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The Eagle Nest Site An Examination of the Stone Tool Technological Organization During the Woodland Period in Central Minnesota

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The Eagle Nest Site:

An Examination of the Stone Tool Technological Organization During the Woodland Period in Central Minnesota

by

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Abstract

The Eagle Nest (21SH85) is a multicomponent Woodland period site located in Sherburne County, Minnesota. The site was first excavated in 2018 during St. Cloud State University's summer field school. A number of artifacts were recovered as part of the survey, including lithic debitage, pottery, fire-cracked rock, and formal and flake tools. Several potential features were also noted which included hearths, a midden, and a living surface.

The primary goal of this research project was to attempt to develop an understanding of the lithic technological organization of the peoples who once occupied the Eagle Nest site by completing a morphological analysis of the lithic artifacts, a raw material analysis, a microwear analysis, and a spatial analysis of the site. Additional goals were aimed at determining the number of components within the site's boundary and to determine the applicability of microwear analysis in the CRM setting, a field with budgetary and time constraints.

The results of the project indicate the Eagle nest was a multicomponent site occupied during the Transitional and Late Woodland periods, with some evidence of an earlier occupation. Peoples occupying the site used a variety of local, non-local, and exotic materials to manufacture both expedient and curated tools. Results indicated both marginal and non-marginal flaking occurred on the site, and there was a heavy reliance on flake tools. The results of the microwear analysis indicate formal tools were frequently hafted with antler and hide working likely occurred on site.

In loving memory of my sister, Cara Joy Clausen, a great soul.

Acknowledgments

First and foremost, I would like to thank my committee members for their endless patience and support. It has been a long journey for me to get to this point and I cannot emphasize enough how grateful I am for the knowledge you have shared with me, the advice you have offered, and constant encouragement when I was doubting myself. The project would not have been completed without you.

A very special thank you to Dan Wendt for teaching me about rocks in Minnesota. You took me under your wing when I knew nothing! Thank you.

Last, but certainly not least, to my family and friends - I would not have gotten to this point without you. Mom and Dad, Ben, David, Emily, and Drew your unconditional support has meant everything to me. I love you.

Jill, Emily, Karissa, and Rachel, I do not know what I would do without you. You are the best, most supportive friends a girl could ask for.

"Archaeology is like a jigsaw puzzle, except that you can't cheat

and look at the box, and not all the pieces are there."

- **Stephen Dean**

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Chapter 1

Introduction

The reporting of Precontact sites and associated material culture by archaeologists in Minnesota has allowed for a broad understanding of the lifeways practiced by the state's earliest occupants. Archaeology within the state largely began during the mid-nineteenth century with the recordation of earthworks, mounds, and village sites (Arzigian 2008). These surveys continued well into the twentieth century and resulted in the documentation of "more than 2,000 mound and village sites" and "detailed, accurate sketch maps and measurements of more than 17,000 individual mounds" (Arzigian 2008:9). By the 1920s, researchers at the University of Minnesota began to conduct archaeological investigations throughout the state in order to develop a cultural framework designed to assist in identifying site types temporally across the landscape. Later, other academic and state institutions followed suit. While systematic field methods were not as advanced as they are today, the descriptions of these sites, their environmental settings and material remains became the foundation from which our understanding of the Precontact past has evolved.

Since the 1980s, Cultural Resource Management (CRM) has developed to become the primary practice used by archaeologists to study the past (King 2013; 2020). Hundreds of archaeological investigations have taken place within the state thanks to support from federal, tribal, state, and local legislature. Methodological and technological advancements in the field have allowed for the potential of more in-depth analyses and interpretations of the past, although time and budget constraints of CRM firms have limited the output of more specialized, fine-tuned studies. Today, opportunities for these types of analyses lie largely within the academic sector, through master's and doctoral theses and/or the specialized research interests of those affiliated with larger institutions. Moreover, while important papers have and continue to be produced each year, gaps remain in our understanding of the technological, social, and cultural aspects of Precontact lifeways in the state. More specialized studies are necessary to answer important research questions and “for improving the quality, effectiveness, and efficiency” of Minnesota archaeology which, in effect, allows for the continued management, protection, and preservation of the state’s cultural resources (Arzigian 2008:10).

Site Overview

The lithic artifact collection analyzed for this study was recovered from the Eagle Nest site (21SH85), a large Precontact village site located in the SW ¼ of the SE ¼ of S27, T35N, R27W, of Sherburne County, Minnesota (Figure 1.1). To date, the site encompasses approximately 19 acres and is situated atop a terrace nestled between uplands to the west, the St. Francis River to the north, and wetlands to the east, which act as a buffer between the site and Rice Lake. Historically used for agricultural purposes, the area was purchased by U.S. Fish and Wildlife Services (USFWS) in the 1960s and has since been restored to an oak savanna.

The Eagle Nest site is located in the Central Lake Deciduous East archaeo-environmental sub-region, one of nine sub-regions designated within the state by former State Archaeologist Scott Anfinson (Anfinson 1990). These sub-regions are based on predominant vegetation, drainages, and available natural resources within each region, and can assist archaeologists in better understanding the Precontact environment and thus better predicting the locations of archaeological sites

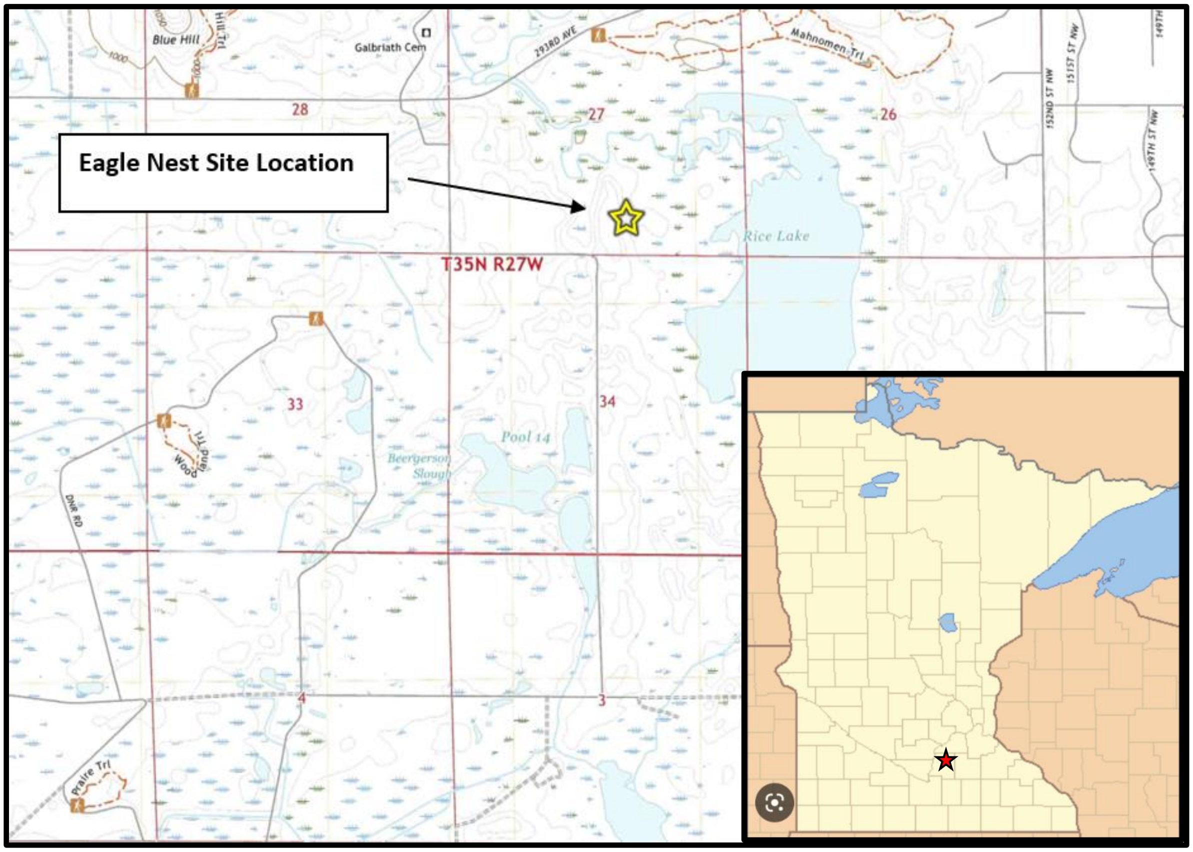


Figure 1.1. Topographic Map Showing Site Location (Yellow Star) (USGS 7.5' Quadrangle, Orrock Township, 2022, 1:24,000). Inset Map of Minnesota in the Bottom Right Corner Shows Location of Site within the State (Red Star).

The Central Lakes Deciduous East region contains most of central and east-central Minnesota. It is characterized by topographical features such as moraines, till plains, and outwash plains, and a number of important lakes and rivers run throughout the region. During the Contact period, the area was largely comprised of oak woodlands and brushlands, ranging from "small groves of trees intermixed with open prairie to a chaparral-like community of scrub forest and dense shrub thicket" depending on the frequency of controlled fires (Wendt and Coffin 1988:1-2). Within Sherburne County, upland prairies and prairie wetlands were also common, especially along its western border. The region contains some known bedrock sources, primarily to the northeast and near Little Falls in Morrison County, but glacial till materials were especially important (Bakken 2011).

During the Woodland period the deciduous forest region contained a wide variety of mammals including white-tailed deer, elk, opossum, rabbit, squirrel, fox, beaver, otter, and wolf (Gibbon 2012:21). Prairie fauna such as bison, badgers, coyote, and gophers were available on prairie uplands and there was an abundance of fish, waterfowl, and other aquatic species found in wetlands, lakes, rivers, and streams (Gibbon 2012).

The site area is comprised of three soil series listed here in order of the largest portion of the project area to the smallest: Zimmerman fine sand, Seelyeville muck, and Markey muck (NRCS 2023). Zimmerman fine sand consists of soils on 0 to 2 percent slopes, 1 to 6 percent slopes, 6 to 12 percent slopes, and 12 to 25 percent slopes found on flats, rises, hills, and outwash plains. The typical soil profile for the series is comprised of sand from 0 to 114 centimeters (cm), loamy fine sand between 114 and 116 cm, followed by fine sand between 116 and 203 cm. However, on hills and outwash plains, soils tend to consist of fine sand from 0 to 203 cm. Seelyeville muck is found on 0 to 1 percent slopes located in depressions on moraines, outwash plains, and stream terraces. The typical profile for this soil series is comprised of muck between 0 and 203 cm. Finally, Markey muck soils appear within depressions and are occasionally ponded. A typical Markey muck soil profile contains muck between 0 and 71 cm, followed by sand between 71 and 200 cm (NRCS 2023).

What is today called the Eagle Nest site was first noted in 1974 by Richard B. Lane, former Assistant Professor of Anthropology at St. Cloud State University (SCSU), and a group of students after undertaking a walk-over surface survey and collection of the area. Initially, the site was divided into two areas of interest, Site #6 and Site #7. As Lane (1974:17-18) noted, the separation of the two sites was based on “a physical gap between them in which no evidence of prehistoric activities was found, and the existence of some major difference in pottery design and decoration from the two areas.” In the 1980s, the vicinity was allotted an alpha site number, a way of listing unnumbered known or potential sites, which lack formal verification by professional archaeologists but are based on historic documentation or word of mouth (OSA Manual 2011). Based on Lane's findings, a more intensive investigation of the area was recommended.

In 2018, 44 years after Lane's initial survey, SCSU returned to the Sherburne National Wildlife Refuge under the direction of Dr. Mark Muñiz for its biennial archaeological field school. The field school participants completed a pedestrian survey, a series of shovel tests, and nine test excavation units producing total of 1,834 artifacts consisting of lithic tools and debitage, fire-cracked rock (FCR), grit-tempered pottery, faunal remains, and charcoal. Several features were noted during the survey including hearths, a midden, and possible floor of a living area. Diagnostic artifacts collected as a result of the 2018 survey are indicative of a Middle to Transitional to Late Woodland period occupation.

Previous Archaeology

To date, a total of 86 Precontact and Post Contact archaeological sites have been documented and given Smithsonian trinomial site numbers in Sherburne County, a relatively low number when compared to other counties in the east-central portion of the state (e.g., Dakota County = 162, Hennepin County = 569, Mille Lacs County = 142, and Stearns County = 200) (OSA Online Portal 2023). This is not for lack of a habitable, resource rich environment; the county contains 152 lakes and rivers, 53,000 acres of wetlands, and 493 miles of streams, prairies and extensive forested areas (Cibulka 2018). Rather, it is in large part due to fewer commercial and residential development projects in the county, which has resulted in fewer archaeological surveys taking place and fewer sites being recorded. The majority of Precontact sites confirmed in Sherburne County are general lithic artifact scatters and burial mounds (OSA Online Portal 2023).

The Eagle Nest site is located within the Sherburne County National Wildlife Refuge, which is comprised of 30,757 acres, 44 percent of which are wetlands (Cibulka 2018). The refuge's potential for containing archaeological sites was noted as far back as the late nineteenth century, though the first reconnaissance surveys within the wildlife refuge did not occur until the 1960s (Lane 1974). In subsequent years, several small-scale pedestrian surveys led by Lane took place within the wildlife refuge. The locality of the Eagle Nest site (Sites #6 and #7 as they were referred to at the time) were first noted in 1974 (Lane 1974).

The 1974 pedestrian survey involved an "on-site walk over surface collection from areas of exposed animal burrow tailings" (Lane 1974:16). If systematic methods were practiced during the survey, they were not mentioned in Lane's final report. A number of artifacts including ceramics, a broken bifacial tool, and lithic debitage were collected at the time but a more detailed analysis of the artifacts was never completed.

A more intensive investigation of the area was conducted in 2018 by SCSU field school participants. Fieldwork began with a pedestrian survey of the area at five-meter (m) intervals. Based on these results, a total of 60 shovel tests were dug in 30 cm levels to assess the presence or absence of artifacts below surface and to help delineate site boundaries. Soils were screened through a ¼-inch mesh screen and all artifacts were bagged upon recovery. Shovel tests indicated the top approximately 30 cm had been previously disturbed by plowing.

Initially, a total of six 1x1 m^2 units were excavated, with three placed in the northern portion of the site (Units N1, N2, and N3) and three placed on the peninsula just west of the wetlands (Units P1, P2, and P3). Units were dug in 10 cm arbitrary levels through the plow zone and in five cm arbitrary levels below the plow zone. Table 1.1 lists the approximate depths of the plow zone within each unit. The majority of the soil was passed through a ¼ inch mesh screen. One quadrant in each unit was sifted using a ⅛ inch mesh screen. All rodent burrows were removed and screened separately in order to isolate disturbed matrixes, and artifacts recovered in situ were point-plotted. Later, the northernmost unit (Unit N1) and one unit on the peninsula (P3) were closed, and three additional units on the peninsula were opened (Units P4, P5, and P6) (Figure 1.2).

Table 1.1. Approximate Depths of Plow Zone by Unit.

N1	**N2**	**N3**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
0 to 30 cmdb	0 to 35 cmdb	0 to 30 cmdb	0 to 30cmdb	0 to 35 cmdb	0 to 30 cmdb	0 to 35 cmdb	0 to 35 cmdb	0 to 35 cmdb

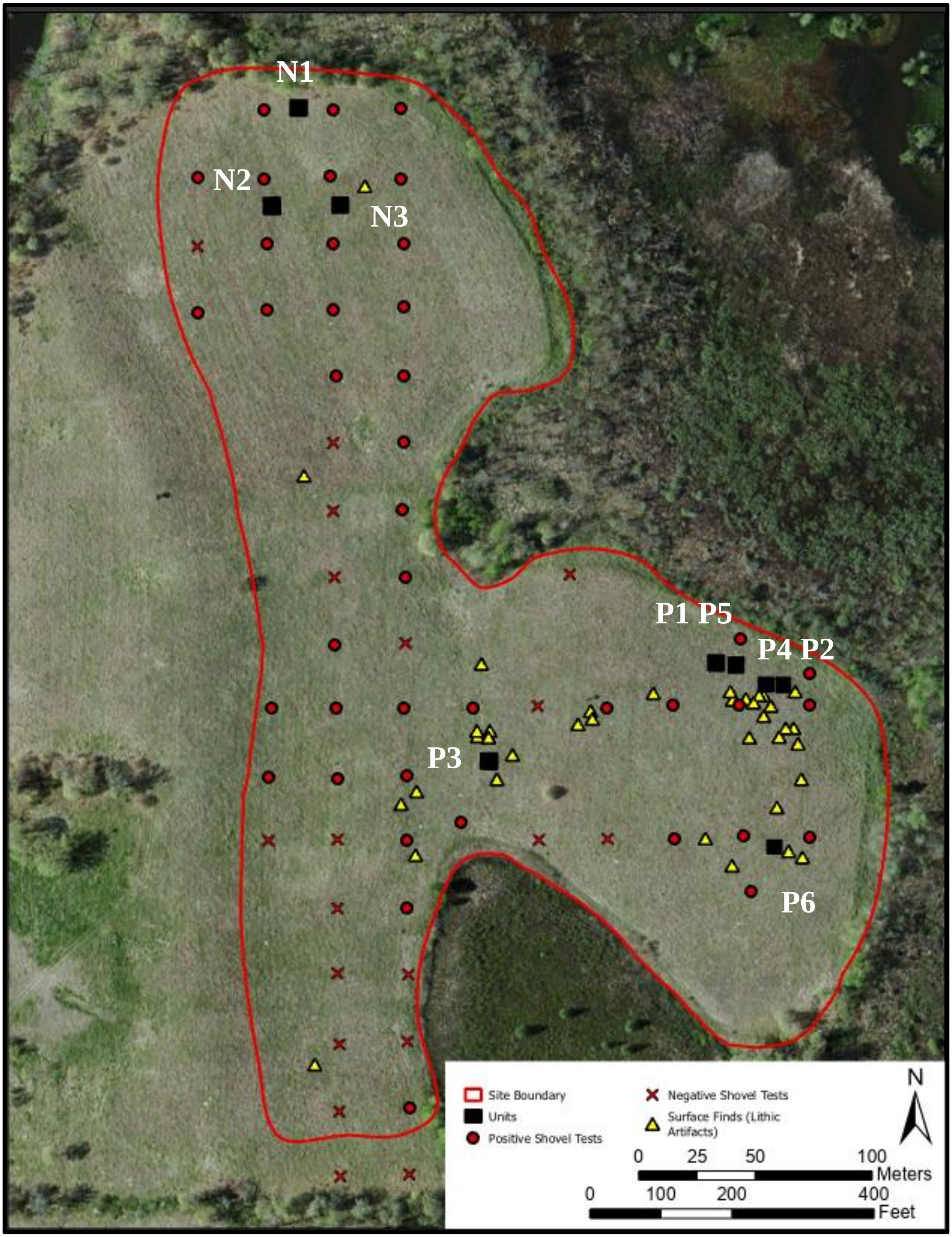


Figure 1.2. Aerial Imagery Showing Locations of Surface Finds (Lithic Artifacts), Shovel

Tests, and Units.

Unit excavation revealed a rather simple site matrix, with the top 5 to 10 centimeters consisting of a sod cap, the following 10 to 25 centimeters the Ap horizon, and below that, the B horizon (Figures 1.3 and 1.4). An examination of the site stratigraphy suggests the past sedimentary environment was stable. Waters (1992:60) states stability is a period "when erosion and deposition are negligible and during which soil formation may occur." Waters further explains that discrete occupations during periods of stability can be difficult to define as temporally distinct artifacts can become mixed and compressed.

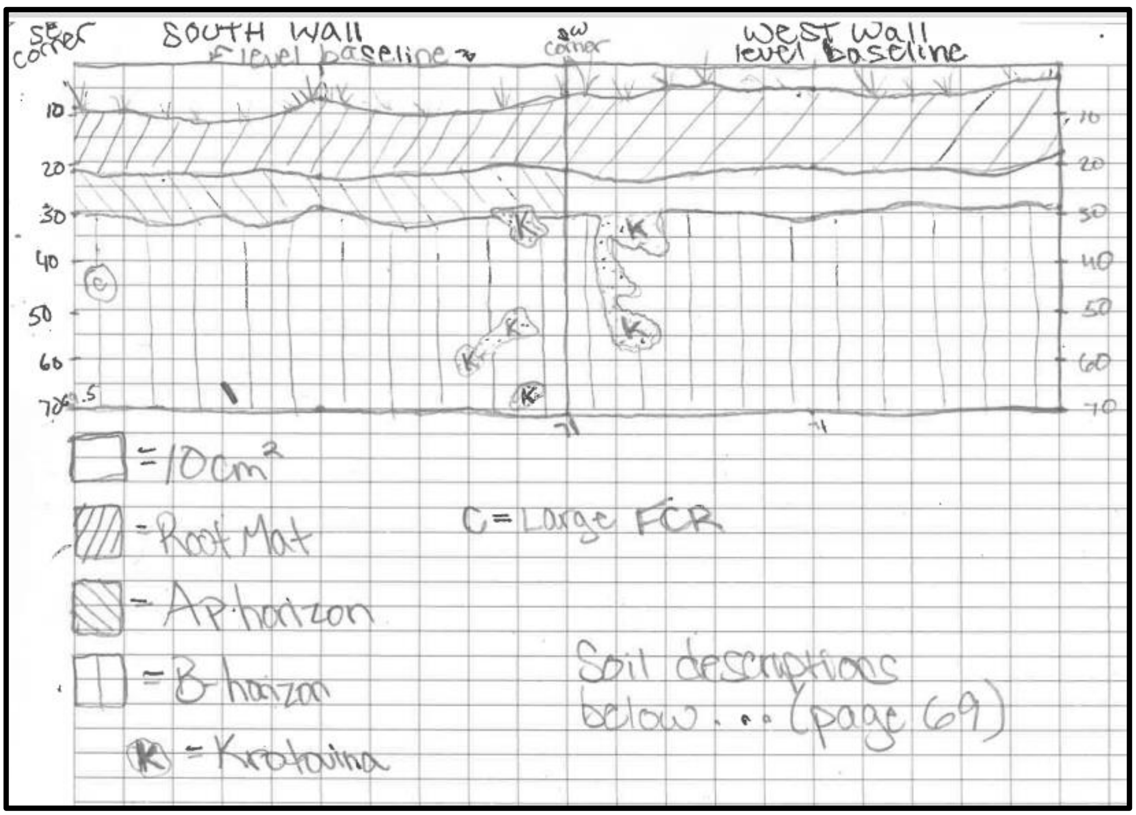


Figure 1.3. Illustration of Unit P1 South and West Wall Profiles (Sandstrom 2018).

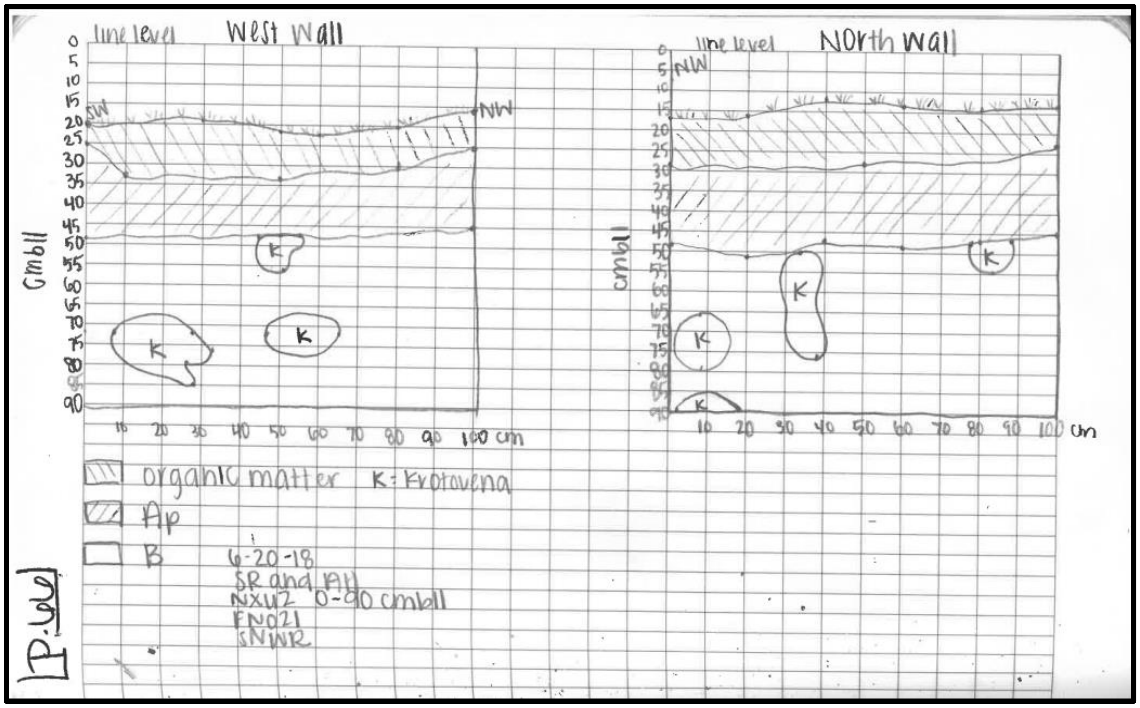


Figure 1.4. Illustration of Unit N2 West and North Wall Profiles (Hedquist 2018).

Preliminary results of the 2018 survey indicate the Eagle Nest site, named after it was given an official site number by the Office of the State Archaeologist (OSA) (21SH85), is a large Middle to Transitional and Late Woodland period village site (Figure 1.5). Several diagnostic artifacts were recovered including two small, unnotched triangular projectile points and a small, side-notched projectile point, both of which are typical of the Late Woodland period (Figures 1.6 and 1.7). Decorated pottery sherds are consistent with St. Croix and Blackduck-Kathio continuum ceramics of the Middle to Transitional and Late Woodland periods, respectively.

Figure 1.5. Aerial Imagery Taken from the Online OSA Portal Showing the Location of the Eagle Nest site (21SH85) (Red) in Relation to Alpha Site 21SHbc (Green).

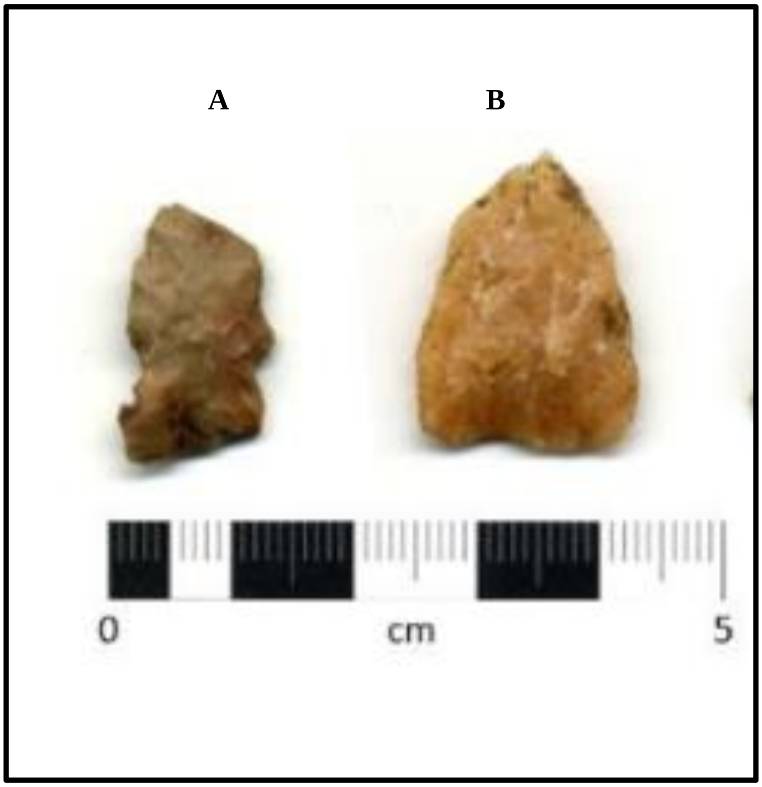


Figure 1.6. Image of Diagnostic Points Collected During the 2018 Pedestrian Survey. [A] Tongue River Silica Prairie Side Notched Point and [B] Swan River Chert Unnotched Triangular Point.

Figure 1.7. Image of Unnotched Triangular Point made from Prairie du Chien Chert (Shakopee Formation). The Point was Recovered from Unit P4, Levels 5-6 During the 2018 Survey.

Of special note, three obsidian flakes were recovered during the 2018 field survey (Figure

1.8). The flakes were found between 50 and 70 centimeters below ground surface (cmbs) in Unit N2. In addition to the stone and ceramic artifacts mentioned, several possible features were noted during excavation. These included a hearth located in Unit P6, portions of a large midden in Units P2 and P4, and a potential living surface and some associated artifact clusters in Units P1 and P3.

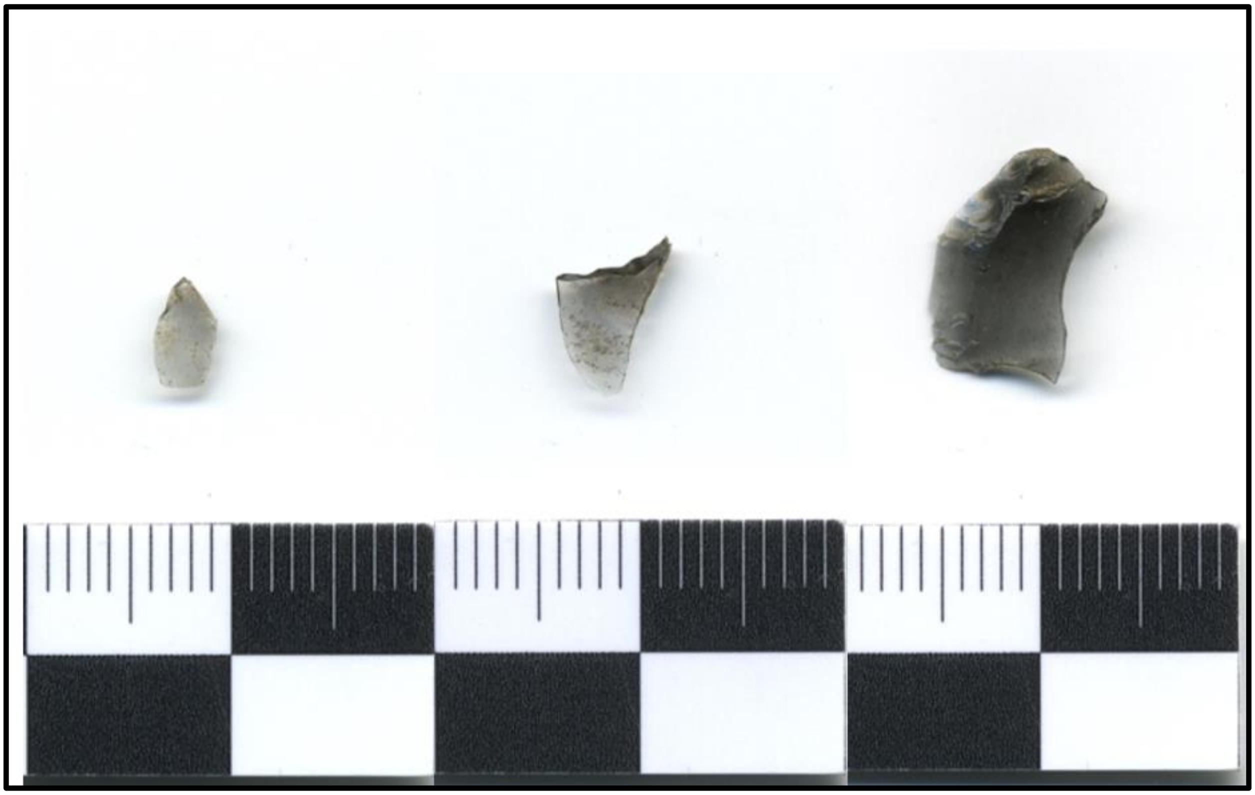


Figure 1.8. Image of Three Obsidian Flakes Recovered from Unit N2 During the 2018 Survey. [A] Obsidian Flake Recovered from Level 10 (55-60 cmbs); [B] Obsidian Flake Recovered from Level 13 (70-75 cmbs); [C] Obsidian Flake Recovered from Level 14 (75-80 cmbs).

Research Goals

The goal of this research project was to develop an understanding of the lithic technological organization practiced by peoples living during the Woodland period in east-central Minnesota (ca. 200 B.C.E. to 1100 C.E.) (Arzigian 2008; Buhta et al. 2014). The project was designed to address several research themes and questions posited by Constance Arzigian (2008) in the *Minnesota Statewide Multiple Property Documentation Form for the Woodland Tradition.* The research themes and questions explored as part of this project are as follows:

- Can internal patterning of activity areas and/or features be discerned? What can this tell us about the nature of activities conducted at the site and/or site function?
- What is the full range of the lithic material culture present at the site, including tools, debitage, and types of materials used?
- How does lithic technology and raw material acquisition and use change through time?
- Can usewear studies yield information about activities and tool use?
- What types of technologies were being employed on the site?
- When and where was bipolar technology used?

Lithic artifacts are arguably the most common objects recovered from Precontact archaeological sites in Minnesota. Too often, analysis of these artifacts in CRM is limited to basic metric measurements and raw material identification due to time and budget constraints. Much less emphasis is placed on the interpretation of these assemblages, resulting in “the accumulation of data with no particular use in mind” (Odell 2004:viii). Moreover, the informational value of debitage in particular is often discounted even though it occurs more abundantly than shaped tools (Shott 1994:71). This is not to say debitage is ignored, especially in academic and research focused spheres of archaeology, where numerous studies have been published illustrating the ways in which lithic artifacts, debitage included, can inform researchers about the strategies and practices of Precontact lifeways (see for example, Ahler 1989; Carr and Bradbury 2001; Chan et al. 2020;Shott 1994; Shott and Nelson 2008; and Patterson 1990). It is merely to suggest that as practitioners of CRM we have room for improvement.

With this in mind, this project aimed to answer the research questions listed above by examining the full range of chipped stone artifacts recovered from a Woodland period site in central

Minnesota. Four separate analyses were carried out to develop an understanding of the ways in which technological organization can illuminate certain aspects of cultural behavior and practice and to offer examples of how these studies can be applied to CRM contexts in order to produce meaningful interpretations of archaeological sites, which may otherwise have been written off as mere lithic scatters. It will attempt to demonstrate that an examination of the full range of lithic artifacts found on a site can inform us of the ways in which people selected for and integrated “strategies for making, using, transporting, and discarding tools and materials needed for their manufacture and maintenance” and how social, economic, and environmental concerns affect “design and activity distribution” as they relate to lithic technology (Nelson 1991:57).

Chapter 2

Culture History

The Central Lakes Deciduous Region of Central and East-Central Minnesota

Minnesota's Precontact culture history currently spans from approximately 14,000 BP to the arrival of the first Europeans in the state. There are four major contexts recognized by archaeologists in Minnesota: the Paleoindian period, the Archaic period, the Woodland period, and the Late Precontact period. These contexts are further subdivided into Early Paleoindian; Late Paleoindian; Early, Middle, and Late Plains Archaic and Early, Middle, and Late Eastern Archaic; Early, Middle to Transitional, and Late Woodland; and in parts of the state, Late Precontact Psinomani complex (Arzigian 2008; Buhta et al. 2011, 2014, 2017; Gibbon 2012).

The following is a brief summary of the four major contexts, with a special focus on the Woodland period and on lithic technology. These summaries were largely drawn from Arzigian's (2008) *Minnesota Statewide Multiple Property Documentation Form for the Woodland Tradition*; Buhta et al.'s (2014) *On the Periphery?: Archaeological Investigations of the Woodland Tradition in West-Central Minnesota*; Buhta et al.'s (2017) *Minnesota Archaic Tradition: An Archaeological and Paleoenvironmental Overview and Assessment*; and Gibbon's (2012) *Archaeology of Minnesota*. Additional sources used for supplemental information are cited throughout.

Paleoindian Period

The Paleoindian period in Minnesota dates from approximately 14,000 to 10,000 BP (Buhta et al. 2017). Gibbon (2012) describes the environment during this period as rapidly changing from glacial to post-glacial conditions, although temperatures were still cold, and there was abundant snowfall during the winter. Paleoindian groups living during this time were highly mobile hunter-gatherers relying heavily on medium to large size terrestrial game like mastodon, mammoth, and white-tailed deer, as well as other seasonal foods.

Stone tools diagnostic of the Paleoindian period in Minnesota include large, well-made lanceolate-shaped projectile points and prismatic blades. Projectile points were fluted at first, a process by which a large channel flake is removed from the center of the tool in order to attach it to a shaft. Large to medium sized lanceolate-shaped points with contracting and squared stems continued into the Late Paleoindian period, after fluting disappears (Gibbon 2012).

Prismatic blade production appeared throughout North America during this time and is often associated with Clovis and Clovis-like cultures (Stoltman 1971; Waters et al. 2011). These are elongated blades with parallel sides; a length at least twice as long as its width, and flake scars on the dorsal surface “parallel to the long axis” (Waters et al. 2011:41). They were manufactured by means of a specialized reduction technique which uses carefully prepared conical or wedge-shaped cores (Waters et al. 2011). The Great Plains and Eastern Woodlands have different cultural, technological, economic and chronological trajectories after the Early Paleoindian period, and archaeologists in Minnesota need to keep these difference in mind when interpreting these sites.

Archaic Period

In Minnesota, the Archaic period spans from approximately 10,700 to 2500 BP (Buhta et al. 2017). There were significant climatic changes throughout this period; a warmer, dryer climate led prairies to initially expand eastward, though by approximately 6850 BP a cooler, wetter environment saw their retreat westward (Gibbon 2012). Groups adapted to these ecological zones differently. Eastern Archaic groups (10,700 to 2500 BP) tended to camp close to lakes and rivers, relying on hunting and gathering subsistence strategies within the forest-lake biotic zone (Buhta et al. 2017). Prairie Archaic peoples (7500 to 2500 BP) practiced nomadic lifeways on the prairies with subsistence strategies focused on bison hunting (Buhta et al. 2017). Groups living within the Lake-Forest and Prairie ecotone likely exploited both ecological zones.

Minnesota is situated between the Great Plains and the Eastern Woodlands which resulted in a diverse material culture with influences from both the east and the west, as well as "geographically and temporally complex patterns of prehistoric cultures across the state" (Morrow 2016:118). The Early Eastern Archaic period in the Central Lakes Deciduous Region overlaps with the Late Paleoindian period. Because of this overlap, the Early Archaic archaeological record includes a mixture of Paleoindian points and smaller stemmed and notched points. In many cases these early points were beveled which suggests these tools were "designed for cutting as well as penetration" (Gibbon 2012:74). Small stemmed and notched points continued to be used into the Middle and Late Archaic periods. There is "tremendous variation" among defined Archaic point types which makes projectile point classifications "nebulous" Morrow (2016:121). This is in part due to a diminishing craftsmanship over time (Morrow 2016). Morrow (2016) states this variation can create morphological similarities between distinct type designations making points from this period difficult to classify.

In addition to small, stemmed and side-notched projectile points, groundstone tools (e.g., choppers, mauls, hammerstones, gouges, picks) and fishing equipment (e.g., harpoons, hooks, nets, and gorges) begin to appear in the archaeological record, especially in the central and eastern parts of the state (Gibbon 2012). The presence of adzes in the Lake-Forest region suggests peoples likely manufactured and used dugout canoes (Buhta et al. 2017). The Middle and early Late Archaic periods saw the emergence of the Old Copper complex, a phenomenon where native copper was collected and worked to produce a variety of utilitarian and ornamental objects. Copper fishing hooks, awls, drills, spear points, as well as beads, bracelets, and pendants were made and distributed through the Upper Great Lakes region (Gibbon 2012).

Archaic sites in Minnesota are not uncommon per se, but the majority of these sites are lithic scatters or isolated finds and are not found in association with datable materials or features (Buhta et al. 2017). Archaic sites are often deeply buried and difficult to detect during typical Phase I surveys (Buhta et al. 2017). Because significant, datable sites in Minnesota are not commonly found, our understanding of Archaic lifeways in Minnesota is limited. Groups living during the Archaic period were likely small in size and highly mobile. Site types likely included "seasonal, open-air base camps, fishing and kill sites, and mortuary sites" (Buhta et al. 2017; Dobbs and Anfinson 1993). The population density within the state was low, though it continued to grow through time, and home ranges may have been as large as 25,000 square miles for some groups (Buhta et al. 2017; Gibbon 2012).

Woodland Period

The Woodland tradition is often divided into three periods: Early, Middle to Transitional, and Late. Two of the defining aspects of the Woodland period in Minnesota are the appearance of pottery and the construction of burial mounds, although it has been suggested that the earliest mounds may have actually been built by Late Archaic peoples (Birmingham and Rosebrough 2017; Gibbon 2012). Groups living during this time became more and more sedentary, likely establishing semisedentary summer and winter villages in addition to other site types (e.g., hunting camps and resource procurement and processing sites) (Arzigian 2008; Gibbon 2012). Subsistence strategies included hunting, foraging, and fishing, with some evidence of horticulture. Later in this period, wild rice became a subsistence staple and was intensely exploited.

Early Woodland Period – The Rum River Phase (200 BCE to 200/300 CE) (Arzigian 2008)

The Early Woodland period in the Central Lakes Deciduous Region is commonly referred to as the Rum River Phase. Malmo ceramics are the most common type of pottery found in the region, though the type is ill-defined and is suspected to have been used as more of a catch term for any thick-walled, grit-tempered, conoidal bottomed vessels with smoothed surfaces found in central Minnesota (Arzigian 2008). It has been noted that the rim decorations present on Malmo pottery have similarities to Havana pottery from the south and east (Arzigian 2008; Gibbon 2012). Gibbon (2012) notes Havana ceramics have been linked to the Hopewell Interaction Sphere, a large-scale trade network that circulated a number of exotic materials throughout the country. It has been suggested that Rum River phase peoples may have been involved in the network, if only peripherally (Gibbon 2012).

Lithic artifacts in this period include scrapers, perforators, anvils, and other expedient tools. Projectile point styles varied widely and included straight and contracting stemmed points, as well as side and corner-notched points. There was a heavy reliance on quartz in the region (60-80 percent) but non-local and exotic materials have also been associated with Early Woodland sites (e.g., obsidian, Hixton Silicified Sandstone, Burlington Chert, Prairie du Chien Chert, and Knife River Flint) (Bakken 2011; Morrow 2017). The presence of these materials is highly indicative of important social and economic relationships with peoples to the west, south, and east of the state. While there is no concrete evidence to support a significant Hopewellian influence in the central and east-central parts of the state, Catlinite from southwestern Minnesota was an important exchange good within the interaction sphere and it is possible Burlington Chert entering the state made its way further north through more localized trade networks. Additionally, influences from the west are evident throughout the Woodland period, and materials like obsidian and high-quality Knife River Flint may have entered the region from neighboring states like North Dakota.

Middle to Transitional Woodland Period – The Isle Phase/The St. Croix Complex (300 CE to 1000 CE) (Arzigian 2008)

One of the defining characteristics of the St. Croix complex is St. Croix pottery. St. Croix ceramics are grit-tempered and semi-subconoidal with a highly pronounced shoulder and significantly thinner walls than its predecessor, Malmo ceramics (Gibbon 2012). Gibbon (2012) describes these vessels as cordmarked, with rims which are frequently decorated with a dentate stamp or a cord-wrapped stick. Vessel size varied from small bowls to large vessels.

Projectile points common during this period include St. Croix, Madison, and Prairie Side Notched points. These points are either unnotched and triangular in shape (Madison points) or side notched (St. Croix and Prairie Side Notched points) (Arzigian 2008; Morrow 2016). Due to their size, these points are believed to be associated with the use of the bow and arrow (Arzigian 2008). Quartz remained the primary lithic raw material used in the region though other materials present in glacial till are common, as are small quantities of non-local and exotic materials (Bakken 2011). Non-local and exotic materials are fairly common in assemblages as well, albeit in lesser amounts. While non-local materials may have been acquired through embedded procurement strategies early on, traveling to acquire resources likely became more and more difficult as populations grew, and territories were established. Groups tended to aggregate “from peripheral regions” during the year and there was likely exchange when this occurred (Gibbon 2012:199).

Gibbon (2012) notes non-lithic tools begin to appear more frequently during the Isle Phase and some have attributed this to a possible phenomenon called the Arvilla Burial complex, identified for the “consistent and recurring pattern of burial traits that span this transitional period” (Gibbon 2012:184). Deer antler hafts used for beaver incisors, bone awls, bone pins, and a variety of nonutilitarian objects including bone and turtle carapace pendants and shell beads and ornaments are examples of some of these traits (Gibbon 2012).

Studies of Middle to Transitional Woodland period sites in central Minnesota have primarily taken place in the Mille Lacs region located north of Sherburne County. Many of these sites are multicomponent with little stratigraphic separation between components. Arzigian (2008:88) notes 21AN0106, a multicomponent site in Anoka County is “one of the few sites with a distinguishable transitional component.” The assemblage contains St. Croix and Onamia series ceramics, lithic artifacts made from local and exotic materials (e.g., Knife River Flint, Hixton Silicified Sandstone, obsidian, and Burlington Chert), and tools including biface fragments, retouched blades, scrapers, modified flakes, and a projectile point (Arzigian 2008:88).

Late Woodland Period – The Blackduck-Kathio-Clam River Continuum (600 CE to 1100 CE) (Arzigian 2008)

The Blackduck-Kathio-Clam River Continuum is defined by a series of pottery types with similar forms and decorative motifs whose distribution appears to grade from north/northwestern Minnesota (Blackduck) through east-central Minnesota (Kathio) into portions of eastern and northwestern Wisconsin and eastern Minnesota (Clam River) (Gibbon 2012). These vessels are grit-tempered and cordmarked, usually globular in shape, with constricted necks (Arzigian 2008). Decorations are confined to the rim, lip, and neck of the vessels and consist of punctates, comb stamping, and cord-wrapped stick impressions (Arzigian 2008).

Kathio Complex lithic assemblages include unnotched and notched triangular projectile points like Madison points, Prairie Side-Notched points, and Plains Side-Notched points. These points are not typically considered diagnostics of the period as they are widespread throughout the state, although they do indicate Woodland period manufacture and use. Kathio lithic assemblages also include knives, side scrapers, end scrapers, drills, gravers, awls, bifaces, and utilized flakes (Arzigian 2008). Unlike earlier periods which saw the movement of non-local and exotic materials into the region, Kathio peoples appeared to rely primarily on locally source materials (Arzigian 2008).

In 1999, a Phase II archaeological survey was carried out in Sherburne County ahead of proposed improvements to CSAH 1 (Arzigian et al. 1999). Three sites, all multicomponent, were recommended as eligible for nomination to the National Register of Historic Places based on their research potential. Two of these sites (21SH0013 and 21SH0032) included Middle to Transitional and Late Woodland components, while the third appeared to contain an Archaic and Middle to Transitional Woodland component (21SH0041). The Woodland components at each of the sites consisted of both St. Croix and either Blackduck-Kathio or Blackduck-Kathio like ceramics; debitage; modified flakes; cores made predominantly from quartz, although one Knife River Flint core was recovered from 21SH0032; and formally shaped tools including scrapers, bifaces, projectile points, and one blade (Arzigian et al. 1999). All three sites represent repeated use over a long stretch of time.

Late Precontact Period/Post Woodland Period – The Psinomani Complex (1100 CE to 1750 CE) (Arzigian 2008)

The primary diagnostic of the Psinomani complex is the presence of Sandy Lake pottery. Sandy Lake ceramics have cordmarked, smoothed, or stamped surfaces and were tempered with a mixture of sand and grit and later shell. They are minimally decorated.

Lithic assemblages from this period were quite similar to Kathio assemblages and included knives, side scrapers, end scrapers, drills, gravers, awls, bifaces, and utilized flakes (Arzigian 2008). Projectile points were usually unnotched and triangular and are not seen as diagnostic.

Literature Review

As only preliminary testing has taken place, very little is currently understood about the Eagle Nest site and those once occupying it. This project will focus on the chipped stone tools and debitage recovered during the 2018 SCSU archaeological investigation in order to develop a greater understanding of the lithic technological organization of the peoples once inhabiting the site. It seeks to answer the aforementioned research questions pertaining to lithic raw materials, their distribution and their use through time; the range of lithic material culture present at the site, the types of technologies employed; whether usewear studies can answer questions about how these technologies were used and how they may have changed through time; and site layout and function (Arzigian 2008).

Technological Organization

William Andrefsky (2008:4) defines lithic technological organization as “a strategy that deals with the way lithic (stone) tool technology is embedded within the daily lives and adaptive choices and decision of tool makers and users.” Margaret Nelson describes three primary components or strategies of lithic technological organization analysis: environmental conditions, social and economic strategies, and technological strategies (Nelson 1991:59). All three have the potential to influence the ways in which humans choose to organize their technology. Artifact forms and their distribution across a site can offer clues about site layout and the location of activity areas. This in turn can help archaeologists more accurately interpret site function. The availability of lithic raw materials, the selection of certain materials over others, and the strategies employed during the production, manufacture, and maintenance of stone tools can help contribute broadly towards the understanding of the decisions and practices carried out by peoples of the past. Technological strategies are intimately intertwined with environmental conditions, and social and economic strategies, which all ultimately affect the ways in which people organize their lithic technology (Binford 1979; Nelson 1991; Odell 2004).

Based on his ethnographic observations of Nunamiut people, Binford (1979) proposed two technological strategies by which people may organize lithic technology: curated tools and noncurated tools. Curated technologies are those in which special care and long-term planning have gone into their maintenance, reuse, and recycling. Non-curated technologies, sometimes referred to as expedient tools or “situational gear,” are manufactured and used in response to a specific need or goal with the expectation there will be a sufficient supply of usable materials, and time available to make the tools needed to accomplish a task (Binford 1979; Nelson 1991). Nelson (1991:65) includes a third category of technological organization, opportunistic technology, which “is not planned…[but] responsive to immediate, unanticipated conditions.” The forms lithic artifacts take and their distribution across the landscape directly correlates to the occasions for and ways in which tools were manufactured, cared for, and ultimately became part of the archaeological record (Carr and Bradbury 2001; Nelson 1991).

To better understand lithic technological organization, it may be useful to begin by examining the “life histories” of lithic artifacts (Andrefsky 2008). From the procurement of the raw materials used to make a tool, to its final discard (whether intentional or unintentional), important aspects of technological organization can be gleaned by examining the life histories of lithic artifacts. The tool production continuum includes the procurement of raw materials, reduction of cores, the manufacturing of tools, the use of a tool, the maintenance of a tool, its recycling, and final discard (Andrefsky 2008). For this reason, it is important to consider *all* forms of lithic tool production byproducts, waste flakes, shatter, tools, and cores alike. Carr and Bradbury (2001) emphasize the importance of debitage analyses in determining the types of activities taking place on site, whether core reduction, biface production, or uniface production. They argue “integrating stone-tool and flake-debris data is essential in understanding lithic technologies and the role these technologies played in prehistoric lifeways” (Carr and Bradbury 2001:127).

Raw Material Procurement

Raw material procurement is a major component of lithic technological organization. Meltzer (1989) lists four ways lithic raw materials can be taken from a source and moved to a site: direct acquisition, indirect acquisition, direct acquisition from secondary sources, and indirect acquisition from secondary sources. Raw material types may be categorized as local, nonlocal, or exotic depending on their proximity to their original source. Bakken (1997:52) differentiates between local, nonlocal, and exotic materials by defining local materials "as those available in the immediate vicinity of the site" or in "territory that might be covered during normal seasonal rounds." Non-local materials are those occurring outside of the resource region, in this case the Western Superior Resource region and there are only four materials considered "exotic" in Minnesota: Knife River Flint, Hixton Quartzite, Burlington Chert, and obsidian (Bakken 2011:47). Bakken (2011) defines exotic materials as high quality, intensely quarried, and broadly circulated whereas nonlocal materials do not generally follow these conditions. Ethnographic studies have suggested any lithic source more than 40 kilometers (approximately 25 miles) away from a site should be considered nonlocal (Kelly 2013; Meltzer 1989). For the purpose of this study, definitions provided by Bakken (2011) will be used to classify materials as either non-local or exotic, and raw materials within 25 miles of a site will be considered local.

The majority of Minnesota is covered by glacial till which carried materials throughout the state, redepositing them in secondary contexts. In the past, this has made understanding raw material origins, their distribution, and use patterns within the state challenging. In 1997, Bakken proposed a regional model of lithic distribution and use in Minnesota, incorporating not only primary source data, but the distribution of secondary glacial deposits as well. The original model outlined three resource regions based on the state's geology: western, eastern, and southern resource regions. Years later, this model was refined and the three resource regions were rearranged to make four regions and several subregions (Bakken 2011). A resource region is defined as "a geographic area distinguished by the co-occurrence of specific lithic raw materials, notwithstanding the wider distribution of one or more of these raw materials, or the presence of other raw materials in parts of the region" (Bakken 2011:54). Subregions are smaller geographically, and lithic resources within them are more homogenous. Each region "contains a different set of raw materials from different combinations of raw material sources" (Bakken 2011:63). Knowledge of what is locally available is necessary to answer questions about material preferences and use, acquisition methods, exchange and interaction, and mobility and technological strategies as they relate to lithic technological organization practiced by people through time and space.

The Eagle Nest site, located in Sherburne County, falls into the West Superior Resource Region and the Quartz Subregion of central Minnesota. Bakken (2011) lists the primary materials used within the Quartz Subregion as quartz (including Winin Wabik, or "Fat Rock" quartz and polycrystalline quartz), Knife Lake Siltstone, and Tongue River Silica. Secondary materials used include Swan River Chert, Jasper Taconite, Gunflint Silica, Biwabik Silica, Hudson Bay Lowland Chert, Lake Superior Agate, and Lake of the Woods Rhyolite. Exotic materials found on sites within this region appear in small numbers and include Knife River Flint, Hixton Orthoquartzite, Burlington Chert, and obsidian (Bakken 2011).

Lithic Tool and Debitage Attributes

The presence or absence of certain attributes on flakes, cores, and tools can answer questions about the types of technological strategies employed by peoples inhabiting the Eagle Nest site. These include but are not limited to the following attributes.

Presence or Absence of Cortex: Cortical flakes are some of the first flakes removed from a nodule or cobble during core reduction activities. It is common during lithic analyses to categorize debitage by the amount of cortex present. These categories include primary flakes (those exhibiting the most cortex), secondary flakes, and tertiary flakes (those exhibiting no cortex). If a site contains large numbers of cortical flakes, it may suggest core reduction activities took place. Similarly, evidence of activities like tool resharpening or recycling may be seen on sites containing higher numbers of tertiary flakes. Andrefsky (1998) employs a 4-rank scale which allows cortex analyses to be replicated, however for the purpose of this project, cortex percentage will be estimated.

Presence or Absence of a Faceted Platform**:** Odell (2004:126) states, "the number of striking platform facets tends to discriminate effectively between core and bifacial reduction because bifacial platforms are typically prepared more carefully…yielding more facets."

Flake Termination: There are four primary flake termination types: feather, step, hinge, and outrepassé. According to Whittaker (1994), feather termination are generally the desired outcome of flake removal whereas the presence of hinge or step fractures often indicate the core was struck with too great or too little force. Evidence of hinge or step factures could indicate inexperience on the part of the flintknapper, a hidden flaw within the lithic core, and/or perhaps experimentation with new, unfamiliar materials.

Bipolar Core Reduction**:** Andrefsky (1998) states that a notable byproduct of bipolar tool reduction is large amounts of shatter. This shatter is generally free of bulbs of percussion and may exhibit compression rings. Additionally bipolar flakes should show some evidence of crushing on both ends.

Andrefsky (1998:147) describes bipolar cores as "amorphously shaped" and states they "can be easily confused with angular shatter." In general, bipolar cores are smaller than freehand cores. There is a correlation between the use of bipolar technology and the size and shape of the raw material and/or its flaking quality. This technology is believed by some to be a way in which to "maximize the use of lithic material" (Andrefsky 1998:227). Nodules or pebbles too small to be reduced by other means *can* be reduced using bipolar technology.

Intentional Blade Production: Waters et al. (2011:41) defines prismatic blades as "specialized elongate flake[s] with parallel or subparallel later edges, a length at least twice the width, and dorsal flake scars parallel to the longitudinal axis." Blades can be differentiated from blade-like flakes by the way they are manufactured and their general uniformity. They are systematically driven from carefully prepared cores at an angle approaching 90 degrees (Waters et al. 2011). Blades or bladelets were produced during the Paleoindian period and then again during the Middle Woodland period when they were exchanged within the Hopewell Interaction Sphere (ca. 50-350 CE) (Nolan et al. 2007). Middle Woodland blade production has been documented on some Minnesota archaeological sites, notably the JJ and Lillian Joyce sites at Knife Lake (Vogt 2017).

Secondary Modification (Retouch): As a tool was used, it occasionally needed resharpening. A tool's edge was retouched through the intentional removal of flakes. Odell (2004) states tools with secondary modification may exhibit contiguous, patterned, and similarly sized flake scarring on one or both sides. When flake scarring occurs on only one side, the tool is called a unifacial tool. When flake scarring occurs on both sides of a tool it is a bifacial tool. The presence of retouch or resharpening suggests the use of a curated tool technology.

Vaughn (1985) states it may be possible in some cases to distinguish intentional reshaping or retouch, from microchipping as a result of use, though this is not easy. He discusses an experimental study published by A. Barnes in 1932 which indicated incidental scarring produced from use was generally smaller than most of the retouch scars, although "on the parts of the edge where the smallest scars from the retouch were still present…it was not possible to distinguish them from the microscarring of wood and bone scraping" (Vaughn 1985:23).

Size: When viewed at the assemblage level, the length, width, and weight of complete flakes can be used to see patterning in flake-size distribution. Patterson (1990) for example, has shown through his own replicative studies, bifacial reduction will appear as an exponential curve when the size ranges of debitage and the percentage of flakes within each size range are plotted.

Microwear

Microwear analyses examine the wear left behind on a tool after it comes into contact with a material. They can help answer questions about tool function, site function, and more broadly, about the activities practiced in the past. Microwear analyses took off during the 1970s and 1980s, although the first record of magnification being used to examine wear on stone tools was in 1914 (Olausson 1980). The large majority of microwear studies have been performed on whole tools, but researchers have more recently begun to turn their attention to lithic debitage. In 1992, Schultz made note during his own replicative usewear study of how frequently he was resharpening his tool while processing hides. Tool maintenance removed most, if not all, of the usewear that had formed on the edge. Depending on the activity, Schultz determined debitage may actually be more effective in examining usewear than formal tools.

The results of a 2020 blind test focused on detecting microwear on lithic debitage were promising (Chan et al. 2020). The blind test showed it was possible to distinguish between flakes formed from used tools and those formed from unused tools. Directionality of the tool could be easily discerned, and usewear traces from contact with bone, wood, and hide could be identified with reasonable confidence. The most experienced microwear analysts were even able to accurately identify specific contact material types.

A blind study carried out by Young and Bamforth (1990) examined the accuracy of macroscopically identifying usewear on lithic artifacts. The study indicated there was a tendency for professional archaeologists to consistently misidentify edge damage as usewear, when in many cases it was created through processes other than use, which they defined as “used to alter some other material” (Young and Bamforth 1990:404). Additionally, the study appeared to show participants often made assumptions about which edges of a tool were used based primarily on the tool’s overall morphology and “how it might be manipulated most easily” (Young and Bamforth 1990). This is problematic because the form a tool takes and therefore the category it may be assigned to (i.e., projectile point or scraper) does not necessarily correlate to a specific function (Andrefsky 1998). While the morphology of Precontact tools may exhibit similarities to modern ones, microwear studies have shown Precontact tools oftentimes served multifunctional purposes (Andrefsky 1998; Nance 1971; Greiser 1977).

As mentioned above, when a stone tool comes into contact with a material, wear can occur. Depending on the “contact material” the tool was used on, the makeup of the stone itself, and the length of time or number of times a tool was used before resharpening, usewear may be observable or not visible at all. Vaughn (1985:19) lists five primary categories of cultural usewear traces potentially observable on stone tools: microchipping, striations, rounding, micropolishes, and residues. Any number of these characteristics may be present simultaneously in varying combinations (Dockall 1997). In fact, the reconstruction of tasks and activities occurring on an archaeological site is usually only possible if an artifact exhibits multiple forms of usewear (Fullagar and Matheson 2014). Striations, while helpful in determining directionality of use, rarely offer clues on their own about the types of materials being processed, and replicative studies have shown the presence of microchipping alone is unreliable because natural processes can create both random and patterned edge chipping identical to that from intentional use (Fullagar and Matheson 2014; McBrearty et al. 1998; Odell 2004; Vaughn 1985). For the purpose of this study, lithic artifacts were examined for microchipping, striations, rounding, and micropolishes. The following is a discussion of these attributes and their importance in usewear studies.

Microchipping: Microchipping refers to the scarring along the edge of a tool as a result of intentional use or natural, post-depositional processes (e.g., trampling, jumbling) (Vaughn 1985). Vaughn (1985) states that in general microchipping is not a reliable identifier of usewear on its own as it can be indistinguishable from intentional retouch and the effects of non-cultural activities. When occurring simultaneously with other usewear traces it could indicate usewear or at least help bolster the interpretation a tool may have been utilized. Microchipping as a result of use should exhibit patterning and should be localized (Tringham et al. 1974). According to Tringham et al. (1974:188), both hard and soft contact materials will create scalar-shaped scars, much like retouch but smaller. Scars formed through contact with hard materials tend to be large and deeper than those formed from soft materials. Additionally, the motion (whether longitudinal or transverse) and angle with which a tool is used can affect where microchipping occurs on its edge (Tringham et al. 1974; Vaughn 1985).

Micropolish: When a stone tool comes into repeated contact with another material, polish, or "a surface which reflects light," can form (Vaughn 1985:11). Polish may be more or less obvious depending on a stone's capacity to reflect light, which relates to its geochemical and structural makeup. There are three primary hypotheses concerning the formation and nature of usewear polish: abrasion, frictional fusion, and silica gel models (Vaughn 1985:12). Briefly, the abrasion model argues that as a stone tool is utilized, the grains making up the surface of the stone are smoothed and worn down. Depending on the nature of the contact material, particles transfer and adhere to the working edge of the tool with greater or lesser ease. The frictional fusion model states the heat generated during the use of a tool "melts" and fuses silica along a worked tool's edge. Finally, the amorphous silica gel model suggests as a tool is used, a silica gel briefly forms and then recrystallizes on the used surface of a stone tool.

There are a number of attributes characteristic of use-wear polish including varying degrees of brightness, linkage, and pitting. Brightness can be described as ranging from dull or matt to bright or glossy and is associated with the duration of use and the hardness of the contact material, with harder materials generally producing brighter polish than softer materials. Linkage refers to the joining of isolated polish components and occurs in later stages of development as the surface of a stone wears. Soft contact materials will create linkages more rapidly than hard contact materials. Lastly, pitting also occurs during later stages of polish development and refers to the areas in between the highpoints of individual mineral grains on a stone's surface.

Vaughn (1985) describes three "stages" of polish development: generic weak polish, smooth-pitted polish, and the formation of diagnostic polish. Generic weak polish can be described as "dull and flat with a surface texture which can be described as stucco-rough or lightly terraced in comparison with the unused flint" (Vaughn 1985:28). It forms in small patches along the edge of the tool and on topographic highpoints on the tool's surface and may look similar to natural bright spots on a stone's surface. Generic weak polish is not a good indicator of use on its own and should be considered only when co-occurring with other wear attributes.

Smooth pitted polish appears as smaller polish components on the high points of a tool. Dark spaces in between the polished areas create a lattice effect when viewed under high magnification. Linkages may begin to form between polish components, though these contain "micropits and pit-depressions which together with the interstitial spaces impart an overall roughish aspect…the surface of the small polish components themselves are more or less smooth" (Vaughn 1985:30). Similar to generic weak polish, smooth-pitted polish is not diagnostic of a specific function on its own and should be considered alongside other wear characteristics.

Diagnostic polish is the final stage of polish development. Polish developed during this state has characteristic features which can help determine the material being worked and the manner of use. Hard contact materials such as bone or antler can create diagnostic polishes quickly on fine-grained lithic materials, whereas soft contact materials tend to develop more slowly (Vaughn 1985). Coarser lithic materials develop diagnostic polish more slowly no matter the contact material. Vaughn (1985) describes eight primary categories of diagnostic polish –

each with their own unique combination of attributes – that occur as a result of intentional use: bone, antler, wood, reed, plant, tanned or dry hide, fresh hide and meat, and stone.

Bone Polish: Sawing motions form a "bright, smooth-pitted lattice of polish, possibly scored with grooves and troughs," while transverse and grooving motions appear as a "very bright, flat polish bevel or band with numerous comet-tails in the polish surface" (Vaughn 1985:32). Bone polish appears similar to antler polish and the two can be very difficult to distinguish from one another. However, if an artifact is cleaned with hydrochloric acid before being examined, bone residue can be removed creating a surface "riddled with micropits, pit-depressions, and interstitial spaces" (Vaughn 1985:31).

Antler Polish: The primary characteristic of antler polish as a result of sawing motions is a "bright smooth-pitted polish, possibly with small areas of diffuse depressions near the working edge" (Vaughn 1985:33). Transverse and grooving actions produce "very bright, localized heavy linkage, diffuse depressions in the polish surface" and "undulating smooth rounded bevels with some vague directional troughs" (Vaughn 1985:33). As mentioned above, antler polish may be difficult to distinguish from bone polish. The best way to differentiate between bone and antler polish is to bathe artifacts in hydrochloric acid prior to examining them. Hydrochloric acid removes bone residue and creates a pronounced pitting effect on the surface of the stone, whereas antler polish will maintain a smooth appearance.

Wood Polish: Wood polish develops slowly on a tool's surface. Contact with soft wood tends to develop polish more quickly than contact with hard wood. Vaughn (1985:34) characterizes wood polish from sawing motions as a "bright, smooth-pitted polish." Transverse and grooving motions form "very bright, smooth polish domes in various stages of linkage, vague interdome 'valleys' indicating use direction," and are "more widespread" across a tool's surface than bone and antler (Vaughn 1985:34).

Reed Polish: Reed polishes as a result of sawing actions may appear as a "bright smooth-pitted polish" or with prolonged use, as a "well-linked pattern of domed polish agglomerates and interstitials" which are "highly reflective" (Vaughn 1985:35). Transverse motions may form "woodlike or antlerlike" polish along the working edge of a tool or "a very flat, smooth, highly reflective polish bevel on the contact surface of the edge" (Vaughn 1985:35). Reed polish shares similar characteristics with antler and wood polishes and may be difficult to distinguish.

Plant Polish: Plant polish is very bright and will appear pockmarked until polish components are linked. This polish is "elevated above the flint surface" and widespread along the edge of a tool (Vaughn 1985:36). With use, striations and pits within the surface of the polish will begin to fill.

Tanned or Dry Hide: Tanned or dry hide polish is "dull, highly pitted" and "widespread" across the utilized edge of a tool (Vaughn 1985:37). It frequently co-occurs with other characteristics such as edge rounding, surface ridges, and striations.

Fresh Hide and Meat: Fresh hide and meat polish appears as a "bright, thin, smooth polish band" along the working edge of a tool with "patches of dull generic weak polish" (Vaughn 1985:38). Vaughn (1985) notes polish from natural soils may make fresh hide and meat polish difficult to observe if these traits overlap.

Stone: On experimental tool edges, Vaughn (1985:41) noted stone-on-stone polish created a "slight beveling of the edge consisting of a thin band of bright polish which is characteristically bumpy or uneven." Residue from the hammerstone can build up just below the beveling on the contact side and flattening and deep grooves may occur near the edge on the noncontact side (Vaughn 1985). Shearing, or the removal of stone, is more likely to occur than rounding as a result of polish development.

Striations: Striations are linear marks which may appear on a tool as a result of transverse (scraping) or longitudinal (cutting or sawing) motions. They can help determine the directionality of use. The width, depth, and shape of striations can be affected by both the granular structure of the material used to make a tool and by the material the tool comes into contact with (Vaughn 1985). Natural site formation processes can also form striations on artifacts over time. To distinguish between "artificial" natural wear and intentional cultural usewear, patterning will be an important component. Artificial striations will commonly be randomly placed and/or intersecting (Vaughn 1985).

Rounding or smoothing: Vaughn (1985) states the angle at which a tool is used can create rounding or smoothing of the working edge and may occur on the interior edge of a tool (where it comes into contact with another material) or on both the interior and exterior edge of a tool. Rounding or smoothing can help determine directionality of use, as these characteristics are most often a result of transverse motions.

Summary and Conclusion

The study of lithic technological organization examines the ways in which all aspects of stone tool technology are embedded within the daily lives of people (Andrefsky 2008). It includes the ways in which raw materials are acquired and selected for; how tools are produced, maintained, reworked, and discarded; the physical forms these tools take; and the ways in which they were used within behavioral and adaptational contexts. It is a holistic way of understanding how peoples made use of the environment around them and enables researchers to better understand important cultural aspects of society including social, economic, mobility, and subsistence strategies.

To examine the ways in which stone tool technology was embedded within the lives of peoples occupying the Eagle Nest site, four analyses were carried out for the completion of this project. These included a raw material analysis, a morphological analysis, a microwear analysis, and a spatial analysis. Each of these analyses is integral to the study of lithic technological organization. A holistic understanding of lithic technological organization is vital if we wish to understand “the conditions (natural, social, cultural) that [facilitate and] constrain human behavior within a given time-space framework” (Nelson 1991:88).

Chapter 3

Research Design and Methodologies

The goal of this research project was to come away with a general understanding of the technological organization of peoples occupying the Eagle Nest site during the Middle to Late Woodland period. This was attempted by 1) identifying the lithic raw materials making up the collection; 2) performing a general morphological analysis of the tools and debitage; 3) completing a microwear analysis of a subset of artifacts; and 4) by conducting a spatial analysis of the lithic assemblage. While each individual analysis worked to help answer the research questions laid out in Chapter 1, they were very much reliant on each other to do so. An understanding of material change through time, for example, could not be had without combining the results of the raw material analysis and the spatial analysis. Collectively they worked towards a holistic understanding of the ways in which stone tool technology was embedded within the daily lives of people and how their own preferences and practices influenced decisions now reflected in the archaeological record. The following is a discussion of the methodologies used for each analysis and the data required to answer the research questions postulated in Chapter 1.

Raw Material Identification

The entire lithic artifact assemblage was analyzed to determine the types of raw materials making up the collection. Knowledge of the types of raw materials, where and how they were acquired, the frequencies of their occurrence on the site, the ways in which they were used, and their vertical and horizontal distribution across the site assisted in answering the following research questions:

1. What is the full range of the lithic material culture present at the site, including tools, debitage, and types of materials used?

2. How does lithic technology and raw material acquisition and use change through time?

In general, the lithic raw material analysis was completed by macroscopically examining each artifact and logging the data in an Excel spreadsheet to allow for the data to be sorted and filtered later. Materials were noted as being local, non-local, or exotic. Materials unfamiliar to the analyst were examined for identifying attributes using a low power jeweler's loupe equipped with a light. The St. Cloud State University lithic comparative collection was used to aid in classification. In a guide created for the comparative collection at the Minnesota Historical Society, Wendt (2018) suggests identifying two to three attributes (listed below) per sample in order to significantly narrow the number of possible material types. As the analyst was familiar with a number of raw materials commonly found on archaeological sites in Minnesota, most materials did not require this level of analysis. If the specific material (e.g., "Cedar Valley Chert," "Hixton Silicified Sandstone") could not be determined, its generic term (e.g., "chert," "quartzite") was used. If materials could not be identified, they were recorded as such. The following is a list of attributes considered when examining unfamiliar lithic materials (Wendt 2018).

Color: The coloring of a stone can offer clues about its mineralogical makeup and therefore the type of rock (e.g., chert versus jasper) (Andrefsky 1998). Heat treatment, a process by which stone is slowly heated and then cooled in order to increase the controlled concoidal fracture characteristics of certain materials, can alter the color of a stone (Morrow 2016; Whittaker 1994). A Munsell Rock Color book (2009) can be used to systematically record color.

Surface and Sediment Texture: Surficial and structural textures can assist in determining the rock type (e.g., chert, quartzite, quartz). Additionally, finer grained stones are in general easier to knap than coarser grained materials and the presence of either, or both, may offer insight into Precontact raw material availability and preferences.

Translucency: Translucency is associated with the structural makeup of the stone (i.e., silica content) and may assist in determining subvarieties (e.g., Cedar Valley Chert opaque and translucent varieties).

Luster: The majority of raw materials in Minnesota are considered dull, although heat treatment can affect luster, resulting in a waxy or glossy sheen (Morrow 2016).

Color Pattern: Occasionally, a stone may exhibit color patterning such as banding or speckling that results from geologic formation processes and can assist with identification.

Magnetic response: Due to the presence of iron, a small percentage of raw materials, namely Iron Formation cherts and igneous rocks, may have a magnetic response which can be used to help identify material type and region of procurement.

Other Features (e.g., Fossils, Inclusions, Structural Features, and Infiltrates): Other defining features of some raw materials include oolites, spicules, vugs, and microfossils. The presence of these features can help greatly with material identification.

Morphological Analysis

The raw material analysis and morphological analysis took place simultaneously. The goal of the morphological analysis was to assist in answering the following research questions:

1. What is the full range of the lithic material culture present at the site, including tools, debitage, and types of materials used?
2. What types of technologies were being employed on the site?
3. When and where was bipolar technology used?

A total of 648 lithic artifacts were sorted into one of seven categories: formal tools, primary flakes, secondary A flakes, secondary B flakes, tertiary flakes, shatter, and other (e.g., modified flakes). Flakes were differentiated from shatter by the presence of a striking platform, bulb of percussion, dorsal-ventral distinction, and/or termination.

Following similar analyses (see Hammond 2013; Wendt 1988), the type of flake was determined by the amount of cortex present on the dorsal surface, with primary flakes exhibiting 100 percent cortex, secondary A flakes >50 percent cortex, secondary B flakes <50 percent cortex, and tertiary flakes showing no cortex. As mentioned earlier, the presence or absence of cortex directly correlates to certain activities practiced on the site (i.e., core reduction, tool production, and maintenance) and an understanding of activities occurring on a site can offer clues about site function(s) and layout. Flake type and percentage of cortex were recorded in a spreadsheet alongside data collected during the raw material analysis. Additionally, all flaking debris was examined, and the following attributes recorded: presence or absence of a faceted platform, flake termination type, presence or absence of bipolar technology, and presence or absence of intentional blade production.

Metric measurements of formal tools (e.g., projectile points) and complete flakes were taken in order to document maximum length, maximum width, thickness and weight. Broken flakes were recorded as broken. All measurements were taken in millimeters (length, width, and thickness) and grams (weight). Length, width, and thickness were rounded to the nearest tenth of a millimeter, while weight was measured to the nearest thousandth of a gram. Measurements were used to look for patterning in flake size distribution.

Following a similar study carried out by Patterson (1990), a statistical analysis was completed using the measurements of the flakes to examine the possibility bifacial-reduction activities may have occurred at the Eagle Nest site. In a perfect scenario, this analysis would have been carried out by physically screening the flakes through different sized, stacked wire mesh screens. Size grades would then be determined based on which sized screen the artifact failed to pass through. Unfortunately, in order to maintain the proveniences of all the artifacts, this was not an option. Instead, this analysis was attempted mathematically. First, the maximum length and maximum width of each flake were multiplied to determine the surface area (mm^2) of each flake. Second, the area of mesh screen openings for four screen sizes were calculated. This was done to determine the minimum size the flake would theoretically need to be in order to get caught in the screen and not fall through. During the 2018 survey, a 1/8-inch screen was used in at least one quadrant of each unit, but the majority of artifacts were screened through a 1/4-inch screen. This suggests artifacts smaller than a 1/4-inch screen opening were potentially missed during unit excavation unless they happened to occur within the quadrant using the 1/8-inch screen size or they were point plotted. If this theory is correct, the actual number of Size Grade 4 flakes in the excavation units could be as much as four times larger. The results of this analysis were plotted with artifact frequency along the *y* axis and size grade along the *x* axis. Patterson (1990) has shown that if bifacial-reduction is occurring at a site, when plotted the graph will show an exponential curve.

The four screen size openings used for this analysis were one inch, 1/2-inch, 1/4 inch, and 1/8 inch. The size grade categories used to organize the flakes for this analysis are as follows:

Size Grade Category 1: Greater than 1" wire mesh screen (~645 mm)

Size Grade Category 2: Greater than 1/2" wire mesh screen (~161 mm)

Size Grade Category 3: Greater than 1/4" wire mesh screen (~40 mm)

Size Grade Category 4: Greater than 1/8" wire mesh screen (~10 mm)

A similar analysis was done using the average weight (g) of the flakes. Flakes within each size grade were calculated to look for patterning suggestive of marginal and nonmarginal flaking activities. Ahler (1989:91) defines marginal flaking as being "associated with operations in which bifacial thinning is the goal," while "nonmarginal flaking is often associated with freehand core reduction and margin trimming and shaping." Nonmarginal flakes tend to be longer, thicker, and heavier than marginal flakes, though the width of both, within a specific size grade, is quite similar (Ahler 1989). Ahler states differences between the two flake types should "be evident even if two flake samples had similar or identical size-grade distributions by count…size grade distributions by weight would be expected to vary significantly" (Ahler 1989:91).

For both of these analyses, flakes recovered from the north area in Units N1, N2, and N3 were viewed as one batch; flakes recovered from Units P1 and P5 were viewed as one batch; and flakes recovered from the two midden units, P2 and P4, were viewed as one batch. Combining these units was justified based on their physical proximity to each other and the in-field interpretation of different site functions for the three areas. This resulted in a larger sample size for each batch and made it easier to examine and compare separate areas of the site through spatial analysis, in order to see if certain flake size distribution patterns were visible horizontally and vertically.

Microwear Analysis

Following the raw material and morphological analyses, a sample of the lithic assemblage was analyzed for microwear. The primary goal of the usewear analysis was to help answer the following research questions:

- Can usewear studies yield information about activities and tool use?
- Can internal patterning of activity areas or features be discerned? What can this tell us about the nature of activities conducted at the site and/or site function?

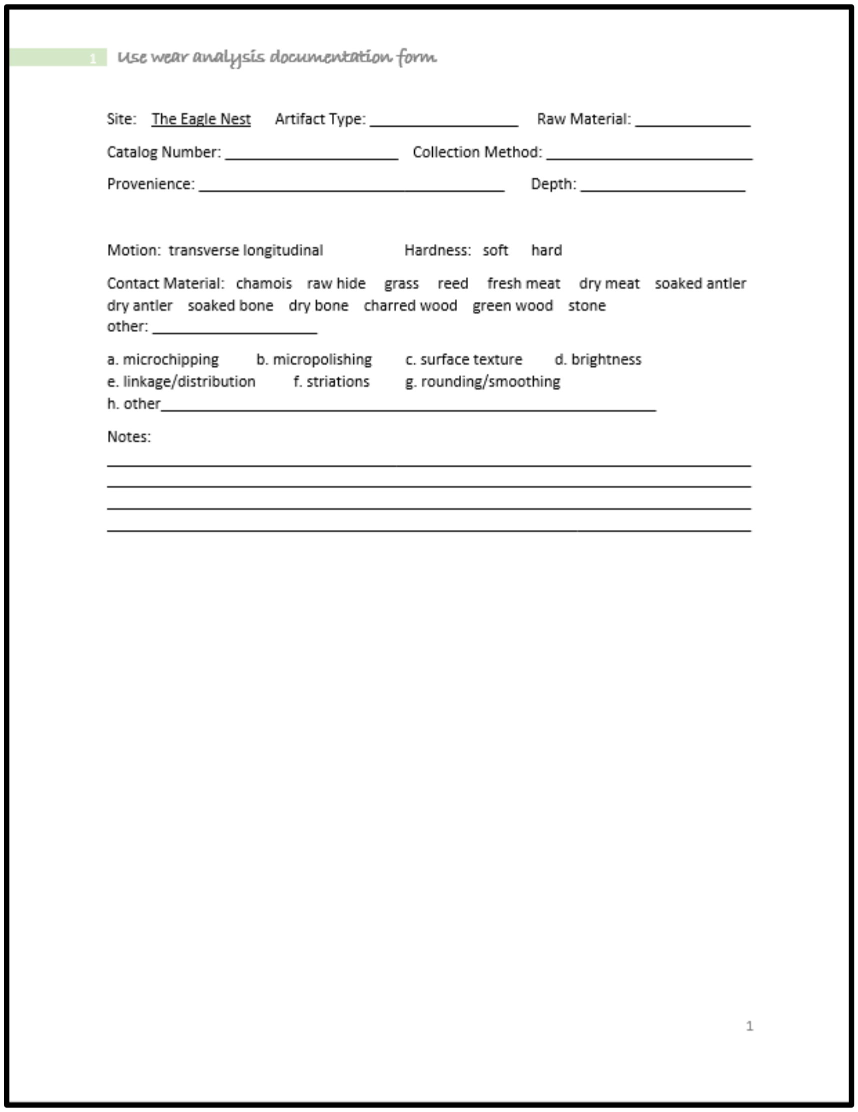
A secondary goal of the usewear analysis was to determine the applicability of usewear studies in CRM, a field with significant time and budget constraints, which have historically made in-depth analyses such as these challenging.

Microwear analyses can assist with determining the function of a stone tool (Vaughn 1985). As Andrefsky (1998:5) notes, these analyses are performed "by examining direct evidence in the form of usewear on the tool surfaces, particularly near the edges." While formal tools are more commonly the subject of usewear analyses, for the purposes of this project both stone tools and debitage was carefully examined. The reason for this is the obligatory resharpening required during or after certain tasks (see Chan et al. 2020 and Schultz 1994). Additionally, it was hoped that analyzing the debitage sample could provide insight on the utility of using this ubiquitous artifact class to learn important information that would otherwise go unnoticed. Considering debitage is one of the most common artifact types encountered during CRM projects, positive results from this study could make a substantive contribution to future CRM methodologies and project outcomes.

The microwear analysis was carried out in two parts. Part I was composed of a replicative usewear study during which flakes were intentionally created using the same or similar raw materials as those occurring most frequently at the Eagle Nest site. Samples of these materials were donated to the analyst by the St. Cloud State University Anthropology department to use for the purposes of this study.

The flakes created for the replicative study were used in controlled transverse and longitudinal motions on 13 materials of varying hardness in order to create diagnostic usewear to use as a reference to which the Eagle Nest collection could be compared. Contact materials for the replicative study included soft and hard wood; chamois and raw hide (to stand in for soft/fresh and hard hide); grass/wheat; fresh and dry meat; soaked and dry antler; fresh and dry bone; green wood; and stone. The flakes were used in stroke intervals of 250, 750, and 1,500 in order to recognize early, middle, and late stages of usewear formation, and to ensure enough usewear developed on the tool that it could be used as a comparative reference for Part II of the analysis. The motion or directionality of use (i.e., transverse or longitudinal), the contact materials, and the number of stroke intervals for each flake were recorded on specialized microwear analysis forms (Figure 3.1). Additionally, a sketch was made of the ventral and dorsal sides of each flake and any major dorsal ridges they may have had. These drawings were used during the replicative microwear analysis to record the types of usewear present on the flake and the location on the artifacts where the usewear occurred.

After use, the test flakes were thoroughly cleaned to remove oils and any other forms of residue adhering to the surface. Cleaning the artifacts was a two-step process. Artifacts were first placed in an ultrasonic cleaner set to a warm temperature and lined with paper towel. The entire surface area of each artifact was covered with Mr. Clean, a cleaning agent that contains hydrochloric acid (HCl), a compound used to help distinguish between bone and antler polish, which are otherwise indistinguishable. If an artifact came into contact with bone, a sodium chloride bath reveals tiny micropits within the polish surface which assists with identification. The artifacts were placed in the ultrasonic cleaner for 15 minutes before they were removed and thoroughly rinsed with warm, fresh water. After this, the artifacts were again placed in the ultrasonic cleaner, this time filled with mineral spirits, for 15 minutes in order to remove oils from handling. Following the mineral spirits bath, the artifacts were once again rinsed with warm, fresh water and patted dry. Gloves were worn by the analyst throughout the cleaning process and during the analysis to avoid the transfer of oils onto the artifact surfaces. Once thoroughly cleaned, the artifacts were examined for usewear traces using an Olympus BX41M-LED Incident Light Stereo Microscope with magnification ranges between 50x to 400x. All findings were carefully logged.



1 Use wear analysis documentation form

Site: The Eagle Nest Artifact Type: ________________ Raw Material: ______________

Catalog Number: ____________________ Collection Method: ________________________

Provenience: ____________________________________ Depth: ___________________

Motion: transverse longitudinal Hardness: soft hard

Contact Material: chamois raw hide grass reed fresh meat dry meat soaked antler
dry antler soaked bone dry bone charred wood green wood stone
other: ___________________

a. microchipping b. micropolishing c. surface texture d. brightness
e. linkage/distribution f. striations g. rounding/smoothing
h. other____

Notes:

1

Figure 3.1. Image of Microwear Analysis Form Used to Document Usewear Present on Replicative Tools.

For Part II of the microwear analysis, both formal tools (i.e., projectile points) and flakes recovered from the Eagle Nest site were examined for usewear. Only a subset of the flakes, those with intact platforms, were analyzed for microwear. This is because as flakes are removed during resharpening, the used edge of a tool becomes the platform by which flakes are struck. Usewear traces are more likely to survive if the platform remains. Once the artifacts (tools and flakes with intact platforms) were pulled from the rest of the assemblage, the sample was further stratified into four categories: shovel tests, surface finds, artifacts recovered from the Ap horizon in each of the units, and artifacts recovered from the B horizon in each of the units. For this particular study, the decision was made to analyze all of the shovel test and surface artifacts and to randomly select one artifact from the plow zone and one artifact from the sub-plow zone from each of the units. All shovel test and surface artifacts were analyzed to recreate a scenario similar to what may occur during a typical Phase I archaeological survey in a CRM context, where the large majority of sites are lithic artifact scatters. Analysis of these artifacts addressed the potential of using this kind of sample to identify if artifact function and activity areas could be discerned. The purpose of analyzing the random samples pulled from each unit was to come away with a greater understanding of how the site may have been horizontally organized in terms of activity areas. The excavation sample also provided a comparison for the surface collection and shovel test samples. Once the artifacts were selected for analysis, they were thoroughly cleaned to remove oils and any other forms of residue adhering to the surface.

Each of the selected artifacts was cleaned in the same manner as in Part I of the study. After being cleaned, the artifacts were examined for the following microwear attributes: microchipping, micropolishing, surface texture, brightness, linkage/distribution, striations, rounding or smoothing, and directionality of use. Additional characteristics were described under the category, “other.” The same specialized microwear analysis sheets used in the replicative study were used to log all attributes present on each of the artifacts and the locations in which they occurred. If microwear could not be discerned, this was noted.

Spatial Analysis

A basic spatial analysis of the Eagle Nest lithic assemblage occurred with the goal answering the following research questions:

- Can internal patterning of activity areas and features be discerned? What can this tell us about the nature of activities conducted at the site and site function?
- How does lithic technology and raw material acquisition and use change through time?

- When and where was bipolar technology used?

Distinct vertical concentrations can assist researchers in establishing site chronology which is crucial if we are to answer questions regarding change through time. The patterning of artifact clusters across the site has the potential to reveal activity or refuse areas and horizontally discrete occupations.

Within each of the units, artifact frequencies were examined to look for vertical concentrations that may suggest multiple components. Unit excavation revealed a stratigraphy that lacked significant signs of geologic erosion or deposition. Sedimentary stability can make it difficult to determine the number of components within a site boundary because temporally distinct artifacts can become compressed and mixed over time (Waters 1992). Cultural and natural site formation processes like plowing and freeze-thaw effects can also move and jumble artifacts. In order to use stratigraphy with any confidence, it should be considered in tandem with other forms of evidence. In situ diagnostic pottery or tools can be useful horizon markers and radiocarbon dating can provide date ranges with statistical confidence. Additionally, technological and stylistic changes may signify different components.

It was inferred, based on the ceramics recovered from the site, that there were at least two components, Transitional and Late Woodland. To determine whether these and potentially other components could be clearly defined, tables displaying artifact frequency by depth were created for each of the units. During the 2018 archaeological excavation, units were dug in 10 cm levels through the plow zone and then five cm levels through the sub-plow zone. This analysis used depth increments of five cm in order to capture as much detail between levels as possible. During the 2018 excavation, artifacts recovered from the plow zone were bagged every 10 cm as well. To address this issue, the total number of artifacts within each 10 cm plow zone level was divided in two and distributed evenly. So, if 10 artifacts, for example, were recovered between 10 and 20 cmbs, the artifact frequency from 10 to 15 cmbs would be five and the artifact frequency between 15 and 20 cmbs would also be five. The artifact frequency tables were then converted into bar charts to help visually display the results.

To complement the vertical analysis of artifact frequencies, a vertical analysis of select raw materials was completed to look for patterns that suggest discrete occupations and change through time. Bar charts were created to examine the vertical frequencies of all exotic materials and select non-local and local-materials. Additionally, it was important to look at the artifacts from surface and plow zone contexts and compare them to those in the sub-plow zone to try to determine whether they could be related or were part of a separate component altogether. Raw material use patterns can change through time depending on source availability or preferences as they pertain to tool technology. If artifacts within the plow zone were manufactured from lithic raw materials that were significantly different than those in the sub-plow zone, it could suggest artifacts within the Ap horizon were part of a separate occupation altogether.

To determine whether the artifacts on the surface and within the plow zone were part of the same parent population as those within the sub-plow zone, a chi-square test was completed looking at the lithic raw material types in the plow zone and those in the sub-plow zone. At first, a chi-square test was run using each identified material type found within both contexts. Unfortunately, certain rules must be followed when using chi-square and too many of the expected values were less than 5. To resolve this issue, select raw materials were used for the analysis. These materials were selected because they were the most commonly used materials on the site. The raw materials included Knife River Flint, rhyolite, polycrystalline quartz, Prairie du Chien chert, and Winin Wabik quartz. For this analysis, the dependent variables were the raw material types (either local or non-local/exotic) and the independent variables were the plow zone and the sub-plow zone. A 2x5 table was created and the chi-square test was then completed in the program PAleontological STatistics, or PAST, Version 4.11. To correct for the possibility of a Type 1 error, a Bonferroni post-hoc test was applied to the results.

The horizontal spatial analysis of the site was carried out in order to observe the site for activity areas. This was done by examining the results of the microwear study, the distribution of the lithic raw materials across the site, and by observing flake size distribution patterning that may indicate differences in tool production activities across the site. The proveniences of the artifacts with usewear were identified in order to observe potential patterning suggestive of specific activity areas. Similar examinations were completed using the results of the mass analyses. Lithic production activities were analyzed across the site to look for patterning indicative of specific activities.

In addition to the vertical and horizontal spatial analyses it was crucial to examine the possibility that the site was affected by natural site formation processes. If the matrix surrounding an artifact freezes, ice can form below the artifact, pushing it upward. When the ground thaws, the void where the ice once was fills with soil, permanently displacing the affected artifact(s) (Waters 1992). In general, larger artifacts tend to be pushed upward more rapidly than smaller artifacts, and over time a temporally related assemblage can be vertically separated through a process called size sorting (Waters 1992).

To examine the site for potential freeze-thaw effects, a *t*-test was completed to determine whether there is a significant difference between the mean surface area (mm^2) of the lithic artifacts located on the surface and within the plow zone, and those located within the sub-plow zone. For this test, a random sample was selected from the surface and plow zone recovered lithic artifacts and those recovered in the sub-plow zone. Box-and-dot plots were created to determine if there were outliers and to inspect the overall shape of the batches. There were several outliers that needed to be dealt with before the t-test could proceed. When a 15 percent trim on each of the batches failed to get rid of all outliers, a 20 percent trim was successfully applied to each batch. The newly trimmed batches were then Winsorized to determine the trimmed standard deviation and the t-test was completed.

Summary and Conclusions

Four analyses were carried out for the completion of this project. A raw material analysis was completed to analyze the full range of raw materials present at the site and to determine whether the use of these materials changed through time. A morphological analysis was completed to understand the full range of material culture at the site and the technological strategies employed by peoples occupying the Eagle Nest site. A microwear analysis was performed to see whether: 1) these studies can reveal information regarding the function of tools, site activities, and site function or layout; and 2) to determine whether microwear analyses can easily be applied to the field of CRM. And finally, a spatial analysis was completed to help answer questions pertaining to site layout and function, technological and raw material change through time, and to examine the possibility that natural site formation processes impacted the site. Each of these analyses worked together to allow for a more complete understanding of lithic technological organization.

Chapter 4

Results

Raw material Analysis

The raw material analysis was completed in order to determine the full range of raw materials making up the Eagle Nest site lithic assemblage. These results were later used in a spatial analysis of the site to gain an understanding of raw material selection, acquisition, and use through time.

A variety of materials were identified within the Eagle Nest assemblage. Table 4.1 lists the total percentage of the raw material types, their frequency, and whether they are considered local, non-local, or exotic. Local raw materials made up 75 percent of the collection, non-local raw materials made up approximately seven percent, and exotic materials just over four percent. Approximately 16 percent of the raw materials in the collection could not be identified and therefore origin could not be determined. Of these unidentified materials, a large proportion was chert, approximately 10 percent. Much of this chert was fine-grained and light tan in color.

The dominant material types occurring at the site were rhyolite, Winin Wabik, or “Fat Rock” quartz, and polycrystalline quartz. Winin Wabik quartz was distinguished from polycrystalline quartz by its foliated texture and white colored, webbed patterned line dislocations (Wendt 2018, 2024) (Figure 4.1). Secondary use materials included Tongue River Silica, Swan River chert, Knife River Flint, and Prairie du Chien chert. Other non-local and exotic materials such as obsidian, Burlington chert, Grand Meadow chert, Hixton Silicified sandstone, and Cedar Valley chert all appeared in very small amounts. In general, the raw materials present at the Eagle Nest site tend to follow use patterns of aggregated data from sites containing Precontact ceramic assemblages (Bakken 2011). The use of quartz was highly important throughout the Woodland period, with other materials such as Tongue River Silica and

Swan River chert also playing important roles in the Quartz Subregion.

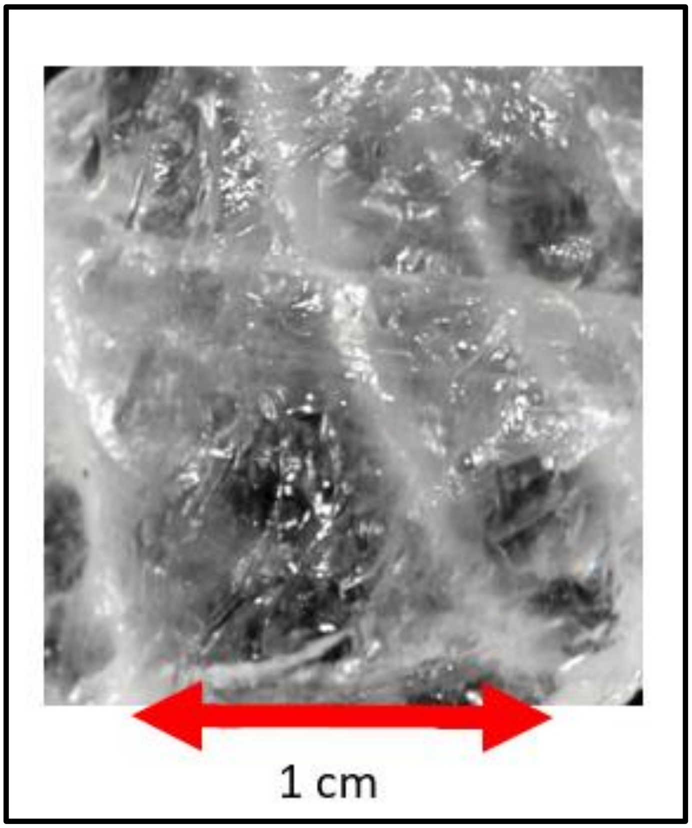


Figure 4.1. Closeup Image Illustrating White, Webbed Line Dislocations Typical of Winin Wabik Quartz.

Interestingly, rhyolite was the dominant raw material recovered from the site. While rhyolite is not uncommon in the quartz subregion per se, it is usually considered a minor, rather than a primary, use material (Bakken 2011). The most common form of rhyolite, Lake of the Woods rhyolite, occurs in the northwestern portion of the state (Bakken 2011; 2016). Other forms of rhyolite occur in glacial till, but natural distribution and cultural use patterns are not well understood (Bakken 2011).

Table 4.1. Frequency and Percentage of Raw Material Types at the Eagle Nest site.

Material Type	Frequency	Percent of Total
Local		
Rhyolite	152	23%
Winin Wabik (“Fat Rock”) Quartz	99	15%
freecrystalline Quartz	75	12%
Tongue River Silica	52	8%
Swan River Chert	53	8%
Jasper	10	2%
Siltstone	7	1%
Gunflint Silica	4	< 1%
Basalt	1	< 1%
Agate	1	< 1%
Non-Local		
Prairie du Chien Chert	33	5%
Cedar Valley Chert	15	2%
Grand Meadow Chert	4	< 1%
Exotic		
Knife River Flint	25	4%
Burlington Chert	5	< 1%
Hixton Silicified Sandstone	4	< 1%
Obsidian	3	< 1%
Undefined Locality		
Chert	65	10%
Unidentified	32	5%
Chalcedony	7	1%
Quartzite	1	< 1%
Total	**648**	**100%**

The use of quartz was also quite high at the Eagle Nest site, but this was to be expected. Quartz occurs widely throughout Minnesota but likely occurs more abundantly within the Quartz Subregion (Bakken 2011). There are two primary forms of quartz found in Minnesota: Winin Wabik or “Fat Rock” quartz, and polycrystalline quartz. The majority of lithic analyses do not separate the two, which is why the natural and cultural distribution of this material is not well understood. For the purposes of this study, the two were separated.

Winin Wabik quartz is quartz material found in central Minnesota (Bakken 2011). There is a known quarry site located at Little Falls in Morrison County, but cobbles and pebbles have also been found north and south of this primary source, near the banks of rivers and within plowed fields (Bakken 2011; Wendt 2024). The flaking quality of Winin Wabik quartz is average when compared to cherts and many other raw materials within the state but is considerably high compared to more commonly occurring polycrystalline quartz (Bakken 2011). In general, these other forms are of rather poor quality and often required the use of specialized technologies when dealing with them due to their package size which tends to range from pebbles (~ 4 to 64 mm) to cobbles (~64 to 256 mm) (American Geosciences Institute 2023; Bakken 2011).

The Eagle Nest assemblage had a wide range of local, non-local, and exotic materials. By far the most heavily used materials were found locally, but there appears to have been connections with groups to the west, east, and south of the state. Burlington Chert is prevalent in portions of Iowa, Illinois, and Missouri, but does not occur in Minnesota naturally (Bakken 2011). It was likely brought into the state through some form of trade or exchange. Similarly, obsidian does not naturally occur in the state, but is commonly found in western and southwestern portions of the country. During the Early to Middle Woodland period, obsidian was exchanged throughout the Midwest as part of the Hopewell Interaction Sphere. While there is currently little evidence linking central Minnesota to the Hopewell exchange, it is plausible this material found its way onto the Eagle Nest site during this time. If anything, obsidian is a relatively rare find on archaeological sites in Minnesota and its presence indicates peoples in the area were participating in complex trading networks, likely with groups residing on the western Plains.

Two pieces of Knife River Flint debitage had weathering or cortex on the dorsal side (8 percent of the total Knife River Flint assemblage). The length, width, thickness, and weight of the flake with cortex was greater than the mean length, width, thickness, and weight of the entire Knife River Flint assemblage. The length, width, and weight of the flake exhibiting weathering was just below the mean of the Knife River Flint assemblage, although its thickness was greater (Table 4.2).

Table 4.2. Metric Measurements of Cortical Knife River Flint Flakes and Mean Metric Measurements of the Knife River Flint Assemblage.

Artifact Number	**Percentage of Cortex**	**Length**	**Width**	**Thickness**	**Weight**
SHB3.30.0494	<50% Weathering	7.4 mm	7.0 mm	2.1 mm	0.114 g
SHB3.30.1479	>50% Cortex	11.3 mm	9.8 mm	2 mm	0.19 g
Total Knife River Flint Assemblage					
Frequency	**Percentage with Cortex**	**Mean Length**	**Mean Width**	**Mean Thickness**	**Mean Weight**
n = 25	8% of entire Knife River Flint Assemblage	9.1 mm	7.4 mm	1.3 mm	0.122 g

The presence of these cortical flakes is interesting, because many exotic raw materials are frequently viewed as coming into the state through some larger trade or exchange network as preforms or already shaped tools. Knife River Flint, while available in Minnesota's glacial till, is rare, small in size (likely no greater than 5 cm for round pebbles and perhaps slightly larger for tabular pieces) and likely of much poorer quality (Bakken 2011:96). A Phase II archaeological survey of site 21SH0032, located in Sherburne County, recovered a Knife River Flint core (Arzigian 1999). The presence of the core at 21SH0032 and the cortical flakes recovered from the Eagle Nest site may indicate this particular toolstone was procured at its primary source in North Dakota and brought into this region as unaltered cobbles by means of exchange.

Other materials like Grand Meadow Chert and Cedar Valley Chert are found within the state, but their availability is restricted, in this case to the southeastern portion of the state, well over 100 miles away from the site. While it is plausible these materials were acquired directly from their source through some form of embedded procurement strategy, it seems more likely, given the age of the site, the materials were obtained through some form of exchange. This inference is based on the idea that as populations grew and became increasingly less mobile during the Woodland period, direct access to certain resources including raw materials diminished (Gibbon 2012) (Figure 4.2).

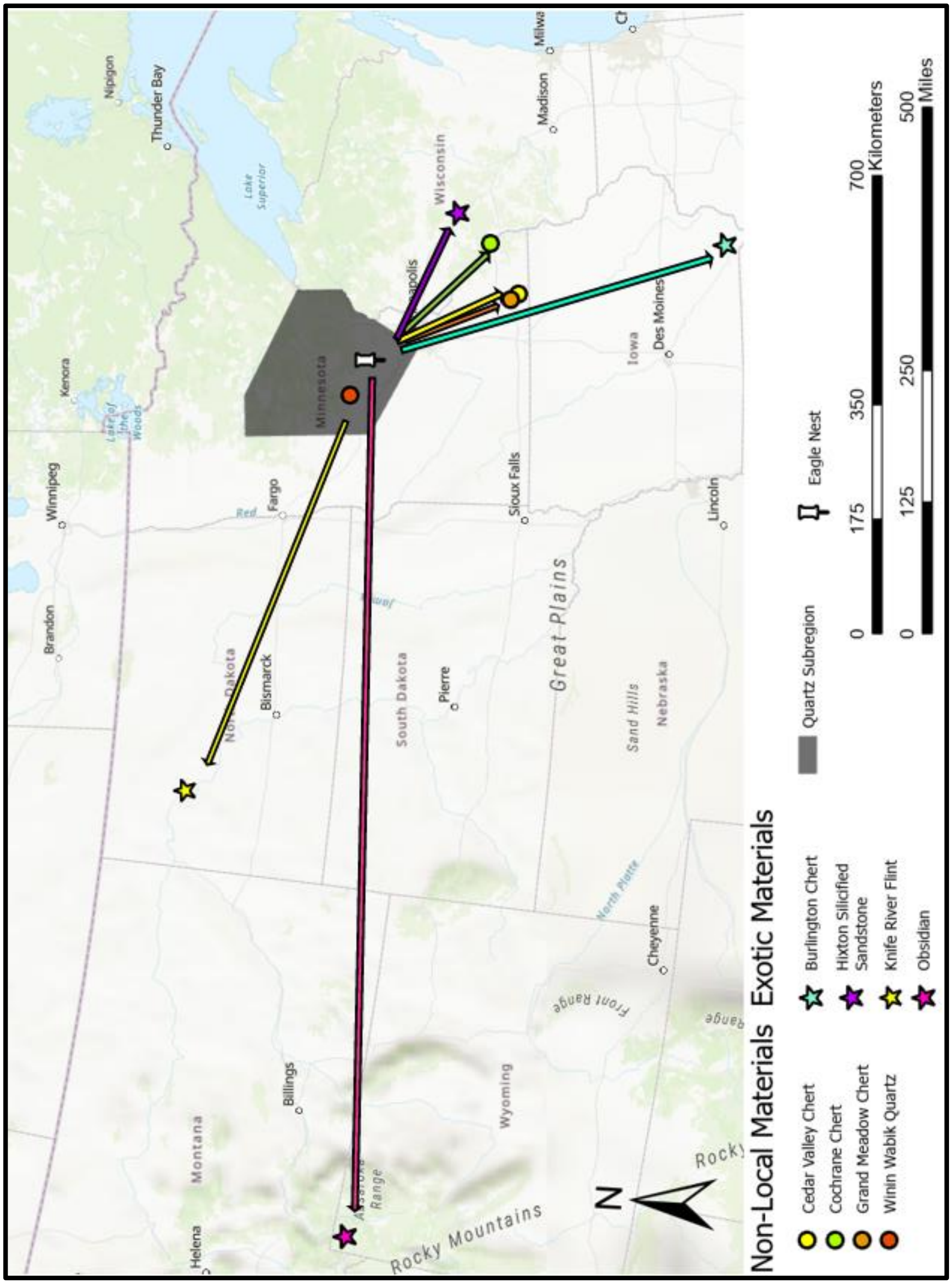


Figure 4.2. Map Showing Extent of Quartz Subregion and Provenances of Non-Local and Exotic Materials.

Morphological Analysis

For the morphological analysis, lithic artifacts were organized into one of seven categories: formal tools and tool fragments, primary flakes, secondary A flakes, secondary B flakes, tertiary flakes, shatter, and other, which included artifacts such as modified flakes and blade-like flakes (Table 4.3).

Table 4.3. Frequency and Percentage of Lithic Artifacts within Each Category.

Artifact Type	**Formal Tools**	**Primary**	**Secondary A**	**Secondary B**	**Tertiary**	**Shatter**	**Other**
Frequency	8	3	40	71	358	149	19
Percentage of Total Assemblage	1%	<1%	6%	11%	55%	23%	3%

The results of the analysis indicate over half of the collection was made up of tertiary flakes while less than 1 percent of the collection (only 3 artifacts) were categorized as primary flakes. The amount of cortex is thought to correlate with different stages of reduction and production strategies. An assemblage primarily consisting of tertiary flakes, such as this one, suggests tool production and maintenance was the prominent form of debitage production taking place at the site.

Twenty-one percent of the collection was comprised of shatter, the overwhelming majority of which was made from rhyolite and quartz, likely collected locally from glacial till. Little is known about the package size of rhyolite in till contexts, though several rhyolite flakes were quite large suggesting cobbles were likely being reduced. They may have been retrieved from along the St. Francis River to the north of the site. The quartz shatter was quite small, the large majority seemingly created from the use of locally acquired large pebbles or small cobbles. Bipolar technology tends to create a lot of shatter, which may exhibit crushing on opposing surfaces as well as both ends of opposing flake scars. The technique involves using a hammerstone to strike a stone on an anvil in order to break open the material. It seems plausible this technique may have been practiced at the Eagle Nest, although clear signs of bipolar technology were not visible among the artifacts analyzed for this study. The technology itself is believed by many to be a response to the package size of raw materials (Andrefsky 1998; De la Peña et al. 2015; Odell 2004; Shott 1989; Sievert and Wise 2001). As cobbles approach the size of pebbles, they become too small to hold in the hand and effectively flintknap. It then becomes more advantageous to break them with the bipolar technique that can produce unexpected sizes and shapes of flakes than to not have a sharp edge at all. Andrefsky (1998:149) states the use of bipolar technology appears to take place "in areas where raw materials that have high chipping quality are rare or absent. In areas where raw materials with high chipping quality are abundant, the pattern of core production is frequently different." It is a form of economizing behavior in which peoples tried to get as much as they could from what they had available to them (Odell 2004).

Of the four types of exotic raw materials found in the collection, two retained cortex or weathering on the dorsal surface. Hixton Silicified Sandstone and obsidian had no cortex and/or weathering, while Burlington Chert and Knife River Flint did exhibit cortex and/or weathering. As mentioned earlier, of the 25 pieces of Knife River Flint recovered from the site, two pieces (8 percent) retained cortex or weathering. Surprisingly, of the five pieces of Burlington Chert, three pieces (60 percent) still had cortex or weathering and were classified as Secondary B flakes. The other two were classified as shatter and a tertiary flake. This may suggest one of two things: 1) Burlington Chert as a raw material nodule was exchanged; or 2) preforms with some cortex remaining on the surface were produced and exchanged. Table 4.4 lists the amount of cortex on each Burlington Chert flake as well as their metric measurements. These data can be compared to the mean metric measurements and percentage of cortex present on the entirety of the Eagle Nest flake assemblage. In general, the length and thickness of the cortical Burlington Chert flakes is greater than the mean length and thickness of the total collection of flakes.

Table 4.4. Metric Measurements of Burlington Chert Flakes and Mean Metric Measurements of the Total Flake Assemblage.

Artifact Number	**Percentage of Cortex**	**Length**	**Width**	**Thickness**	**Weight**
SHB3.30.0017	<50% Cortex	25.4 mm	17.7 mm	7.3 mm	3.5 g
SHB3.30.0024	>50% Weathering	16.3 mm	6.5 mm	3 mm	0.3 g
SHB3.30.1750	0%	10.7 mm	5.4 mm	2 mm	0.1 g
SHB3.30.1763	<50% Cortex	13.8 mm	7.3 mm	5.4 mm	0.4 g
Total Flake Assemblage Containing Cortex					
Artifact Frequency	**Percentage of Cortex**	**Mean Length**	**Mean Width**	**Mean Thickness**	**Mean Weight**
n = 472	24% Cortex	10.9 mm	9.3 mm	2.5 mm	0.8 g

Formal Tools

A total of eight formal tools and tool fragments were collected during the 2018 survey (Table 4.5). These consisted of three Transitional/Late Woodland period projectile points, three projectile point tip fragments, one projectile point midsection, and one shaped tool base or handle fragment.

Unnotched triangular points are common in Minnesota and the eastern United States and are frequently referred to as “Madison” points (Morrow 2016). The two belonging to this collection are made from Swan River Chert and Prairie du Chien Chert (Shakopee Formation). The point made from Swan River Chert is nicely made and with nearly equilateral sides (Figure 4.3). The other was manufactured from Prairie du Chien Chert (Shakopee Formation) and is rather crude (Figure 4.4). It appears to have been discarded during the bifacial thinning stage as it is lumpy and quite rounded at the tip and along the sides. The Prairie Side-Notched point was manufactured from Tongue River Silica. It was broken at some point and it appears someone attempted to salvage it. This is based on flake scars along the base of the tool that lacked the same polish as the rest of the base.

Figure 4.3. Swan River Chert Unnotched, Triangular Projectile Point Recovered from the Surface in the Peninsula Area.

Figure 4.4. Prairie du Chien Chert Unnotched, Triangular Projectile Point Recovered from Unit P4, Levels 5-6.

Table 4.5. Formal Tools and Tool Fragments Recovered During 2018 Survey

Type	**Associated Cluster**	**Material**	**Provenience**	**Length (mm)**	**Width (mm)**	**Thickness (mm)**	**Weight (g)**
Unnotched Triangular Point	Late Arrow Point Cluster (1000 CE to 1700 CE)	Swan River Chert	Surface	22.9	18.3	4.7	2.158
Prairie Side-Notched Point	Late Arrow Point Cluster (1000 CE to 1700 CE)	Tongue River Silica	Surface	19.6	11.4	4.2	1.33
Tool Handle or Base Fragment	Undetermined	Animikie Group Silicate?	Unit N1, Level 7	8.9	9.5	1.7	0.228
Projectile Point Tip Fragment	Undetermined	Winin Wabik Quartz	Unit P2, Level 7A	8.4	10	2.5	0.292
Projectile Point Tip Fragment	Undetermined	Prairie du Chien Chert	Unit P4, Levels 4	7.5	7.5	1.5	0.094
Unnotched Triangular Point	Late Arrow Point Cluster (1000 CE to 1700 CE)	Prairie du Chien Chert	Unit P4, Levels 5-6	18.6	11.7	5.2	1.007
Projectile Point Tip Fragment	Undetermined	Animikie Group Silicate	Unit P5, Levels 3-4	14.2	8	1.3	0.117

Projectile Point Midsection	Undetermined	Winin Wabik Quartz	Unit P5, Levels 3-4	10.8	13.6	2.8	0.641

The projectile point fragments could not be assigned a date range as they lacked bases which are typically their most diagnostic feature. One of these, however, tells a unique story. The Animikie Group silica projectile point tip recovered from Unit P5 (levels 3-4) was snapped from its blade during impact (Figure 4.5). The very tip of the point is intact with a thin strip of the point's medial section still attached as an impact fracture. Compression waves can be seen on the stone indicating it struck something with force, probably during hunting. It is very small in size and quite delicate and it would not have been possible to rework the fragment into a useable tool should it have been intentionally recovered. The fact that it appears on the site suggests it was probably brought back to the village inside the meat or carcass of an animal. Furthermore, the location it was recovered from (Unit P5) is likely a living surface with a hearth and may have been removed from the animal and redeposited during cooking or eating activities.

Figure 4.5. Image of Front and Back of Projectile Fragment Believed to Have Broken During Impact.

Lastly, the category "other" contained eight retouched flakes and two small blade-like flakes and other probable tools and tool fragments. The presence of these materials suggests the occupants of the Eagle Nest site practiced a flake/tool and blade technology. The blades (one made from Winin Wabik quartz and the other a type of rhyolite) do not appear to have been made as part of a mass blade production technology as was commonly practiced and distributed during the Middle Woodland period. This is based on their lack of uniformity and the materials they were made from, rather poor quality when compared to the desirable obsidian blades circulating further south during the Middle Woodland period. This suggests the blade-like flakes were made for the express purpose of use at the site.

Lithic Artifact Size Grades Analyses and Spatial Analysis

Mass analyses of the lithic flakes were carried out using size grades to investigate the types of lithic production strategies that occurred at the Eagle Nest site (Table 4.6). To see if differences in strategies could be observed across the site and through time, these analyses were performed in conjunction with part of the spatial analysis.

Table 4.6. Frequency of Flakes from Each Context Organized by Size Grade.

	Size Grade 1	Size Grade 2	Size Grade 3	Size Grade 4
	1” Screen (>645 mm)	1/2” Screen (>161 mm)	1/4” Screen (>40 mm)	1/8” Screen (>10 mm)
North Area (Units N1, N2, and N3	2	6	20	23
Units P1 and P5	3	18	91	13
Units P2 and P4	2	34	92	65

First, tables displaying artifact frequency by depth were created for each of the units and the data were converted into bar charts in order to look for vertical artifact concentrations suggestive of multiple components. Figures 4.6 through 4.15 display the results of the Artifact Frequency by Depth tables and bar charts. Based on peaks and gaps in the results, the bar charts indicate the likelihood of at least three components. However, additional diagnostic artifacts or radiocarbon dates are needed to confirm this.

Unit N1	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	1
Level 2	5-10	1
Level 3	10-15	1
Level 4	15-20	2
Level 5	20-25	1
Level 6	25-30	6
Level 7	30-35	3
Level 8	35-40	1
Level 9	40-45	1
Level 10	45-50	1
Level 11	50-55	
Level 12	55-60	
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Unit N2	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	
Level 2	5-10	1
Level 3	10-15	1
Level 4	15-20	1
Level 5	20-25	4
Level 6	25-30	0
Level 7	30-35	2
Level 8	35-40	2
Level 9	40-45	6
Level 10	45-50	5
Level 11	50-55	2
Level 12	55-60	6
Level 13	60-65	4
Level 14	65-70	2
Level 15	70-75	2

Unit N3	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	
Level 2	5-10	
Level 3	10-15	
Level 4	15-20	1
Level 5	20-25	4
Level 6	25-30	9
Level 7	30-35	1
Level 8	35-40	0
Level 9	40-45	0
Level 10	45-50	1
Level 11	50-55	
Level 12	55-60	
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Unit P1	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	2
Level 2	5-10	3
Level 3	10-15	3
Level 4	15-20	4
Level 5	20-25	2
Level 6	25-30	8
Level 7	30-35	3
Level 8	35-40	4
Level 9	40-45	7
Level 10	45-50	11
Level 11	50-55	1
Level 12	55-60	4
Level 13	60-65	2
Level 14	65-70	1
Level 15	70-75	

Unit P2	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	8
Level 2	5-10	7
Level 3	10-15	9
Level 4	15-20	9
Level 5	20-25	8
Level 6	25-30	41
Level 7	30-35	24
Level 8	35-40	10
Level 9	40-45	24
Level 10	45-50	21
Level 11	50-55	24
Level 12	55-60	25
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Unit P3	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	
Level 2	5-10	
Level 3	10-15	
Level 4	15-20	
Level 5	20-25	
Level 6	25-30	
Level 7	30-35	2
Level 8	35-40	
Level 9	40-45	
Level 10	45-50	
Level 11	50-55	
Level 12	55-60	
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Unit P4	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	1
Level 2	5-10	1
Level 3	10-15	1
Level 4	15-20	7
Level 5	20-25	11
Level 6	25-30	14
Level 7	30-35	11
Level 8	35-40	8
Level 9	40-45	10
Level 10	45-50	6
Level 11	50-55	9
Level 12	55-60	
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Unit P5	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	1
Level 2	5-10	
Level 3	10-15	5
Level 4	15-20	5
Level 5	20-25	4
Level 6	25-30	7
Level 7	30-35	14
Level 8	35-40	17
Level 9	40-45	20
Level 10	45-50	21
Level 11	50-55	
Level 12	55-60	
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Unit P6	Depth (cmbs)	Lithic Artifact Frequency
Level 1	0-5	
Level 2	5-10	
Level 3	10-15	1
Level 4	15-20	1
Level 5	20-25	2
Level 6	25-30	1
Level 7	30-35	
Level 8	35-40	
Level 9	40-45	1
Level 10	45-50	
Level 11	50-55	
Level 12	55-60	
Level 13	60-65	
Level 14	65-70	
Level 15	70-75	

Figure 4.6. Tables Showing Artifact Frequency by Depth in Each Unit.

Artifacts in Unit N1 were concentrated between 25 to 30 cmbs (Figure 4.7). Unit N2 appears to have three possible components, the first occurring between 20-25 cmbs, the second occurring between 40-45 cmbs, and the third around 55-60 cmbs (Figure 4.8). The majority of Unit N3’s artifacts clustered between 25 and 30 cmbs and completely dropped off after 35 cmbs (Figure 4.9). Artifacts picked back up again beginning at 45 cmbs which may indicate two separate components. Unit P1 may have up to three components based on peaks occurring between 25-35 cmbs, 40-50 cmbs, and 55-65 cmbs (Figure 4.10). Units P2 (Figure 4.11) and P4 (Figure 4.13) are both associated with a probable midden and peaks displayed in the charts may represent refuse dumping episodes, though more research should be done to explore this. The abrupt drop off at 60 cmbs in Unit P2 is due to the excavation of this unit being halted because of time constraints. The midden likely continues deeper into the matrix. Unit P4, located east of P2, probably represents the midden's margin. Lithic artifacts were scarce in Unit P3 and solely occurred between 30-35 cmbs (Figure 4.12). Unit P5 may have two to three potential components based on a gap between 5 and 10 cmbs and peaks between 10-20 cmbs and 40-55 cmbs (Figure 4.14). Excavation of Unit P5 ended at 55 cmbs because several potential features had been uncovered at the end of the field season and there was not "time to adequately deal with such a complex and important deposit" (Muñiz 2018). Finally, the bar chart illustrating the artifact frequencies in unit P6 suggests two potential components, one between 20-25 cmbs and another between 40-45 cmbs (Figure 4.15).

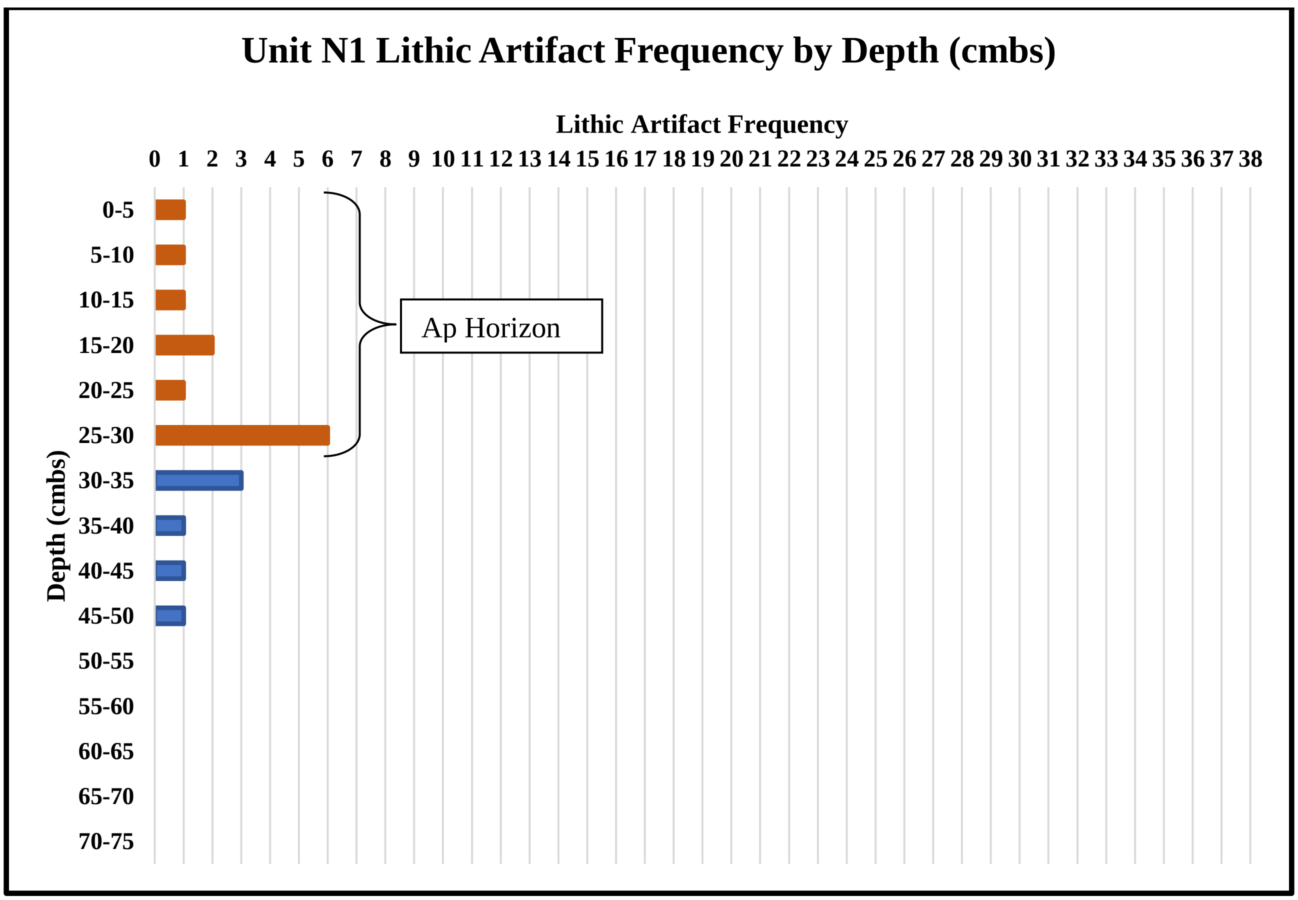


Figure 4.7. Unit N1 Lithic Artifact Frequency by Depth.

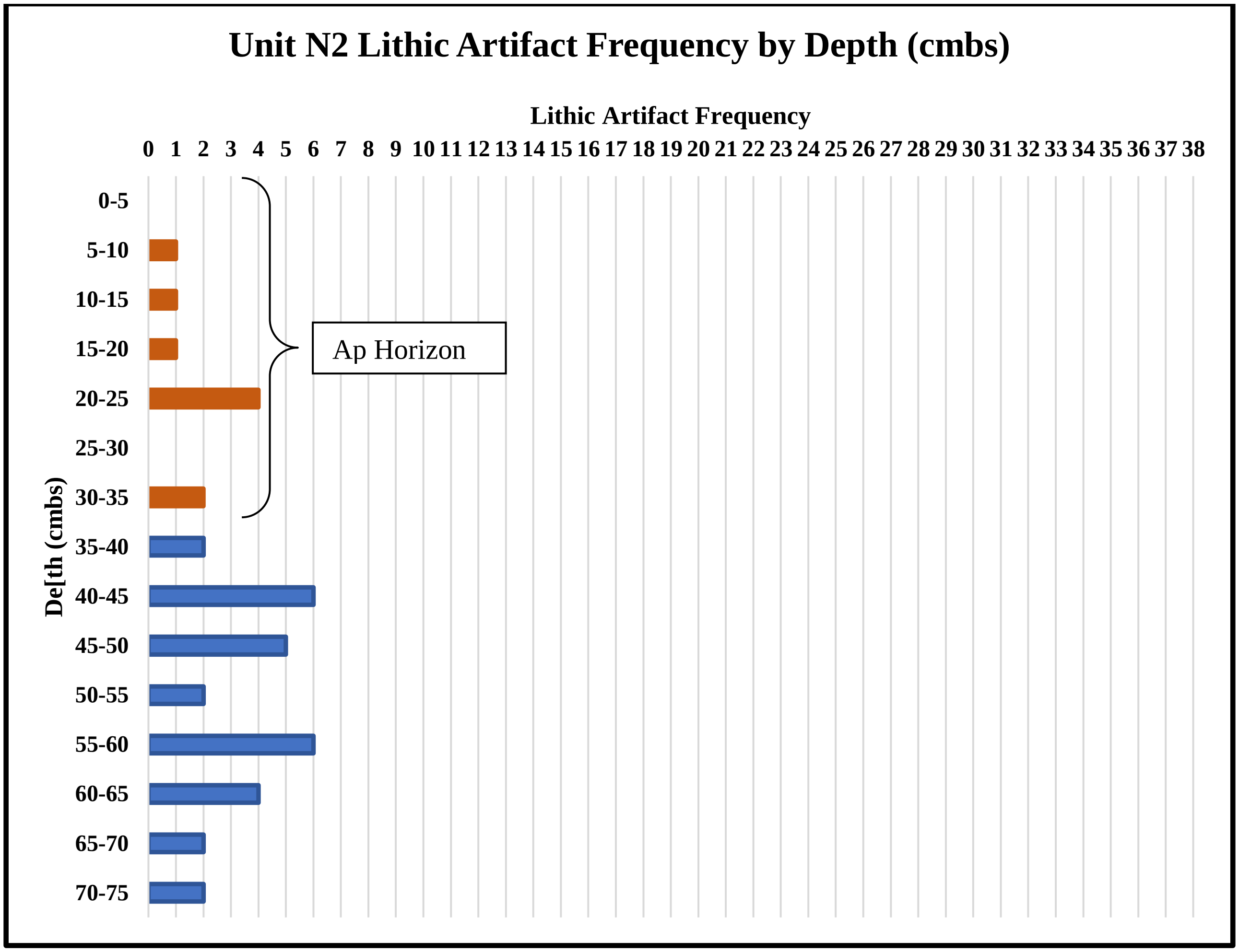


Figure 4.8. Unit N2 Lithic Artifact Frequency by Depth.

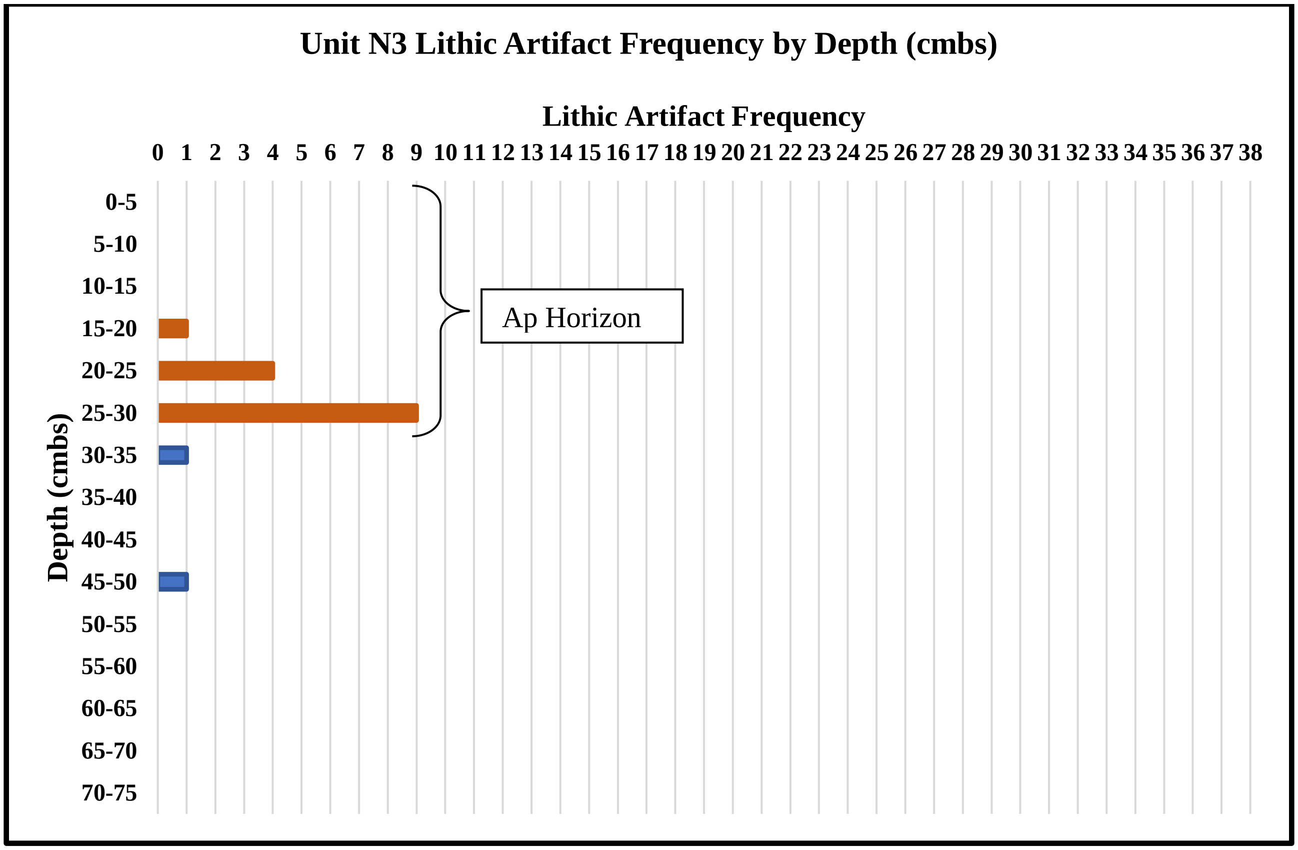


Figure 4.9. Unit N3 Lithic Artifact Frequency by Depth.

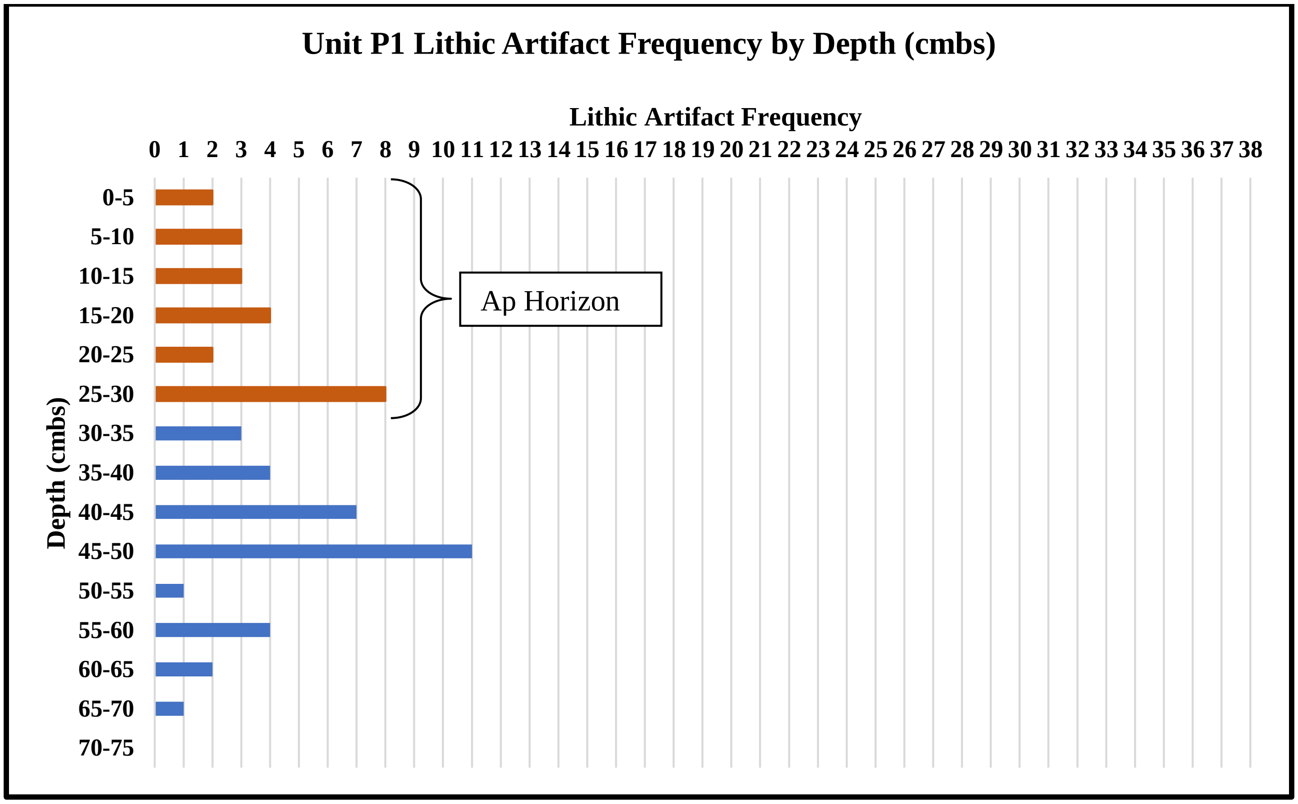


Figure 4.10. Unit P1 Lithic Artifact Frequency by Depth.

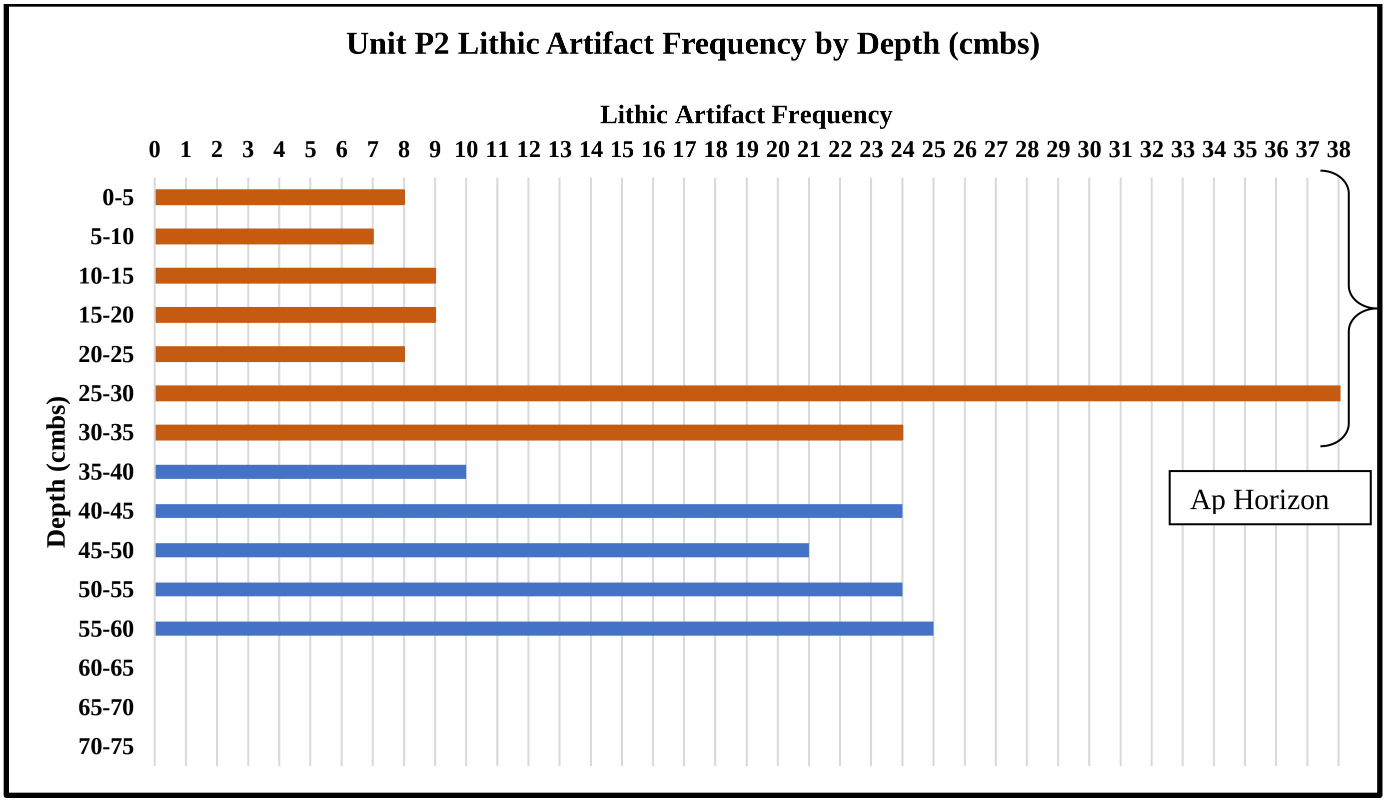


Figure 4.11. Unit P2 Lithic Artifact Frequency by Depth.

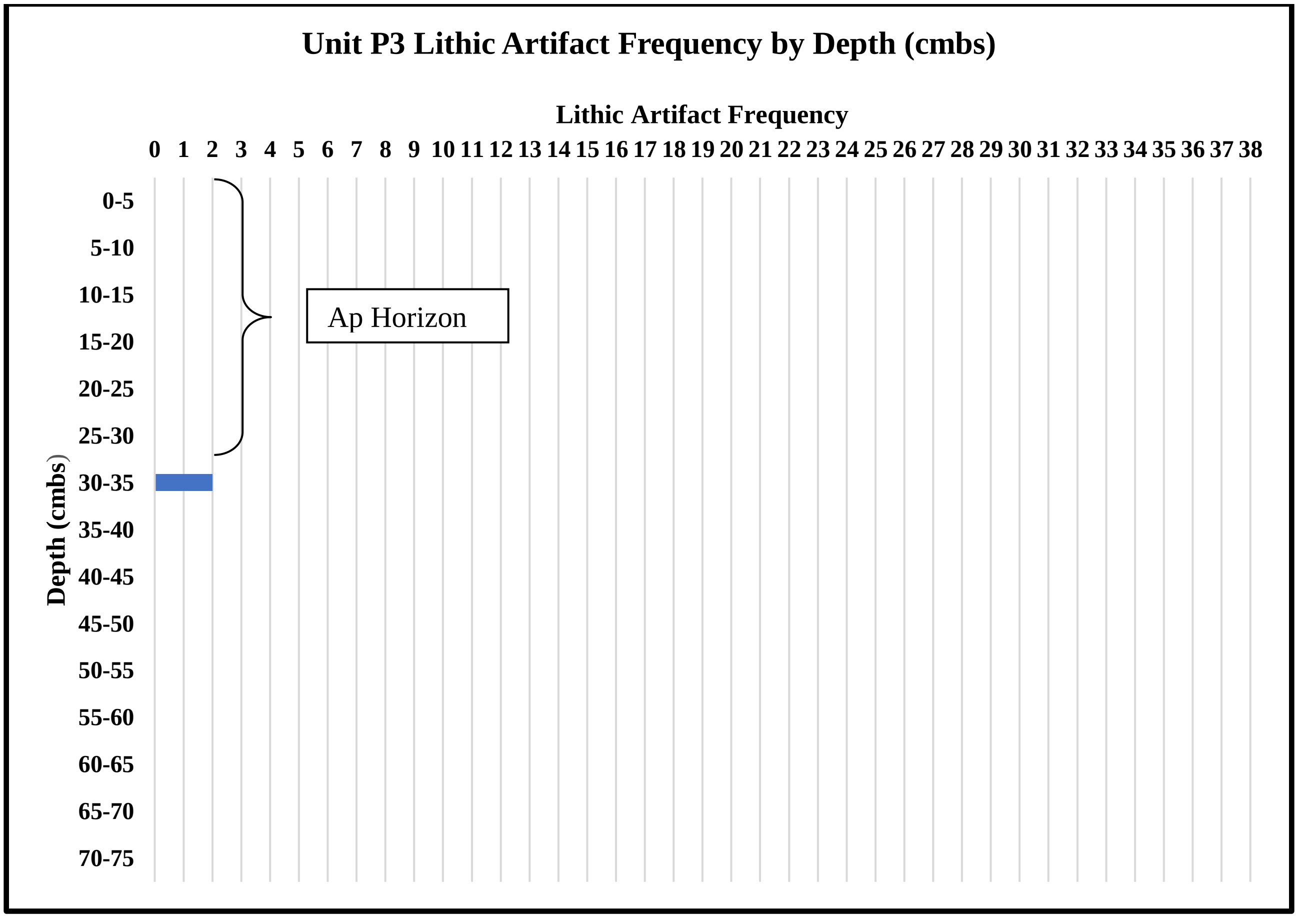


Figure 4.12. Unit P3 Lithic Artifact Frequency by Depth.

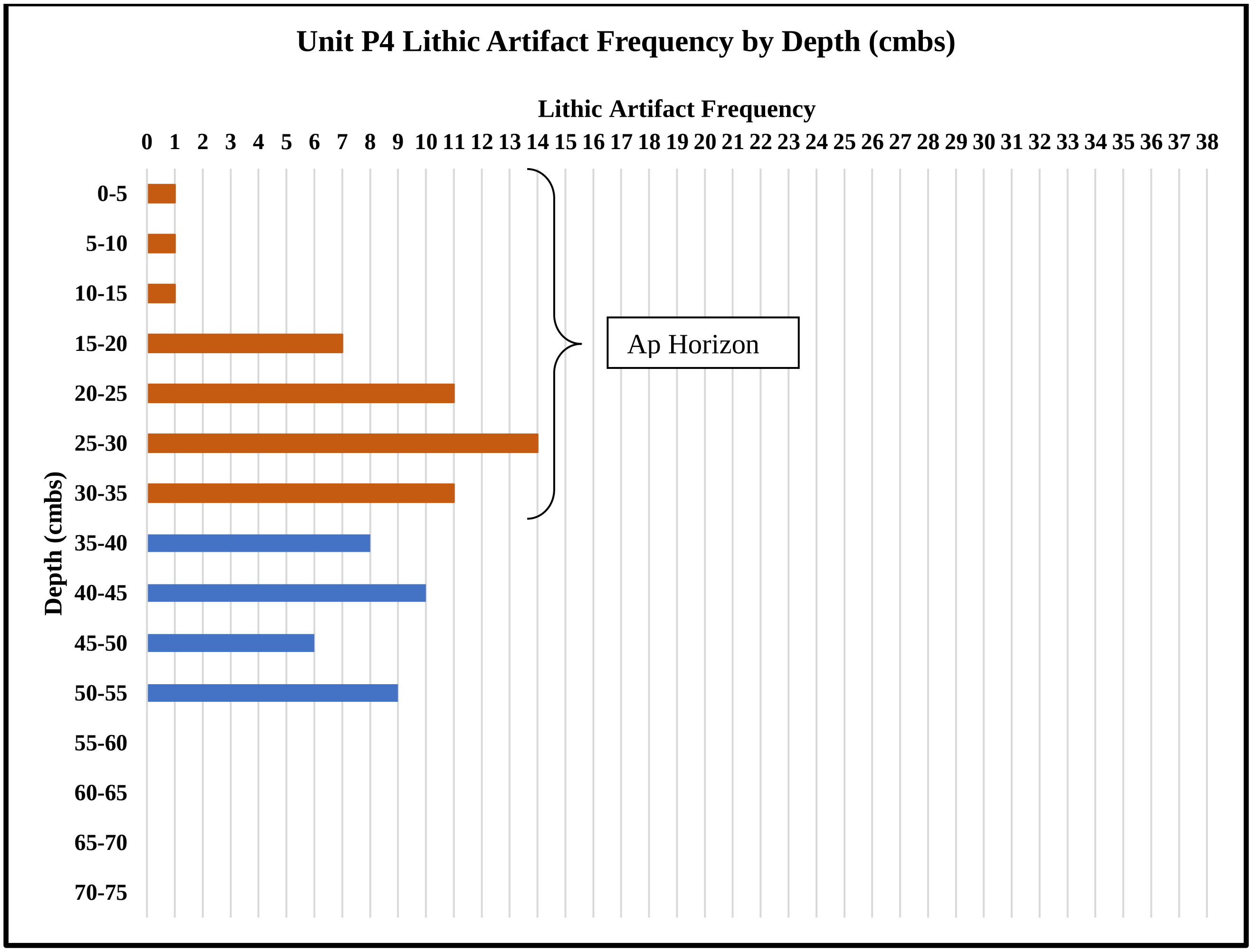


Figure 4.13. Unit P4 Lithic Artifact Frequency by Depth.

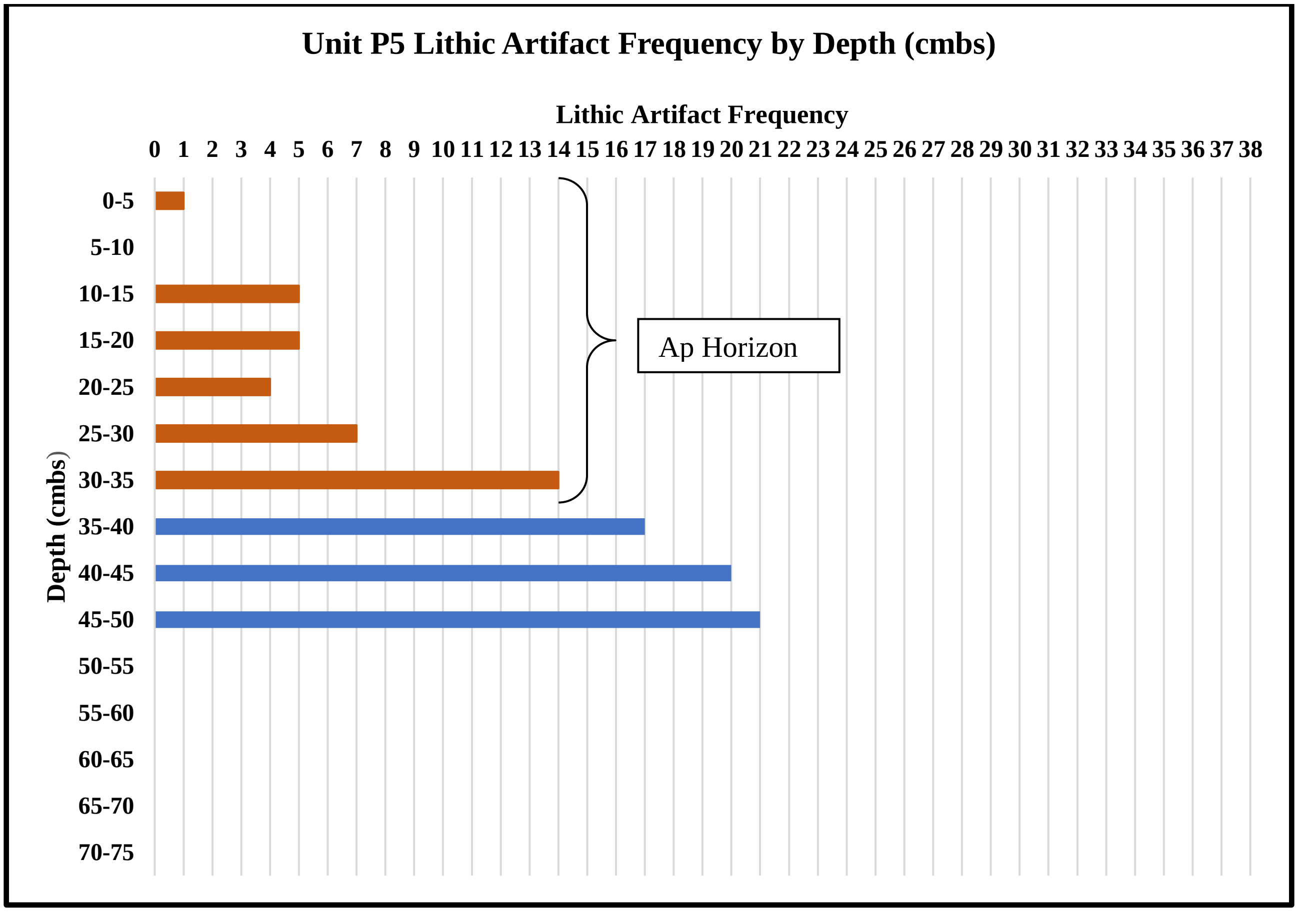


Figure 4.14. Unit P5 Lithic Artifact Frequency by Depth.

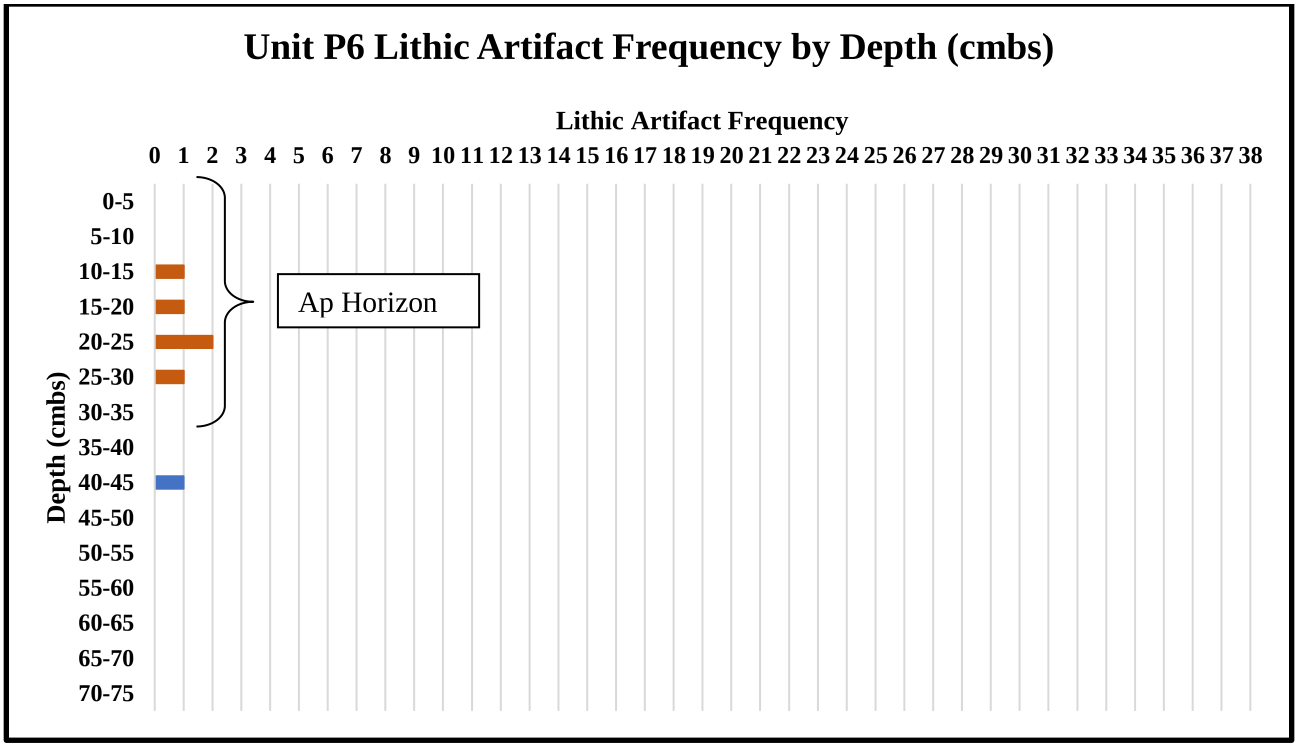


Figure 4.15. Unit P6 Lithic Artifact Frequency by Depth.

Once the potential components were established, flakes recovered from unit levels with the highest artifact concentrations and the levels immediately above and below them were sorted into corresponding size grades and then plotted using Excel. The goal was to see if bifacial-reduction occurred on the site. Patterson (1990) has shown that when plotted by size grade, bifacial-reduction will show as an exponential curve. For the purpose of this analysis, Component 1 extends from approximately 20 - 35 cmbs, Component 2 from 40 - 50 cmbs, and Component 3 from 55 - 65 cmbs.

Limiting the analysis to focus on specific level groupings of artifacts affected the sample size and there was concern that this would skew the overall results. In an attempt to combat this issue, units were combined. These combinations were chosen based on physical proximity and possible functional associations between the units. Units N1, N2, and N3 in the northern area were combined; units P1 and P5 on the peninsula were combined, and units P2 and P4 on the peninsula were combined. Additionally, to investigate how the use of a 1/8-inch screen on only one quadrant, rather than four, might have affected the total number of flakes recovered from a unit (and therefore the results of this analysis) an additional dataset was created by multiplying the number of artifacts in Size Grade 4 by four. The inflated data were plotted and placed overtop the original data in order to compare results. Figures 4.16 through 4.18 display the results of this analysis.

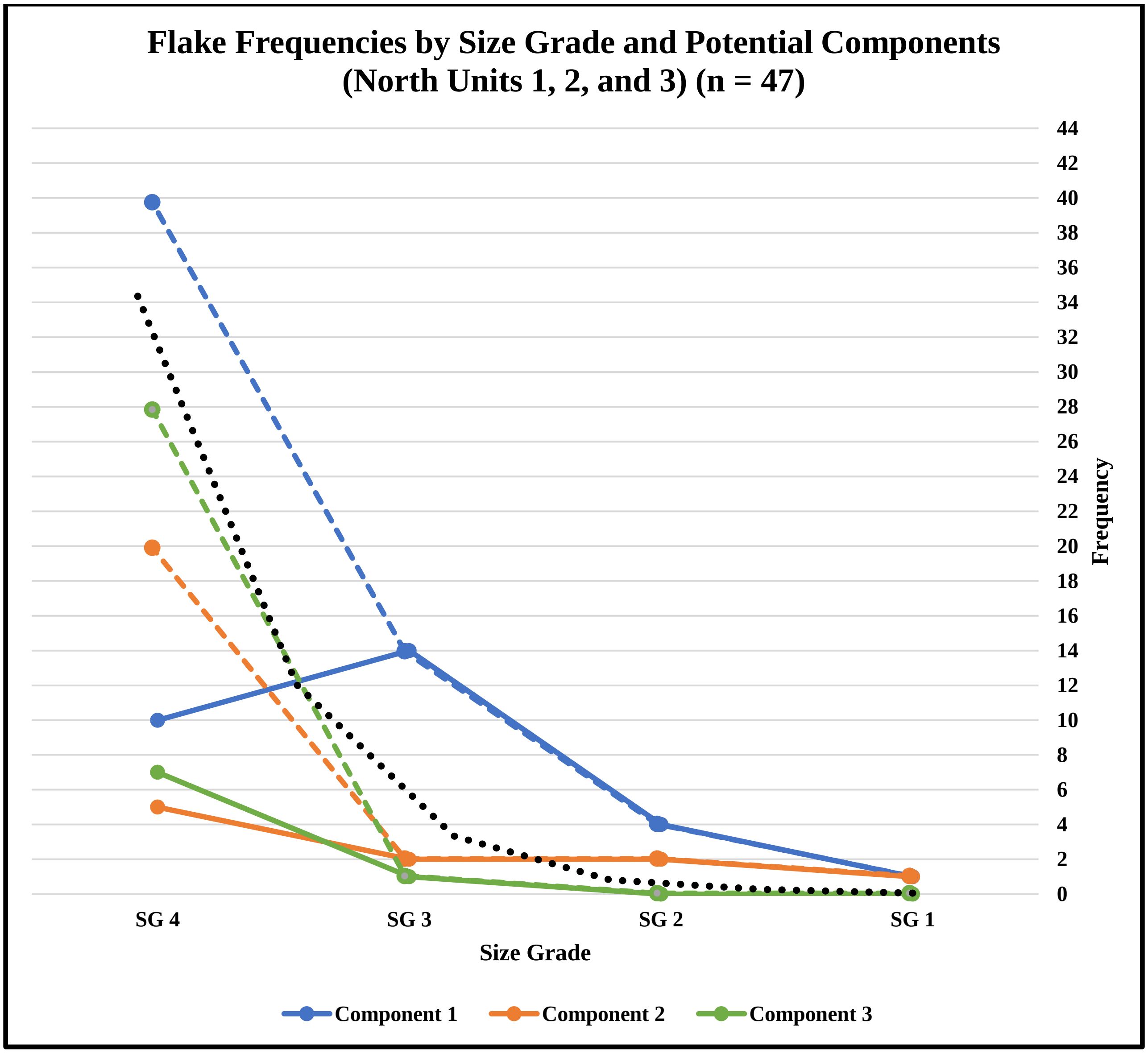


Figure 4.16. North Area Flake Frequency by Size Grade and Potential Components. Solid Line Displays the Original Data and the Dashed Line Displays Inflated Data. Black Dotted Line Represents What a Bifacial Reduction Curve Might Look Like in Comparison.

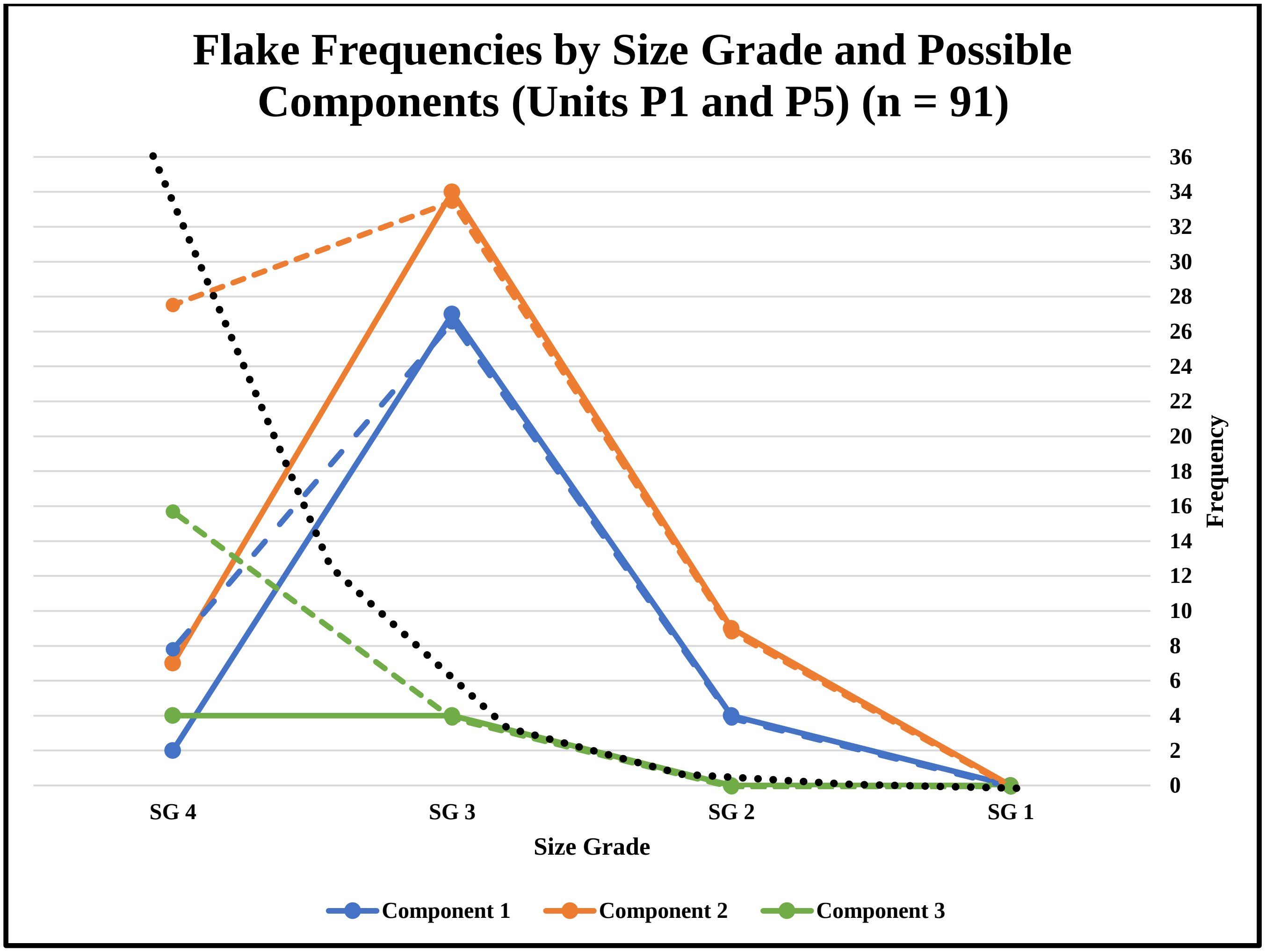


Figure 4.17. Units P1 and P5 Flake Frequency by Size Grade and Potential Components. Solid Line Displays the Original Data and the Dashed Line Displays Inflated Data. Black Dotted Line Represents What a Bifacial Reduction Curve Might Look Like in Comparison.

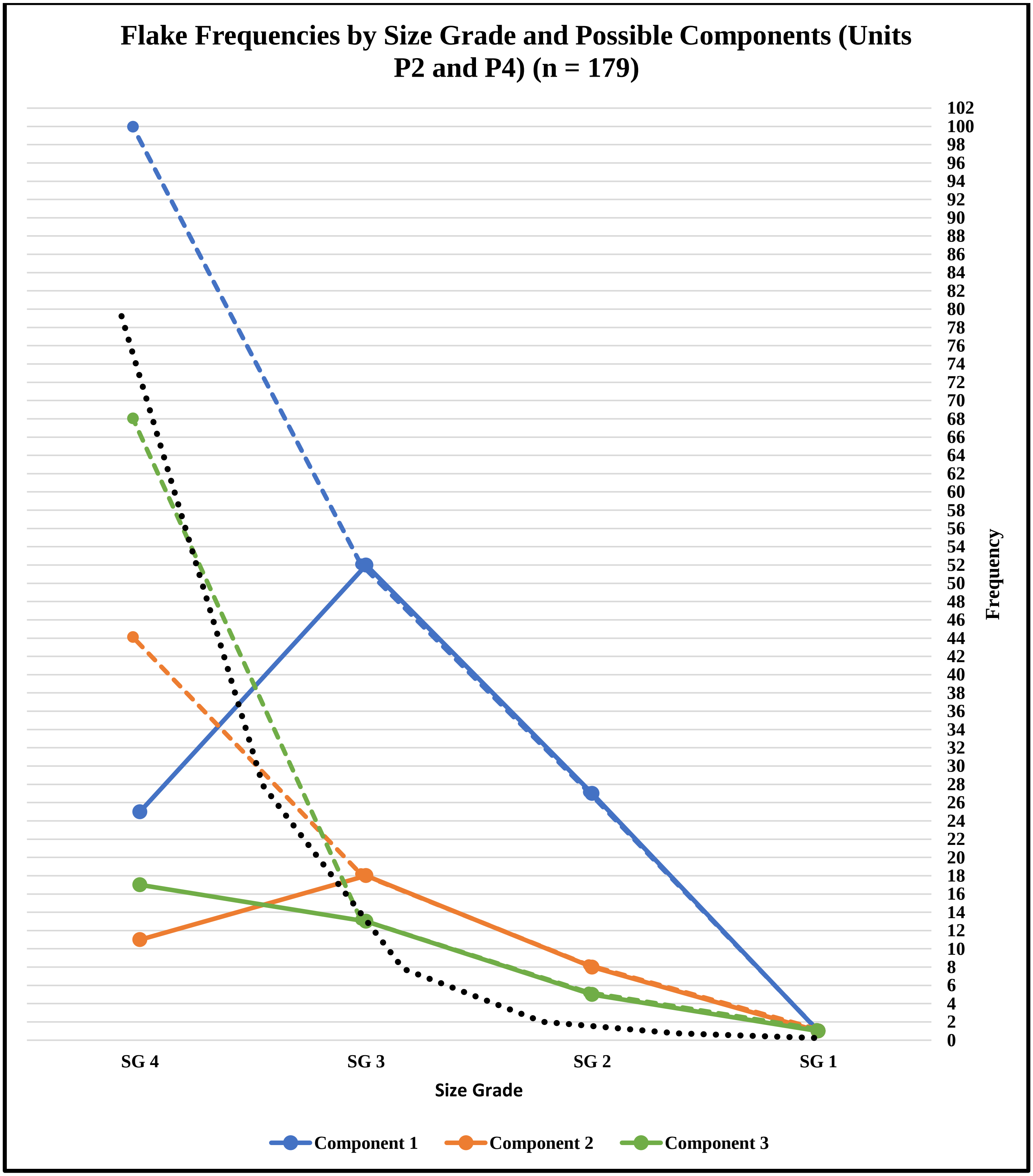


Figure 4.18. Units P2 and P4 Flake Frequency by Size Grade and Potential Components. Solid Line Displays the Original Data and the Dashed Line Displays Inflated Data. Black Dotted Line Represents What a Bifacial Reduction Curve Might Look Like in Comparison.

Patterson (1990:555) states, "most of the plot will be a straight line for bifacial-reduction debitage, with a deviation sometimes occurring at the end of the plot due to low percentages of large flakes." The results of this analysis seem to suggest biface reduction likely occurred on the site, though the original data failed to produce a true exponential curve. This may, in part, be due to sample size. The inflated data indicates bifacial reduction may have been more likely to occur in the north area than near units P1 and P5. The inflated data of the midden units (P2 and P4) also appears to indicate bifacial-reduction activities. It is possible that if a 1/8-inch screen had been used on four quadrants rather than one, bifacial reduction may have been more detectable. The high frequency of midsized flakes (Size Grade 3) in Units P1 and P5 but the relatively low number of very small and very large flakes suggest the possibility that other tool production activities occurred in this area such as flake tool production.

As mentioned above, the flake size grades were compared vertically to look for differences in patterning that may indicate change through time and multiple components. Components 1 and 2 in Units P1 and P5 have very similar shapes and really only differ in terms of artifact frequency. This suggests these "components" may be related and are, perhaps, one component rather than two. The recovery of a Blackduck-Kathio ceramic sherd at the transition between the Ap and B horizons helps to support this theory and suggests these levels may be part of a Late Woodland component. Likewise, Components 2 and 3 in the northern area are similar in shape, possibly suggesting two components, rather than three, in this location as well. In all areas, flakes in Size Grade 3 occurred more commonly in the plow zone and upper B horizon, than in depths between 50 and 65 cmbs. There is also a drop in Size Grade 4 artifacts in these contexts, while there is an uptick of this size class between 50-65 cmbs. While this may be contributed to screen size, it could also indicate different activities such as flake-tool production, occurred in the later component (Component 1), while tool maintenance activities were the focus in earlier occupations.

The other flake-size distribution analysis conducted was one based on work by Ahler (1989). Using the same size grades, the average weight of each size grade for each unit and "component" was calculated. This was done by adding up the weights of all the flakes within a size grade and context and dividing by the frequency of flakes within that size grade and context. This was done to determine whether marginal and non-marginal flaking patterns emerged (Table 4.7).

Table 4.7. Average Weight of Flakes from Each Context Organized by Size Grade. Standard Deviation Noted Where Applicable.

North Area	**Component 1 (~25-35 cmbs)**	**Component 2 (~40-50 cmbs)**	**Component 3 (~55-65 cmbs)**
SG1	0.00 g (n = 0)	4.22 g (n = 1)	0.00 g (n = 0)
SG2	1.45 g (n = 3) (*sd* = 0.64 g)	0.35 g (n = 1)	0.00 g (n = 0)
SG3	0.25 g (n = 3) (*sd* = 0.15 g)	0.13 g (n = 5) (*sd* = 0.11 g)	0.18 g (n = 1)
SG4	0.05 g (n = 1)	0.03 g (n = 7) (*sd* = 0.06 g)	0.04 g (n = 8) (*sd* = 0.09 g)
P1 and P5	**Component 1 (~25-35 cmbs)**	**Component 2 (~40-50 cmbs)**	**Component 3 (~55-65 cmbs)**
SG1	0.00 g (n = 0)	77.35 g (n = 2) (*sd* = 1.63 g)	0.00 g (n = 0)
SG2	0.70 g (n = 4) (*sd* = 0.27 g)	0.35 g (n = 5) (*sd* = 0.60 g)	0.00 g (n = 0)
SG3	0.46 g (n = 32) (*sd* = 1.15 g)	0.13 g (n = 22) (*sd* = 0.16 g)	0.18 g (n = 4) (*sd* = 0.06 g)
SG4	0.05 g (n = 1)	0.03 g (n = 4) (*sd* = 0.05 g)	0.04 g (n = 3) (*sd* = 0.04 g)
P2 and P4	**Component 1 (~25-35 cmbs)**	**Component 2 (~40-50 cmbs)**	**Component 3 (~55-65 cmbs)**
SG1	6.14 g (n = 1)	9.98 g (n = 1)	249.60 g (n = 1)
SG2	1.31 g (n = 13) (*sd* = 0.96 g)	1.91 g (n = 7) (*sd* = 0.97 g)	0.85 g (n = 5) (*sd* = 0.35 g)
SG3	0.24 g (n = 26) (*sd* = 0.16 g)	0.15 g (n = 17) (*sd* = 0.09 g)	0.18 g (n = 13) (*sd* = 0.13 g)
SG4	0.03 g (n = 14) (*sd* = 0.02 g)	0.03 g (n = 11) (*sd* = 0.02 g)	0.02 g (n = 17) (*sd* = 0.02 g)

The results of this analysis suggest marginal flaking occurred across the site in all the proposed components, while evidence of non-marginal flaking activities occur in the first component near the northern units and near units P1 and P5. Marginal flaking is evidenced by similar average weights of flakes within each size grade and context. For example, the weights of Size Grade 3 flakes within Component 2 are nearly identical (North Area = 0.13 g, P1 and P5 = 0.13 g, and P2 and P4 = 0.15 g). Alternatively, non-marginal flaking is evidenced by significant differences in the average weight of flakes within each size grade and context. An example of this can be seen between Size Grade 2 artifacts within Component 1, where average weights of flakes from the northern area and Units P2 and P4 are significantly larger than P1 and P5 (North

Area = 1.45 g, P1 and P5 = 0.70 g, and P2 and P4 = 1.31 g). Units P2 and P4 show evidence of both marginal and non-marginal flaking in all proposed components. As these units are associated with a potential midden, this variability is to be expected. This analysis suggests marginal flaking occurred throughout time in all parts of the site, while non-marginal flaking techniques appear to have been used more frequently within the most recent component in the northern area. This seemingly suggests activities such as flake tool production were practiced more regularly in the Late Woodland period than earlier periods, which may indicate technological change through time, perhaps a gradual change from a reliance on more formal, curated tools to a focus on more expedient tools. Units P2 and P4 do show some evidence that suggests non-marginal flaking activities may have been practiced during these earlier components, but more research is needed to confirm this. The midden context contained flakes within Size Grades 1 and 2 in Components 2 and 3 and these flakes either differed significantly from those occurring in the northern area and Units P1 and P5, or they were absent in Units P1 and P5 and the northern area all together.

It is important to reiterate here that many of the units are associated with potential features. Units P1 and P5, for example, contain a possible living surface, hearths, and associated artifacts. It would not be too farfetched to assume activities within the domestic sphere differed from other activities carried out in other portions of the site, although more testing should be done to confirm this.

Microwear Analysis

The microwear analysis was completed with the primary goals of determining if the types of activities occurring on the site could be discerned and determining whether the overall function of the site could be gleaned from usewear studies. The secondary goal of the usewear study was to determine the applicability of usewear analyses in CRM contexts.

The microwear analysis began with a replicative study during the summer of 2022. Flakes were created for the express purpose of using them to cut, saw, or scrape select materials. The goal was to create diagnostic polish on the flakes and to then use the flakes as a comparative collection with which the lithic artifacts from the Eagle Nest site could be compared. Beginning in October 2022, the analyst began to view the replicative tools under a microscope to become familiar with the how and where the polishes form, and how they differed depending on the contact materials. Photos and notes were taken for each artifact if diagnostic polish was present. Unfortunately, this was not always the case. Green wood, soaked antler, and raw hide (standing in for hard hide) developed the most diagnostic polish of any of the samples (Figures 4.19 – 4.22). Originally, the tool used to cut grass did not develop a diagnostic polish, so the tool was used again (adding additional strokes) on wheat, which improved the brightness and distribution of the polish ever so slightly (Figure 4.18).

Once the replicative collection had been examined, photographed, and logged, the Eagle Nest artifact assemblage was examined. The collection was stratified in four ways. First, tools, potential flake tools, and flakes with a faceted platform were pulled from the assemblage to be

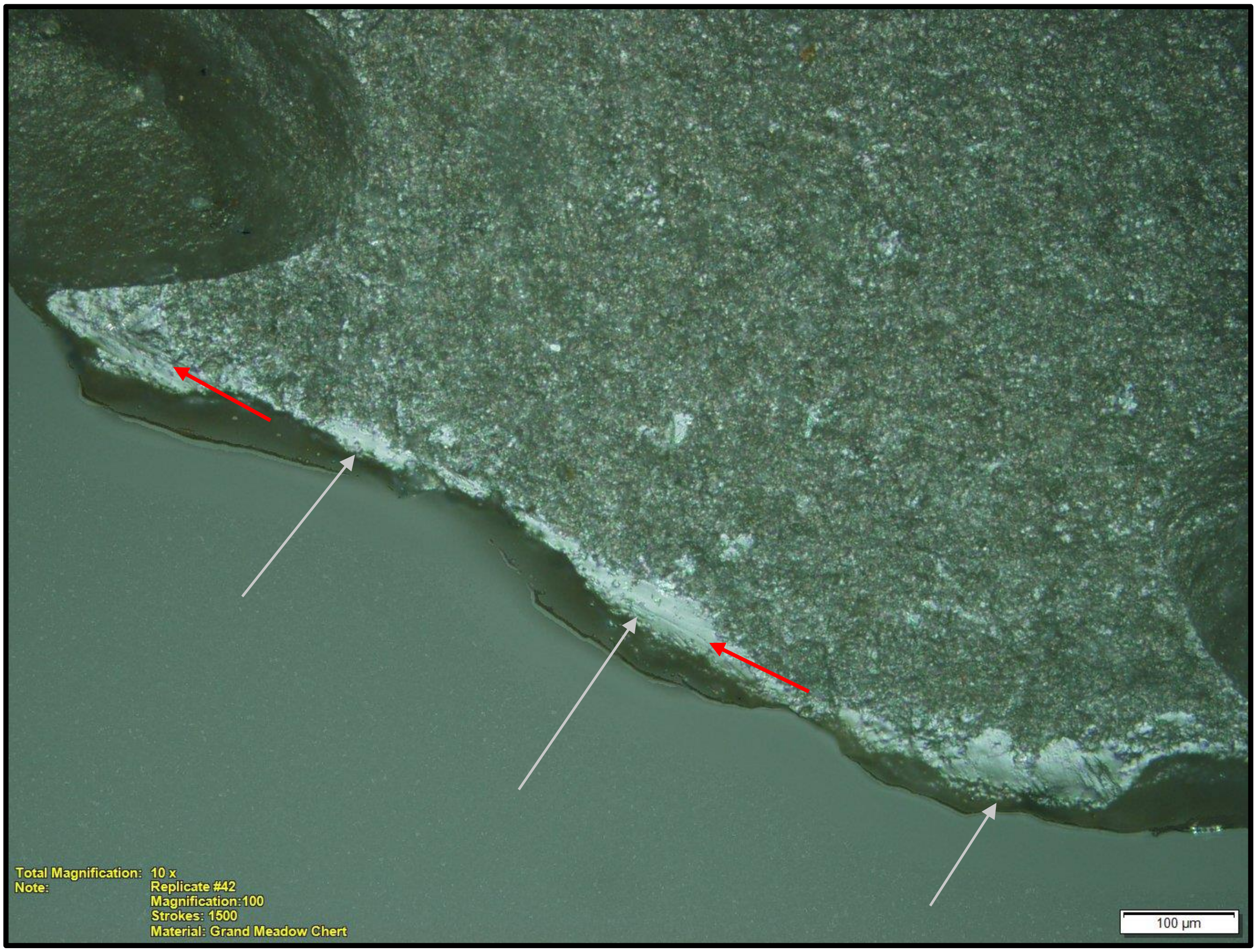


Figure 4.19. Replicative Tool Used on Green Wood viewed at 100x. Gray Arrows Point to Polish Buildup Along Edge of Tool. Red Arrow Points to Striations Indicating Longitudinal Directionality.

Figure 4.20. Replicative Tool Used on Soaked Antler Viewed at 400x. Gray Arrows Point to Polish Accumulation Along Dorsal Ridge of Tool. Red Arrow Points to Deep Striations Indicating Longitudinal Directionality.

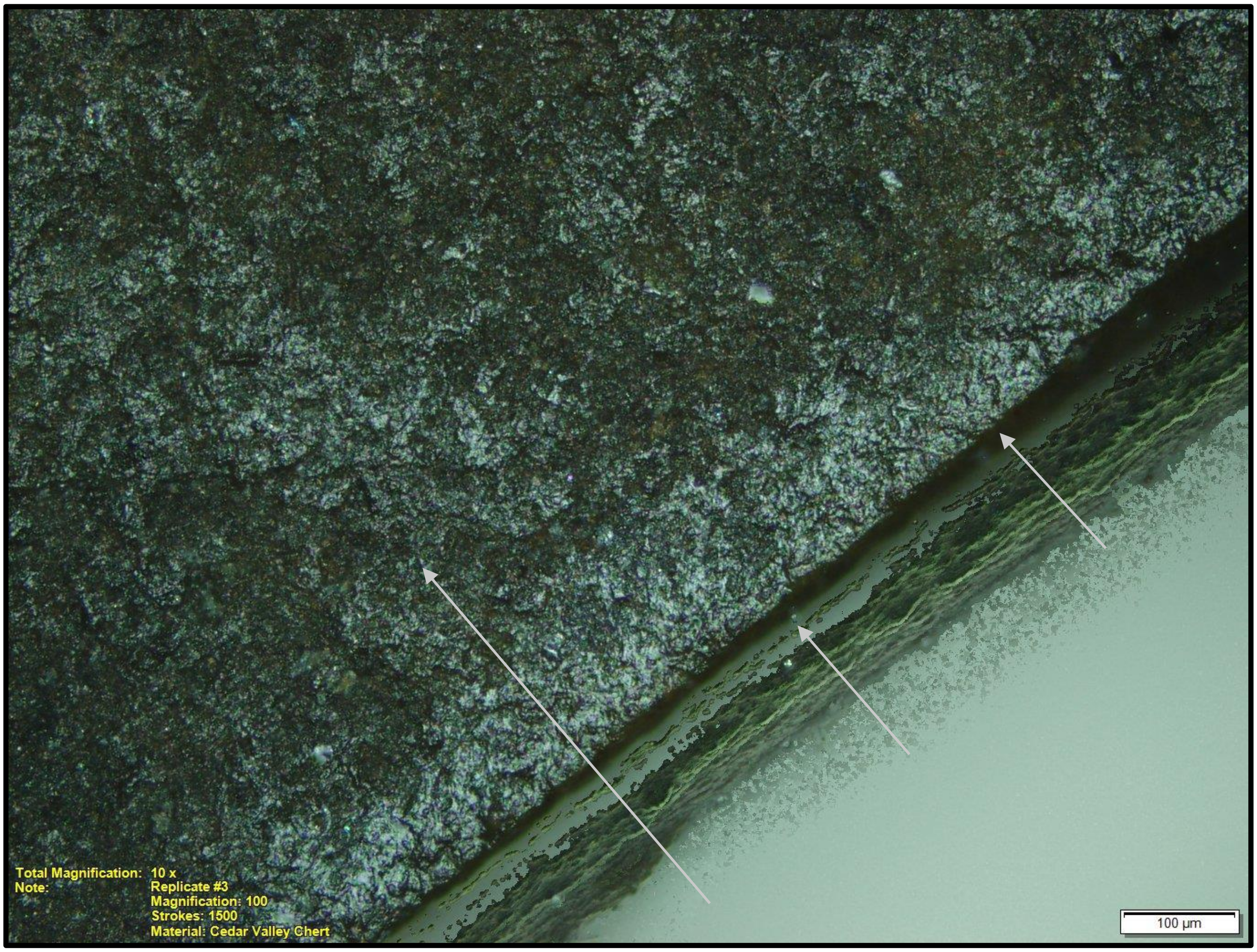


Figure 4.21. Replicative Tool used in Transverse Motion on Hard Hide Viewed at 100x. Gray Arrows Point to Polish Development Along Edge of Tool, Extending into the Interior of the Tool.

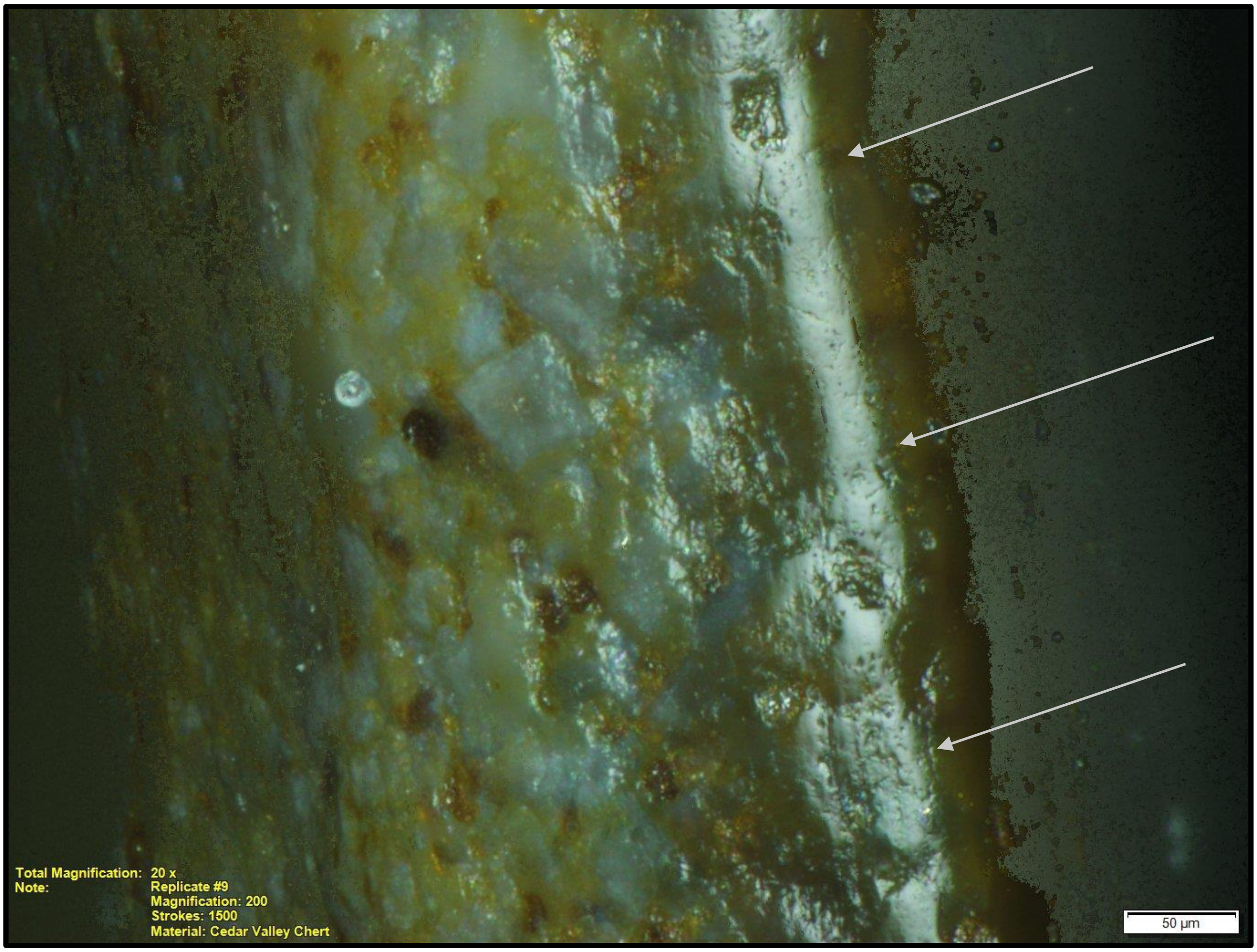


Figure 4.22. Replicative Tool Used with Longitudinal Motion to Cut Grass and Wheat, Viewed at 200x. Gray Arrows Point to Polish Accumulation Along Edge of Tool.

analyzed. The decision was made to examine all of the pulled artifacts recovered from the surface and from within shovel tests to determine the feasibility of microwear analyses in CRM contexts, as a large majority of sites recorded by archaeologists are found on the surface or in shovel tests and they are largely lithic scatters. This subset of artifacts totaled 15 specimens. Because this meant portions of the site and the artifacts recovered from them would be left unanalyzed, and to increase the total sample size, a decision was made to examine two artifacts from each of the units as well. One artifact was randomly selected from the Ap horizon from each unit, and one artifact was randomly selected from the B horizon in each unit. Three of the units (N1, P3, and P6) only had one artifact examined because these units lacked tools and/or flakes with the necessary criteria (i.e., faceted platform) in either the plow zone or the sub plow zone.

In total, 30 artifacts from the Eagle Nest site were analyzed for usewear of which, 16 showed signs of usewear and 14 did not. Table 4.8 is a list of the 16 artifacts with usewear present. It includes the context from which they came, and the types of polish observed.

Hafting Polish

Three artifacts examined for the usewear study displayed evidence of what is likely hafting polish. One of these artifacts was a projectile point recovered during the surface survey, and the other was a tool base fragment recovered in Unit N1 (Figure 4.23). The polish on the projectile point covered the lower portion of the point, ending at approximately the midsection. The polish is consistent with soft polish suggesting hide may have been used as a shim. The tool base fragment showed signs of a hard material polish on the topographic highpoints of the artifact. The material used to haft this tool was likely antler as no micropitting was visible after washing.

Soft Polish

Several artifacts exhibited characteristic signs of a soft polish, possibly hide, including the two projectile points. Figure 4.24 is an image of polish accumulation along the base of the Tongue River Silica Prairie Side-Notched point. Interestingly, the majority of these artifacts were debitage. This suggests that when it becomes necessary to sharpen a tool the polish is, in many cases, removed with the detachment of resharpening flakes. This is especially important to think about in terms of the applicability of this type of analysis in the CRM context. Lithic scatters may actually contain more instances of polish than formally shaped tools.

Table 4.8. Artifacts from the Eagle Nest Assemblage with Usewear.

Catalog Number	**Context**	**Artifact Type**	**Material Type**	**Notes**
SHB3.30.0008	Surface	Unnotched Triangular Point	Swan River Chert	Hafting polish (soft polish, probably from being secured in a haft using a shim) located on base of tool
SHB3.30.0019	Surface	Flake	Prairie du Chien Chert (Shakopee Formation)	Mix of generic weak to slightly more voluminous polish along dorsal ridge with longitudinal directional indicators.
SHB3.30.0020	Surface	Prairie Side-Notched Point	Tongue River Silica	Soft polish, probably hide, located on the base of the tool suggesting it was hafted
SHB3.30.0032	Surface	Flake/Flake Tool	Grand Meadow Chert	Hard and soft polish present along primary dorsal ridge – likely antler and hide. Longitudinal directional indicators
SHB3.30.0063	Surface	Flake	Swan River Chert	Polish present along edge of flake – generic weak to smooth pitted polish and volume buildup. No clear directional indicators.
SHB3.30.0078	Surface	Flake	Chert	Soft polish buildup on primary dorsal scar and near the platform. Striations indicate longitudinal motion.
SHB3.30.0107	Shovel Test 2	Flake	Chert	Dry hide polish concentrated on high points of the stone. Transverse motion
SHB3.30.0140	Shovel Test 16	Flake	Chalcedony	Hide polish (soft). Transverse motion
SHB3.30.0209	Shovel Test 44	Flake	Cedar Valley Chert	Generic weak and smooth pitted polish present on dorsal surface of flake. Flake was once attached to a biface. The biface was sharpened while the flake was still attached – two flake scars are present on its dorsal surface
SHB3.30.0264	Unit N1	Tool Handle (Drill?)	Jasper	Evidence of hafting on tool handle/base. Polish is consistent with antler.
SHB3.30.0366	Unit N2	Flake	Obsidian	Polish along edge of tool and along broken edge of flake consistent with use on hard material. Longitudinal directional indicators. This may be a burin produced from a biface.
SHB3.30.0391	Unit N3	Flake	Agate	Edge rounding and polish build up on high points on dorsal side. Transverse directional indicators. This was probably removed during the sharpening of a unifacial tool
SHB3.30.1346	Unit N3	Flake/Flake Tool	Chert	Early-stage polish buildup with some volume. No obvious directional indicators.

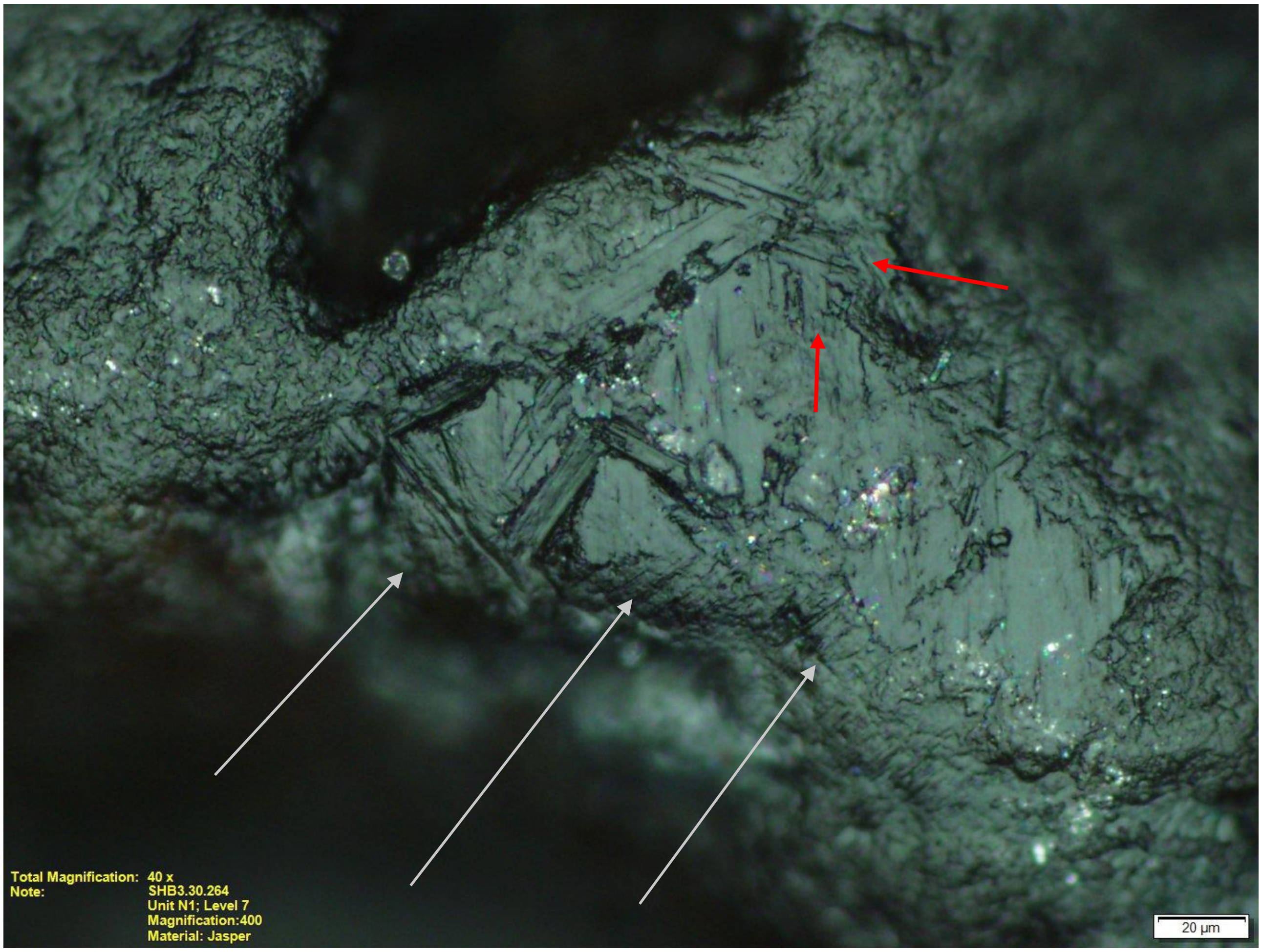


Figure 4.23. Tool Handle Fragment with Hafting Polish, Likely Antler Viewed at 400x. Gray Arrows Point to Polish Accumulation Along Tool Handle. Red Arrows Point to Diagonal Hatch Mark Striations Typical of Hafting Polish.

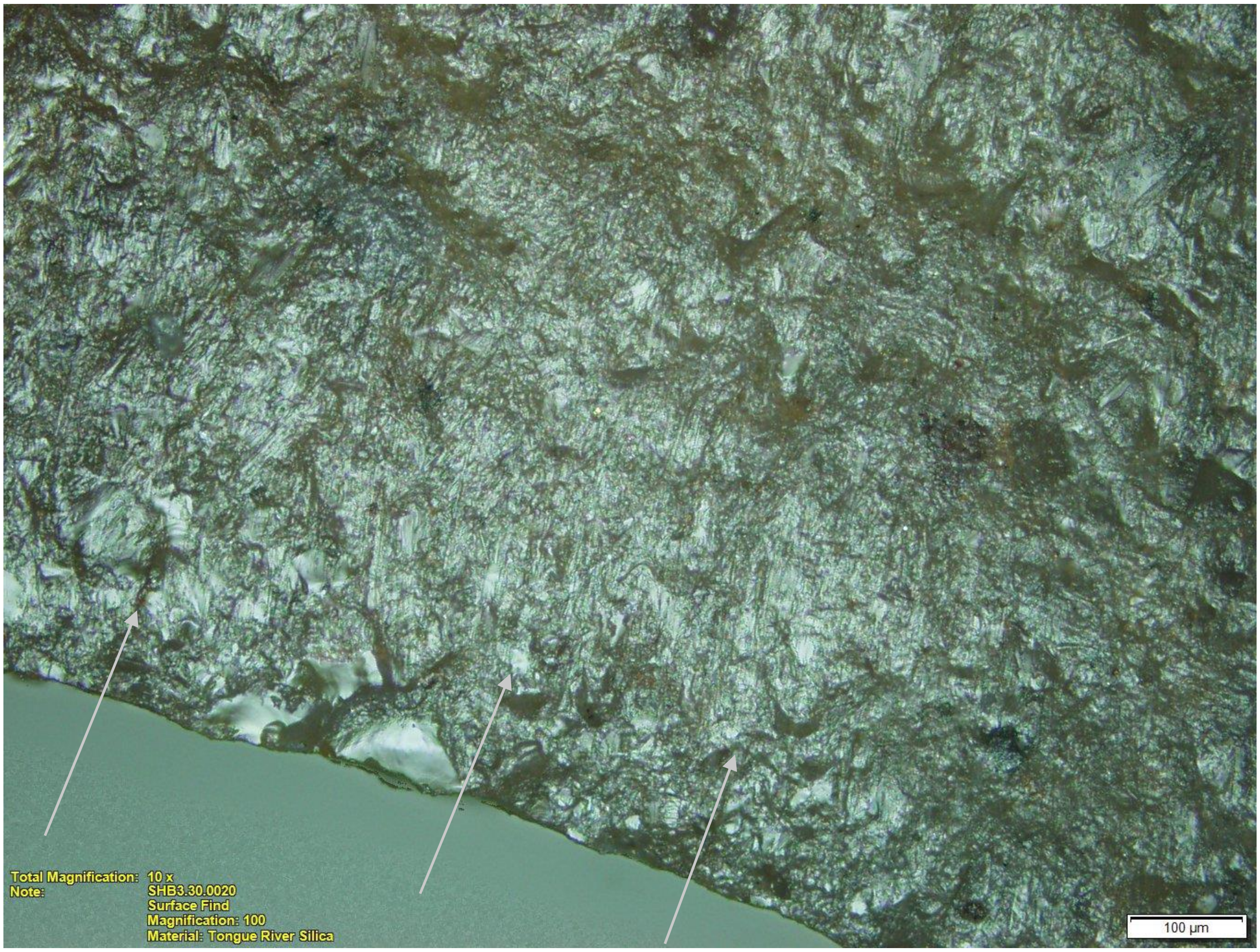


Figure 4.24. Soft Polish Located at the Base of a Projectile Point Suggesting Hafting Viewed at 100x. Gray Arrows Point to Soft Polish Buildup Along Base of Tool.

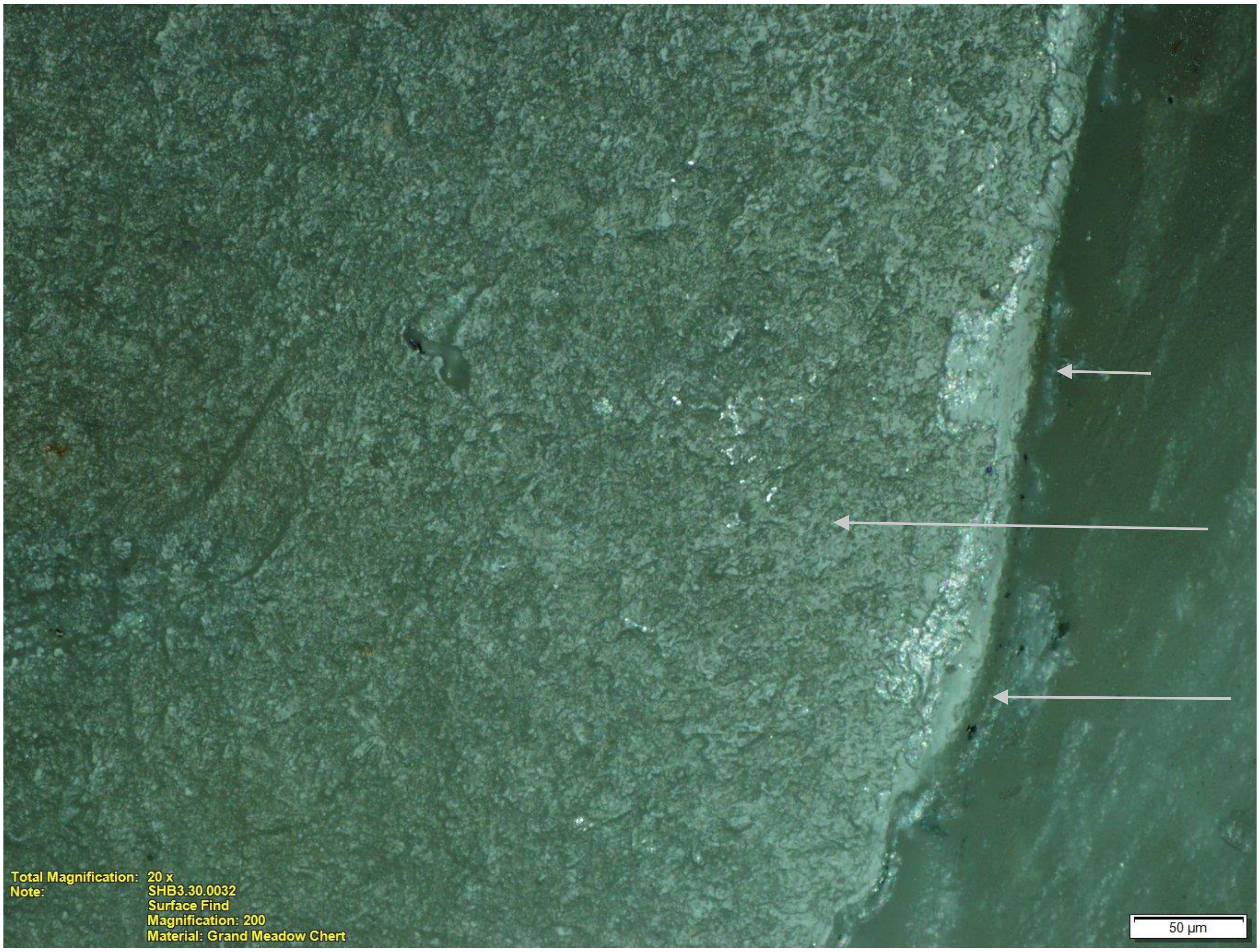


Figure 4.25. Soft Polish Developed Along Edge of Flake Tool Viewed at 200x. Gray Arrows Point to Polish Buildup Along Edge and into the Interior of the Flake.

Hard Polish

Several artifacts showed signs of hard polish. One in particular, a flake made from Grand Meadow chert, showed signs of both hard and soft polish (Figure 4.25 and 4.26). In closely examining the flake, it was apparent it had been detached from a biface, based on the curvature of the flake and the presence of a faceted platform. The biface was probably sharpened and at that time the flake was removed. Polish on the ventral surface near the platform, and along the dorsal ridge was consistent with having been created with a soft contact material and further back towards the interior of the flake along a ridge there were deep striations and a smooth, beveled polish consistent with antler. A close look at the platform suggests it may have also been used as a graver after removal. This is enlightening, as it indicates peoples were using every last scrap of certain materials, in this case Grand Meadow Chert but likely others as well. Grand Meadow Chert is a high-quality lithic material, and it is not available locally. If a flake is removed from a biface but can still function as a tool for other tasks, it would make sense that these high-quality materials were reused, reworked, and well maintained.

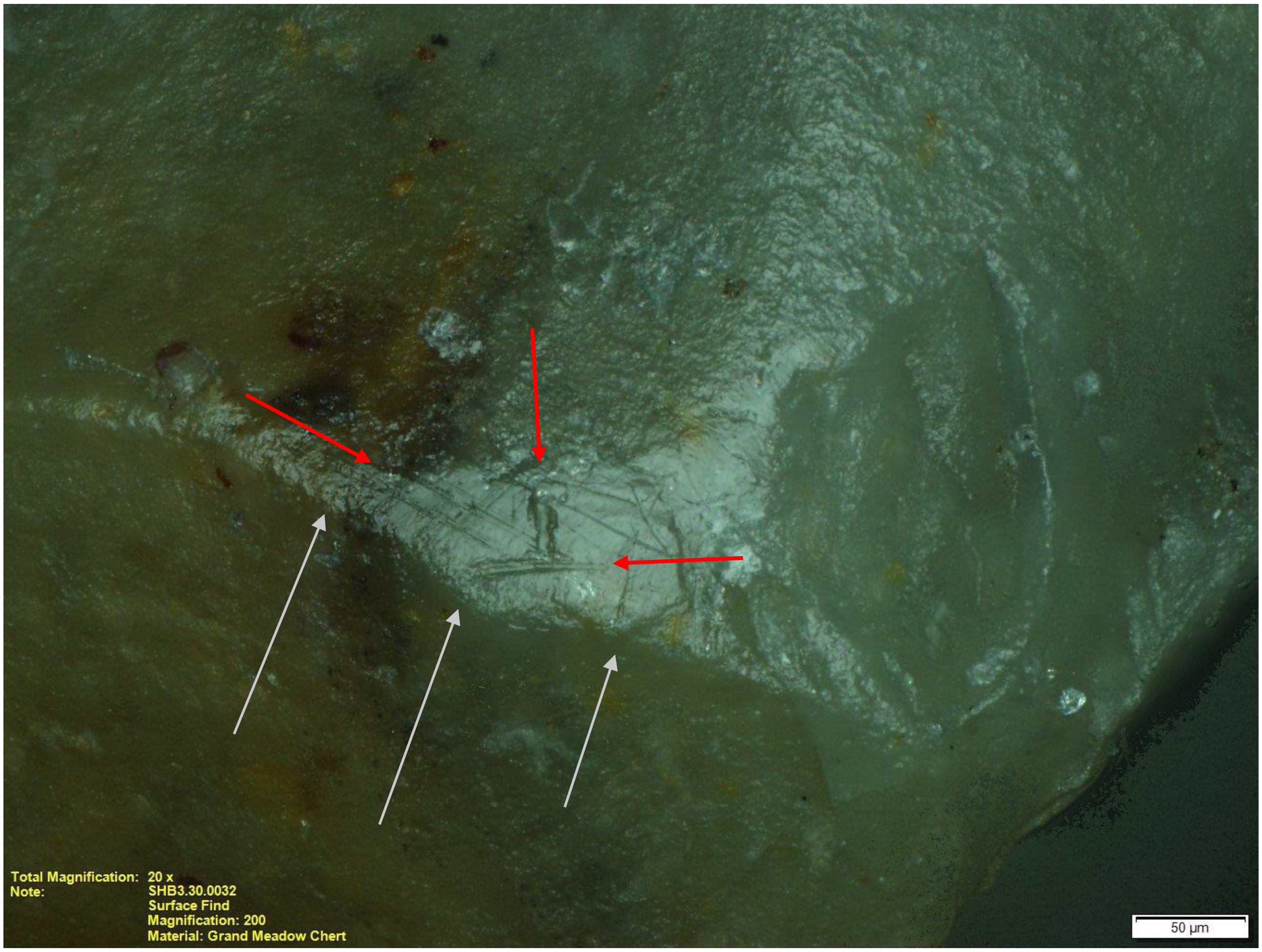


Figure 4.26. Hard Polish Located Near the Platform on a Grand Meadow Chert Flake Viewed at 200x. It is Suggested that This Flake was Repurposed After Removal from a Biface and Possible Used as a Graver and to Work Hide. Gray Arrows Point to Polish Buildup at Platform of Flake. Red Arrows Point to Deep Striation Directional Indicators.

Over half of the artifacts analyzed for the microwear study showed signs of cultural usewear. Ten of these artifacts were flakes that were likely removed during tool maintenance.

When they were removed, they retained the polish built up during use. Three of the flakes (SHB3.30.0032, SHB3.30.0366 and SHB3.30.0391) exhibiting polish were initially attached to a more formal tool, removed during sharpening, and then recycled and used as a flake tool. In two of the instances in which this occurred, the materials were non-local or exotic (Grand Meadow Chert and obsidian). This suggests people living at the Eagle Nest site were using these rare, high-quality materials until they were no longer functional (i.e., too small). Based on the sample observed, tougher, coarser grained materials appeared to be the preference for projectile points, while finer grained cherts or chalcedony may have been selected for activities such as hide working.

Spatial Analysis:

The spatial analysis was completed to attempt to: 1) discern the number of components making up the site and how the artifacts recovered in the plow zone fit into the site's chronology; 2) determine whether natural site formation processes like freezing and thawing had affected the site; and 3) see if activity areas or site function can be determined based on the results of the microwear analysis and on documented features and associated artifacts.

First, bar charts were created in order to observe raw material frequencies by depth. Select local, non-local, and raw materials were used for this analysis including rhyolite, Winin Wabik quartz, Knife River Flint, Cedar Valley chert, Grand Meadow chert, Hixton Silicified sandstone, Burlington chert, and obsidian. The goal of examining vertical concentrations of raw materials was to look for change through time in their use and deposition. Figures 4.27 through 4.35 illustrate the results of this analysis. Second, a map was created to show the horizontal distribution of select raw materials which included rhyolite, Winin Wabik quartz, Knife River Flint, Grand Meadow chert, Hixton Silicified sandstone, obsidian, Burlington chert, and Cedar Valley chert. Figure 4.36 displays the results of the horizontal analysis.

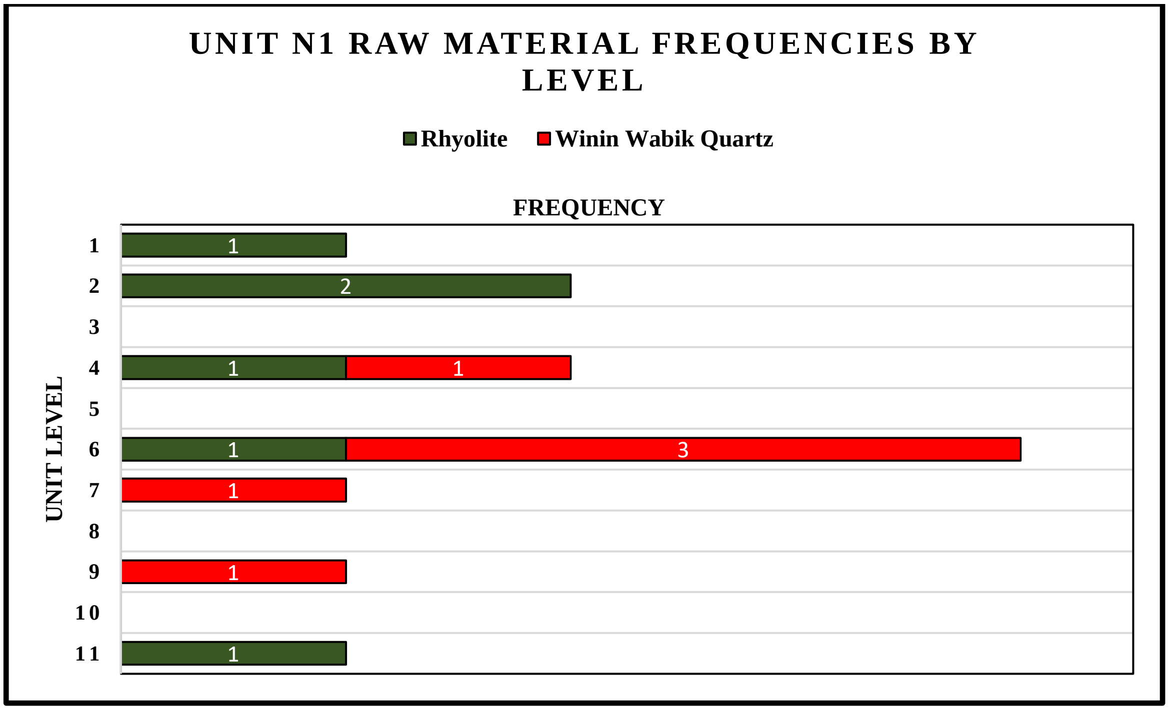


Figure 4.27. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit N1.

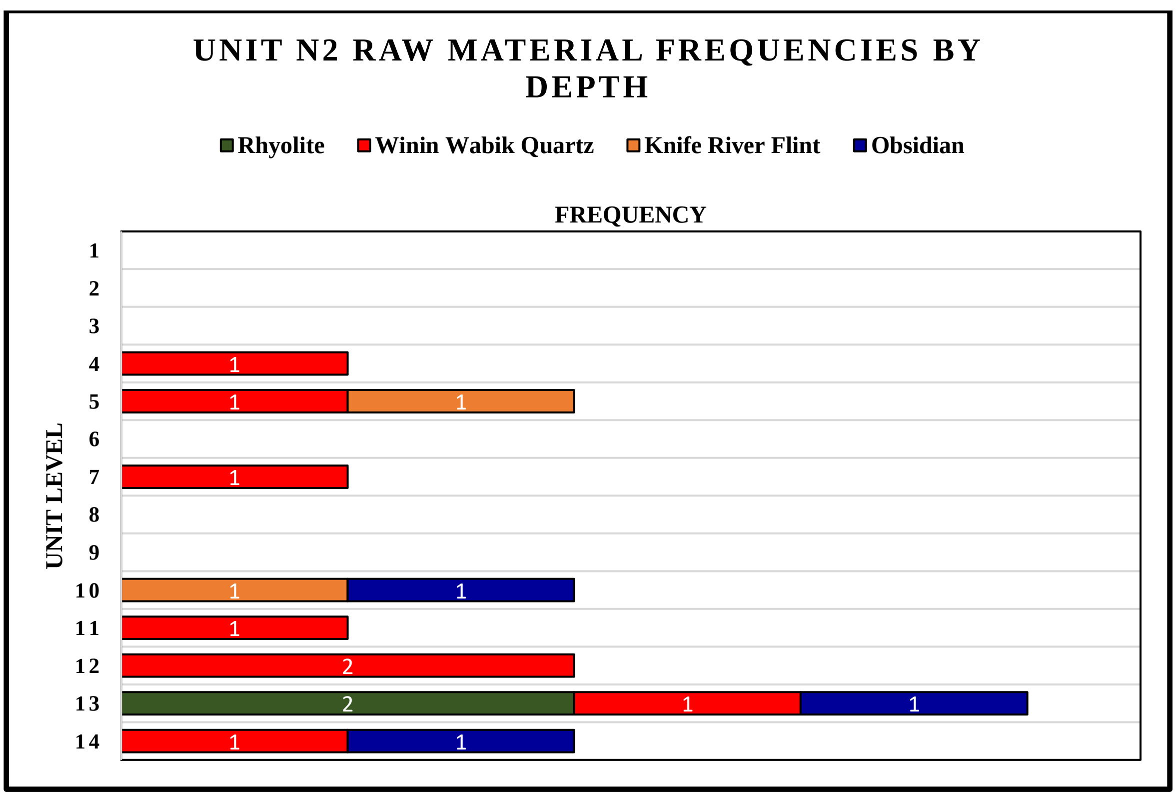


Figure 4.28. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit N2.

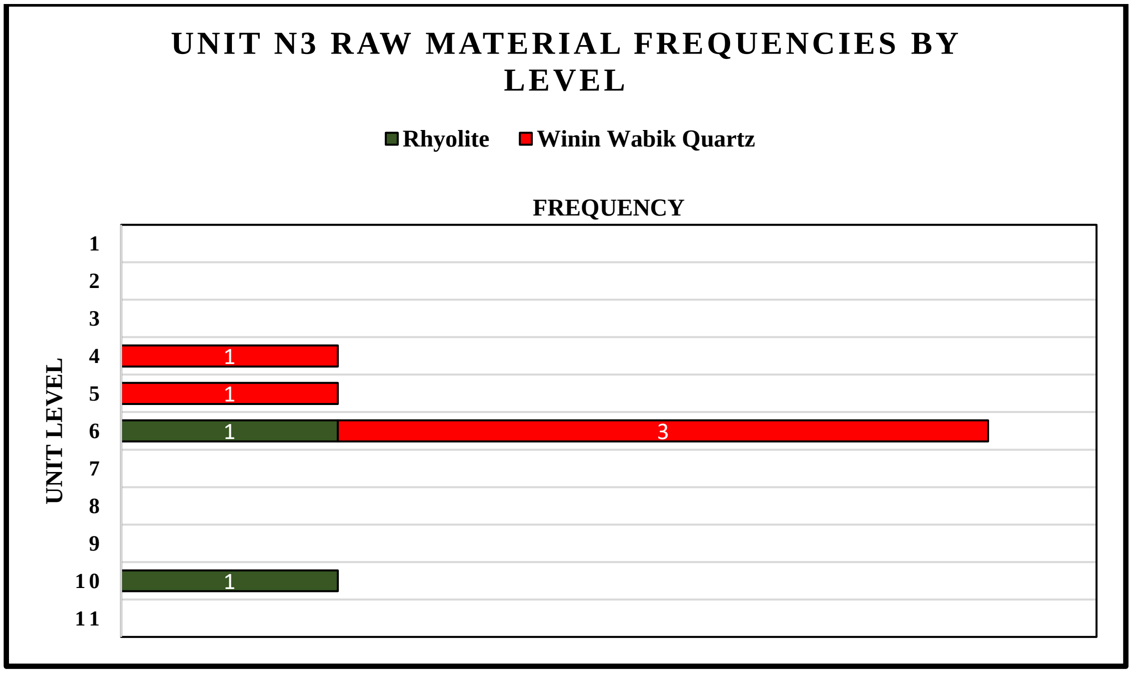


Figure 4.29. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit N3.

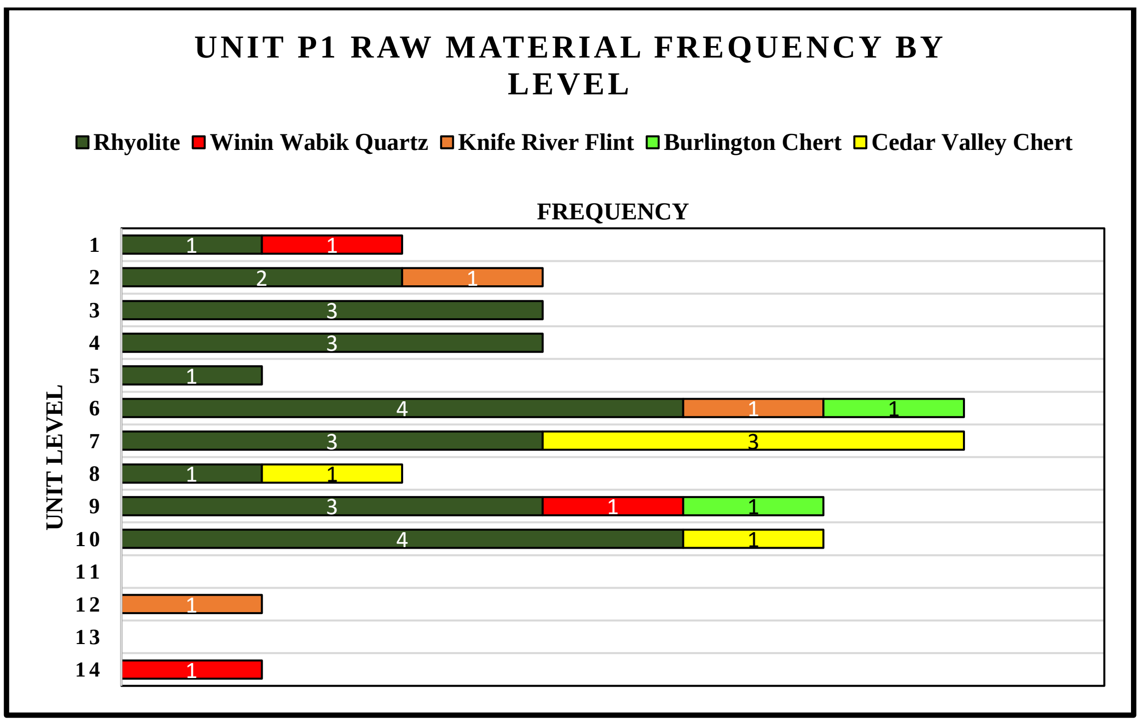


Figure 4.30. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit P1.

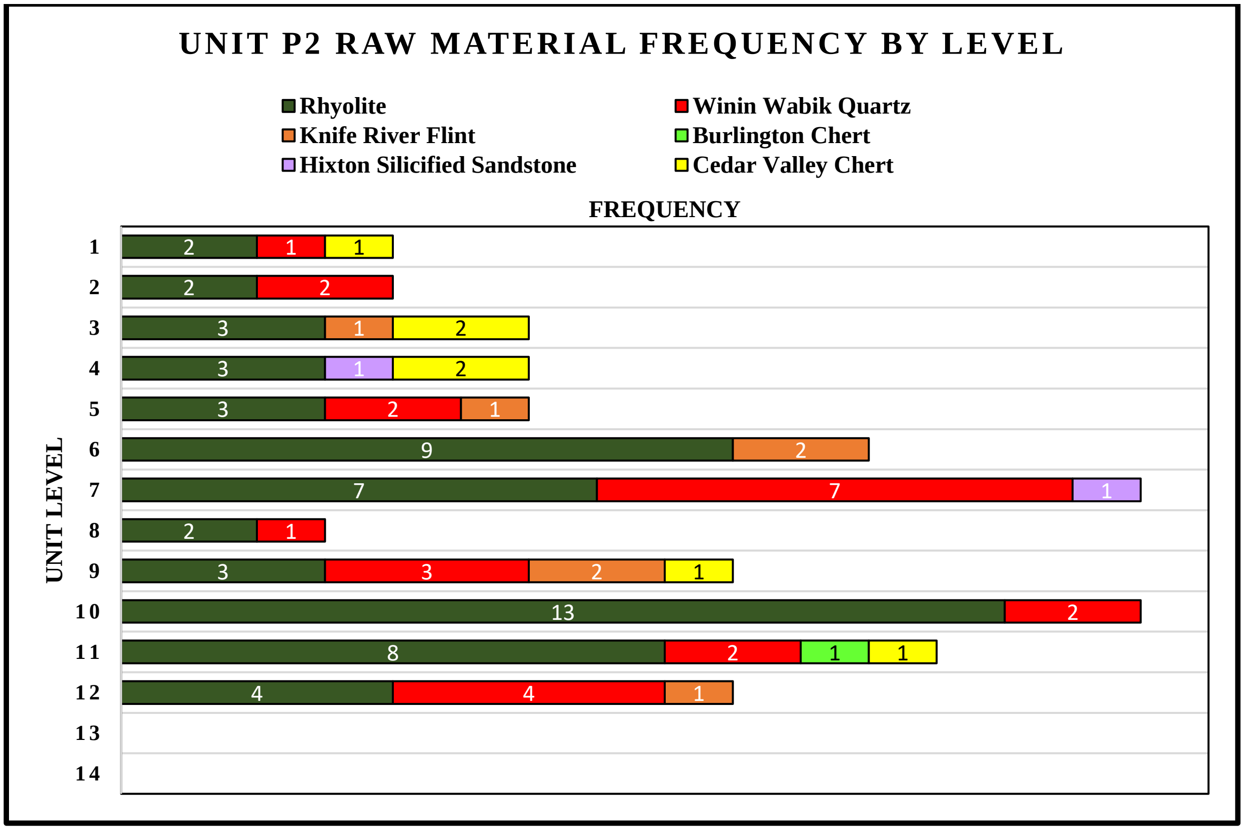


Figure 4.31. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit P2.

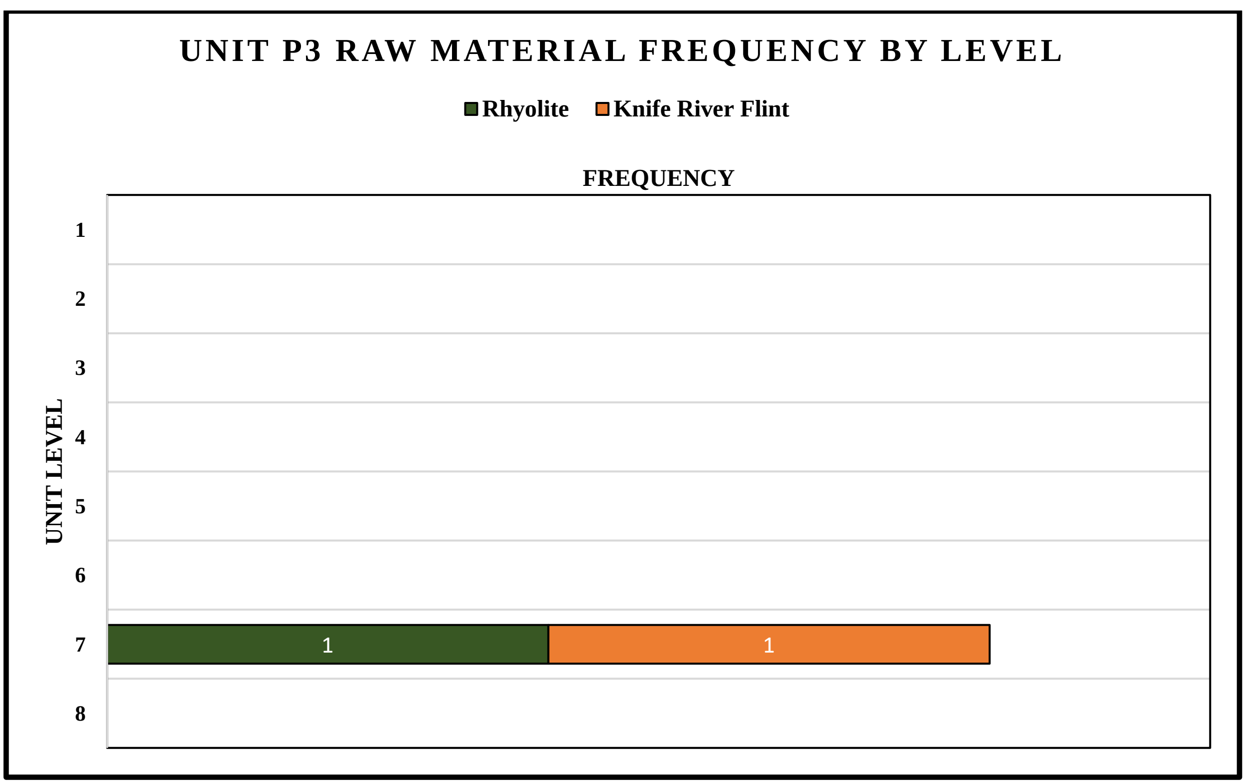


Figure 4.32. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit P3.

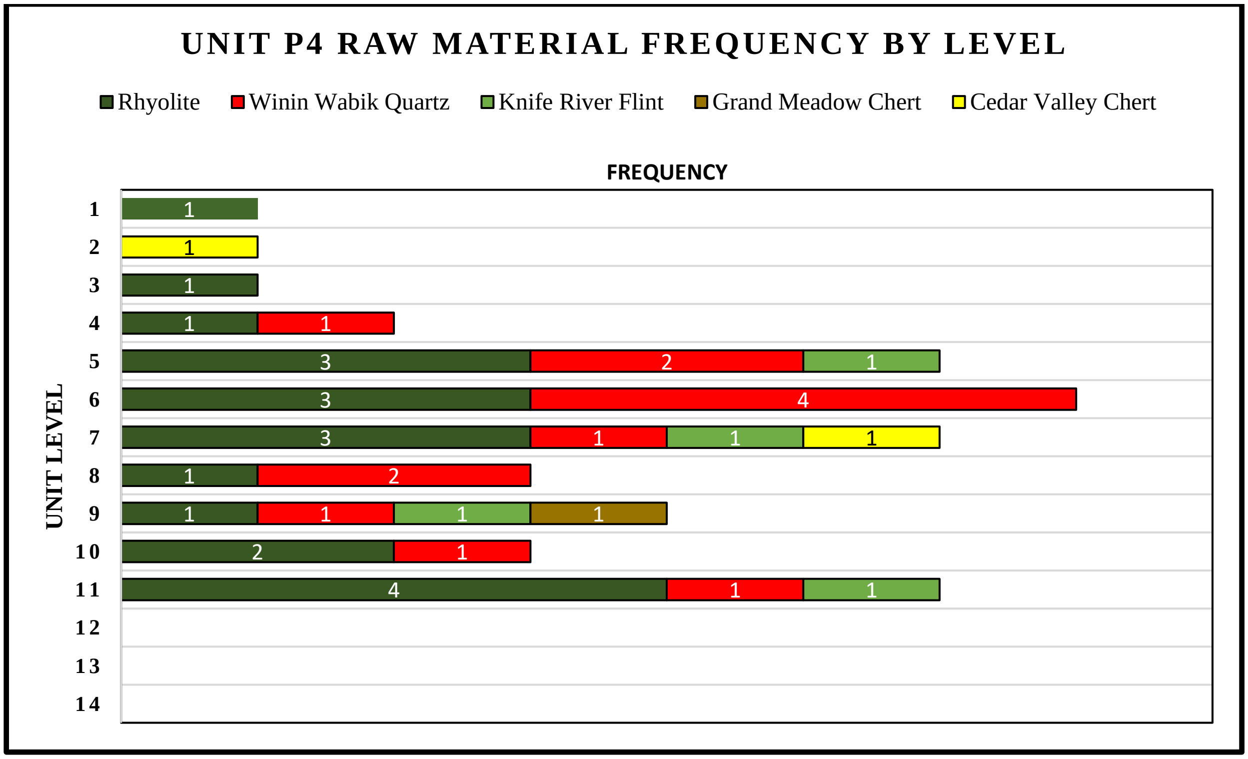


Figure 4.33. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit P4.

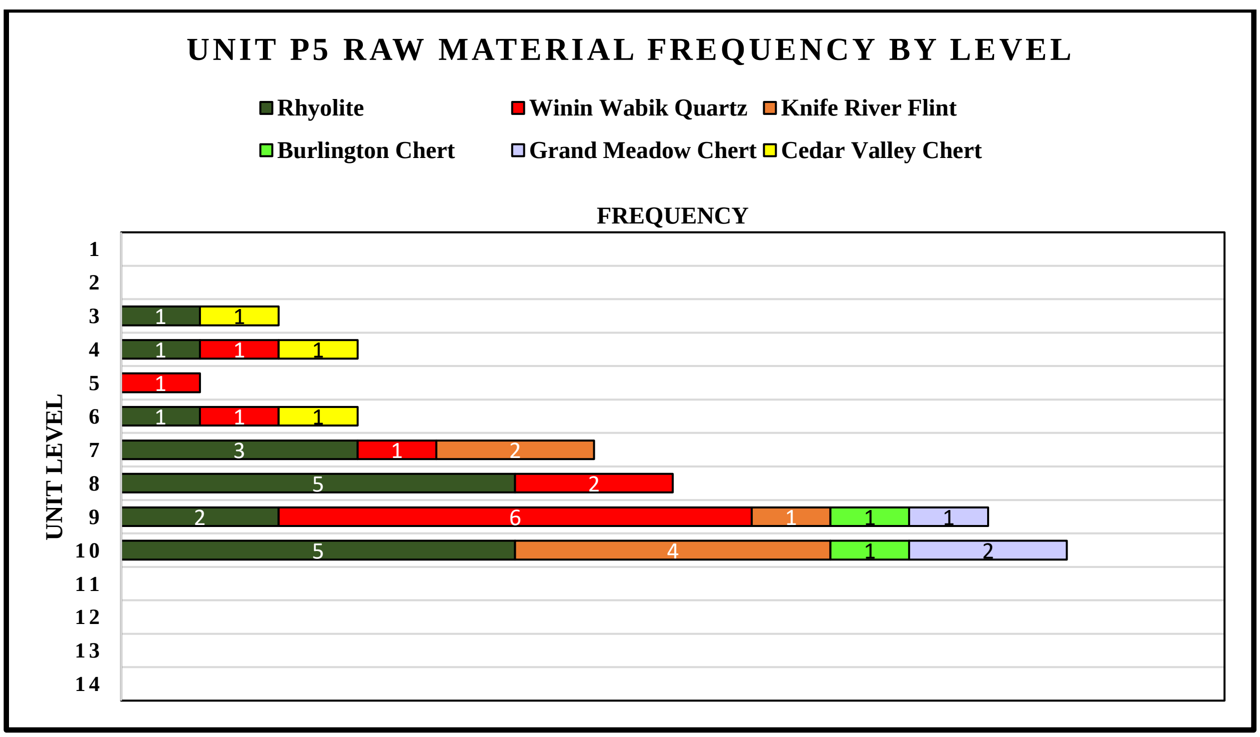


Figure 4.34. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit P5.

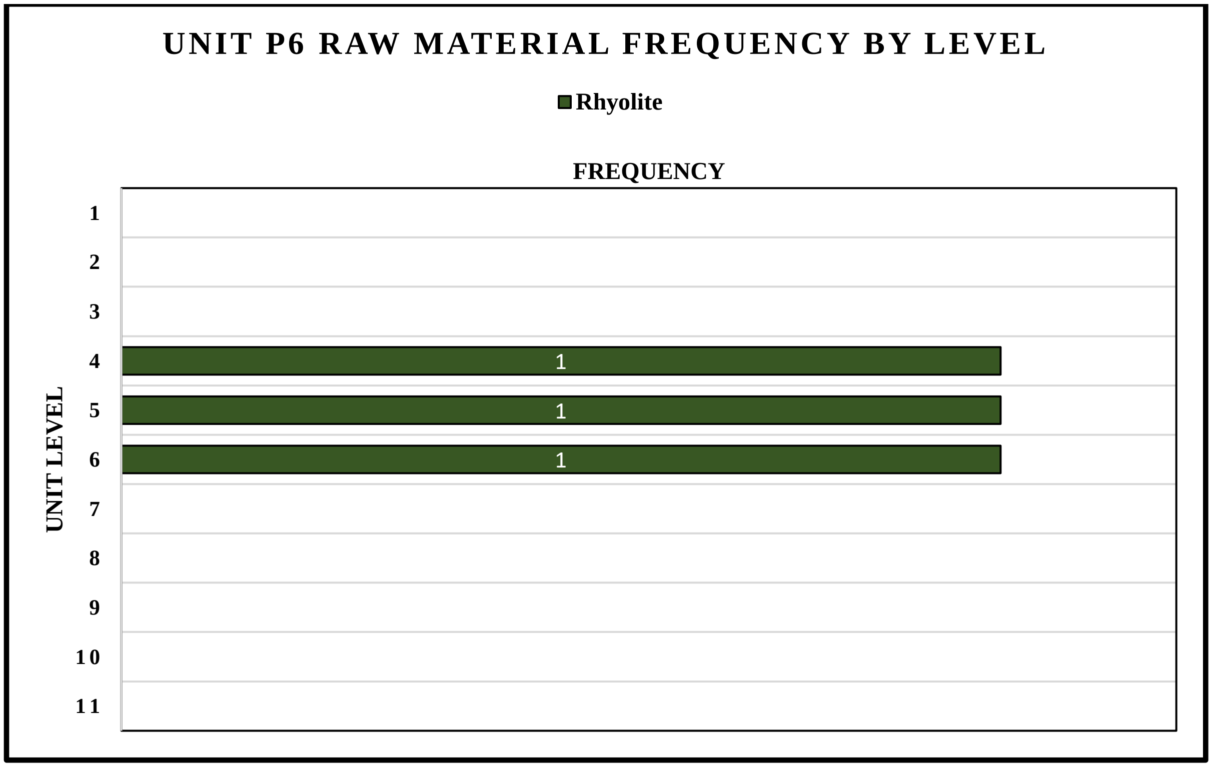


Figure 4.35. Bar Chart Illustrating Frequency of Select Raw Materials by Depth for Unit P6.

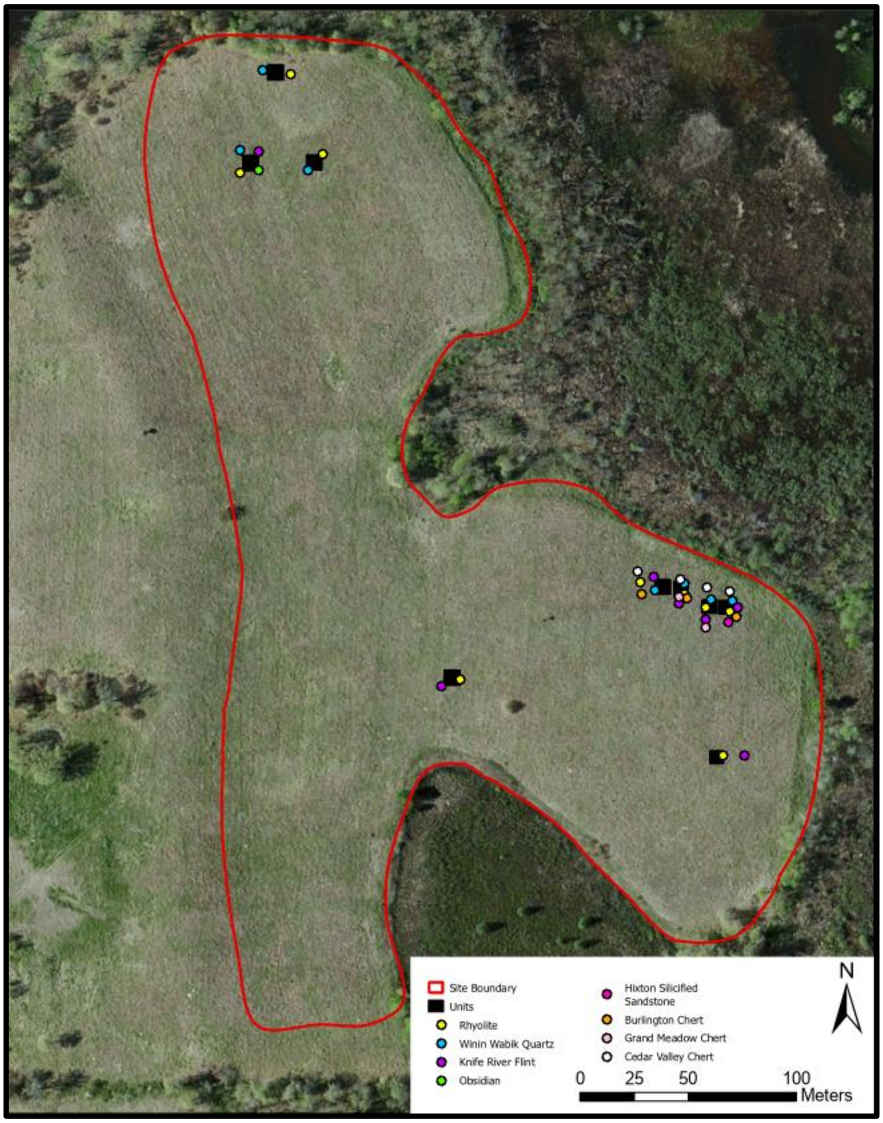


Figure 4.36. Map showing Horizontal Distribution of Select Raw Materials.

The results indicate rhyolite occurred in all units across the site while Winin Wabik quartz occurred in all units except for P3 and P6. It appears as though both were used fairly consistently through time. A closer look at the other raw materials suggests a slightly different use pattern both vertically and across the site. Obsidian, for example, only occurs in one unit (N2) and is confined to the deepest levels of the units. Cedar Valley chert tends to appear in the middle and upper levels of most units and the frequency of this material seems to increase through time. Knife River Flint occurs throughout many of the units, with higher frequencies found in the middle levels. Burlington chert tends to be confined to the lower and middle levels of the units but is largely absent from upper contexts. Finally, Hixton Silicified sandstone and Grand Meadow chert appear to be confined to the middle and upper levels and the lower levels respectively. Hixton Silicified sandstone only occurs in midden unit P2, while Grand Meadow chert only occurs in units P4 and P5. These results help to support the hypothesis of there being up to three components at the site. Specifically, the appearance of obsidian between 45 and 70 cmbs in Unit N2 and the appearance of Grand Meadow chert between 40 and 50 cmbs in Units P4 and P5 suggest an older component may be present within these units.

The next part of the spatial analysis involved comparing the lithic raw material types within the plow zone and to those within the sub-plow zone to see if major differences in raw material type, indicative of a separate component, could be detected. This analysis used chi-square to determine statistically the likelihood one population (plow zone artifacts) does not significantly differ from the other (sub-plow zone artifacts). The raw material types that occurred most frequently within the project area were selected for this analysis. These materials included Knife River Flint, rhyolite, polycrystalline quartz, Prairie du Chien chert, and Winin Wabik quartz. The dependent variables for this analysis were the raw material types and the independent variables were the plow zone and the sub-plow zone. A 2x5 table was created and the chi-square test was then completed in the program PAleontological STatistics, or PAST, Version 4.11. To correct for the possibility of a Type 1 error, a Bonferroni post-hoc test was applied to the results. The results of the Chi Square test can be viewed in figures 4.36 through 4.39.

The results of the chi-square test indicate the difference between the plow zone and the sub-plow zone with respect to proportions of material types is not significant (x^2 = 0.99716, p = 0.318). This suggests the artifacts within the plow zone are not necessarily a separate component of the site but may have been part of a larger site component, one extending into the B Horizon, and got jumbled by means of agricultural practices.

Table 4.9 Chi Squared Results.

Chi squared

Rows, columns:	2, 5	**Degrees freedom:**	4
Chi2:	4.5261	***p* (no assoc.):**	0.33946
Monte Carlo *p*:	0.3465		

Fisher´s exact

Not available

Other statistics

Cramer´s *V*:	0.14859	**Contingency *C*:**	0.14697

Table 4.10 Raw Residuals from Chi Squared.

Raw residuals

	Knife River	Rhyolite	Winin Wabi	Polycrystall	Prairie du C
Plow Zone	-2.4537	-0.10732	1.4098	-2.2	3.3512
Sub-Plow Z	2.4537	0.10732	-1.4098	2.2	-3.3512

Table 4.11 Expected Values from Chi Squared.

Expected values

	Knife River	Rhyolite	Winin Wabi	Polycrystall	Prairie du C
Plow Zone	5.4537	28.107	25.59	17.2	9.6488
Sub-Plow Z	7.5463	38.893	35.41	23.8	13.351

Table 4.12 Bonferroni Correct P

Bonferroni corrected p

	Knife River	Rhyolite	Winin Wabi	Polycrystall	Prairie du C
Plow Zone	1	1	1	1	1
Sub-Plow Z	1	1	1	1	1

To answer the question as to whether the site was affected by cryoturbation, a *t*-test was performed. The *t*-test was done to determine whether there was a significant difference between the mean surface area (mm^2) of the lithic artifacts located on the surface and within the plow zone, and those located within the sub-plow zone. A random sample was selected from the surface and plow zone lithic artifacts and those recovered in the sub-plow zone. Box and dot plots were created to inspect any potential outliers prior to the test (Figure 4.40). Unfortunately, there were several outliers that needed to be taken care of before the *t*-test could move forward. Initially, a 15 percent trim on each of the batches was attempted, but when this failed to get rid of all the outliers, a 20 percent trim was applied (Figure 4.41). The newly trimmed batches were then Winsorized to determine the trimmed standard deviation and the *t*-test was completed.

The results of the *t*-test show the 77 mm^2 difference between the mean surface area (mm^2) of lithic artifacts recovered from the surface and plow zone and those recovered in the sub-plow zone is highly significant ($t = 71.46$, $p < 0.001$). This indicates the differences observed between the mean surface area (mm^2) of the artifacts recovered on the surface and in the plow zone and those collected in the sub-plow zone are real and not just the result of the vagaries of sampling. This may, in part, be due to size sorting from freeze-thaw effects, or cryoturbation, affecting the site. Repeated cryoturbation over the years can cause larger artifacts to be heaved towards the surface, displacing them from their original context (Waters 1992). Other effects such as animal and insect burrowing may have also played an important role in size-sorting. Burrowing animals can cause small artifacts to be pushed up towards the surface (Waters 1992). These same animals tend to burrow beneath artifacts too large to be moved causing large artifacts to move downward as they fall to the base of the burrow (Waters 1992). However, based on other forms of evidence previously discussed, it seems likely the plow zone is its own component altogether.

Finally, the artifacts identified as having usewear were mapped to show their distribution across the site and determine whether activity areas could be identified based on the results (Figure 4.38). Hafting polish occurred in both the northern area and the peninsula area, hard polish occurred primarily in the northern area, soft polish occurred in the southern portion of the site, and an artifact with both hard and soft polish occurred in the peninsula area. Generic polish was present on the peninsula and in the northern area. While this does not necessarily distinguish true activity areas on the site, the presence of hard polish on the northern area and the near absence of it on the peninsula could indicate differences in the types of activities being practiced between the two contexts. More research should be done to determine if the northern portion of the site was used differently than the peninsula area.

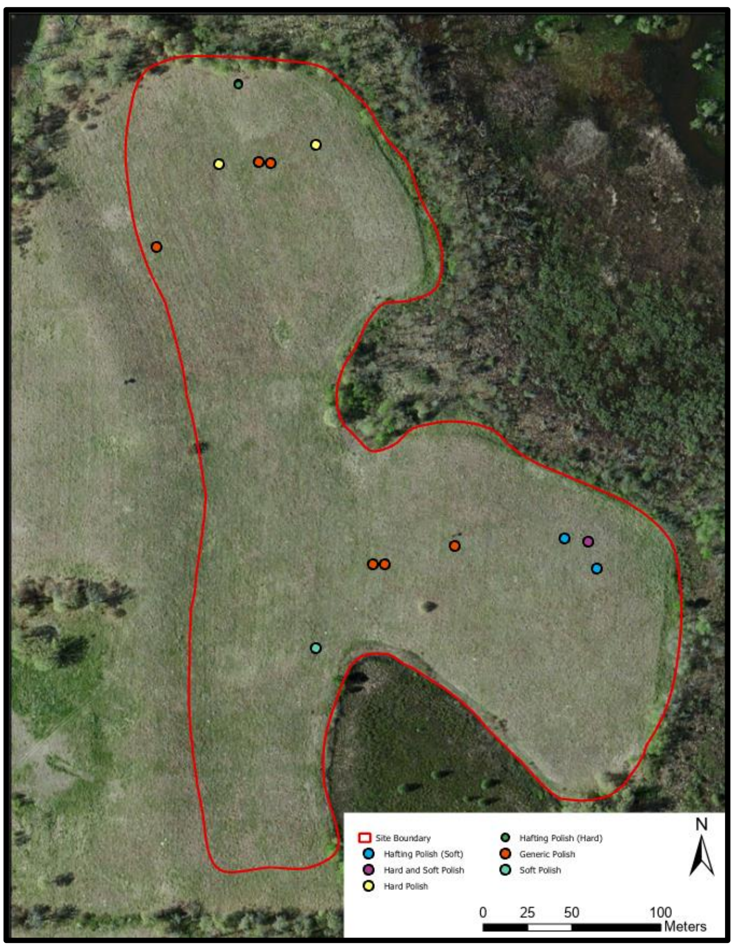


Figure 4.37. Map Showing Horizontal Distribution of Artifacts Identified as Containing

Usewear.

Summary

Based on the evidence above, the site appears to contain three distinct cultural occupations. The first component occurs largely within the plow zone and at times, the Ap/B Horizon transition (~20-35 cmbs). The second component occurs between approximately 40-50 cmbs, and the third component occurs between 55-65 cmbs. This was based on the combined results of the analyses performed above. Charts displaying artifact frequencies by depth show concentrations of artifacts occurring between approximately 20-35 cmbs, 40-50 cmbs, and 55-65 cmbs. These multimodal peaks and their adjacent levels were sampled to look at flake size distribution patterns between proposed components. The bifacial reduction analysis indicated the presence of at least two components, one in the upper levels (20-50 cmbs) and one in the lower levels (55-65 cmbs). The analysis that looked at the weight of each size grade and context further suggests the upper levels may actually be two components rather than one. This was based on differences in the average weight of flakes between 20-35 cmbs and those in other levels. Together, these two analyses seem to indicate a shift in technological strategies through time, from a focus on marginal flaking activities in earlier components and a potential move towards a more expedient flake tool technology in the late Woodland period.

The results of the raw material distribution analyses also suggest three components. Obsidian only occurs within the deepest levels of Unit N2, and no other exotic or non-local materials appear at this depth other than Knife River Flint which can be found in all units and within each of the proposed components. Grand Meadow Chert exclusively occurs within the proposed middle component between 40-50 cmbs. The appearance of exotic materials within these specific contexts is telling and suggests a change in access to certain materials through time.

The *t*-test results indicated a significant difference between the mean area (mm^2) of lithic artifacts recovered from the surface and plow zone and those recovered in the sub-plow zone. This suggests freeze-thaw effects likely affected the site, causing larger artifacts to move towards the surface. Additionally, plowing can affect the vertical position of artifacts and frequently cause larger artifacts to move towards the surface. However, based on other evidence presented in this section, the plow zone seems to be a component in its own right. The flake size differences between the plow zone and sub plow zone are probably a result of different technological strategies practiced during the Late Woodland period.

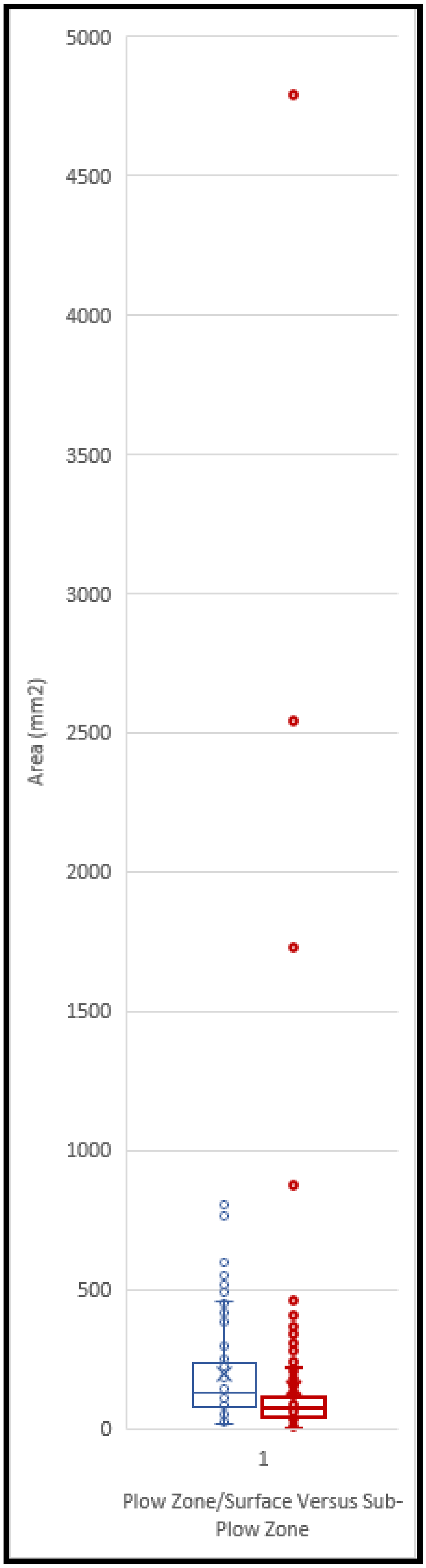


Figure 4.38. Box and Dot Plot Showing Outliers Before Trimming the Batch.

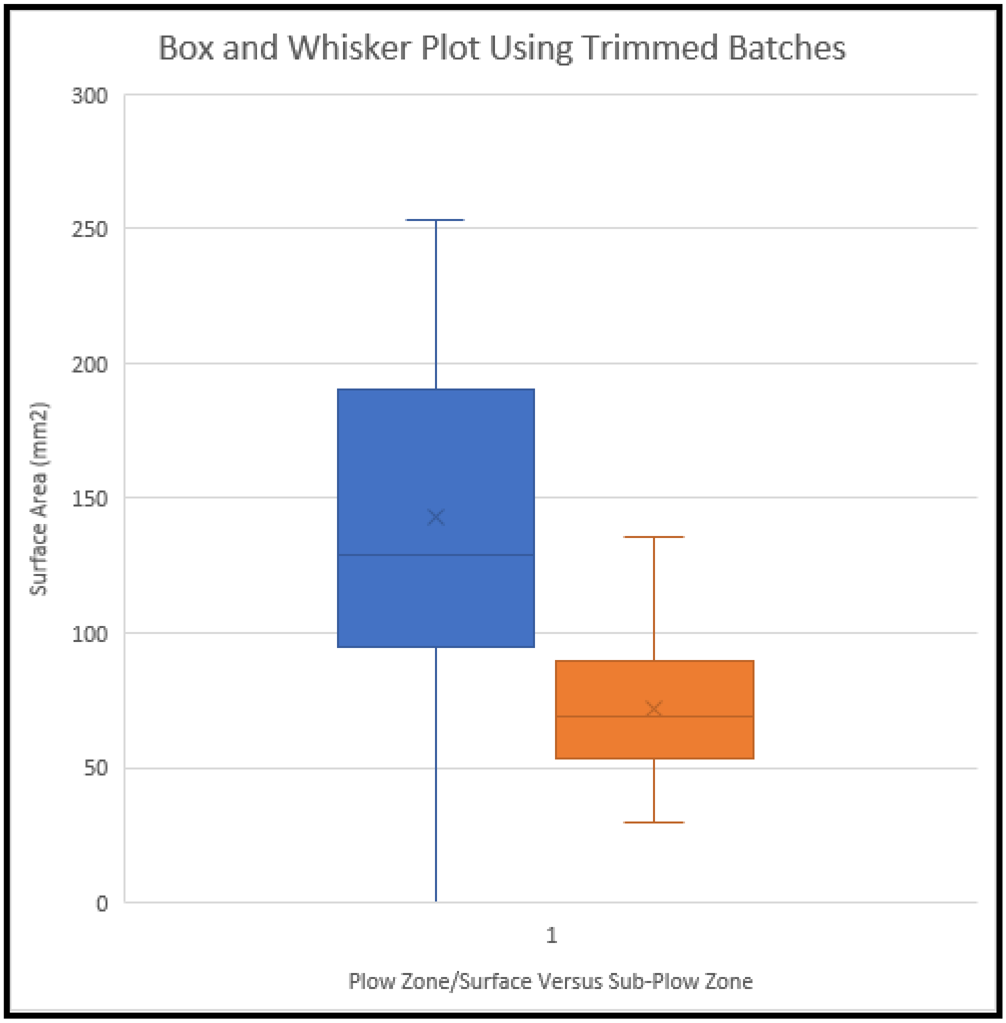


Figure 4.39. Box and Dot Plot Illustrating Batch After a 20 Percent Trim.

Conclusion

To conclude, based on this analysis, the Eagle Nest site is a multicomponent Woodland period site that was repeatedly occupied over time. The lithic technological organization of the peoples occupying the site suggests involvement in important exchange networks, at least peripherally, with other groups to the east and west, and especially the south. This is largely based on the exotic raw materials recovered from the site. As populations grew during the Woodland period, "the transformation of band-based societies into tribal societies involved the shift from a forager way of life to a collector way of life" (Gibbon 2012:199). This typically involved "a central settlement" that is used over the course of several years. Traveling to acquire resources was not always an option due to distance and territorial control. Groups tended to aggregate “from peripheral regions” during the year and there was likely exchange when this occurred (Gibbon 2012:199). The abundance of toolstone coming into the region from the south and southeast suggests important connections between these groups, possibly familial or intermarital. As obsidian is quite rare in Minnesota and only three pieces of it were recovered from the Eagle Nest site, it seems likely connections to the west were more limited. We know Minnesota had connections with groups in North Dakota because Knife River Flint occurs relatively frequently throughout much of the state. It seems likely that obsidian could have been brought into the state through North Dakota which is connected to obsidian sources in Wyoming via the Missouri River.

Tools made of high-quality raw materials appeared to have been used in their entirety as is evidenced by microwear found on non-local materials which indicated continued use after being struck and removed from larger bifacial tools during resharpening. Non-local and exotic materials were brought into the site and were recycled so as to get as much use as possible from these superior raw materials. Odell (2004:199) states, “in assemblages from sites at which suitable toolstone was scarce or unavailable, economizing behavior [such as this] can often be recognized.” Lithic technological strategies taking place on the site appeared to focus primarily on tool maintenance and possibly flake tool production based on the flake-size distribution in units P1 and P5. As P1 and P5 are likely associated with a living surface, tool production activities may have differed in domestic and non-domestic areas of the site. Nearly every unit contained small pieces of debitage indicating that tool maintenance was practiced in most areas. Future research may indicate the north area was used for specific activities, while the area near the peninsula may have served as more of a living space. For now, this is just a hypothesis.

The results from the vertical spatial analysis showed there were not major differences in tool production strategies between the upper and middle levels of most units, but the lower levels did reflect a somewhat different patterning. The upper and middle levels of the units reflect a mixture of tool maintenance and non-marginal flaking activities. Non-marginal flaking activities do not appear to be as pronounced in the lower levels. This may reflect technological change through time, as peoples began to rely less on formally shaped tools and instead employed a more expedient tool technology. Examining these data with the vertical distribution of raw material types bolsters the hypothesis of the site having several components, but more research should be carried out to attempt to see whether there are more than two. Additional diagnostic artifacts would be helpful. A thorough examination of the pottery to complement this study is advised. As it currently stands, we can say there are two components with confidence.

While no direct evidence of bipolar technology was seen during the analysis, it is possible this technology was practiced on the Eagle Nest site, though further research must be completed to say anything with certainty. Curated and expedient tool technologies seemed to have both been used, although the only curated tools recovered from the site were projectile points and one tool handle fragment. This suggests curated tools may have been manufactured for hunting purposes while other tasks were carried out with more expedient tools that were created as needed.

The microwear analysis indicates activities like hide working may have occurred on site. These activities along with the hearths, midden, and all of the pottery sherds suggest the site may have been a village or camp. The locations of the potential living surface and hearths should be studied to confirm this. Additionally, based on hafting polish, we can presume curated tools were probably hafted with antler or bone, and appear to have been lined at times with some sort of soft hide shim.

More research is needed to better understand the complicated chronology of the Eagle

Nest site, but my hope is that the results of this project will significantly contribute to our understanding of the Woodland period groups living in Central Minnesota.

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