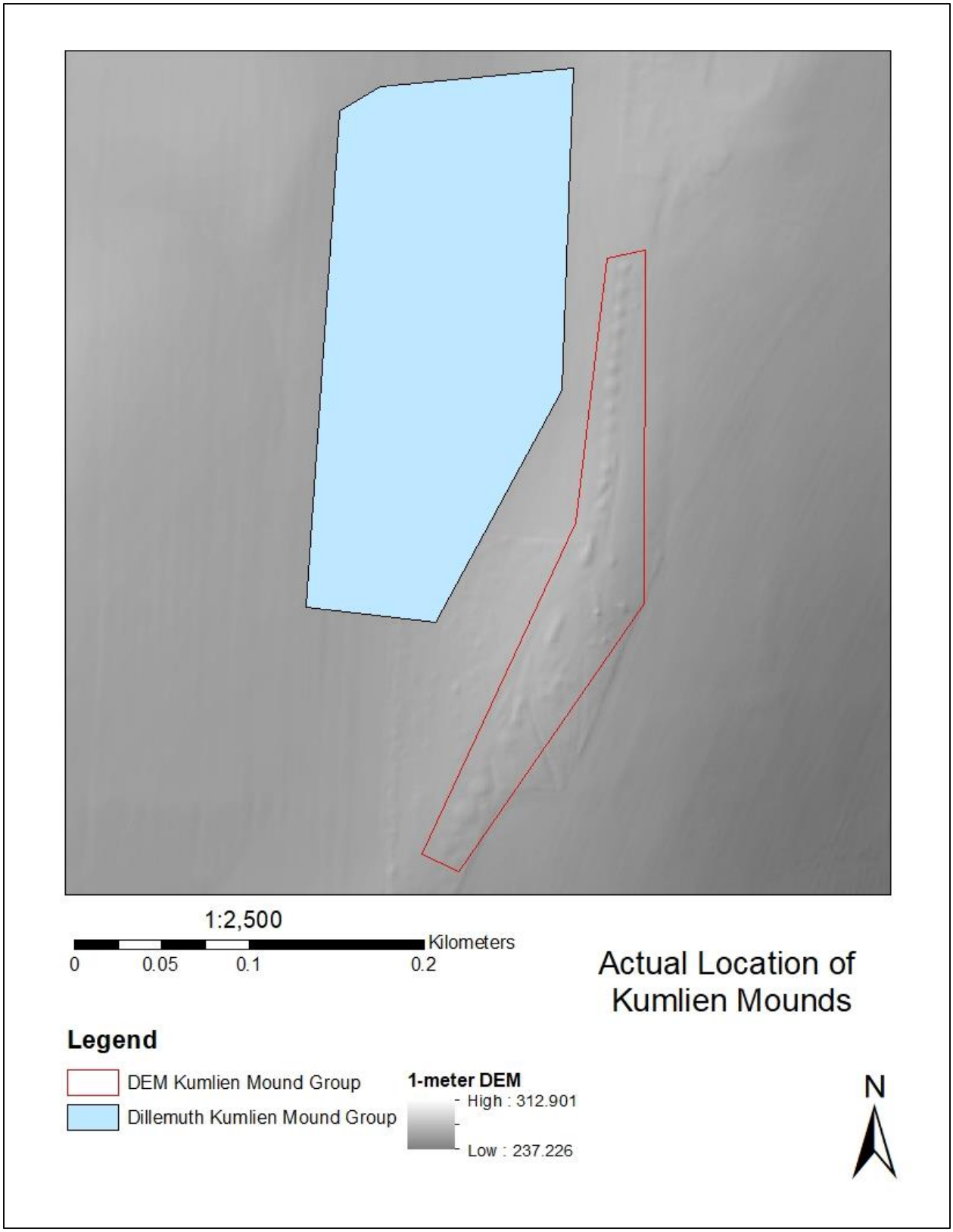

Figure 16. Actual Location of Kumlien Mound Group

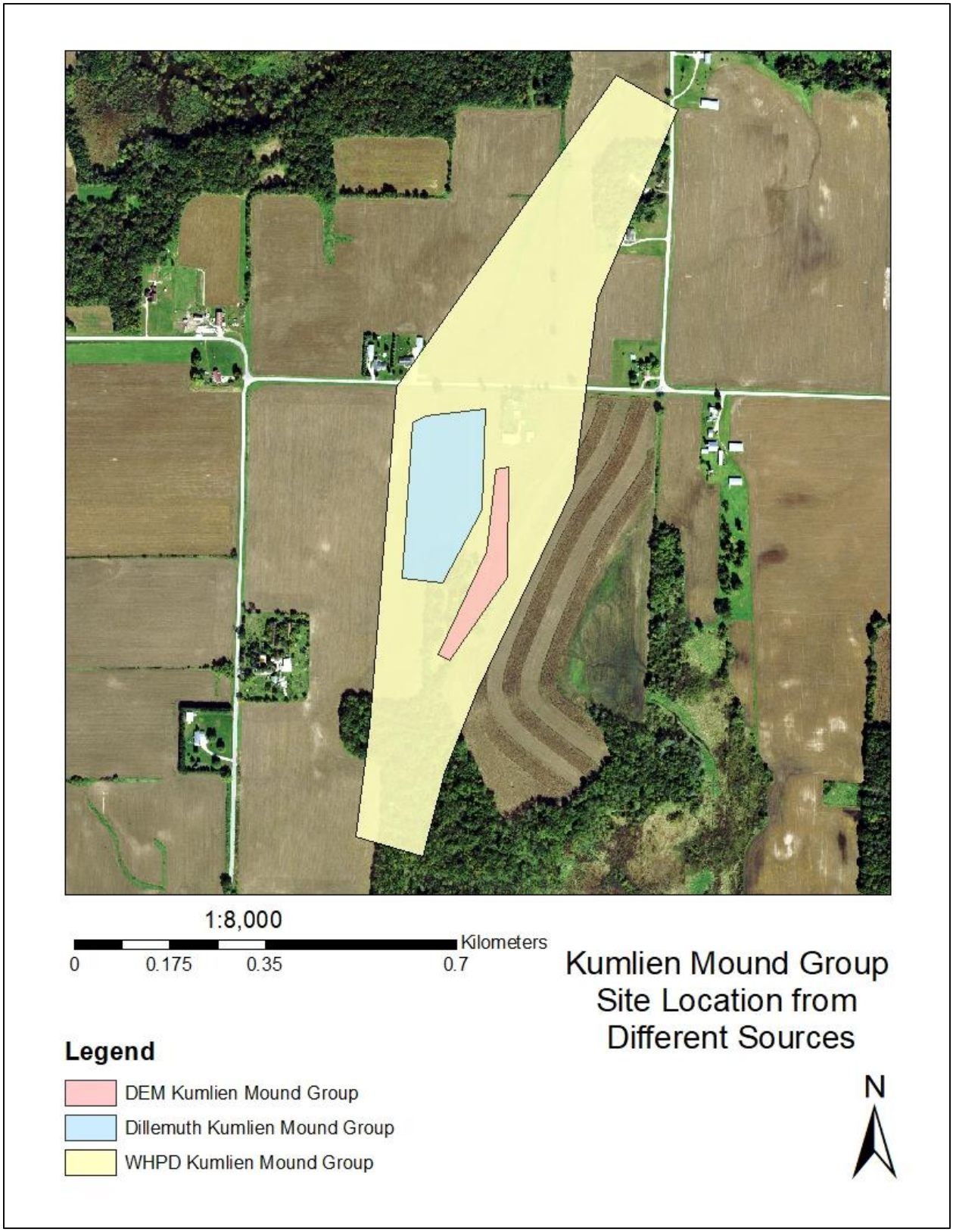

Figure 17. Discrepencies between Different Sources of Spatial Data

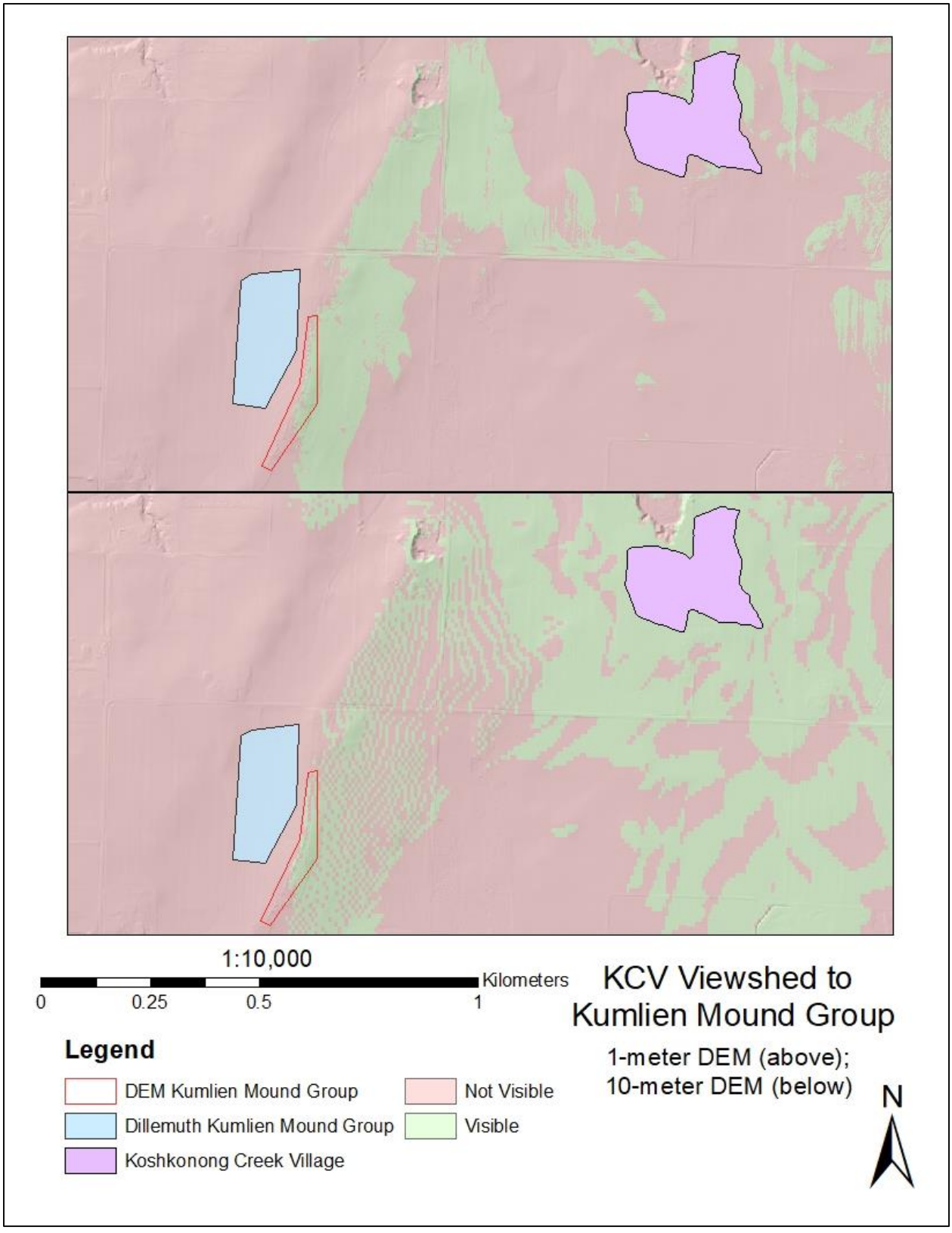

Figure 18. Comparison of the viewshed of 1-meter DEM to 10-meter DEM

Crescent Bay Hunt Club

All five Oneota period sites have reciprocal visibility with CBHC (Figure 19, Table 5). However, each of these sites has only a partial view of CBHC, while CBHC has a full view of both Purnell and Schmeling and a partial view of KCV, Crab Apple Point, and Carcajou Point. There are a total of five Effigy mound sites within the 5 km buffer surrounding CBHC and one, Draves Mound Group, is able to be viewed from CBHC, constituting 20.0%. The ratio doubles for Woodland mound sites, as 40% of the sites within the buffer are visible from CBHC. There is a total of eleven Late Woodland habitations within 5 km of CBHC, seven of these, 63.6%, are within the viewshed of CBHC. There are six multi-component sites, four Late Woodland habitation/Effigy mound and two Late Woodland habitation/Woodland mound sites within the 5 km buffer, however, only one of these, Thiebeau Point, is visible from CBHC.

Similar to the viewshed from KCV, CBHC is constrained by the glacial ridges that bound the Koshkonong Creek watershed. This enables CBHC to have a relatively clear view towards the uplands and several non- Effigy mound sites. Additionally, because it is located much further south than KCV, CBHC has visibility across Lake Koshkonong to Thiebeau Point. However, the entirety of the western and northeast portions of the lake are not visible at all. This shields CBHC from viewing or being viewed by Late Woodland habitation/Effigy mounds on the western edge of the lake.

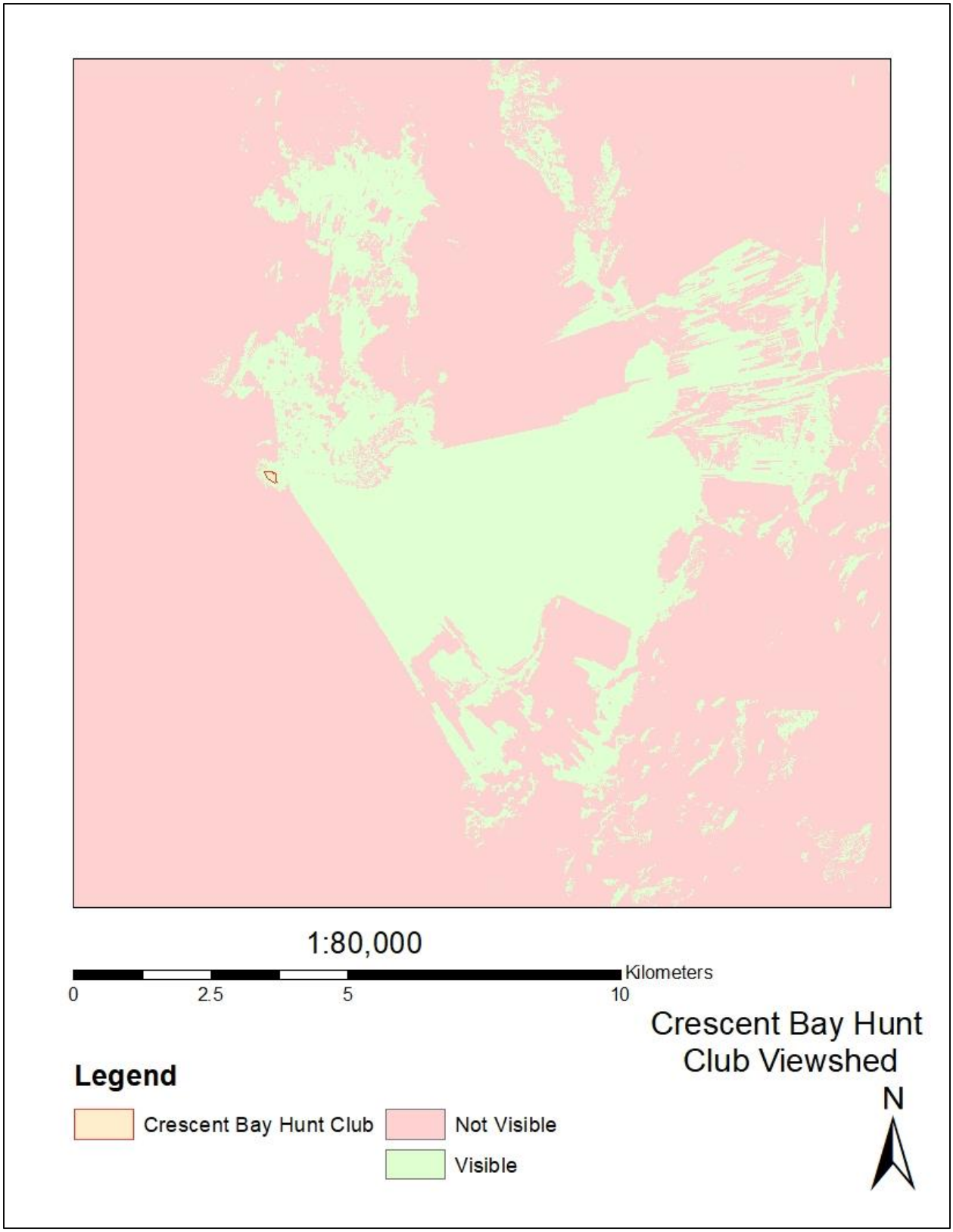

Figure 19. Crescent Bay Hunt Club Viewshed

Table 5. Sites visible to and from Crescent Bay Hunt Club within 5 km Buffer

Site Name	Type	Sites Visible from CBHC	Sites with Visibility of CBHC
Draves Mound Group	Effigy Mound	Full	Full
Kumlien Mounds**	Effigy Mound	Full	Full
47JE1002	Late Woodland Habitation	Full	None
47JE1003	Late Woodland Habitation	Partial	None
Carcajou III	Late Woodland Habitation	Partial	Partial
Carlson Creek II	Late Woodland Habitation	Full	Partial
Carlson Knoll	Late Woodland Habitation	Full	Partial
Hunn Farm	Late Woodland Habitation	Full	Partial
Marsden Site	Late Woodland Habitation	Partial	Partial
Myrtle Site	Late Woodland Habitation	Partial	Full
Punzel Site	Late Woodland Habitation	None	Partial
Thiebeau Point	Late Woodland Habitation/ Woodland Mound	Partial	None
Carcajou Point Mounds	Woodland Mound	Partial	Partial
Kirby Mound	Woodland Mound	Full	Partial
Koshkonong Creek Mounds/Twin Knolls Mounds	Woodland Mound	None	Partial
Loge Bay Mound Group	Woodland Mound	Partial	Partial
Skavlem Mounds	Woodland Mound	Full	Partial
Carcajou Point	Oneota	Partial	Partial
Crab Apple Point	Oneota	Partial	Partial
Koshkonong Creek Village	Oneota	Partial	Partial
Purnell	Oneota	Full	Partial
Schmeling	Oneota	Full	Partial

*Shading Indicates Reciprocal Visibility

** From 1-meter DEM analysis

Schmeling

Due to its close proximity to CBHC, Schmeling has a similar number of sites that it has visibility to, however it does vary slightly (Figure 20, Table 6). All five Oneota sites within the study area have reciprocal visibility with Schmeling. Only 20% of Effigy mound sites within the buffer can be seen from Schmeling. Four Woodland mound sites are visible from Schmeling, constituting 40% of Woodland mound sites in the 5 km buffer, however, like the Effigy mound

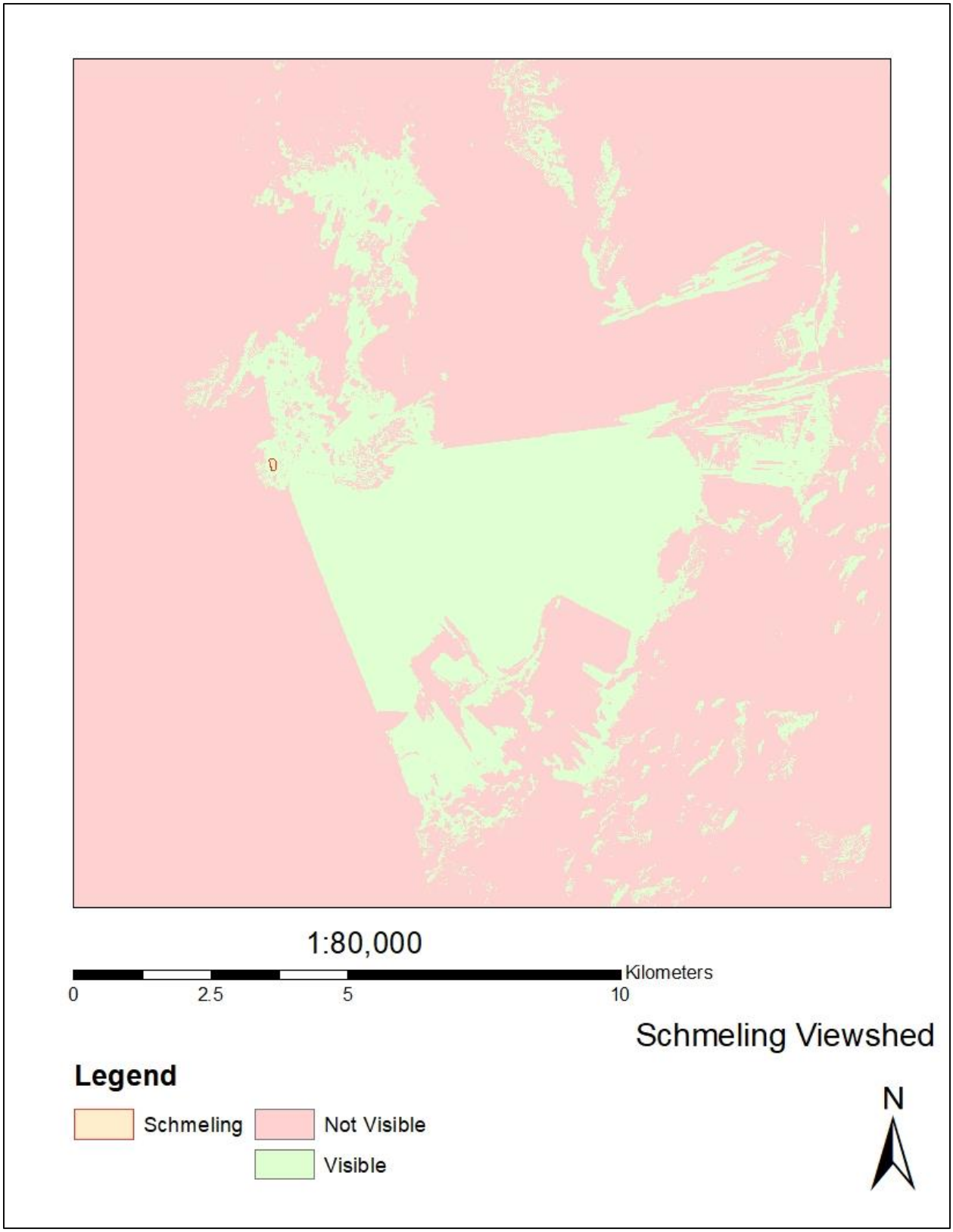

Figure 20. Schmeling Viewshed

sites, all four of these sites have reciprocal visibility with Schmeling. There are a total of eleven Late Woodland habitations within 5 km of Schmeling, nine of which are visible from the Schmeling site. The same six multi-component sites within the buffer of CBHC are also within the Schmeling buffer, however like Crescent Bay, only Thiebeau Point is visible from Schmeling. As Schmeling and CBHC have nearly identical viewsheds due to their proximity, the same sites that are outside of CBHC's viewshed are also out of Schmeling's. Including the entirety of the western and northeast portions of Lake Koshkonong. The difference between these two sites is that Schmeling has reciprocal visibility with all of the sites that someone would be able to view within the 5 km buffer.

Table 6. Sites visible to and from Schmeling within 5 km Buffer

Site Name	Type	Sites Visible from Schmeling	Sites with Visibility of Schmeling
Draves Mound Group	Effigy Mound	Full	Partial
Kumlien Mounds**	Effigy Mound	Full	Full
47JE1002	Late Woodland Habitation	Full	Partial
47JE1003	Late Woodland Habitation	Full	Partial
Carcajou III	Late Woodland Habitation	Partial	Partial
Carlson Creek II	Late Woodland Habitation	Full	Partial
Carlson Knoll	Late Woodland Habitation	Full	Partial
Hunn Farm	Late Woodland Habitation	Full	Partial
Marsden Site	Late Woodland Habitation	Partial	Partial
Myrtle Site	Late Woodland Habitation	Partial	Full
Punzel Site	Late Woodland Habitation	None	Partial
Thiebeau Point	Late Woodland Habitation/ Woodland Mound	Partial	Partial
Carcajou Point Mounds	Woodland Mound	Partial	Partial
Kirby Mound	Woodland Mound	Full	Partial
Loge Bay Mound Group	Woodland Mound	Partial	Partial
Skavlem Mounds	Woodland Mound	Full	Partial
Carcajou Point	Oneota	Partial	Partial
Crab Apple Point	Oneota	Partial	Full
Crescent Bay Hunt Club	Oneota	Full	Partial
Koshkonong Creek Village	Oneota	Partial	Partial
Purnell	Oneota	Full	Partial

*Shading Indicates Reciprocal Visibility

** From 1-meter DEM analysis

Additional Oneota Sites

The Purnell and Crab Apple Point sites also fit into the spatial pattern of visibility discussed above. Crab Apple Point is located directly south of both the CBHC and Schmeling sites meaning that also has reciprocal visibility with all of the Oneota sites. This is not true for Purnell, and due to its location, has more restricted visibility. Carcajou Point and KCV are outside of Purnell's viewshed. Due to its slightly higher elevation, Carcajou Point can view Purnell, whereas KCV and Purnell cannot view one another.

Question 2: What is the Visual Relationship between Mound Sites and Oneota Sites?

Effigy Mound Sites

The majority of Lake Koshkonong is designated as high visibility from Effigy mounds sites (Figure 21). This means that between 70-100% of the Effigy mounds sites in the study area can see this portion of the lake. This correlates with the results from the Effigy mound viewshed conducted by Dillemuth (1999). Only the northeast and southwest portions of the lake are medium visibility. Areas of medium visibility include the mouth of Koshkonong Creek as it enters Lake Koshkonong and the area of land south of Thieubeau Point. Before Euro-American development was this area was a marsh (Dillemuth 1999:125). These areas are both also medium visibility from Effigy mound sites. Areas of land immediately surrounding Lake Koshkonong consist primarily of low visibility areas which quickly taper off into no visibility further on land. Mud Lake also has medium/low visibility from Effigy mound sites as does the confluence of the Rock River and Lake Koshkonong. This indicates that the Rock River was not the central focus of these sites with visibility centering on the lake more than surrounding waterbodies.

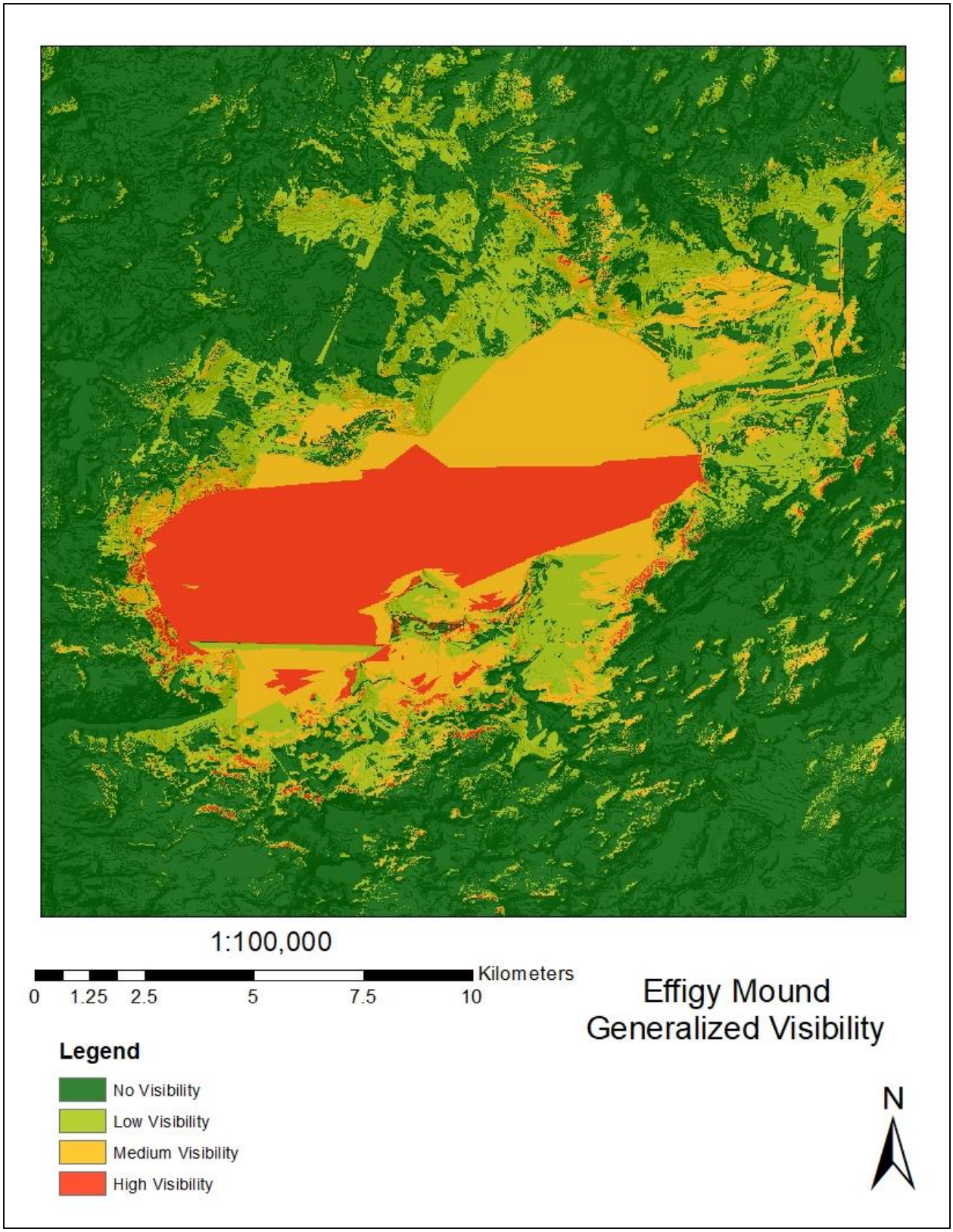

Figure 21. Generalized Effigy Mound Site Visibility

The number of Effigy mound sites within 5 km of Oneota villages sites ranges from four at KCV, five at CBHC and Schmeling, to seven at Carcajou Point. The visibility of Oneota sites from Effigy mound sites is not great, likely stemming from the location of these sites (Figure 22). While there are Effigy mound sites within the same area as Oneota sites, they are not directly adjacent to one another. Only Kumlien Mounds can view KCV even though there are four within the buffer. Draves Mound group is the only Effigy mound site that includes CBHC and Schmeling in its viewshed. Carcajou Point is visible from the greatest number of Effigy mound sites, four, or 57.1% of those within the buffer. However, there is an interesting pattern with the sites that do have a viewshed of Oneota villages. They all have reciprocal visibility, that is if someone at an Effigy mound site can see an Oneota village, then people at that Oneota village will also be able to view that Effigy mound site. This pattern continues with Late Woodland habitation/Effigy mound sites. Carcajou Point is the only Oneota site that is visible from a Late Woodland habitation/Effigy mound site, General Atkinson Mound Group. Like the Effigy mound sites discussed above, there is reciprocal visibility between these two sites.

Woodland Mound Sites

Of all the temporal groups, Woodland mound sites have the smallest amount of high visibility on Lake Koshkonong (Figure 23). The high visibility is focused only on the central portion of the lake as well as Bingham's Bay and a small portion of Haight's Bay in the southern portion of the lake. The remainder of the lake is within medium visibility with the exceptions of the southwesterly most point of the lake as it feeds back into the Rock River which is low visibility and the mouth of Koshkonong Creek which is medium/high visibility. Mud Lake is within medium visibility area. Like Effigy mound sites, Woodland mounds have low visibility on areas immediately surrounding Lake Koshkonong as well as no indication of a focus on the

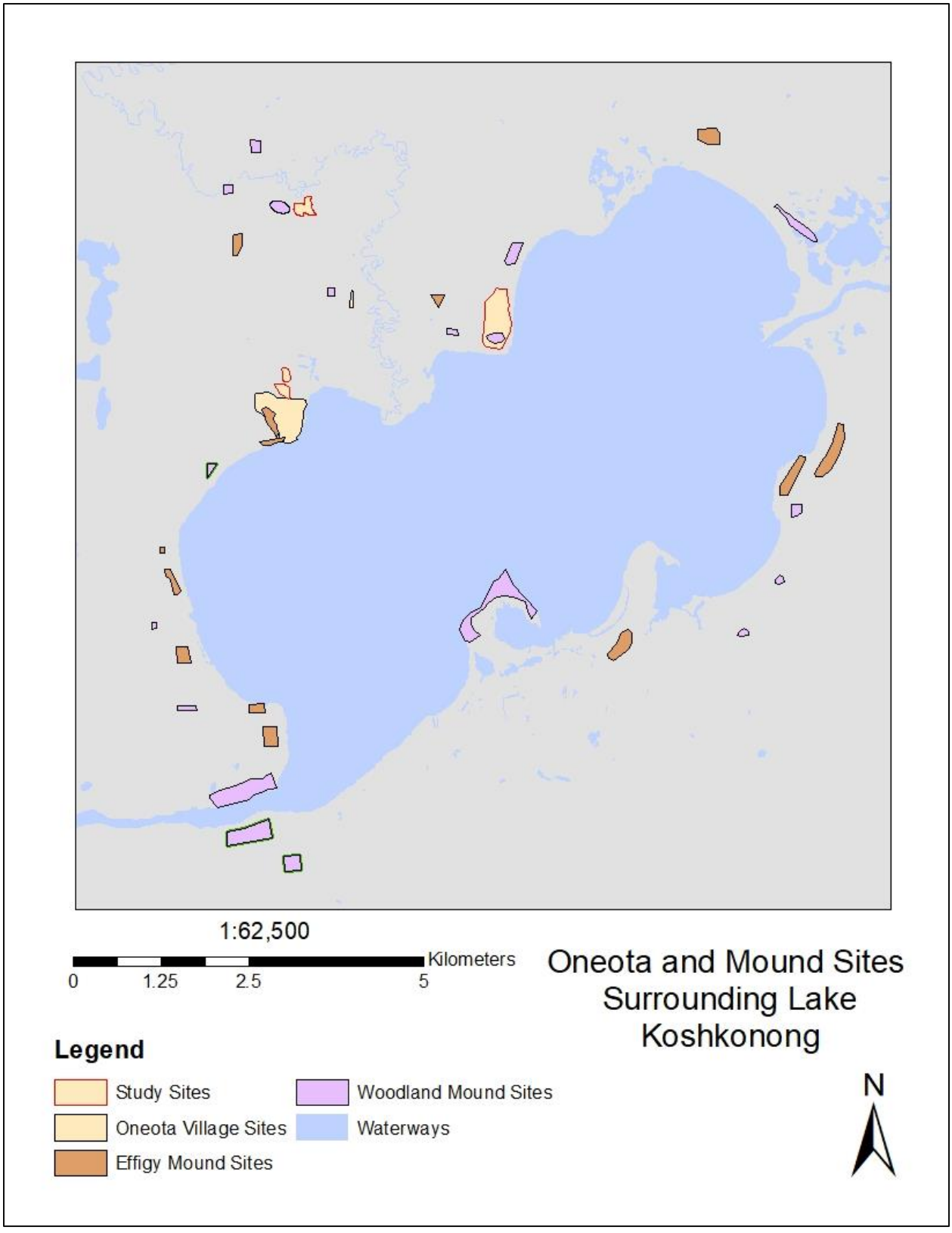

Figure 22. Mound Sites surrounding Lake Koshkonong

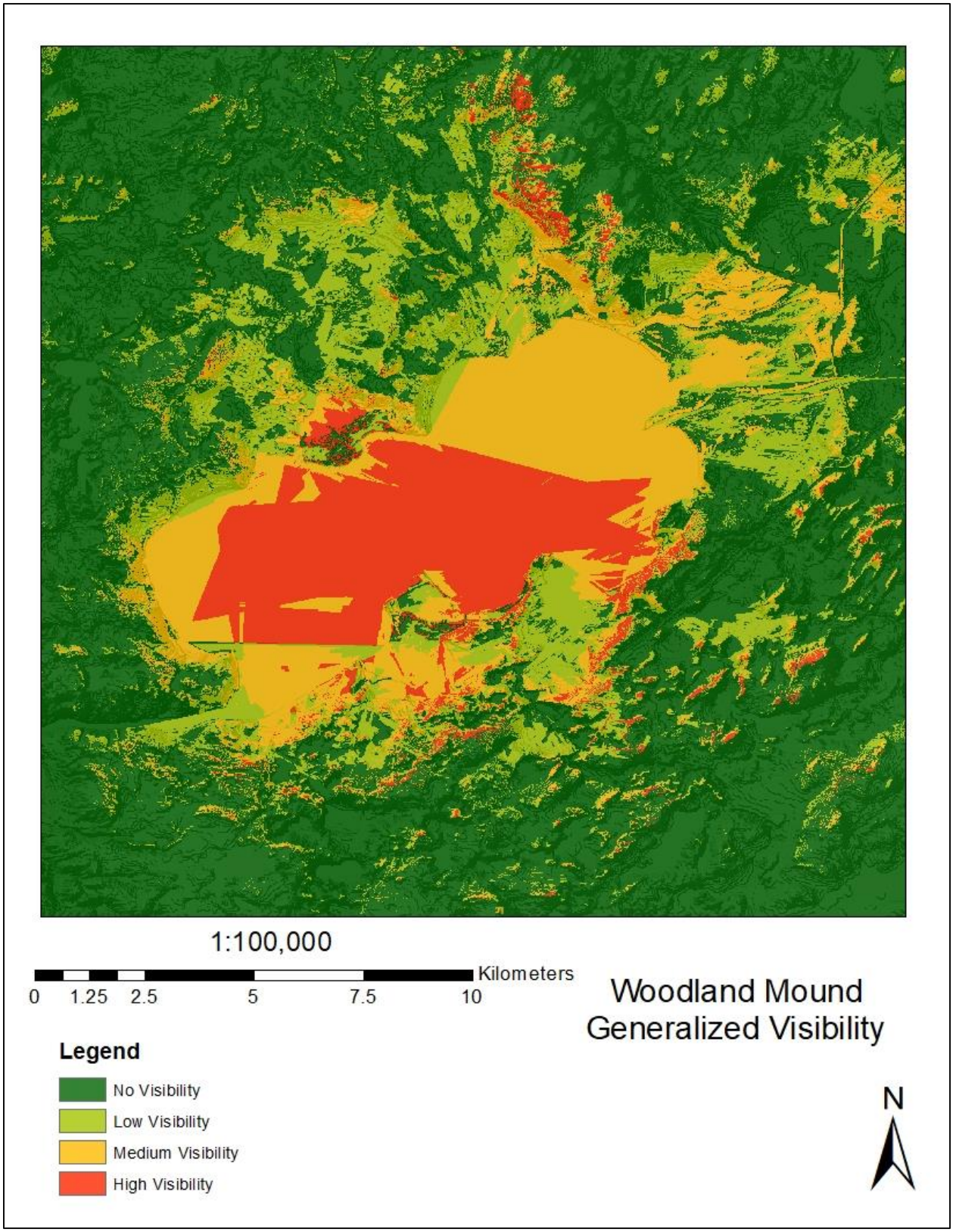

Figure 23. Generalized Woodland Mound Site Visibility

Rock River. One exception is the Woodland mounds also have low/medium visibility within the Koshkonong Creek watershed whereas Effigy mound sites generally have limited visibility in this area.

The number of Woodland mound sites within the 5 km buffer of the Oneota village sites is between 8 at KCV, 9 at Carcajou Point, and 10 at CBHC and Schmeling. The spatial relationship between these sites is close with mound sites being located within Oneota village site boundaries (Carcajou Point) or directly adjacent to the site boundary (KCV). Between 2–5 of these sites within 5 km of Oneota villages or 25–50% have a viewshed that encompasses Oneota villages. CBHC is visible from the greatest number of Woodland mound sites, five. While it shares reciprocal visibility with four sites: Kirby, Loge Bay, Skavlem, and have reciprocal visibility with CBHC is Koshkonong Creek Mounds/Twin Knolls Mounds. Koshkonong Creek Mounds/Twin Knolls Mounds has excellent visibility of Oneota sites and can view all of the study sites excluding Schmeling. Carcajou Point can be seen from 3 Woodland mound sites: Loge Bay, Koshkonong Creek Mounds/Twin Knolls Mounds, and Carcajou Point Mounds. Reciprocal visibility occurs with 2 of these sites Koshkonong Creek Mounds/Twin Knolls Mounds and Carcajou Point Mounds. Two Woodland mound sites with visibility to KCV are Koshkonong Creek Mounds and Koshkonong Creek Mounds/Twin Knolls Mounds. Both of these sites share reciprocal visibility with KCV.

Question 3: What is the Visual Relationship between Late Woodland Habitations and Oneota Sites?

Late Woodland habitations are located throughout the landscape of Lake Koshkonong and are by far the largest group discussed (Figure 24). Most of these sites consist of small

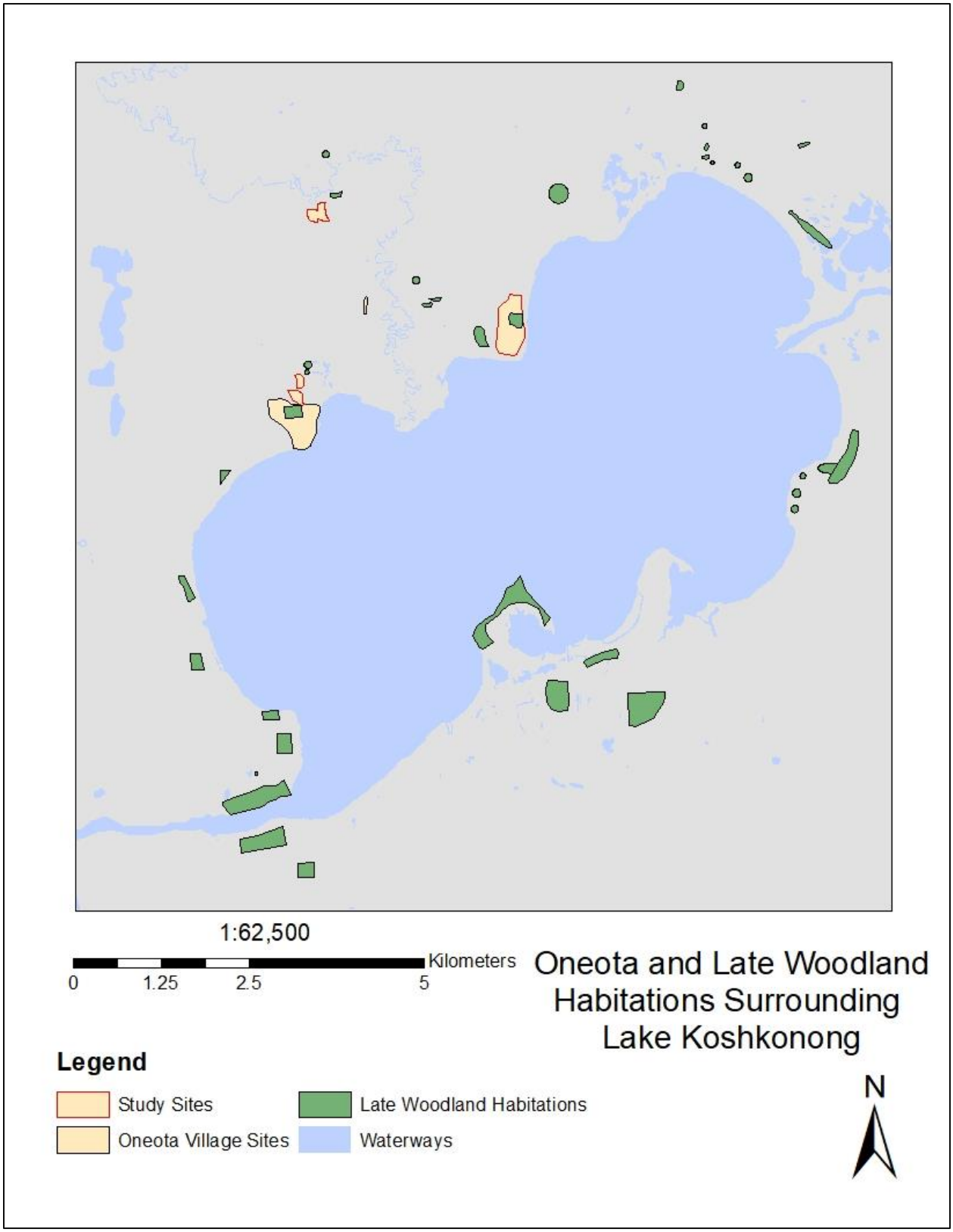

Figure 24. Late Woodland Sites surrounding Lake Koshkonong

campsites/villages, however, there are a number that include both Effigy and Woodland mounds as well as proto- and postcontact Native American habitations and burials. The majority of these mound sites are concentrated on the western edge of the site with a few sites located on the south and eastern edges.

Each of the Oneota sites in the study area are located either adjacent to a Late Woodland habitation site, or there is a Late Woodland habitation site within the boundary of the Oneota village site. The Marsden site is directly south of CBHC and within the boundary of Crab Apple Point. JE1002 and JE1003 are located just outside the boundary of Schmeling. Purnell is located directly across Koshkonong Creek from three Late Woodland habitations: Myrtle, Carlson Knoll, and Carlson Creek II. Punzel is adjacent to the boundary of KCV. Carcajou Point III is within the boundary of Carcajou Point and Hunn Farm is also spatially adjacent to Carcajou Point.

As with each of the preceding temporal groups discussed, Late Woodland habitations have a focus on Lake Koshkonong (Figure 25). The majority of the lake is taken up by high visibility areas, excluding the southwest and northwest portions and the eastern edges of the lake which all have medium visibility. The historic marsh south of Thiebeau Point is also in the medium/high visibility category. Mud Lake and the mouth of Koshkonong Creek are also included in the medium visibility group. There is a clear tapering of visibility from the central portions of the lake outwards. Like the Effigy mound sites, Late Woodland habitations do not appear to be focusing on the Rock River and have areas of limited visibility on land immediately surrounding Lake Koshkonong. While there are some areas of low visibility in the upland

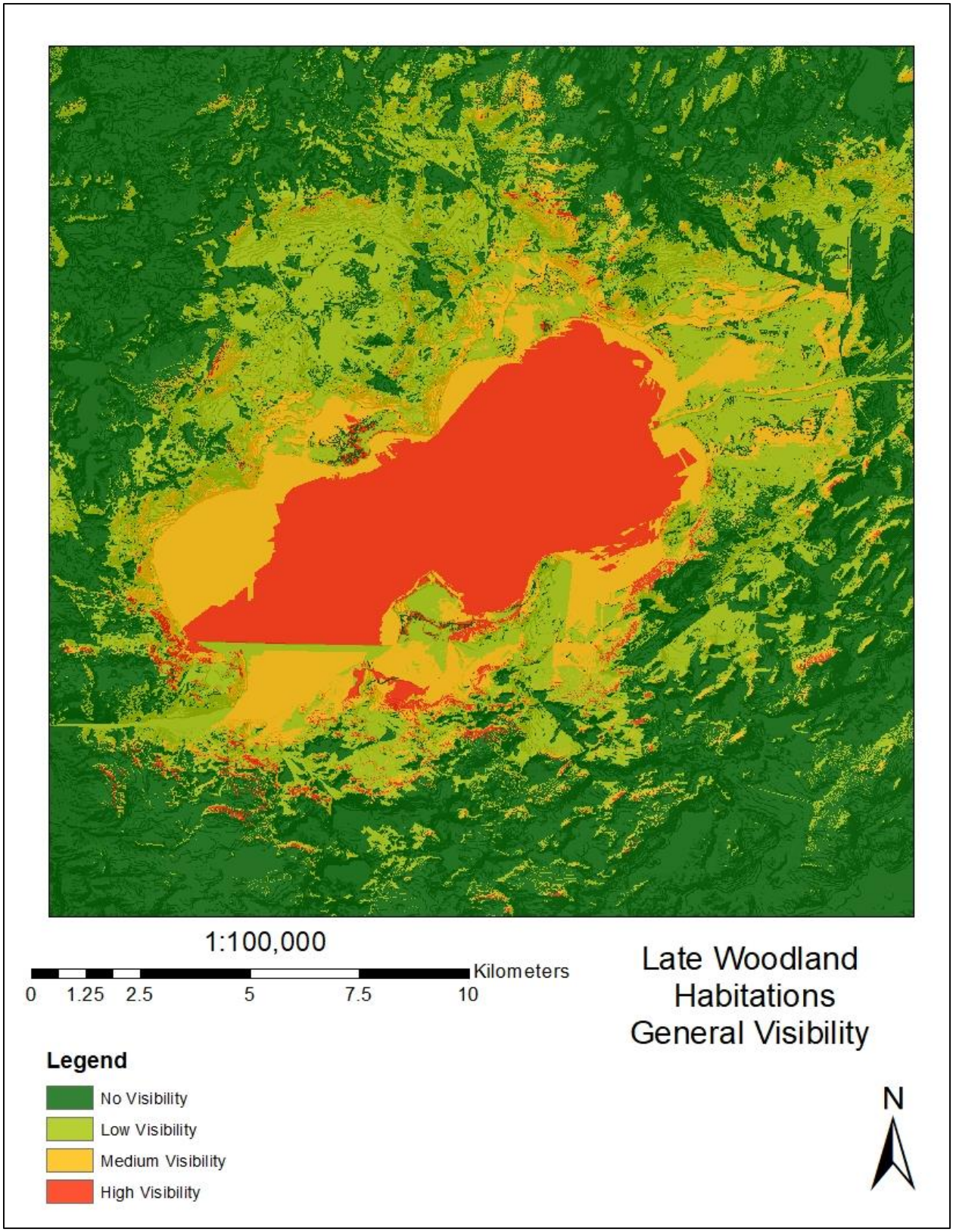

Figure 25. Generalized Lake Woodland Site Visibility

regions of Koshkonong Creek, these are most likely due to a small number or sites having visibility of that region and not indicative of the overall viewshed of Late Woodland habitations.

There are 11 Late Woodland habitations within the 5 km buffer of KCV, Schmeling, and CBHC and 25 sites within the 5 km buffer of Carcajou Point. Late Woodland habitations have by far the greatest number of sites within the study area and the highest percentage of sites with visibility of Oneota villages. KCV is visible from the least number of Late Woodland habitations, four, however, each of these sites can also be seen from KCV. CBHC is visible from seven sites and has reciprocal visibility with six. Likewise, Schmeling is visible from nine Late Woodland habitations and visibility is reciprocal with eight. Neither CBHC nor Schmeling can view the Punzel site, but someone at Punzel could view both CBHC and Schmeling.

Because of this, Late Woodland habitations are the only temporal group that does not share complete visual reciprocity with the Schmeling site. For all other sites, if they can view Schmeling, then Schmeling can view them back. Carcajou Point is visible from sixteen Late Woodland habitations and fifteen are reciprocal; the Art Hoard site is the exception. No multicomponent Late Woodland habitation/mound sites have visibility of KCV or CBHC. One Late Woodland habitation/Woodland mound site, Thiebeau Point, shares reciprocal visibility with Schmeling. One Late Woodland habitation/Effigy mound site, General Atkinson, and one Late Woodland habitation/Woodland mound site, Sake Village, share reciprocal visibility with Carcajou Point.

Implications

There are several implications that can be inferred from these results. The primary inference is that Oneota sites valued intervisibility with one another. Each village site in the

study area can view at least three other Oneota village sites and some, like CBHC and Schmeling, can view all other village sites. Interestingly, if looked at as a cooperative unit, instead of individual sites, Oneota villages have a nearly comprehensive viewshed of the entire Lake Koshkonong region. Crab Apple Point can view much of the western portion of the lake and Carcajou Point the eastern portion. CBHC and Schmeling fill in other sections. An outlier of the Oneota sites is KCV, which has both reduced visibility on the landscape and is hidden from many non-Oneota sites from viewing it. The only temporal group that KCV can view more than 50% of the available sites in the 5 km buffer are Oneota sites. This conforms with the findings of Edwards (2010, 2017) and McTavish (2019) who have identified that the environment, subsistence habits, and faunal signatures at KCV differed from the Oneota sites located adjacent to Lake Koshkonong. KCV also provides visibility to the north and northeast that the locality would otherwise be lacking.

Another implication of these results is the high reciprocal visibility Oneota villages share with Effigy mound sites. If an Effigy mound site can see an Oneota village, then that village has visibility back towards the mound site. This is particularly interesting given the lack of proximity of Effigy mound sites to Oneota villages despite their extensive distribution around Lake Koshkonong (Richards and Jeske 2002:41). When compared to Late Woodland habitations and Woodland mound sites which are located either directly adjacent to or within Oneota village site boundaries, Effigy mound sites are noticeably rare.

Chapter 7: Discussion

Research Questions

What sites are encompassed and excluded from Oneota village site viewsheds?

Generally, the Oneota site viewshed was more concentrated when compared to the Effigy mound, Late Woodland habitation, or Woodland mound sites in the same vicinity. The Oneota village sites focused on northwestern Lake Koshkonong as well as Koshkonong Creek as it feeds into Lake Koshkonong. This focus on Koshkonong Creek is likely due to the fact that all six sites included in the Oneota viewshed are located on ridges either overlooking or adjacent to the Koshkonong Creek floodplain. While Oneota populations were withdrawing from the wider world, they were also consolidating settlements sites at the locality level (Hollinger 2018:271; Jeske 2020:104). While Oneota village sites are located adjacent to Lake Koshkonong, it appears that they spread their sites out to view Koshkonong Creek to the north.

Late Woodland habitation, Effigy mound, and Woodland mound sites are spread out all over the study area and not concentrated the way Oneota period sites are. Oneota site concentration also lends itself to a high reciprocal visibility between Oneota sites. Carcajou Point, Crescent Bay, KCV, and Schmeling all had between 60-100% reciprocal visibility with other Oneota period sites. This increased visibility with each another is tied to both physical and social closeness (Kim et al. 2020:10). This closeness reinforces the idea that Lake Koshkonong Oneota had a locality-wide economic and social system (McTavish 2020:83). High reciprocal visibility also indicates that communication between village sites was important. This would also make defense easier (Jeske et al. 2020; Jones 2006:536–537), which is an important feature of settlement on a perilous landscape (Krus et al. 2022:129).

Most of the Oneota village sites have a similar viewshed, excluding KCV. The non-KCV Oneota viewshed includes a high degree of visibility toward earlier mound and habitation sites. Schmeling and Crescent Bay have the same visibility metrics—unsurprising given how close in space they are to one another. Carcajou Point is slightly different in that it is much larger than both Schmeling and CBHC and has roughly twice the amount of Effigy mound, Woodland mound, and Late Woodland habitations within its 5-kilometer buffer. More sites and a larger surface area increases the chances of being able to see sites within the buffer. Interestingly, KCVs is the only Oneota site not visible from Carcajou Point. It is blocked by a large ridge that sits to the northwest of Carcajou Point.

An exception to this pattern of visibility is KCV. KCV has a much smaller number of Late Woodland habitations, Effigy mound, and Woodland mound sites within its 5 kilometer viewshed. KCV is also the only Oneota village site that does not have any visual relationship with Effigy mound sites—KCV cannot view any Effigy mound sites and they cannot view KCV. KCV is the only Oneota village site that is not located directly adjacent to Lake Koshkonong and is situated in a drier, upland setting (Edwards 2010; Edwards and McTavish 2012:1). Set apart from other village sites, KCV is in a unique position as it appears, from a visibility perspective, to have been hidden on the landscape. When it is visible from Late Woodland habitations and other Oneota village sites, it is a reciprocal relationship. Within visibility studies, there is a notion that lack of visibility can tell you more than physical visibility (Kim et al. 2020:1).That is, purposefully hiding within the landscape is a sign that group does not want to be seen by anyone—friend or foe. The relative lack of visibility to KCV from all sites besides Oneota sites hints at the possibility that its occupants were trying not to be seen.

What is the visual relationship between mounds and Oneota village sites?

The viewshed from Oneota village sites to mound sites included more Woodland mound than Effigy mound sites. Whereas more Oneota village sites were able to be viewed from Effigy mound sites than Woodland mound sites. Oneota groups may have purposefully placed their settlements within the viewshed of Effigy mound sites, even if those sites were not visible from the village sites themselves. Interestingly, Effigy mound sites are not very common within the area where Oneota sites were placed. The greatest concentration of Effigy mound sites is located along the southeast and southwest shores of Lake Koshkonong. In addition to higher site concentration, individual sites in these areas have greater numbers of mounds within the mound groups. The relative scarcity of Effigy Mound sites in the Oneota portion of the lake compared to the rest of Lake Koshkonong suggests that the relationship between Effigy Mounds and Oneota sites is not simply random or coincidental.

A greater number of mounds at a site represents a greater investment in both time and calories of the community that built them and may also indicate that the mound group or individual mounds within the group were revisited over a long period of time (Arnold and Murray 2002). It is therefore reasonable to assume that sites with a higher number of mounds would hold greater significance (Dillemuth 1999:109). The mound sites with the greatest number of mounds surrounding Lake Koshkonong are General Atkinson (72), Hoard Mound Group (36), Koshkonong Mound Group (78), and Noe Spring (62) (Dillemuth 1999:109). Additionally, Noe Springs has been identified as a possible short term Oneota site potentially displaying the interwoven relationship between mound sites and Oneota groups (Jeske et al. 2020:4)

In addition to having a large number of mounds, General Atkinson also shares high reciprocal visibility, 86%, with other Effigy mound sites around Lake Koshkonong (Dillemuth 1999:115). Of the four Oneota village study sites, Schmeling and Crescent Bay share reciprocal visibility with General Atkinson mound group, while Carcajou Point shares reciprocal visibility with both General Atkinson and Hoard Mound Group, and KCV shares reciprocal visibility with Koshkonong Mound Group. While this trend may be attributed to the increased perimeter accommodating a larger number of mounds, it could also demonstrate a powerful social and cosmological forces that compelled Oneota individuals to place their villages within the viewshed of Effigy mounds.

"Mounds are placed on high and commanding situations evincing a taste for beauty or scenery or a watchfulness, perhaps, rendered necessary by the presence of enemies" (Lapham 1855). The high and commanding position of mounds would increase the ability of people at these sites to see great distances. Most of the Lake Koshkonong region would have been visible from these sites. Likewise, Oneota villages are also on high ground—although not the highest ground in the region. This differing preferential placement may be part of the reason why the visibility between Oneota village sites and mounds sites is so high.

Visibility toward earlier Woodland mounds may be coincidental based on the spatial proximity of Oneota sites to previous Late Woodland habitations. Late Woodland habitation sites may have placed their settlements to be able to view the mounds. Later Oneota groups settled near those sites to use the organic soils as fertile fields. Hence, the Oneota visibility towards Woodland mounds is just a coincidence. This explanation is undercut by the placement of CBHC, the only single component Oneota site in this study. While CBHC shares the same

trends in visibility as the other Oneota sites, it was not placed near an earlier Late Woodland component. It's high visibility with Late Woodland mounds cannot be explained by previous habitations.

What is most likely is that site locations were chosen based on many factors including having to work within the constraints of a landscape that had been heavily occupied for thousands of years. A combination of environmental, historical and cosmological constraints left the Oneota pattern we can see today.

What is the visual relationship between Late Woodland habitations and Oneota village sites?

Late Woodland habitations appear both in immediate and adjacent relation to Oneota sites. Both Carcajou Point and Crab Apple Point have Late Woodland habitations that overlap the Oneota site boundaries. While Schmeling and KCV have Late Woodland habitations adjacent to the Oneota occupations of the site, intermixing of Late Woodland and Oneota indicators at Lake Koshkonong is rare. This indicates that the overlap between these two traditions was short (Edwards 2017:35; Krus et al. 2022:137). One hypothesis is that Oneota groups reused Late Woodland village sites as garden beds (Benchley 1997:163; Richards and Jeske 2002:40). During the Oneota period, subsistence trends began to shift with a greater emphasis on maize and lower levels of meat and fish (Krus et al. 2022:128). As such, subsistence strategies also had to change. The arrival of corn hills and garden beds intensified subsistence and increased the ability to produce a surplus (Benn 1995:164–165; Moffat 1979:141; Riley 1987:300). These new agricultural techniques also helped to mitigate seasonal change, extending the growing season by protecting against frost damage and flooding (Moffat

1979:238; Gallagher and Sasso 1987:148; Gallagher et al. 1985:611). This increased reliance on cultigens represented a shift from horticulture to agriculture (Riley 1987:296).

It is not known what kind of cultivation method was used, if any, for the Late Woodland agricultural fields, but if they had been ridged fields, it is likely that no evidence of this would be left as many have been plowed down and destroyed in the last 150 years (Moffat 1979:231). There are historic records of raised fields and corn-hill farming, but we do not have enough data to know which fields may have been pre-contact or postcontact. Whatever their form, their hypothesized function remains the same. Their proximity to Oneota village sites also makes logical sense. Ash and charcoal are often found in ridged fields as fertilizer (Gallagher and Sasso 1987:147). Abandoned settlements would have refuse pits full of decaying organic material that is beneficial for growing plants (Benchley 1997:163). The location of these potential sites adjacent or overlapping Oneota settlement sites would have been an intentional choice to keep an important subsistence source close by for security (Edwards 2020a:136). The fields would be able to be protected if they came under attack from rival groups. Additionally, having an agricultural field close to the village would make it easier to tend to the crops and would eliminate the logistics of carrying the harvest very far.

There are three main ideas that we can take away from this research regarding settlement choice:

1) Archaeological sites in the study area were placed logically based on the environment and their purpose. Subsistence diversification was the goal of Late Woodland groups, and their habitation sites reflect this. These sites are situated close to Lake Koshkonong and the rivers which feed in and out of the lake. Proximity to these large waterbodies allows groups to take

advantage of wetland resources such as wild rice, waterfowl, and fish, while still being able to walk a short distance and take advantage of upland resources such as deer and elk. Cultigens such as corn and squash began to be grown during the Late Woodland period. Habitation sites situated on the large wetlands have highly fertile soils perfect for growing a wide variety of cultigens.

Oneota sites sought to exploit the same cultivation focus as Late Woodland groups, however with a much greater dependence on maize agriculture (Edwards 2020a). Oneota sites are placed in similar locations to Late Woodland habitations. In fact, many Late Woodland sites are within or adjacent to the boundaries of later Oneota sites. The refuse from the previous habitation would have enriched the soil making it fertile and the oak openings would have been previously cleared by Late Woodland groups making it easier to begin planting those fields again.

Mound sites were also placed in environmentally logical locations. Both Effigy mound sites and Woodland mound sites are placed on highly visible ridge tops. These earthworks were constructed to see and be seen throughout the landscape. Many Late Woodland and Effigy mounds were built in the same locations as earlier mound forms and revisited over generations. Mounds are sacred and located throughout the Lake Koshkonong Locality. This created a landscape imbued with social and spiritual meaning.

2) Oneota sites were placed defensively on the landscape. All of the Oneota village sites are located within the Koshkonong Creek drainage and are on ridges overlooking the creek itself. Koshkonong Creek, with its marshes and wetlands, would act as a barrier for hostile groups coming overland. It is difficult to stealthily move through a swollen wetland.

Additionally, the "D" patterning of the Oneota villages and their close placement to one another would have allowed reinforcements to quickly come to the aid of one another if attacked. The way Oneota villages were placed appears to be with the intention of communication. The increased visibility of having many sites spread out strategically significantly increases the overall visibility of the landscape. All village sites have near complete reciprocal visibility between one another. This would be important in the event of an attack. Lookouts at Oneota villages would be able to signal to others when an attack was coming and have reinforcements ready before the attackers even made it to the village. The way Oneota visibility was centered, attacks were likely coming from either overland or from Koshkonong Creek. This would mean KCV was especially important as it is the most northern Oneota village and has the greatest visibility of the creek valley. This also fits as KCV is semi-secluded in an area with a much lower density of any sites other than other Oneota sites, but a high degree of viewshed reciprocity.

3) Oneota sites were placed to maintain a viewshed of mound sites. All Oneota village sites have visibility to surrounding mound groups. While it is not surprising that Mound groups would be able to see many parts of the lake due to their location high on ridge tops, what is surprising is that at least one mound group is visible from all Oneota villages. This visibility suggests some sort of relationship between these two groups. While it may seem coincidental, CBHC also shares this trend of visibility and does not have an earlier Late Woodland component. It is not possible to know for certain what that relationship was—possibly a shared cosmology or Oneota groups were placing mound sites within their own cosmology.

Chapter 8: Conclusion

Multiple factors go into settlement choice (Jones 2006:523). Both physical and cultural factors are considered in choosing the best place to construct a permanent village. Available subsistence, water sources, climate, as well as defense from outside groups and communication with allies are all considerations. It appears settlement choice at Lake Koshkonong during the 11th-15th century was highly logical and based on more than just environmental factors. However, environmental factors do not completely explain why Oneota sites were placed where they were. As evidenced by Late Woodland habitations, there were plenty of environmentally logical locations to settle around Lake Koshkonong, but Oneota sites were placed clustered together in the northwest corner of the lake. This indicates that non-environmental factors—such as viewshed and defense, were also being factored into settlement choice. Oneota groups had many factors to consider when placing their settlements. Based on the viewshed analysis of these sites, the two most likely factors that went into settlement placement other than environmental factors, were defensive positioning and proximity and viewshed of both woodland and Effigy mounds. Lake Koshkonong Oneota groups did not prioritize one factor over all others, instead it appears that they were balancing these competing goals while also navigating a landscape that had been heavily occupied for thousands of years.

Limitations

GIS are a powerful tool for archaeologists to analyze landscapes (Ebert 2004:335). However, as with most archaeological methods, GIS are not without faults. There are limitations as to what information can be extracted from landscape data as well as a lack of

readily available high quality data sets that match the study area. The information archaeologists are able to infer about past can only be as accurate as the data that is input to analyze. This limitation is made abundantly clear by the example of Kumlien Mounds noted in Chapter 6 . I adjusted the site boundary to accurately indicate where the mounds were located, because people working at Koshkonong Oneota sites suggested that the viewshed analysis was wrong. I was then able to make corrections to show that visibility from KCV was possible. In general, when errors were identified, they were accounted for mitigated to the best of my ability, however no analysis is completely without error. Mistakes in data as well as possible user error contribute to the overall imperfection in GIS methodology.

One of the imperfections of GIS methodology is that it assumes its subjects are static in a way that does not reflect human behavior or movement. In this research, I looked at viewsheds from the edges of sites toward other sites. However, people were not confined to the boundaries of the site limits. Just by moving outside of the site limits, climbing a tree or walking to the top of a hill completely changes what the viewshed looks like. Once we recognize the built environment—watchtowers, palisade bastions, stockades–we can see thatf these would alter the perception of distance and what was visible on the landscape.

Data

One of the main problems with GIS analysis is that it relies on the availability of high-quality data sets. Many sources of data can be found open access online; however some are behind paywalls or no data has been collected for a specific area of study. For this project, I had hoped to use LiDAR derived DEMs. These data have a much higher resolution and more accurately represent the bare earth surface at the time of survey, however when I was

gathering data for my analysis, only Jefferson County had LiDAR derived DEMs available. As I needed to mosaic the data together, I had to choose the option that all three counties had in common.

As Jones' notes, DEMs are not perfect data sets (2006:534). The quality of the data depends on the individual who processed it (Wheatley 1995:6–7). Since I did not personally collect these data, I had to rely on the provider of the data to assure it was accurate and correct. All of my data were downloaded from state and national agencies (USGS 2022; WDNR 2022; WHPD 2022) therefore quality was not an immediate concern. There is one area of error in the DEM. It occurs on the south side of Lake Koshkonong where Rock County and Jefferson County meet. There is a single line of pixels that was not accounted for in either county DEM and is nearly indistinguishable when looking at the DEM data, however once the hillshade is applied, the error becomes apparent. This manifests as a dark line running through the area indicating no data which defaults to a value of 0. This also influenced the viewshed results, however it is a discrete disruption that is confined to the lake.

The DEMs that I used for my analysis are derived from topographic maps and as such, do not show the true ground surface. Instead, they show generalized elevation changes that are suitable for mapping large areas. For example, mound sites are not visible with this dataset, because they are not included on a topographic map. However, even if I was able to use LiDAR derived DEMs, the land as it presents today is not the same as it was when Oneota groups occupied Lake Koshkonong between the 11th and 15th century. Roads, railroad lines, and housing developments have scarred the ground and vegetation has changed. Human

modification to the landscape is nothing new, and as it exemplified within just the Lake Koshkonong region, has been occurring for thousands of years.

Interpretation

Several factors intrinsic to GIS methodology limit the ability of the user to use that data to answer specific questions. For example, GIS do not take into account temporal dimensions of spatial data (Kim et al. 2020:9). Archaeological sites or features that are hundreds of years apart are often part of the same dataset. Depending on research purpose and intent, this can either be a problem or a valuable feature of the software. The onus for organizing the data and asking questions that make sense both spatially and temporally falls to the researcher.

Applying the concepts of visibility and landscape studies to archaeology is done in order to recreate the environment within with past peoples have lived and extrapolate how they those people fit within both the physical and perceptual areas of space (Kim et al. 2020:1). Arguments against the use of GIS have been that it is too environmentally deterministic (Richards-Rissetto 2017:10). This argument follows that people do not choose habitations or subsistence based on the most logical choice but are heavily influenced by culture. Therefore, analyzing quantitative data will not produce archaeological (qualitative) results. What this argument does not consider is the interpretation of quantitative data into archaeological theory. For example, Berrocal et al. (2014), used the location of rock art sites to reconstruct the lived landscape of the Neolithic Mediterranean. Similarly, McEwan (2012) created predictive models utilizing qualitative archaeological site location data.

The analysis of both archaeological and environmental data is what makes it useful in archaeological analysis. Patterns in environmental data do not necessarily mean that those

patterns exist archaeologically. Indigenous peoples may not have had the same conceptualization of space or place that we attribute to the environment. The important distinction is between raw patterns in the data and how those patterns are interpreted with known archaeological data on specific sites and periods. Environmental data does not explicitly tell us about what has occurred in the past, but it contributes to our understanding of past organization and behavior (Wheatley 2014:120).

Future Research

Future research regarding the Oneota occupation of Lake Koshkonong could both improve and expand on the research presented in this thesis. This study took a high-level look at the visibility surrounding the entirety of Lake Koshkonong and sites within a study area of more than 24,000 acres. A more narrowly focused study area with an emphasis on the Koshkonong Creek floodplain would be able to use higher resolution DEM data, which would have the added benefit of increasing the resolution of the viewshed analysis as well as being able to both see the boundaries of mound sites on the DEM.

Two more possibilities for future research are based not on the data, but the techniques employed to create the viewsheds. This study utilized a viewshed based on the bare ground surface. Inclusions of precontact vegetation and man-made features like palisades or structures could be incorporated for a more holistic look at visibility during this time. Another possibility is the use of a fuzzy viewshed. This technique is the same as my current research, however the program includes a distance decay function which shows which areas of visibility have the greatest impact on the viewshed. Continued excavations and analysis of previous excavations at

these sites will also yield a plethora of data that can be correlated to environmental and spatial data.

This research analyzed the viewshed from 65 sites surrounding Lake Koshkonong including Oneota villages, Late Woodland habitations, and mound sites. Viewshed analysis was run on each of these sites and it was analyzed to determine the degree of visibility and intervisibility on this landscape. The focus of this analysis was four Oneota village sites dating from the 11th-15th centuries: Crescent Bay Hunt Club (47JE904), Schmeling (47JE833), Carcajou Point (47JE002), and Koshkonong Creek Village (47JE379). The purpose of this research was to understand if viewshed had a role in determining settlement choice and if viewshed could elucidate relationships between these contemporaneous groups.

The results indicate that Oneota village sites were located in environmentally logical places to build a settlement, however there were many logical places to settle around Lake Koshkonong but all Oneota sites are clustered in the Koshkonong Creek river valley. Analysis of the viewshed indicates that Oneota sites were also chosen for their visibility. All Oneota sites in the locality had visibility to and from most, if not all, Oneota villages. This indicates that communication was important to these groups as was settlement close to one another. Additionally, it appears that Oneota sites were also chosen for their spatial proximity to Late Woodland habitations and visual proximity to mound sites.

While I think that my research was successful at taking a high-level look at visibility of archaeological sites surrounding Lake Koshkonong, as with all research, additional data from excavations, higher resolution spatial data, and more accurate site locations will only enhance

our understanding of Oneota village site and their relationships with their Lake Koshkonong neighbors.

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