

**An Intra-site Spatial Analysis of the Late Paleoindian
Mackenzie I Site (DdJf-9), near Thunder Bay, Ontario**

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ABSTRACT

This thesis presents the results of the intra-site spatial analysis of the Mackenzie I (DdJf-9) Late Paleoindian site, located ~30 kilometers east of Thunder Bay, Ontario. The Mackenzie I assemblage consisted of a wide range of artifacts and formal tools suggesting a repeatedly occupied, large-scale, habitation site. The large sample size allowed for the application of in-depth spatial analysis techniques that had not yet been applied to Lakehead Complex habitation sites. The primary goal of this thesis is to determine whether statistically significant and diagnostic patterns exist which represent discrete activity areas, and spatial organization.

To accomplish this, six study areas were determined through the visual inspection of artifact distribution. Locations were selected along the site periphery to avoid the more intensely occupied, and potentially less interpretable, areas of the site. After visually comparing multiple aspects of the assemblage, various statistical tests were used to determine the presence or absence of significant patterning, the optimal number of clusters, and cluster composition. Observed artifact patterning was then interpreted using diagnostic patterns discussed in the ethnoarchaeological and archaeological literature.

The mixed-methods approach applied within this thesis allowed for the direct identification of lithic manufacturing and tool finishing/re-working activities within the study areas. Additionally, indirect evidence based upon various tool types suggests the presence of more diverse activities (e.g. hide, wood, antler, and bone working, small-scale butchering, and food preparation). Tools associated with these activities were likely not being used within the study areas, but rather represent the manufacture or refurbishing of such tools which were then used elsewhere.

Results suggest that many of these lithic activities were co-occurring within the same activity area regardless of tool type or the intended purpose of the tool. The close vertical and horizontal association of various tool types suggests that these lithic activities were not spatially segregated. Conversely, discrete patterns were detected between *in-situ* activity zones and refuse middens. Evidence within some clusters suggests the consistent reuse of middens across separate knapping events, and possibly separate occupations. The segregation and reuse of middens indicates the purposeful organization of space.

This study enabled the exploration of a methodology that could detect spatial organization given the taphonomical processes and poor preservation affecting Boreal forest sites, as well as data derived from Cultural Resource Management (CRM) mitigations. The intra-site spatial analysis of the Mackenzie I site expands upon our knowledge of Late Paleoindian occupation in northwestern Ontario, and provides a better understanding of the spatial organization and behavioural patterns of Mackenzie I's past inhabitants.

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CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

This thesis presents a spatial analysis of six loci within the Mackenzie I archaeological site, located east of Thunder Bay, Canada. The primary goal is to determine whether statistically significant and diagnostic patterns existed that might suggest discrete activities represented by the spatial organization. Mackenzie I was excavated during the 2010 and 2011 field seasons by Western Heritage according to provincial standards and guidelines prior to the twinning and expansion of Highway 11/17 (MTCS 2011). This salvage operation included the excavation of eight archaeological sites, all of which were located on relict shorelines of Lake Superior and demonstrated an association with Late Paleoindian (Plano) culture. Plano sites in northwestern Ontario are generally dated to 10,700-7,800 calibrated (9,500-7,000 ¹⁴C) years Before Present (yr BP) and define the earliest presently known human occupation of the region (Kingsmill 2011).

Since the early 1950s, a number of sites assigned to the Plano culture have been found along ancient shorelines throughout the northern Superior region (Fox 1975; Halverson 1992; Hinshelwood 1990; Hinshelwood and Webber 1987; Julig 1994; MacNeish 1952; Ross 1995). Most sites yielded large concentrations of lithic debitage but few diagnostic tools, suggesting the importance of primary lithic reduction within temporary encampments. Unlike many of the Plano sites in the region, the wide range of artifacts and formal tools recovered from Mackenzie I suggest that it was a repeatedly

occupied, large-scale, habitation site. The high artifact count and varied nature of the lithic assemblage is rare in northwestern Ontario. Therefore, an extensive study of Mackenzie I allows for in-depth research into the social and spatial organization of Late Paleoindian people within the region.

1.2 STUDY AREA: THE MACKENZIE I SITE

Mackenzie I (DdJf-9) is located approximately 30 km east of Thunder Bay along the relict shoreline of glacial Lake Minong, on the west bank of the Mackenzie River (Figure 1.2.1). Western Heritage was contracted by the Ministry of Transportation of Ontario (MTO) to conduct a Stage 4 mitigation of the site prior to the twinning of Highway 11/17. A Stage 4 excavation includes the documentation and removal of artifacts from a site prior to development, if protection of the site is not viable (MTCS 2011). The highway expansion was completed in the summer of 2013, culminating in the complete destruction of the site to allow for graded approaches to the new bridge over the Mackenzie River.

The unique characteristics of the Mackenzie I site are significant for regional research as they contribute new insight into the Paleoindian history of northwestern Ontario. In total, 2,539 m² were excavated over two field seasons. Artifacts ranged from debitage representing each stage of lithic reduction including primary reduction and finishing flakes, to a large number of tools including projectile points, adzes, drills, knives, scrapers, reworked tools, retouched flakes, cores, grinding stones, and hammerstones. Although the assemblage was dominated by Gunflint Formation lithic material (i.e. taconite and gunflint silica) other raw materials include Hixton Silicified

Sandstone, Hudson Bay Lowland Chert, Knife Lake Siltstone, and Rhyolite (Markham 2013). Due to the acidic nature of the soil and antiquity of the site, no organic artifacts remained to be recovered.

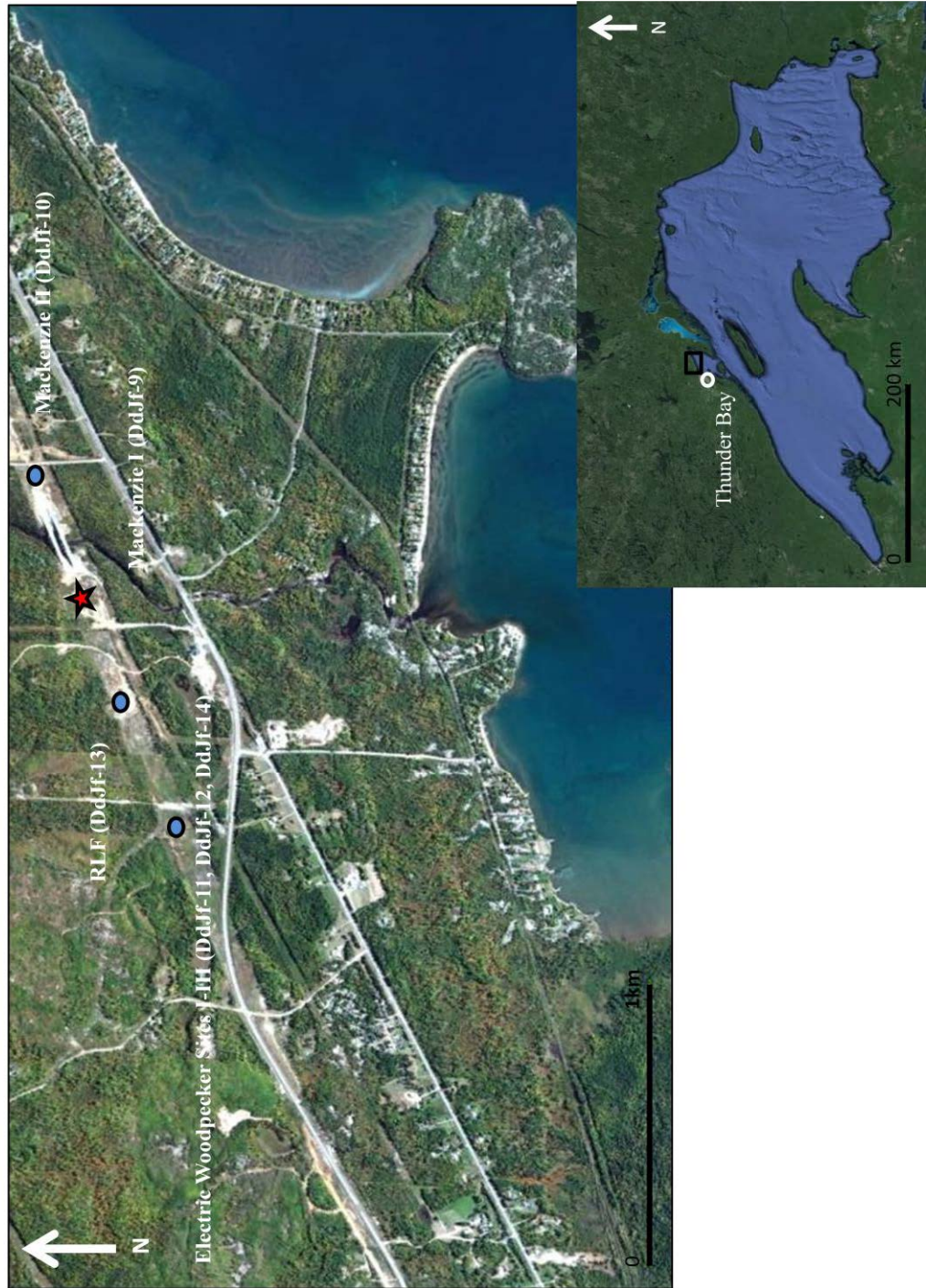


Figure 1.2.1: Location of Mackenzie I (DdJf-9), and other sites mitigated by Western Heritage.

1.3 PREVIOUS ARCHAEOLOGICAL WORK IN NORTHWESTERN ONTARIO

Many Plano sites have been excavated in the region since the 1950s and each contributes to the contextual framework of this thesis. Plano sites in the region are considered to represent similar cultural groups and therefore are grouped within the Lakehead Complex (Fox 1975, 1980), within the wider Interlakes Composite (Ross 1995). The Lakehead Complex was a term coined by Bill Fox in 1975, who concluded that Plano sites in the region shared traits such as the use of local Gunflint Formation material and lanceolate shaped projectile points (Fox 1975). With the addition of new sites, Ross (1995) suggested that the Interlakes Composite be defined to demonstrate the similarities between four regional complexes: Lake of the Woods/Rainy River, Quetico/Superior, Lakehead, and Reservoir Lakes (Figure 1.3.1). The classification of the regional assemblages developed by Fox (1975, 1980) and Ross (1995) provide a framework in which the Mackenzie I site assemblage was analyzed.

With the exception of a few comprehensive studies (see Julig 1994), many reports have focused on the lithic assemblage from a culture historical perspective. Due to the nature of boreal forest archaeology (poor preservation, low sample size, and a general lack of diagnostics) it has been necessary to use the culture historical approach to place northwestern Ontario Plano populations diachronically. The recent mitigation work for the Highway 11/17 expansion provides the opportunity for researchers to approach the assemblage from a different perspective.

1.4 SPATIAL ANALYSIS IN ARCHAEOLOGY

Spatial analysis is used to examine the intra-site patterning of material culture in order to determine activity areas and inferred cultural behaviours. Its use in determining the organization of past populations has been recognized as an effective means of interpreting inter and intrasite relationships (Kroll and Price 1991). For example, many studies have successfully conducted spatial analyses to determine activity areas such as butchering or lithic manufacturing (Baales 2001; Mills 2007). Although some of these studies include faunal or other organic remains, this method of study has also been completed when the lithic material is all that remains; such is the case with Mackenzie I (Mills 2007; Odell 1980, 404).

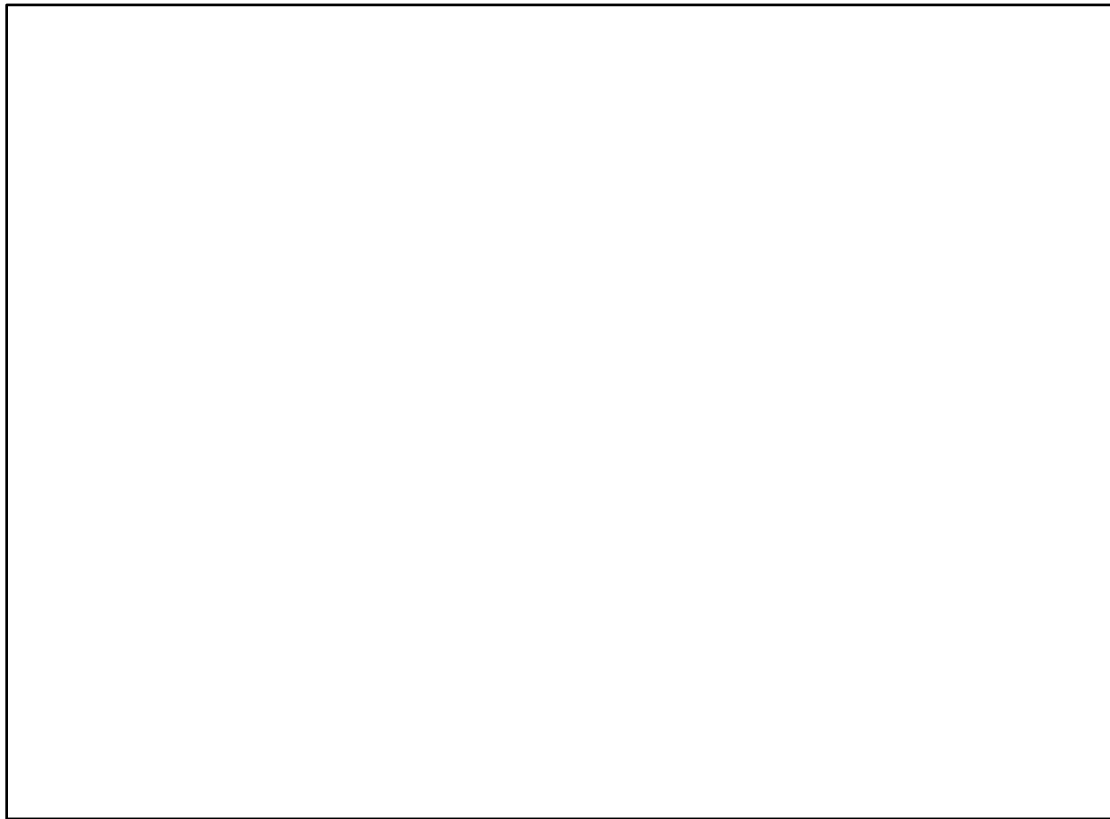


Figure 1.3.1: Location of the archaeological complexes within the Interlakes Composite, after Ross (1975).

The term 'activity area' refers to the specific location in which a human event has taken place, and can be recognized through quantitative analysis of the artifact patterning and by drawing comparisons with ethnographic research (Kent 1984). These activity areas can be explored through the use of Geographic Information Systems (GIS), which are computer programs that can be used to locate, define, and evaluate artifact clustering. These programs provide visual representation of the site and include spatial statistics that can be used to determine if an observed pattern is statistically significant. The spatial analysis of Mackenzie I will include both a visual and quantitative approach to identify any spatial organization that may be present. This spatial information will allow for the inference of social organization at the site, and will function as a test to determine whether spatial analysis of this large habitation site within the boreal forest environment is feasible.

1.5 STUDY OBJECTIVES

The primary objective of this research is to address the lithic recoveries from Mackenzie I in order to demonstrate potential spatial and social organization. A small number of spatial studies have been conducted in the region but their interpretations have been limited due to the time constraint inherent in Cultural Resource Management (CRM) archaeology. However, the combined effort of Western Heritage and Lakehead University to make the artifact recoveries available to students has provided the opportunity for more detailed analyses of the sites that were discovered during mitigation.

Through the examination of point plotted lithic recoveries, six areas of high artifact density were identified that represented localized and potentially interpretable clusters. These study areas are designated by their location within the site: North, Central North, West, Central West, East, and South. The nature of the lithic remains from each individual study area was then examined, and clusters were analyzed for statistically significant patterns. These patterns could determine the presence of any spatial organization which allows for interpretation of social organization of the region's earliest inhabitants.

CHAPTER TWO

NORTH AMERICAN PREHISTORY: ENVIRONMENT AND CULTURE

2.1 INTRODUCTION

This chapter provides a brief overview of North American deglaciation and initial peopling of the continent, followed by a more in-depth analysis of the prehistory of northwestern Ontario. An understanding of the glacial history and paleoenvironment that affected the Paleoindian populations provides context for a discussion about Plano culture, technology, and subsistence patterns. Furthermore, environmental factors and the availability of floral and faunal resources influence the tool-kit, and as such they affect the interpretation of archaeological sites. In regions with limited organic preservation, such as northwestern Ontario, studies that incorporate various lines of evidence such as geomorphology, paleo-ecology, sedimentology, and paleohydrology become valuable interpretive tools (Björk 1984; Boyd et al. 2012; Breckenridge et al. 2010; Kingsmill 2011; Liu 1990; Phillips and Fralick 1994; Shultis 2013). These studies enable archaeologists to hypothesize what the region could have looked like and how it would have influenced early inhabitants such as the people at Mackenzie I.

2.1.1 North American Deglaciation

Multi-proxy studies, including climatic reconstructions, concerning the deglaciation of North America are significant considerations when discussing early population migrations. Absolute dates associated with glacial advances and retreats are correlated with relative dates from archaeological sites situated along glacial

morphological features (e.g. end moraines). This information can then be used by archaeologists to infer the temporal and spatial aspects of human migration.

During the Last Glacial Maximum (LGM) around 18,000 (~21,700 cal) yr BP, the major North American ice sheets had coalesced. By 15,500 (~18,800 cal) yr BP the Laurentide and Cordilleran Ice Sheets began to separate creating an Ice-Free Corridor that some believe to be one of the major routes for early human migration into the continent (Dyke 2004). Further east, the northward recession of the Laurentide Ice Sheet (LIS) allowed for the creation of proglacial lakes in newly deglaciated land south of the ice margin. The geographical position of the ice sheets and the ebb and flow of glacial margins were heavily influenced by a series of warming and cooling climatic trends (Dyke 2004; Newby et al. 2005). This would have consequences for human population movement.

The late glacial Interstadial (13,500-11,000 or ~16,500-13,000 cal yr BP) was comprised of the Bølling and Allerød warm phases, and an intermediate Older Dryas cooling trend. After the warm Bølling-Allerød phase of glacial retreat, a cooling trend known as the Younger Dryas (11,000-10,000 or ~12,900-11,600 cal yr BP) caused a period of glacial readvance, resulting in the southward advancement of the ice margins (Dyke 2004; Newby et al. 2005). The large inflow of water from the Mackenzie River in the Northwest Territories into the Arctic Ocean at 13,000 (~15,900 cal) yr BP may have been the cause of this particular cooling trend (see Murton et al. 2010). After the culmination of the Younger Dryas, renewed climatic warming caused glacial retreat. This was followed by the Hypsithermal (ca. 8,000-4,500 ¹⁴C or ~8,900-5,200 cal yr BP) wherein environmental conditions allowed for the northward and eastward expansion of

the prairie ecosystem, reaching as far east as eastern Minnesota (Kingsmill 2011; Liu 1990). This warm and dry atmosphere also allowed the Great Lakes-St. Lawrence forest to expand 140 kilometres north of its current margin (Liu 1990).

Many environmental and climatic factors influenced the sequence of deglaciation in North America. Deglaciating landscapes were quickly inhabited by cold-adapted floral and faunal species, followed by humans in search of game and a new resource base. By approximately 6,000 (~6,800 cal) yr BP ecological biomes were similar to modern distributions with the exception of areas to the north and east of the continent that experienced delayed deglaciation (i.e. Baffin Island and northern Quebec/Labrador) (Dyke 2005).

2.1.2 Peopling of North America

As the Cordilleran and Laurentide ice sheets retreated, the emergent landscape began to generate new life. Humans expanded throughout the continent following the migration of vegetation and fauna into newly opened land. However the timing and migration pattern of these groups are contentious and frequently debated topics (Bever 2006; Bradley and Stanford 2004; Easton 1992; Fladmark 1979; Goebel et al. 2008; Meltzer 1989, 1995). Research consensus is continually changing with dating techniques and recent archaeological discoveries providing new evidence. Debates include the timing of migration, and the migration route: coastal, inland via the Ice-Free Corridor, and the Solutrean Paleolithic theory via the Atlantic (see Bradley and Stanford 2004, 2006 and Straus et al. 2005 for more information on the Solutrean debate).

Many contemporary researchers agree that the first people migrated from Siberia, across Beringia and into Alaska sometime after 16,600 (~19,900 cal) yr BP following deglaciation of the coast (Goebel et al. 2008). Although this theory is supported with DNA research, the reliability of radiocarbon dates has been called into question (Bever 2006; Fiedel 1999). Sites such as Monte Verde, Chile and Meadowcroft Rock Shelter, Pennsylvania cast doubt on certain theories because radiocarbon dates obtained from these sites suggest an earlier human presence, deep into the North and South American continents. The heavily stratified site of Meadowcroft Rock Shelter (Adovasio et al. 1978, 1990) suggested a human presence by 14,000-14,500 (~17,200-17,600 cal) yr BP (Dillehay et al. 1982). Multiple migration routes are plausible although there is little doubt that humans were present in North America prior to Clovis culture. It is evident that humans migrated relatively quickly throughout the continent, creating new toolkits and regional Paleoindian traditions.

2.1.3 Paleoindian Tradition: Definition

Archaeologists refer to the word 'Paleoindian' to distinguish the first inhabitants of the continent. The term can be further divided into Early Paleoindian and Late Paleoindian (Plano) to signify loose temporal boundaries. There are distinguishing differences between the two traditions including toolkit (Fluted vs. Lanceolate varieties), geographical range, and subsistence patterns. In addition, dates attributed to each tradition vary according to geographical location (Kooyman 2000). As groups migrated into new territory, the evolution and diffusion of cultural ideas and toolkits also spread. According to conventional interpretations, Early Paleoindians are generally associated with big game hunting, utilizing the mammoth and mastodon populations that roamed the

continent during the Late Pleistocene. Once into the early Holocene, bison played a large role for Paleoindians on the Plains.

Early Paleoindian traditions are identified by the presence of Clovis and Folsom projectile points in the archaeological record. Clovis dates range from approximately 11,000 to 11,500 ^{14}C (~12,600-13,700 cal) yr BP. The extended flute points of the Folsom tradition range from 10,900 to 10,200 ^{14}C (~11,500-13,000 cal) yr BP (Kooyman 2000). In eastern North America projectile point variability increased to include point types such as Cumberland and Barnes (Mason 1997; Markham 2013). The Clovis tradition may be found as far north and east as Nova Scotia, as evidenced by the Debert site assemblage with fourteen associated radiocarbon dates (Ellis 2004; MacDonald 1968).

In eastern North America, Early Paleoindian dates range from 11,200 to 11,300 (~13,100-13,200 cal) yr BP (Mason 1997, 89). Although evidence is lacking for parts of the Great Lakes region, there are a limited number of examples in the northern United States including a broken Clovis point made of gunflint silica found north of Duluth, Minnesota, and a potential Folsom point of the same material from Round Lake, Itasca County, Minnesota (Mulholland et al. 1997, 397). Eventually, non-fluted point varieties begin to appear in the archaeological record, as the fluted point tradition gradually disappeared. This technological change has been linked by some researchers to the end of the Younger Dryas cooling event and resulting environmental change (Kingsmill 2011, 74; Newby et al. 2005).

As glacial ice margins continued to retreat, populations migrated into new territory. Plano traditions exhibit diverse morphologies including both lanceolate and stemmed varieties. In some regions, these projectile points have also appeared in association with ground stone adzes and other wood working tools (Mason 1997). Plano sites generally date to between 10,000 and 7,000 (~11,500-7,800 cal) yr BP (Mason 1997, 98). The increased geographical distribution of humans allowed for a wider variation in regional projectile point expression. Examples include Goshen, Alberta, Hell Gap, Dalton, Eden, Scottsbluff, and Frederick point types (Markham 2013). In eastern North America, regional variants of the Plano tradition include Holcombe, and Hi-Lo points (Ellis 2004; Ellis and Deller 1982; Fitting et al. 1966). Regional variants in southern Ontario include Gainey, Barnes, and Crowfield points (see Markham 2013 for a more in-depth analysis of the ambiguity and inherent issues of traditional projectile point typologies).

2.2 PREHISTORY OF NORTHWESTERN ONTARIO

A number of studies in northwestern Ontario have provided insight into the prehistory of the region, that include deglaciation, the glacial lake history, and the environmental factors that affected floral and faunal resource availability (Björk 1984; Boyd et al. 2012; Dyke 2004; Julig et al. 1990; Kingsmill 2011; Phillips and Fralick 1994b; Saarnisto 1975; Shultis 2013). This section provides a more in-depth review of the region's late Pleistocene and early Holocene prehistory that influenced the behaviour of the region's early inhabitants.

2.2.1 Deglaciation and Glacial Lake History

The landscape of northwestern Ontario was heavily influenced by the deglaciation and glacial lake sequences, and their consequent effects on topography and water levels. Glacial lake history is directly tied to the movement of ice margins, and in the Superior basin the lake sequence began soon after deglaciation $\sim 11,000$ ^{14}C (12,900 cal) yr BP when water from Lake Algonquin to the south drained into the basin (Shultis 2013). During the Marquette advance ($\sim 10,000$ ^{14}C or $\sim 11,500$ cal yr BP), Lake Washburn (a post-Duluth phase lake) occupied the west portion of the Superior basin and Early Lake Minong in the east. By $\sim 9,600$ ($\sim 11,000$ cal) yr BP, the Marquette lobe had retreated northwards, allowing the two lakes to coalesce and form Glacial Lake Minong (Boyd et al. 2012) (Figure 2.2.1).

Further to the west, Lake Agassiz had formed after the LGM and eventually drained into the Lake Superior basin via a series of outlets on the western side of Lake Nipigon (Leverington et al. 2000; Teller and Thorleifson 1983) (see Figure 2.2.1). This hydrological connection between Lake Agassiz and the Superior basin heavily impacted the fluctuation of Glacial Lake Minong (Shultis 2013). At one point during the Marquette advance, glacial Lake Minong's water levels were high enough that drainage direction briefly changed and flowed west into Lake Agassiz (Clayton 1983).

As the ice margin once again retreated northwards after the Marquette advance, further ice recession occurred from Lake Nipigon at $\sim 9,000$ ($\sim 10,200$ cal) yr BP allowing Lake Agassiz to discharge to the east (Dyke 2004). Permanent glacial morphological features that remain in the region demonstrate the extent of the glacial advances and

retreats, including the Dog Lake and Marks Moraines; sediment that was pushed up under the weight of the Hudson Bay ice lobe and Superior ice lobe, respectively (Phillips and Fralick 1994b).

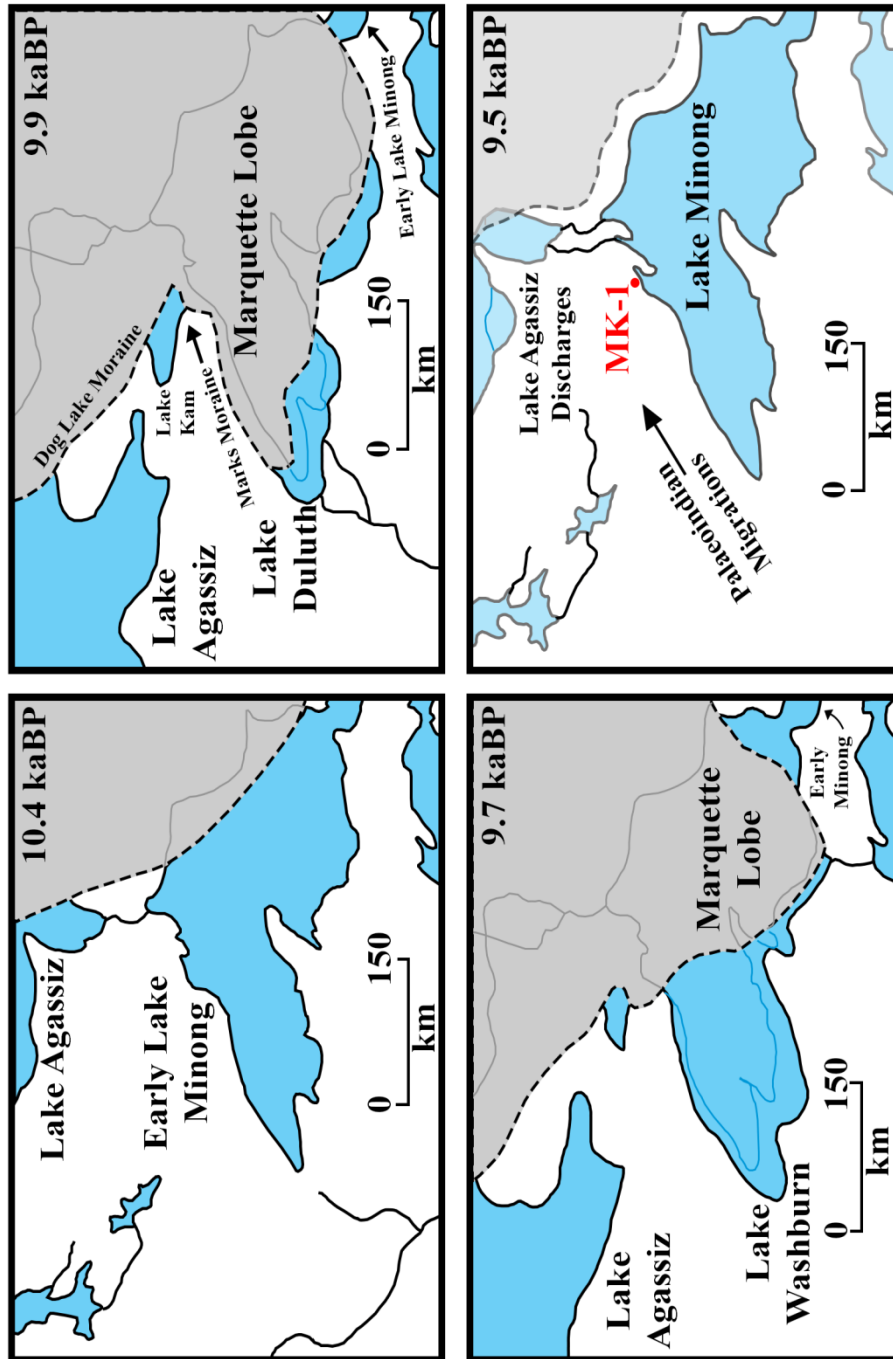


Figure 2.2.1: Interaction of the Marquette Lobe, and Glacial Lakes Minong and Agassiz. Modified from Langford (2015), after Phillips (1993).

Water levels in the Superior basin have been reconstructed according to shoreline features (Breckenridge et al. 2010) and associated absolute dates (Julig et al. 1990; Zoltai 1965). Minong beach elevations ranged from 225 to 240 metres above sea level (asl), controlled by a morainal sill ridge located from Nadoway Point, Michigan to Gross Cap, Ontario (Boyd et al. 2012; Julig et al. 1990). The terminal Lake Minong level was determined by a wood sample from a gravel pit just outside of Thunder Bay, near Rosslyn (Zoltai 1965). This date of $9,380 \pm 150$ years was later correlated with dated wood at the base of Cummins Pond ($9,260 \pm 170$ yr BP) and a date from a Minong level beach near Grand Marais, Minnesota ($9,345 \pm 240$ yr BP) (Julig et al. 1990, 24). Minong lake levels and associated dates are significant to the understanding of Mackenzie I because of its geographical location along a Minong strandline. Although the actual water level in relation to site occupation is unknown, this well-drained, sandy ridge would have been ideal even after the water level had retreated.

The Superior basin was later affected by other changes in water level, including the Houghton low phase ($\sim 8,400 - > 8,000$ ^{14}C or $< 9,500$ cal yr BP) and the succeeding Nipissing transgression, a high water phase which occurred between $\sim 5,950$ - $4,000$ ($\sim 6,800$ - $4,500$ cal) yr BP (Boyd et al. 2012). This glacial lake sequence and resulting lake level fluctuations, particularly during the Minong phase is an important aspect for Paleoindian research in northwestern Ontario. High sandy beach ridges can make a pleasant environment to traverse whether for its good drainage, escape from insects, avoidance of difficult terrain, or as a lookout for game. An understanding of the paleohydrology is useful for an interpretation of Mackenzie I in an effort to understand the human behaviour behind site occupation.

2.2.2 Plano Tradition of Northwestern Ontario

The resulting topography and glacial lake fluctuations affected Paleoindian movement across the landscape. In northwestern Ontario, the majority of sites are located on relict shorelines and as Julig et al. (1990) discussed, the pattern of these sites could be the result of both the readily available lithic raw material (from the Gunflint Formation) and abundance of subsistence resources. The high proclivity towards shoreline sites is also discussed by Jackson et al. (2000) in southern Ontario, stating a potential link between more open landscape and resource efficiency. However, there are potential biases that affect Paleoindian site distribution in the region. Research has been limited to near shore locations in part due to easy accessibility or site visibility of the landscape resulting in a potential sample bias (see Boyd 2007a; Hill Jr. 2007; Kornfeld and Larson 2008).

Regardless of site visibility and excavation bias, many Paleoindian sites in the region are located on relict Minong strandlines. Phillips and Hill (2004, 275) analyze the geomorphology of the area to suggest that early populations could have moved between the Agassiz and Superior basins prior to the Marquette advance, even as early as 11,000 (~12,900 cal) yr BP. Unfortunately any evidence that existed was likely destroyed when the Marquette ice lobe advanced back into the basin. Therefore, the oldest currently known date for Plano occupation in northwestern Ontario is 9,500 (10,700 cal) yr BP.

Like other Plano traditions, regional toolkits included general lanceolate shaped projectile points. However the high percentage of lithic tools that exhibit a parallel oblique flaking pattern distinguishes the region's toolkit from other assemblages

(Markham 2013). Regionally, local use of Gunflint Formation material such as taconite and gunflint silica predominates. Although Plano groups on the Plains still focused their subsistence base around the availability of bison, there is evidence in northeastern North America for a more broad based subsistence strategy (Kuehn 1998, 2007; Newman and Julig 1989). Caribou were likely important, as were smaller game such as hare, deer, or fish and a variety of floral species. A more detailed discussion of Plano subsistence in the Great Lakes Region is found in Section 2.3.2.

2.3 PALEOECOLOGY OF NORTHWESTERN ONTARIO

As stated previously, numerous studies have reconstructed the environment of northwestern Ontario. This section provides an overview of the region's paleoecology during the early Holocene to demonstrate potential resources available to the Late Paleoindians who inhabited Mackenzie I.

2.3.1 Floral Resources

General vegetation zones in northwestern Ontario followed the northward retreat of the Laurentide Ice Sheet, transitioning from scrub/tundra, to open boreal/spruce forest and finally to a closed mixed coniferous and deciduous forest (Peers 1985). This transition is thought to have occurred rapidly in northwestern Ontario with a sparse tundra phase that lasted no more than 50-100 years after ~10,200 (~11,900 cal) yr BP. The tundra phase was quickly succeeded by a spruce-birch dominated boreal forest with possible poplar, oak, and elm that then transitioned to an open boreal forest by ~9,200 (~10,300 cal) yr BP (Björk 1984; Boyd 2013; Hamilton 2004). A buried 8,900 (~10,000 cal) yr BP forest in the lower Kaministiquia Valley demonstrates that a boreal

composition similar to today was established by this time (Boyd et al. 2012). The increased aridity and temperature of the Hypsithermal event caused an increase in forest diversity and an influx of pine (Hamilton 2004). Evidence has suggested that Prairie advanced further north and east, appearing as far east as Kenora, Ontario until the Hypsithermal dry period ended ~7,000 (~7,800 cal) yr BP (Björk 1984; McAndrews 1982).

After the pine-dominated forest of 7,000 (~7,800 cal) yr BP, species from the Great Lakes-St. Lawrence forest migrated north, expanding to 140 km north of its present position (Liu 1990). This phase was followed by a cooling climate ~4,000 (~4,500 cal) yr BP with a decrease in white pine and increase in spruce and jack pine. Afterwards, spruce became the dominant Boreal species associated with a rise in lake levels during the Nipissing Transgression (Björk 1984; Boyd 2013).

Flora in the western Great Lakes region resembled modern flora by ~10,000 to 8,000 (~11,500-8,900 cal) yr BP (Kuehn 2007). During the time of Plano occupation, northwestern Ontario would have been considered a spruce-pine transitional boreal forest (Kingsmill 2011). However, vegetation would not have been uniform. As the recent research by Boyd et al. (2012) demonstrates, microclimates would have increased the variability of floral resources.

2.3.2 Faunal Resources and Paleoindian Subsistence Strategies

The faunal resources for Plano populations in northwestern Ontario have been reconstructed with the aid of paleoecological studies as well as preserved organic remains. Unfortunately, the number of organic remains available for interpretation is low

due to the podzolic soil composition of the boreal forest. This section will provide local and regional evidence that archaeologists currently have to base their interpretations including evidence from the surrounding western Great Lakes region (Table 2.3.1).

The most significant example of a faunal analysis in northwestern Ontario came from the Cummins site (DcJi-1) (Julig 1984; Newman and Julig 1989), although the interpretation was criticized (Fiedel 1996). The bone assemblage included three calcined caribou bone fragments that were associated with artifacts. Newman and Julig (1989) conducted blood residue analysis on a selection of lithic tools and although results could not be classified to the species level, some were found to contain remnants of the *Cervidae* and *Bovidae* families. *Cervidae* includes deer, elk, caribou, or moose. Additionally, several results exhibited examples of the *Rodentia* family such as muskrat, beaver, or porcupine (Newman and Julig 1989, 128). The reliability of this blood residue analysis was questioned in part because one lithic flake reacted to antiserum from multiple species including human, deer, mouse, bear, and rabbit (Fiedel 1996). However, these results still demonstrate the likelihood that multiple species were utilized.

Bison may have been a potential prey species for Plano populations, as evidenced by the presence of bison remains found at the Itasca site in northern Minnesota and the Sinnock site in southeastern Manitoba (Julig 1984). *Bison antiquus* remains found near Kenora, Ontario were radiocarbon dated to $4,850 \pm 60$ (~5,600 cal) yr BP; however the remains were not associated with any archaeological material (McAndrews 1982).

Table 2.3.1

List of sites as discussed in Section 2.3.2

Site	Province/State	References
Alpena-Amberley Ridge	Ontario	O'Shea and Meadows 2009
Bull Brook	Massachusetts	Spiess et al. 1985
Cummins	Ontario	Julig 1984; Newman and Julig 1989
Deadman Slough	Wisconsin	Kuehn 1998, 2007
Duchess Quarry Cave	New York	Spiess et al. 1985
Itasca	Minnesota	Julig 1984
Kenora Bison site	Ontario	McAndrews 1982
Sinnock	Manitoba	Julig 1984
Sucices	Wisconsin	Kuehn 1998, 2007
Udora	Ontario	Ellis and Deller 1997
Wapekeka	Ontario	Hamilton 2004
Whipple	New Hampshire	Spiess et al. 1985

Although there is limited information in northwestern Ontario to enable conclusive interpretations for Plano subsistence, information from faunal evidence in nearby regions may be extrapolated. Until recently, archaeologists based their interpretation for caribou based resource exploitation from the heavy reliance of big game observed on the Plains (see Peers 1985). Some sites in America's northeast have recently provided well preserved faunal assemblages from which better interpretations can be

made. These sites suggest that while caribou still played a major role in Plano subsistence, a wide variety of game was utilized.

The western Great Lakes region – which includes Wisconsin, Michigan, northeast Minnesota, and northwestern Ontario – contains similar archaeological factors that make it possible to extrapolate information from one region and apply it to the interpretation of another. Such similarities include paleoecological, environmental and lithic assemblage factors (Kuehn 1998). The Deadman Slough and Sucices sites in Wisconsin (~10,000 to 8,000 ^{14}C or ~11,500-8,900 cal yr BP) include lanceolate projectile forms like Plainview and Scottsbluff, and a general use of Hixton Silicified Sandstone which is similar to other sites within the Interlakes Composite. A wide range of species were identified from the faunal assemblages such as various turtle species, migratory waterfowl, and many other examples of small to medium sized game (Kuehn 1998, 2007). This assemblage represented various environments such as “wetland, aquatic, mixed forest and forest edge” (Kuehn 1998, 94).

Although evidence now suggests Plano people took advantage of a wide variety of small to medium sized game, caribou likely played an important role in their diet. Limited remains from Dutchess Quarry Cave in New York, Bull Brook in Massachusetts, and the Whipple site in New Hampshire include medium to large game, a small percentage of which is attributed to caribou (Spiess et al. 1985). Faunal remains attributed to caribou were also found at the Udora site in southern Ontario (Ellis and Deller 1997). More recently, a 2009 publication provides evidence for a Late Paleoindian caribou drive lane underneath Lake Huron. A ridge running the length of the lake would have been exposed during the Lake Stanley low stage ~10,000 to 7,000 (~11,400-7,800

cal) yr BP splitting the lake in two and potentially providing an attractive location for resource exploitation (O'Shea and Meadows 2009; O'Shea et al. 2014).

Even with a broad-based subsistence strategy, Plano groups would have likely encountered resource stress during certain times of the year. Skeletal remains recovered from the Wapekeka site in northwestern Ontario were dated to ~7,000 (~7,900 cal) yr BP and showed evidence of hypoplastic lines on the dentition as a result of nutritional stress (Hamilton 2004).

Regional variability also played a role in resource exploitation. Kuehn's work, along with that of Hill Jr. (2007) on the Plains demonstrates that environmental variability can produce a range of adaptive strategies. A greater range of species are exploited in diverse environments such as valleys or foothills whereas prairie may result in greater reliance on big game. Until the well preserved sites in the northeast were excavated, many interpretations were based on excavations in the Prairies. This led to a variety of strategies being interpreted in the northeast that were not always visible (Kornfeld and Larson 2008). However, the recent excavations in northeastern North America provide a good alternative for a discussion of northwestern Ontario Plano subsistence strategies.

2.4 SUMMARY

People living at Mackenzie I would have lived on a well-drained, sandy ridge which was once a shoreline of Glacial Lake Minong. The ice margin had since moved northeast, inviting new floral species into the deglaciated landscape and quickly transitioning into the spruce-pine transitional boreal forest that Plano groups inhabited.

Various vegetative species were available from the more arid species such as jack pine to the spruce and balsam fir of moist lower river valleys. Due to a lack of organic preservation there is limited evidence about available game; however, research on the Cummins site (DcJi-1) demonstrated variable resource exploitation. Data from excavations in surrounding regions can be extrapolated to aid in our interpretation of Plano subsistence as well. The multiple microclimates and varying landscape of northeastern North America demonstrates the exploitation of a wide range of animal species from small and medium sized game, to large game such as caribou. Fish, waterfowl and numerous plant resources were likely also a part of Plano subsistence. This type of environment would have provided an ideal living space for Plano populations, including people at Mackenzie I.

CHAPTER THREE

CULTURE HISTORY OF NORTHWESTERN ONTARIO AND SURROUNDING REGIONS

3.1 INTRODUCTION

The cultural history of the Great Lakes region provides context and a framework within which the Mackenzie I assemblage is analyzed. Although evidence for an Early Paleoindian occupation exists in southern Ontario (Ellis and Deller 1997), as well as the upper southwest shore of Lake Superior (see Mulholland et al. 1997), the earliest evidence for the occupation of northwestern Ontario is associated with Plano traditions after ~9,500 (~10,700 cal) years BP. This chapter will discuss evidence of Plano occupation for the Great Lakes region with a specific focus on a selection of sites from northwestern Ontario.

Within the Thunder Bay district, although chronometric dating has been conducted on a small scale, results are often contentious and at odds with the archaeological interpretation (Gilliland 2012; Ross 2011; Shultis 2013). Radiocarbon and OSL (Optically Stimulated Luminescence) samples that were gathered from Mackenzie I will be discussed in relation to the lithic assemblage. In addition, section 3.5 provides an overview of regional excavations with a spatial component, of which many lack the in-depth analysis performed for this study. Great Lakes culture history is pertinent to the study of Mackenzie I because similarities between these regional assemblages indicate a level of interaction spanning a wide geographical range (Ross 1995).

3.2 LATE PALEOINDIAN PERIOD: SURROUNDING REGIONS

Variable preservation throughout the Great Lakes region allows researchers to extrapolate information about Late Paleoindian society from one region and use that to make inferences about other Plano assemblages. These similarities aid in the interpretation of Mackenzie I where little else remains but the lithic material. Evidence for Plano occupation along the southwestern shore of Lake Superior, including Minnesota and Wisconsin, demonstrate similar technological factors (e.g. parallel oblique flaking) that are seen at Mackenzie I and other Plano sites of northwestern Ontario.

3.2.1 Western Great Lakes Region

For the purposes of this thesis, the geographical range of the western Great Lakes region includes Wisconsin and Minnesota. Site assemblages throughout the region exhibit multiple similarities with Plano sites in northwestern Ontario, indicating a cultural or technological relationship between these Plano groups (Ross 1995). Comparable factors include the presence of taconite, and variation within projectile point morphology including what has been recognized as Scottsbluff, Agate Basin, Eden, Hell Gap, and Plainview (Steinbring 1974).

A number of excavations in the Great Lakes region have prompted researchers to compare their data with tool assemblages in northwestern Ontario (Haywood 1989; Markham 2013; Ross 1995; Salzer 1974; Steinbring 1974). Inter-assemblage relationships are also suggested by selection of certain raw materials for lithic production. Rhyolite and Knife Lake Siltstone are used in northern Wisconsin and northern Minnesota (Magner 2001), and Hixton Silicified Sandstone and taconite are present in

other sites throughout Wisconsin (Kuehn 1998, 2007; Mason and Irwin 1960; Salzer 1974). While proportional representation of each type varies, this range of raw material is reminiscent of sites in northwestern Ontario, including Mackenzie I.

Unfortunately, many artifacts in the Great Lakes region reside in private collections, severely limiting the availability of information on these assemblages (see Markham 2013 for an updated and comprehensive review of accessible data and information on private collections). Regardless, the comparable factors between this region and the study area reveal an interaction sphere over a wide geographical area.

3.3 REGIONAL THEORIES FOR PLANO OCCUPATION

3.3.1 The Lakehead Complex and the Interlakes Composite

In the last forty years, two important taxonomic units were formulated by regional archaeologists to provide a framework for Late Paleoindian sites in northwestern Ontario and regions south along the Lake Superior shore (Fox 1975, 1980; Ross 1995). The Lakehead Complex was first termed by Fox (1975) to account for the similarities observed between Plano sites in northwestern Ontario. The main components of the Lakehead Complex included the use of Gunflint Formation material, predominately taconite, lanceolate shaped projectile points, and the geographical placement of sites along glacial Lake Minong shorelines (Fox 1975).

Ross (1995, 258) suggested the term Interlakes Composite to encompass four geographically distinct complexes: Lake of the Woods/Rainy River, Quetico/Superior, Lakehead, and Reservoir Lakes (see Figure 1.3.1). Along with the variable presence of Gunflint Formation material, representative assemblages included the use of parallel

oblique flaking during tool manufacture, presence of Hixton Silicified Sandstone, and lanceolate shaped projectile points (Ross 1995). The projectile point variation observed at Mackenzie I can also be found in many other sites within the Interlakes Composite (Markham 2013).

The Reservoir Lakes Complex along the west shore of Lake Superior, for example, demonstrates a widespread use of taconite, and morphological variation in the Plano projectile points (Salzer 1974). To the northwest of the Reservoir Lakes Complex is the Lake of the Woods/Rainy River Complex that includes northern Minnesota and northwestern Ontario. The lack of taconite within the complex was notable (Magner 2001). However, the wide variety of point morphologies and presence of parallel oblique flaking is reminiscent of the Lakehead Complex. Along with the limited representation from the Quetico/Superior Complex (Reid 1980), the Reservoir Lakes, Lake of the Woods/Rainy River, and Lakehead Complexes make up the Interlakes Composite (Ross 1995).

The Flambeau and Minocqua phases (Salzer 1974) are also located in northern Wisconsin, though they are not included within the Interlakes Composite. The Flambeau phase was defined from two surface collections, three sites, and one multicomponent site. The Minocqua phase was similarly defined from a combination of surface finds and a multicomponent site (i.e. the Robinson site; Salzer 1974). Although the usefulness of this typological compartmentalization is questionable due to low sample size, the use of taconite and Hixton Silicified Sandstone is also seen in Lakehead Complex sites.

Many archaeological sites throughout the Thunder Bay region have been placed within the Lakehead Complex (e.g. Arthurs 1986; Dawson 1983; Halverson 1992; Hamilton 2004; Hinshelwood 1990; Hinshelwood and Webber 1987; Julig 1984; MacNeish 1952; Markham 2013; McLeod 1978; Wright 1963). Although many are found on Minong shorelines, the proximity to raw material sources – specifically the Gunflint Formation – also played a role in site location (Hinshelwood 1990; Figure 3.3.1). A site sampling bias along geographically accessible areas contributes to the large percentage of sites found within these areas (Boyd 2007a); however, inland sites such as those at Dog Lake have been found (McLeod 1981). The discovery of new sites, likely through development and CRM, will contribute to existing information.

3.3.2 Recent Research in the Thunder Bay District

The series of sites excavated by Western Heritage just east of Thunder Bay between 2010 and 2012 are the newest discoveries in the region and will add significantly to the body of knowledge for Late Paleoindian habitation in northwestern Ontario. The largest of these sites, Mackenzie I, is studied within the conceptual framework of the Lakehead Complex and Interlakes Composite provided by Fox (1975, 1980) and Ross (1995). The large data set from Mackenzie I allows for a different approach to regional Plano studies that has not always been possible at other sites in the area.



Figure 3.3.1: Minong shoreline in relation to the Gunflint Formation and archaeological sites discussed in Section 3.4. Modified from Fox 1975; Julig 1990. Note: the Gunflint Formation likely extends further towards the Brohm site.

3.4 EXCAVATIONS FROM THE THUNDER BAY REGION

Plano sites along the northwest shore of Lake Superior are generally found between ~ 225 and 250 metres asl, coinciding with beaches of glacial Lake Minong (Shultis 2013) (see Figure 3.3.1). However, site bias and visibility play a role in the association with relict shorelines. For example, ancient shorelines are more visible than inland sites that may be logistically hard to reach (Boyd 2007a). Financial constraints of Cultural Resource Management (CRM) projects can also be a limiting factor to further inland exploration, and in-depth academic studies are few and far between (Hamilton 1996). Despite these biases, the well-drained ridges of the shoreline would have been attractive to people looking for game, while back beach locations would have provided protection from the elements. This section provides an overview of a selection of Plano sites within the region to provide a sample of site variation within the Lakehead Complex (see location of sites in Figure 3.3.1).

3.4.1 The Brohm Site (DdJe-1)

The Brohm site, located approximately 40km east of Thunder Bay, was excavated and reported by R. MacNeish in 1952 (Hinshelwood 1990; Wright 1963). This site yielded both Paleoindian and Archaic tools suggesting an initial occupation near the shore of glacial Lake Minong, followed by a later re-occupation during the Nipissing phase of Lake Superior. The Paleoindian tools were predominantly manufactured from taconite and exhibited significant variation in tool form (MacNeish 1952). The projectile points from the Brohm site exhibited the same parallel oblique flaking that is a dominant characteristic of the Mackenzie I assemblage (Markham 2013). More fieldwork was

conducted at the Brohm site in 1987 in order to increase sample size and to test new hypotheses about site use. Hinshelwood (1990) concluded that the site reflected animal procurement and processing activities most typical of Lakehead Complex groups. Brohm is one of a limited number of sites that have a clear association with the active Minong beach (Shultis 2013).

3.4.2 The Cummins Site (DcJi-1)

The Cummins site was a quarry workshop and possible habitation site that represented extensive use by a Late Paleoindian population (Dawson 1983; Julig 1984; Julig et al. 1990). The site was closely associated with a Gunflint Formation outcrop as well as an active Minong beach. The deepest occupational component yielded heavily waterworn lithics indicating that this early habitation likely coincided with active Minong beach levels (Julig 1994). Until recently, this site also provided one of the only absolute dates for the area ($8,480 \pm 390$ ^{14}C years BP (NMC-1216)) deriving from a cremated human burial. These remains were recovered from a disturbed context from backhoe push in a modern gravel pit, thus limiting their usefulness for site interpretation (Julig 1994, 39).

The presence of side-notched projectile points indicated some Archaic re-occupation of Cummins, reminiscent of many other sites in the area (Hinshelwood 2004). Julig (1994) provided a comprehensive study of the site including residue analysis, geomorphological, stratigraphical, and taphonomical data (see also Fiedel 1996; Newman and Julig 1989 for information and critique of residue analysis on the Cummins assemblage).

3.4.3 The Cascades Site (II) (DcJh-37)

The Cascades Site (II), located in a local conservation area, represented a small lithic site that Arthurs (1986) considered Plano based on the observed lithic reduction strategy. The small, 4 m² excavation was point plotted to analyze spatial distribution although no further spatial studies were undertaken beyond basic distribution patterns. Arthurs (1986) concluded that the site represented a single component, inland manifestation of the Late Paleoindian tradition.

3.4.4 The Biloski Site (DcJh-9)

Biloski represents multiple knapping stations with a focus on biface reduction, rather than tool finishing, which was likely conducted elsewhere (Hinshelwood and Webber 1987). Stemmed and lanceolate points were excavated which are indicative of Plano occupation. However the site was only dated in relation to other Minong strandline sites (Markham 2013). The majority of the raw material assemblage consisted of taconite, and tools included hammerstones and failed biface preforms (Julig 1994). The assemblage was analyzed spatially by point plotting artifact locations on a map, to reveal two distinct flintknapping activity areas (Hinshelwood and Webber 1987, 26).

3.4.5 The Simmonds Site (DcJh-4)

The Simmonds site, located along the Current River in Thunder Bay, was first reported by Dawson in 1974. He discussed the presence of four distinct debitage concentrations with associated FCR (Arthurs 1986). The site was later interpreted as a fishing site due to its river mouth location (Halverson 1992), although no stratigraphic work was included in the original report to determine contemporaneity with an active

river (Shultis 2013, 36). A large percentage of the assemblage consisted of secondary pressure flakes indicating that the primary activity was likely final lithic reduction and finishing (Halverson 1992, 43).

3.4.6 The Crane Cache (DcJj-14)

Unlike most Plano sites in northwestern Ontario, the Crane Cache was not found near a major source of water, or any other high potential factor that archaeologists typically look for when assessing site potential (Ross 2011). Regardless, the Crane Cache provides a rare opportunity to study a Late Paleoindian inland site. The assemblage consisted of two biface caches, all of which were manufactured out of Gunflint Formation material. Of the 153 bifaces found, 152 were manufactured out of taconite while the remaining one was manufactured out of Kakabeka chert, another Gunflint Formation material (Ross 2011, 10).

Site interpretation suggests that these bifaces were stored for later use, due to the high number of blanks and clustered distribution. The presence of four post molds is also unique to this area, and as Ross (2011) states they suggest a possible winter structure. Radiocarbon dates from within the burnt remains of the post mold came back with a date too recent to be associated with Paleoindian occupation – a problem consistent with the regional issues regarding absolute dating (see section 3.5).

3.4.7 Dog Lake, Ontario

The Dog Lake Reservoir is located approximately forty kilometres inland from Lake Superior, and represents one of the few inland manifestations of Plano culture in northwestern Ontario (McLeod 1981). The series of sites along Dog Lake consist of a

projectile point assemblage with wide morphological variation. Markham (2013, 236) suggests that this variety is similar to the diverse projectile point assemblage from Mackenzie I.

3.5 ABSOLUTE DATING

Absolute dating within the larger Great Lakes region, and especially in northwestern Ontario, has been extremely limited. Although some dates have been provided, potential disturbance or issues with dating techniques have called into question their validity (Gilliland 2012; Mulholland et al. 1997; Shultis 2013). Locally derived samples, whether radiocarbon or OSL dates, rarely coincide with date ranges suggested by securely dated assemblages from elsewhere (Mulholland et al. 1997).

Western Heritage conducted OSL sampling on Mackenzie I, from three locations within unit 478N/518E. This unit exposed a pit feature, and all three samples were taken from the same lithofacies (Shultis 2013). The dates from bottom to top came back as 6,500-5,680 (~7,400-6,400 cal) yr BP; 6,210-5,330 (~7,100-6,100 cal) yr BP; and 5,820-5,180 (~6,600-5,900 cal) yr BP (Gilliland 2012; Kinnaird et al. 2012). OSL dates were also consistently younger than expected at the Electric Woodpecker 2 site (DdJf-12 also known as WP2) west of Mackenzie I.

A charcoal sample from WP2 at 30 centimeters below surface was found within beach shoreface sediments and associated with archaeological material. The date for this sample came back at $8,680 \pm 50$ ¹⁴C years BP (Beta 323410) (9,760 to 9,540 cal yr BP) (Shultis 2013). Conversely, the pit feature from Mackenzie I that yielded a radiocarbon date from charcoal of $3,550 \pm 30$ ¹⁴C (Beta 301998) (3,910 to 3,820 cal) yr BP is

considered disturbed likely because of soil sampling prior to mitigation work (Shultis 2013).

The combined data from site stratigraphy and artifact assemblage at both WP2 and Mackenzie I suggest that the OSL dates are inconsistent with Paleoindian occupation. However, the nature of the pit features has not been resolved. Until further testing is completed, dates yielded from geomorphological features and tests from pollen cores for example, provide the most consistent data for the association of early archaeological material (Mulholland et al. 1997).

3.6 REGIONAL SPATIAL ANALYSES

Spatial analysis on Lakehead Complex sites has often been limited to a map of provenienced artifacts and a generalized overview of the distribution of particular tool types or groups of artifacts (Arthurs 1986; Halverson 1992; Ross 2011). Other sites like Biloski (Hinshelwood and Webber 1987) included more detailed methods such as the size grading of debitage to detect knapping patterns. Julig's comprehensive 1994 report of the Cummins site included a detailed description of stratigraphy and taphonomy to determine post-depositional movement of artifacts, including a refit analysis.

The lack of in-depth spatial studies is due in part to poor stratigraphic sequencing and/or small assemblage size. Many excavations are also part of mitigation work completed by CRM companies where time and finances can limit post-excavation analysis. The Naomi site (DcJh-42) represented an exception to the paucity of regional spatial work (Adams 1995).

The Naomi site consisted of three discrete clusters with a focus on lithic biface reduction. Situated at 260 m asl the vast majority of the assemblage consisted of taconite debitage, and broken bifaces representing all reduction stages (Adams 1995). Three complete tools were recovered, including a heavily reworked Hixton Silicified Sandstone projectile point, a taconite projectile point base, and a siltstone drill (Adams 1995, 2). Site interpretation suggests that the final reduction of biface preforms into formal tools occurred elsewhere, as did the initial primary reduction as evidenced by the lack of cores and finishing flakes (Adams 1995, 14 and 25).

All artifacts were provenienced during excavation to provide detailed maps of the Naomi assemblage which revealed three distinct activity areas. To further explain the spatial analysis the assemblage within each cluster was discussed in detail and patterns were detected. For example, in Area 'C' broken bifaces were located on the periphery of the cluster, perhaps reminiscent of Binford's (1983) toss zone deposition pattern (Adams 1995, 23). Adams' study provides one of the only examples of spatial analysis within the Lakehead Complex that utilized ethnoarchaeological research in site interpretation and is subsequently useful for the spatial analysis of Mackenzie I.

3.7 SUMMARY

Inter-site comparisons between regions of the Great Lakes provide compelling information about Late-Paleoindian occupation and interaction. As with other sites in the Thunder Bay region, the Mackenzie I site is considered part of the Lakehead Complex within an overarching interaction sphere implied by the Interlakes Composite. Excavations in northwestern Ontario, Wisconsin, and Minnesota in particular have

revealed similarities in raw material use, a consistently wide variation in lanceolate shaped projectile points, and the presence of Hixton Silicified Sandstone as an exotic raw material. Within Northwestern Ontario, Lakehead Complex sites are generally associated with Minong strandlines although only a few can positively be associated with an active shoreline (Shultis 2013). Focus along the Lake Superior shore has sometimes limited research further inland however there is evidence of inland Plano occupation as exemplified by sites located around Dog Lake (McLeod 1981) and the Crane Cache (Ross 2011).

Little absolute dating has been performed on Lakehead Complex sites (Gilliland 2012; Kinnaird et al. 2012). The inconsistency between OSL dates and relative dates derived from geomorphology and lithic assemblages could mean there is some factor(s) that skews the data from absolute dating techniques. Geology based approaches such as lake cores or geomorphological features have provided the best record for regional Plano occupation (Mulholland et al. 1997).

Archaeological spatial analysis has been limited in the region due in part to the nature of CRM work and poor stratigraphic integrity in the Canadian Shield. The application of intra-site spatial analysis has consisted primarily of point plotting the artifacts and subjectively noting the observed distributions. Certain sites such as Biloski (Hinshelwood and Webber 1987) and Cummins (Julig 1994) further studied vertical distribution or conjoined artifacts. The work by Adams (1995) on the Naomi site represents the most detailed spatial investigation available for Lakehead Complex sites. It provides a relatively good case study on a confined, single component site which can

provide detailed information about the brief human activity that occurred there (see also Langford 2015)

The large sample size from Mackenzie I provides researchers with the opportunity to study many aspects of regional Plano occupation. A detailed spatial analysis on a habitation site of this scale has not been done in the region before; it would provide an opportunity to study the methodology and feasibility of such an analysis on this Boreal forest site.

CHAPTER 4

THE MACKENZIE I SITE

4.1 INTRODUCTION

The Mackenzie I (DdJf-9) site is located ~ 30 km east of Thunder Bay along the relict shoreline of glacial Lake Minong. Located directly on the west bank of the Mackenzie River gorge, this site was part of a Stage 4 mitigation project prior to the twinning of Highway 11/17. As stated previously, the site itself has now been completely removed to allow for graded approaches to the new bridge over the Mackenzie River. Therefore, current and future research on the site will rely on the information and artifacts collected by Western Heritage. Utilizing CRM-derived data for academic research has its limitations, however, an in-depth geoarchaeological study and the potential for soil susceptibility tests increase the level of interpretive resolution about Mackenzie I. This chapter will review methods used throughout the mitigation process, and specifically, provide details about each of the six study areas defined in this study.

4.2 EXCAVATION METHODS

The Mackenzie I block excavation was expanded to locate the boundaries of the site and thereby maximize information recovery. Once the excavation was complete, the site boundaries were defined by the river gorge to the east, sterile units to the west, a bedrock cliff to the north, and the already disturbed sediment within the hydro corridor to the south (Figure 4.2.1). Although the Mackenzie River valley is a deeply incised gorge today, it was likely filled with sediment during site occupation. The river may have been

a glacial spillway filled with sediment from glacial water or till, which is further suggested by the river-mouth sediments in the southern part of the site (Shultis 2013).

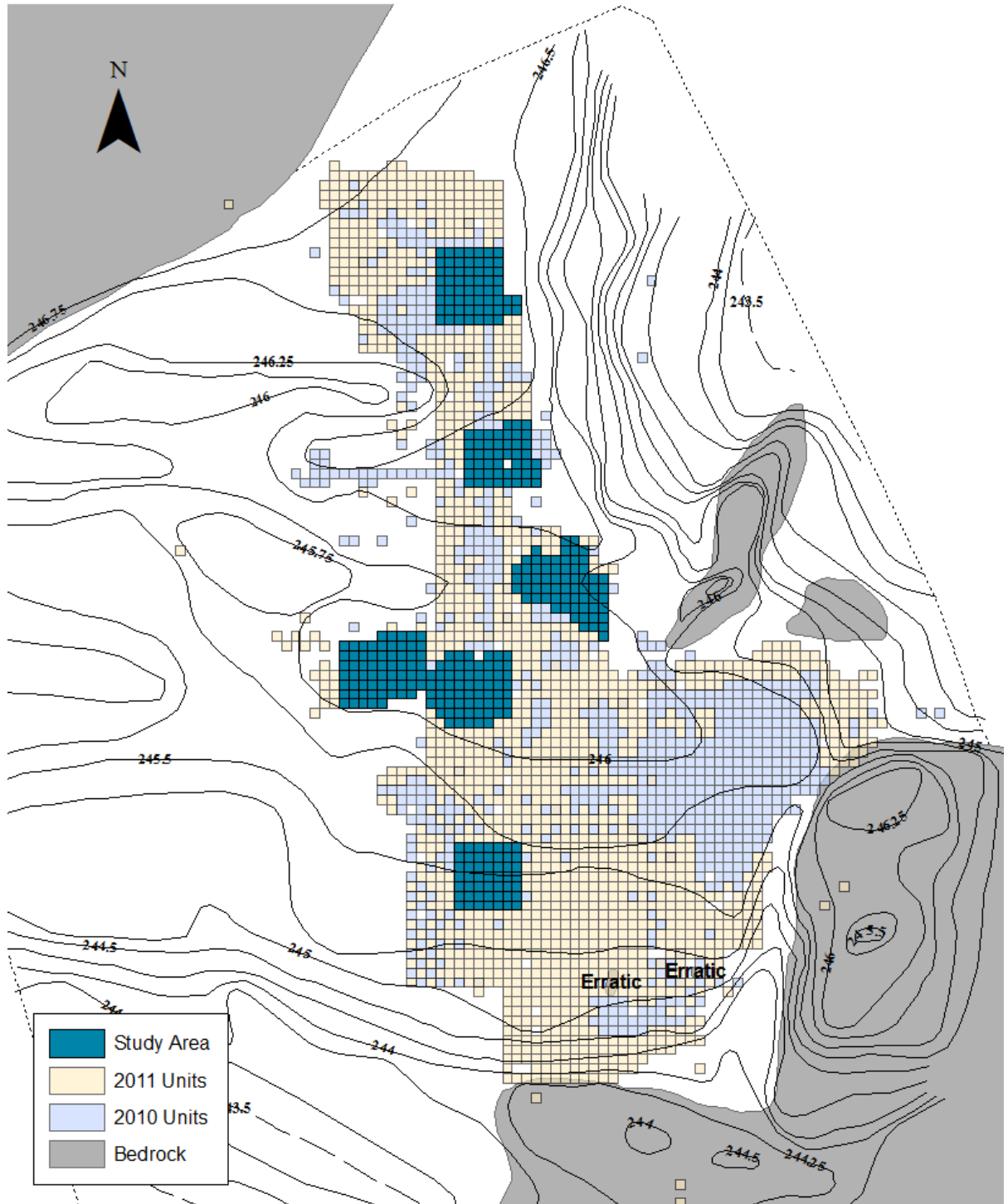


Figure 4.2.1: Map demonstrating the Mackenzie I site boundaries, and designated study areas. Each small square represents a 1m² excavation unit.

Each 1x1m unit was shovel-shaved, in five centimeter arbitrary levels. These units were further divided into four quadrants (i.e. NE, SE, NW, and SW) for increased spatial resolution. Three-point provenience (i.e. the northing, easting, and depth below surface) was required for significant recoveries such as lithic tools, charcoal samples, potential features, or obvious flake clusters. Debitage, shatter, and other screen recoveries were batch collected by level, and quad. Soil was sifted through nested screens of 3mm and 6mm mesh, to increase the likelihood of recovering microdebitage. A unit would be deemed complete after one or two sterile levels or bedrock was encountered.

Trowels were used to excavate potential features or areas of high artifact density and photographs were required during the excavation of such features. Furthermore, excavators were required to fill out forms describing each excavation level including a detailed map with provenienced tools, areas of roots or other disturbance, large rocks, and changes in soil colour and texture.

During the second year of fieldwork, soil samples were taken by level and quadrant, for future soil susceptibility tests. Near surface magnetometry was completed on small portions of Mackenzie I, and so these tests may provide some of the only information about site use not visible to the naked eye (e.g. hearths). This approach was often confounded by the proximity of bedrock. Although soil susceptibility was beyond the scope of this analysis, it will be a welcome addition to future Lakehead Complex research.

4.2.1 Excavation Limitations

Although excavation and recording procedures were strictly enforced, the time constraints of CRM archaeology and the number of people required to complete this large project resulted in some inconsistencies with data collection. Unlike many CRM-derived projects, “value-added” fieldwork activities were included to further future academic research at the site. This included collection of soil samples for soil susceptibility, and increased recovery resolution through the application of 3mm screening.

Throughout the 14 months required to complete the excavation, over 30 people worked on the site. Excavators had varying levels of archaeological experience and some were trained on-site. The result was some level of inconsistency in individual approach to artifact collection, and quality of notes and maps. Hindsight also indicates that too few photographs were taken to verify or enhance unit maps, features, disturbances, etc. Regardless of these factors, analyzing overall patterns can reduce the impact of such limitations.

4.3 GEOARCHAEOLOGY

The geomorphology of Mackenzie I and the effect of sediment movement on the archaeological assemblage is an important aspect of site interpretation. A detailed geoarchaeological study conducted by Shultis (2013) provides the basis for much of the information presented here.

Overall, the north end of the site is distinctive, consisting of medium to coarse grained sand with occasional granules, 2-3 cm pebbles, and a small pebble layer. Below, is a well-sorted fine-medium sand with parallel magnetite-rich layers and non-magnetite

rich sand (Shultis 2013, 206). The upper lithofacies (11) likely represents a beachface environment at ~ 249 m asl, with pebble and massive layers the result of storm events along the Lake Minong shoreline (Shultis 2013: 210, 212).

Lithofacies 71 represents the uppermost lithofacies throughout the rest of the site, and the location in which the majority of artifacts were recovered. It is silty medium to coarse grained sand with pebbles within the upper 25 to 50 cm of the site, and demonstrates evidence of floralturbation (Shultis 2013, 211). The south end of the site likely represents a river-mouth environment at ~ 246 m asl (Shultis 2013, 232).

This information, along with the detailed description of three potential pit features, can be applied to the six study areas analyzed in this research. Detailed analyses were done for units 549N/517E, 548N/517E, and 549N/516E which are roughly eight metres north of the North study area. Although units 459N/528E, 470N/528E, 468N/526E, and the pit feature from 462N/529E are located further south than the South study area boundary, the pit feature from 478N/518E is directly within this study area (Figure 4.3.1). The West study area contains pit feature 497N/506E, and two other units that were analyzed in detail: 496N/508E and 497N/508E. This allows for the direct inference of sediments and geoarchaeology within two of the study areas for this research, and indirect inferences for the remaining four.

All three pit features were roughly 1m deep and 1m wide, and contained a high concentration of lithic artifacts (Shultis 2013, 142). Unit 497N/506E in the West study area consists of lithofacies 71, whereas 462N/529E and 478N/518E are 61: silty, medium-grained sand with pebbles, poorly sorted to massive. This lithofacies is only found in the

pit features and one linear feature in the south (Shultis 2013, 208). The cultural nature of these pits is questionable, although 478N/518E demonstrated the presence of microscopic Gunflint Formation material and organics (Gilliland 2012; Shultis 2013, 210). It was postulated that buried ice melts may also be the cause for the Mackenzie I pit features, but additional sedimentological analysis would be required to determine the exact nature of these pit features (Shultis 2013, 210).

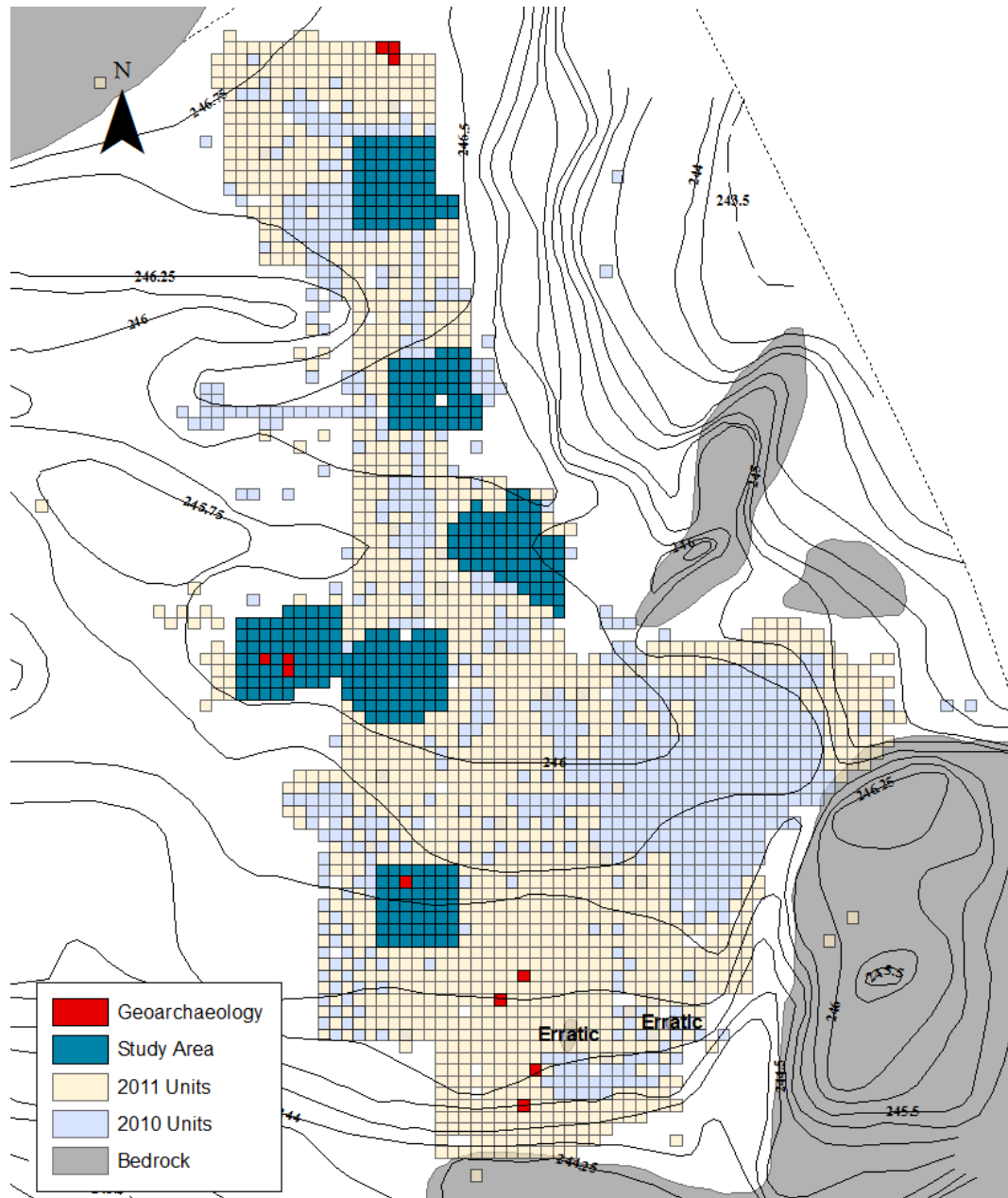


Figure 4.3.1: Map highlighting previous geoaerchaeological work and pit features.

4.4 EVIDENCE OF DISTURBANCE

The various forms of cultural and natural processes affecting artifact deposition and post-depositional movements are the focus of section 4.5. This section briefly reviews the evidence for disturbance at Mackenzie I.

Engineer soil sampling was conducted in the south end of the site, prior to mitigation work. This modern disturbance may even be responsible for the linear feature, and two of the three pit features on the site (Shultis 2013, 214; Figure 4.4.1). A shoe insole was found in this area ~ 20 cm below surface further indicating modern disturbance in the south extent of the site (Shultis 2013, 140). Although animal burrowing was not photographed, field notes indicate the presence of infilled holes ~10 cm in diameter (Shultis 2013, 214). With the exception of animal burrows, these forms of modern disturbance seem relatively isolated to the southern portion of the site. Root disturbance was noted throughout the site, including some units with displaced artifacts up to 80 or 90cm below the surface.

4.5 LABORATORY METHODS

Once the material was transported back to the lab, methods were employed to streamline the cataloging process. The methods and definitions used to define the lithic assemblage are outlined in this section. To remain consistent, lithic definitions used during the Western Heritage cataloging process were also used for this research (see limitations of such an approach in section 4.5.1).

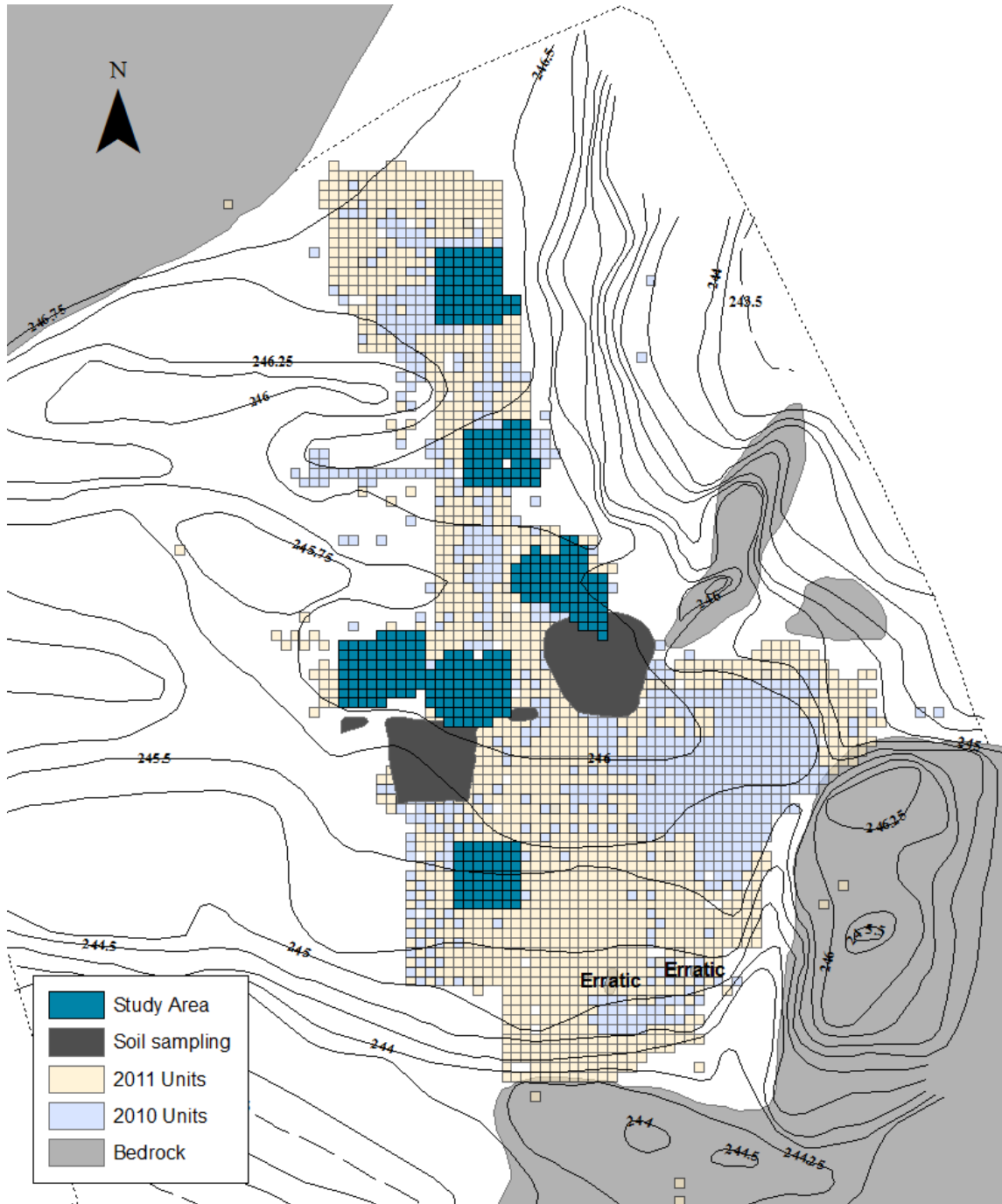


Figure 4.4.1: Location of modern disturbance throughout Mackenzie I.

A program entitled ADEMAR (Archaeological Data Entry, Manipulation, and Reporting), created by Terry Gibson, was employed to enable cataloguing of artifacts and preliminary data tallies, queries and tabulation of recoveries. Due to the time-sensitive

nature of the project, 15 people from four laboratories cataloged the assemblage. Only preliminary identifications were made, to the detriment of further analysis which had to wait for academic research interest. Guidelines were provided with definitions to designate tool type, flake type, or material type. For example, FCR was classified as a 'Lithic Item', 'Other' material type, and 'FCR' artifact type. Ochre on the other hand, was classified as 'Other' material, with ochre designated under the 'Comments' section. The lithic assemblage was designated following the proceeding guidelines:

Flakes:

Flakes are described as any piece of debitage or microdebitage that exhibits a feature such as a bulb of percussion or striking platform, and are categorized by the following size grades: 0-2mm, 2-6mm, 6-12mm, 12-25mm, 25-50mm, and 50+mm. Debitage was further classified as any flake greater than 6mm in size and designated as primary (decortication flakes with cortex present), secondary (greater than 12mm with no cortex), or tertiary (less than 12mm with no cortex). Conversely, microdebitage is any flake between 0mm and 6mm in size. Cortex, as seen on primary flakes for example, is the chemically or mechanically altered outer surface of the raw material.

Shatter:

Shatter refers to a blocky piece of raw material, of any size, without characteristic flake features such as the bulb of percussion or striking platform.

Cores:

Cores include both complete and fragmentary pieces of raw material that were utilized in the manufacturing of lithic flakes and tools. These blocky pieces demonstrate the presence of a useable platform, and at least one clean flake plane.

Tool – Retouched Flake:

These flakes demonstrate one or more reworked edges. For the purposes of this catalogue, utilization was not identified and left for future analysis. Analyzing unintentional vs. intentional retouched flakes would be a useful exercise for any study relating to Lakehead Complex sites, however, the intensive time required for such a study was not available.

Tools – Knife:

A knife is bifacially worked with an asymmetrical tip. There may be some slight curvature along the lateral edge of the tool, with possible grinding along the base. The tip may demonstrate retouch to create a sharp, working edge.

Tools – Drill:

Drills at Mackenzie I are all bifacially worked, although the base morphology may differ. Some have a 't'-shaped base, whereas others have a straight base.

Tools – Perforator:

A perforator can be any pointed tool, minimally flaked on the tip, or unifacially flaked.

Tools – Scrapers:

There are various morphologies and sizes under the designation of end or side scraper. Some are worked bifacially, while others are unifacial. There is also evidence for reworked tools, generally projectile points, exhibiting a reworked edge for use as a scraper.

Tools – Adzes:

Adzes range in morphology, size, and raw material but are generally ‘wedge-shaped’.

Tools – Projectile Points:

Various morphological shapes are present in the assemblage and include completes, bases, midsections, and tips. Bases may be straight, convex, deep, or low, with stemmed, parallel, or constricting morphologies (see Markham 2013; Table 4.5.1).

Tools – Biface:

A biface is bifacially worked on both faces, and can be found in varying production stages (see Bennett 2015). A biface can further be reduced into other formal tools such as projectile points or knives.

Tools – Uniface:

A uniface is only worked on one face, and will range in size and morphology.

Table 4.5.1

Projectile point classification reference for this text, following Markham (2013).

Category	Sub-category	Basal Morphology	Code
Constricting		Deep	A1
		Low	A2
		Straight	A3
		Convex	A4
	Eared	Deep	B5
		Low	B6
		Straight	B7
		Convex	B8
	Fishtail	Deep	C9
		Low	C10
Parallel		Deep	D11
		Low	D12
		Straight	D13
		Convex	D14
Stemmed		Deep	E15
		Low	E16
		Straight	E17

Preforms:

A preform is any lithic item that represents varying stages of the manufacturing process. Generally, the majority of tool preforms at Mackenzie I exhibited parallel oblique flaking patterns, and basal grinding. A striking platform may still be visible on the item. Unless a preform type was unidentifiable, they were cataloged under the respective type (e.g. biface, projectile point, knife).

Hammerstones:

Hammerstones are stone cobbles used during lithic manufacturing. At Mackenzie I, hammerstones are generally a granitic material and vary in size.

Grinding Stones:

There are a number of artifacts that were cataloged as grinding stones in the laboratory, although there was inconsistent identification amongst both field and laboratory technicians. It is possible that some may also be anvil stones, although without further analysis the data will be used as cataloged.

Undetermined:

Although the frequency is minimal, there were lithic artifacts from Mackenzie I that were unidentifiable beyond initial designation as a tool. These undetermined tools are still considered in the spatial analysis though the interpretation available from their distribution is minimal.

4.5.1 Laboratory Limitations

Identification was the only goal during the cataloging process, to the exclusion of in-depth analysis of tool morphology, or use-wear. Therefore, tool definitions were basic and the catalogue data used for this research lacks some detail. The definitions used for cataloging were employed for this research to maintain consistency. The time constraints of this analysis inhibited the re-analysis of the catalogue database. Many lithic items, such as flakes, were batch cataloged within their level, quad, and flake size and type. This is not ideal for a spatial analysis because one catalogue number could represent a

frequency of one or 100. Though some spatial analytical tests take actual frequency into account, not every test has that ability.

Additionally, a small number of catalogue entries were left blank, effectively discounting that entry in catalogue queries (e.g. If one were to query the number of siltstone flakes, any items with a blank raw material entry, would be left out of the overall frequency count). However, some human errors are unavoidable. Many of these factors are limited by utilizing a mixed methods approach to the spatial analysis. A combination of methods can illuminate such errors that can subsequently be taken into account throughout the analysis.

4.6 STUDY AREAS

This thesis focuses on six study areas, chosen for their location within the site, and the density of lithic tool distribution. Although study area specifics are the focus in this section, it is important to understand the context of the whole site; the nature and number of recoveries, variety of raw material found, etc. (for a representative sample of artifacts see Appendix). Overall, 2,539 m² were excavated with the majority of artifacts recovered between 15cm and 30cm below surface. Occasionally, pit features and units affected by tree stumps, contained artifacts down to a depth of Level 19 or 20 (~100cm below surface). Material recovered included FCR, ochre, charcoal, lithics, a small number of unidentifiable objects, and some bone. The calcined bone recoveries were clustered within the first two levels of a single unit, thus these are likely recent remains.

In total, there are 89,584 catalogue entries, representing an even greater frequency of 290,603 items. At the time of writing, the data set for these study areas is incomplete.

Some units have only the tools catalogued, in addition to the twelve boxes that remain to be catalogued. Thus, these numbers will increase once the database is completed. The majority of lithic tools exhibited parallel oblique flaking, though collateral, random, or a combination were also noted on the projectile points (see Markham 2013; Table 4.6.2). Debitage, microdebitage, and shatter account for at least 86,325 catalogue entries, representing a frequency of over 286,299.

Table 4.6.2
Overall Tool Count for Mackenzie I

<u>Tool Type</u>	<u>Frequency</u>	<u>Tool Type</u>	<u>Frequency</u>
Adze	15	Perforator	5
Biface	710	Preform	2
Chopper	1	Projectile Point	401
Complete			
Core	109	Retouched Flake	330
Core			
Fragment	350	Reworked Tool	9
Drill	87	Scraper	91
Grinding		Undetermined	
Stone	22	Tool	12
Hammerstone	34	Uniface	26
Knife	54		
		TOTAL	1382

For the six study areas, 348 m² were excavated, yielding 377 tools representing seventeen distinct tool types (Table 4.6.3). Of the 377 tools, 153 (40.58%) lack three-point provenience. While this is not ideal, recoveries without three-point provenience still retain some spatial resolution within the quad and level it was recovered from. The majority of the artifacts were recovered between Levels 3 and 6 (10cm to 30cm below surface; Figure 4.6.1).

The raw material recoveries from within these study areas are representative of the rest of Mackenzie I and include: taconite, amethyst, siltstone, mudstone, rhyolite, sandstone, chert, gunflint silica, Hixton Silicified Sandstone, quartz, quartzite, cortex fragments, FCR, ochre, charcoal, granite, and unknown or unidentified specimens (Table 4.6.4). Gunflint Formation material (this includes both taconite and gunflint silica) is the most predominant raw material on site. Many times throughout the thesis however, the two materials are differentiated to account for different distribution patterns. The following sub-sections review the nature of the assemblage per study area.

Table 4.6.3
Breakdown of Tool Types within the Study Areas

<u>Tool Type</u>	<u>Frequency</u>	<u>Tool Type</u>	<u>Frequency</u>
Adze	2	Perforator	1
Biface	108	Preform	2
Burin	1	Projectile Point	104
Complete Core	16	Retouched Flake	47
Core Fragment	41	Reworked Tool	2
Drill	20	Scraper	13
Grinding Stone	4	Undetermined	3
Hammerstone	4	Uniface	3
Knife	6		
		TOTAL	377

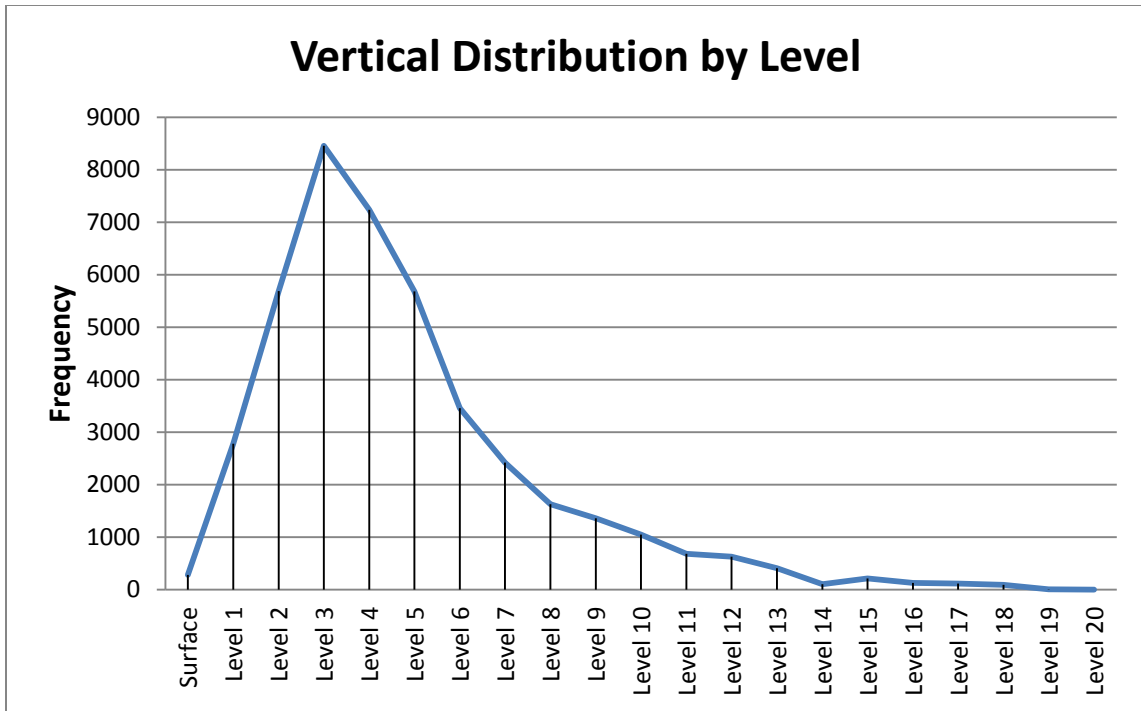


Figure 4.6.1: Vertical distribution of artifacts within all six study areas.

Table 4.6.4

Breakdown of Raw Material within the Study Areas

Material	Frequency
Amethyst	111
Chert	136
Gunflint Silica	7055
Hixton Silicified Sandstone	64
Mudstone	32
Quartz	633
Quartzite	13
Rhyolite	32
Sandstone	16
Siltstone	846
Taconite	35143
TOTAL:	44081

5.6.1 North

The North study area encompasses 60 m² (see Figure 4.1.1). Tool recoveries include bifaces, complete and fragmentary cores, drills, projectile points, retouched flakes, a grinding stone, and an undetermined tool for a total of 45 tools (Table 4.6.5 A-C). Eighteen (40%) are without three-point provenience. Note that preforms were included within their respective type unless it is unidentifiable (e.g. a biface preform is included in the biface tool count).

There were seventeen pieces of FCR, a large unidentified material cobble at 50mm+ with possible utilization, one quartz fragment, and 3 amethyst fragments. These catalogue entries did not provide further data. Lastly, there were 1,459 catalogue entries for debitage and microdebitage (including shatter), with a frequency of 3,553.

Sixty one items demonstrated evidence of potlids on the surface with material ranging from taconite (n=59), siltstone (n=1), and Hixton Silicified Sandstone (n=1). Although most of the artifacts are pieces of shatter or flakes, one taconite drill was potlidded.

Table 4.6.5A

Tool Recoveries from the North Study Area.

Tool Type	Raw Material	Fragment	Frequency
Biface (19)	Taconite	Complete	1
		Tip	9
		Midsection	1
		Base	5
		Lateral Edge	3
Complete Core (3)	Taconite		3
Core Fragment (9)	Taconite		9
Drill (2)	Siltstone	Complete	1
	Taconite	Tip	1
Grinding Stone (1)	Granite		1
Projectile Point (3)	Taconite	Base	3
Retouched Flake (7)	Siltstone Taconite	Midsection	1
		Tip	1
		Midsection	1
		Unknown	4
Undetermined (1)	Other		1

Table 4.6.5B

North Bifaces According to Stage following Bennett (2015).

Note: UID = unidentified.

Stage	Frequency	Raw Material	Fragment
UID	5	Taconite	Tip (1) Base (3) Lateral Edge (1)
2	2	Taconite	Tip (1) Lateral Edge (1)
3	8	Taconite	Complete (1) Tip (2) Midsection (1) Base (2) Lateral Edge (2)
4	2	Taconite	Tip (2)
5	1	Taconite	Tip
6	1	Siltstone	Tip

Table 4.6.5C

Projectile Point Classification for North Recoveries following Markham (2013).

Type	Frequency	Material	Fragment	Description
A1	2	Taconite	Base	Constricting and Deep
D11	1	Taconite	Base	Parallel and Deep

4.6.2 Central North

The Central North study area includes 48 m² (see Figure 4.1.1). Tool recoveries include bifaces, fragmentary cores, projectile points, retouched flakes, scrapers, a burin,

and an unidentified preform for a total of 35 tools (Table 4.6.6 A-C). Twenty tools (57%) lack three-point provenience.

Table 4.6.6A

Tool Recoveries from the Central North Study Area.

Tool Type	Raw Material	Fragment	Frequency
Biface (6)	Taconite	Complete	1
		Tip	3
		Base	1
		Lateral Edge	1
Burin (1)	Taconite	Tip	1
Core Fragment (14)	Gunflint Silica		1
	Taconite		12
	Quartz		1
Projectile (4)	Taconite	Complete	1
		Tip	2
	Unknown	Base	1
Retouched Flake (7)	Taconite	Complete	1
		Tip	1
		Lateral Edge	2
		Unknown	3
Scraper (2)	Taconite	Complete	2
Preform (1)	Unknown	Unknown	1

There were ten pieces of FCR, eighteen pieces of charcoal, one unidentified lithic cataloged as a possible fossil, and three catalogue items without any further specifications. Lastly, there were 1,145 catalogue entries for debitage and microdebitage (including shatter), with a frequency of 2,540.

Table 4.6.6B

Central North Bifaces According to Stage following Bennett (2015).

Note: UID = unidentified.

Stage	Frequency	Raw Material	Fragment
UID	2	Taconite	Tip (1) Lateral Edge (1)
3	1	Taconite	Tip
4	3	Taconite	Complete (1) Tip (1) Base (1)

Table 4.6.6 C

Projectile Point Classification for Central North Recoveries following Markham (2013).

Type	Frequency	Material	Fragment	Description
A3	1	Taconite	Complete	Constricting and Straight
B5	1	Taconite	Complete	Eared and Deep

Thirty items were potlidded including twenty seven taconite fragments, and three gunflint silica pieces. All items were either flakes or shatter fragments.

4.6.3 West

A total of 63 m² were excavated in the West study area (see Figure 4.1.1). Tool recoveries include bifaces, fragmentary cores, drills, a hammerstone, a knife, a perforator, projectile points, retouched flakes, scrapers, and an undetermined tool for a total of 73 tools (Table 4.6.7 A-C). Of the 73 tool recoveries, twenty five were not three-point provenienced (34%).

Table 4.6.7A

Tool Recoveries from the West Study Area.

Tool Type	Raw Material	Fragment	Frequency
Biface (17)	Mudstone	Complete	1
		Tip	1
	Quartz	Midsection	1
		Taconite	Complete
		Tip	1
		Midsection	2
		Base	2
		Lateral Edge	6
Core Fragment(3)	Gunflint Silica		1
	Quartz		2
Drill (7)	Taconite	Tip	5
		Midsection	1
		Base	1
Hammerstone (1)	Other	Complete	1
Knife (2)	Siltstone	Tip	1
	Taconite	Complete	1
Perforator (1)	Taconite	Complete	1
Projectile Point (34)	Agate?	Base	1
	Taconite	Complete	3
		Tip	15
		Midsection	4
		Base	8
		Preforms	3
Retouched Flake (5)	Gunflint Silica	Tip	1
	Quartz	Lateral Edge	1
	Taconite	Base	1
		Lateral Edge	2
Scraper (2)	Quartz	Complete	1

	Taconite	Complete	1
Undetermined (1)	Other	Complete	1

There were two pieces of FCR, one piece of cataloged ochre, and three unidentified catalogue items. Lastly, there were 2,204 catalogue entries for debitage and microdebitage (including shatter), with a frequency of 11,703. Twenty six taconite flakes and pieces of shatter were potlidded.

Table 4.6.7B

West Bifaces According to Stage following Bennett (2015).

Note: UID = unidentified.

Stage	Frequency	Raw Material	Fragment
UID	4	Taconite	Lateral Edge
2	1	Taconite	Complete
3	6	Taconite	Complete (2) Tip (1) Midsection (1) Base (1) Lateral Edge (1)
4	2	Mudstone Taconite	Complete (1) Lateral Edge (1)
5	2	Taconite	Tip (1) Base (1)
6	1	Taconite	Complete

Table 4.6.7C

Projectile Point Classification for West Recoveries following Markham (2013).

Type	Frequency	Material	Fragment	Description
A1	4	Taconite	Complete (2) Base (2)	Constricting and Deep Constricting and Deep
A2	1	Agate?	Base	Constricting and Low
A3	3	Taconite	Complete (1) Base (2)	Constricting and Straight Constricting and Straight
A4	2	Taconite	Base (2)	Constricting and Convex
E17	1	Taconite	Complete	Stemmed and Straight

4.6.4 Central West

Within the Central West study area, 64 m² were excavated (see Figure 4.1.1). Tool recoveries include bifaces, complete and fragmentary cores, drills, a grinding stone, hammerstones, a knife, projectile points, retouched flakes, scrapers, a uniface, an undetermined tool, and an unidentified preform, totaling 66 tools (Table 4.6.8 A-C). Seventeen tools (26%) lack three-point provenience.

There were two pieces of FCR, four unidentified pieces of amethyst under 'Other Lithic', one shell, and 5 unspecified flakes. Lastly, there were 3,244 catalogue entries for debitage and microdebitage (including shatter), with a frequency of 10,750.

Thirty three items were potlidded with material ranging from taconite (n=27), and gunflint silica (n=4), to an unspecified material (n=1). Although most of these artifacts

were pieces of shatter or flakes, a retouched flake and one projectile point (both taconite) also exhibited potlidding.

Table 4.6.8A

Tool Recoveries from the Central West Study Area.

Tool Type	Raw Material	Fragment	Frequency
Biface (24)	Gunflint Silica	Tip	1
		Taconite	Complete
	Taconite	Tip	11
		Midsection	2
		Base	3
		Lateral Edge	5
Complete Core (1)	Unknown		1
Core Fragment (1)	Taconite		1
Drill (6)	Chert	Tip	1
		Taconite	Tip
	Taconite	Midsection	3
Grinding Stone (1)	Other	Lateral Edge	1
Hammerstone (3)	Other	Complete	3
Knife (1)	Taconite	Midsection	1
Preform (1)	Taconite	Base	1
Projectile Point (17)	Mudstone	Base	1
		Taconite	Complete
	Taconite	Tip	3
		Midsection	2
		Base	10
Retouched Flake (6)	Taconite	Complete	3
		Tip	1
		Base	1

		Lateral Edge	1
Scraper (3)	Gunflint Silica	Complete	1
	Taconite	Complete	2
Undetermined (1)	Taconite		1
Uniface (1)	Amethyst	Lateral Edge	1

Table 4.6.8B

Central West Bifaces According to Stage following Bennett (2015)

Note: UID = unidentified.

Stage	Frequency	Raw Material	Fragment
UID	3	Taconite	Base (1) Lateral Edge (2)
2	4	Gunflint Silica Taconite	Tip (1) Tip (2) Midsection (1)
3	8	Taconite	Complete (1) Tip (3) Midsection (1) Base (1) Lateral Edge (2)
4	6	Taconite	Tip (5) Base (1)
5	1	Taconite	Tip (1)
6	1	Taconite	Tip (1)

Table 4.6.8C

Projectile Point Classification for Central West Recoveries following Markham (2013).

Type	Frequency	Material	Fragment	Description
A1	5	Taconite	Base (3) Base and Mid (2)	Constricting and Deep
A2	1	Taconite	Complete	Constricting and Low
A3	1	Taconite	Base	Constricting and Straight
B5	1	Mudstone	Base	Eared and Deep
D13	2	Taconite	Refit-Complete (1) Base (1)	Parallel and Straight

4.6.5 East

The East study area encompasses 64 m² (Figure 4.1.1). Tool recoveries include an adze, bifaces (including one potential chopping tool), complete and fragmentary cores, drills, grinding stones, projectile points, retouched flakes, reworked tools, scrapers, and unifaces, totaling 101 tools (Table 4.6.9 A-C). Forty three tools (43%) were not three-point provenienced.

There were twenty eight pieces of FCR, ten charcoal samples, and some amethyst samples including one with the dimensions 13cm x 15cm x 6cm. ‘Other Lithics’ included rolled chert pebbles, indeterminate quartz pieces, and a couple of blank catalogue items. Lastly, there were 3,024 catalogue entries for debitage and microdebitage (including shatter), with a frequency of 8,551.

Table 4.6.9A

Tool Recoveries from the East Study Area.

Tool Type	Raw Material	Fragment	Frequency
Adze (1)	Siltstone	Complete	1
Biface (22)	Siltstone Taconite	Tip	1
		Complete	2
		Tip	9
		Midsection	5
		Base	2
		Lateral Edge	3
Complete Core (7)	Taconite		7
Core Fragment (9)	Taconite		9
Drill (4)	Taconite	Tip	4
Grinding Stone (2)	Other	Complete	1
	Siltstone	Complete	1
Projectile Point (34)	Gunflint Silica Siltstone	Base	1
		Complete	1
		Tip	1
		Base	1
	Taconite (31)	Complete	3
		Tip	6
		Midsection	8
		Base	11
		Lateral Edge	1
		Preform	1
Retouched Flake (13)	Gunflint Silica Taconite	Tip	1
		Complete	2
		Tip	3
		Midsection	3
		Unknown	3
	Unknown	Complete	1
	Reworked Tool (2)	Taconite	Tip
Base			1
Scraper (5)	Taconite	Complete	3
		Lateral Edge	1
		Unknown	1

Uniface (2)	Taconite	Tip	1
		Unknown	1

Forty one items were potlidded with material ranging from taconite (n=36), gunflint silica (n=3), Hixton Silicified Sandstone (n=1), and one unspecified material. Besides flakes and shatter fragments, one taconite biface and one taconite retouched flake were also potlidded.

Table 4.6.9B
East Bifaces According to Stage following Bennett (2015).
Note: UID = unidentified.

Stage	Frequency	Raw Material	Fragment
UID	12	Gunflint Silica	Complete (1) Tip (1)
		Taconite	Tip (4) Midsection (3) Lateral Edge (3)
2	3	Gunflint Silica	Tip (1)
		Taconite	Tip (1) Midsection (1)
3	3	Taconite	Tip (1) Midsection (1) Base (1)
4	3	Siltstone	Base (1)
		Taconite	Complete (1) Tip (1)
6	4	Siltstone	Tip (1)
		Taconite	Tip (1) Midsection (1) Lateral Edge (1)

Table 4.6.9C

Projectile Point Classification for East Recoveries following Markham (2013).

Type	Frequency	Material	Fragment	Description
A1	2	Taconite	Base	Constricting and Deep
A2	2	Taconite	Base	Constricting and Low
A3	2	Chert Taconite	Complete Base	Constricting and Straight
A4	1	Siltstone	Base	Constricting and Convex
B5	1	Taconite	Base	Eared and Deep
B6	1	Taconite	Complete	Eared and Low
B7	2	Taconite	Base	Eared and Straight
D11	1	Taconite	Complete	Parallel and Deep
D12	1	Taconite	Complete	Parallel and Low

4.6.6 South

The South study area includes 49 m² (Figure 4.1.1). Tool recoveries include an adze, bifaces, complete and fragmentary cores, a drill, knives, projectile points, retouched flakes, and a scraper, totaling 57 tools (Table 4.6.10 A-C). A full thirty tools (53%) lack three-point provenience.

Table 4.6.10A

Tool Recoveries from the South Study Area.

Tool Type	Raw Material	Fragment	Frequency
Adze (1)	Taconite	Base	1
Biface (20)	Gunflint		
	Silica	Base	1
	Siltstone	Complete	1
	Taconite	Complete	1
		Tip	8
		Midsection	2
		Base	1
		Lateral Edge	6
Complete Core (5)	Chert		1
	Quartz		1
	Taconite		3
Core Fragment (5)	Gunflint		
	Silica		2
	Taconite		3
Drill (1)	Taconite	Midsection	1
Knife (3)	Taconite	Tip	3
Projectile Point (12)	Gunflint		
	Silica	Midsection	1
		Lateral Edge	1
	Taconite	Complete	1
		Midsection	4
		Base	4
		Preform	1
Retouched Flake (9)	Quartz	Tip	1
	Taconite	Complete	2
		Midsection	1
		Lateral Edge	2
		Unknown	3

Scraper (1) Quartz Complete 1

There were two pieces of FCR recorded. ‘Other Lithics’ included seven pieces of unidentified amethyst from 12-50mm in size, one undetermined siltstone fragment, two pieces of quartz from 25-50mm, and one taconite fragment 25-50mm in size with supposed unifacial flaking. Lastly, there were 2,263 catalogue entries for debitage and microdebitage (including shatter), with a frequency of 6,749.

Table 4.6.10B
 South Bifaces According to Stage following Bennett (2015).
 Note: UID = unidentified.

Stage	Frequency	Raw Material	Fragment
UID	5	Taconite	Midsection (2) Lateral Edge (3)
2	2	Taconite	Tip (1) Lateral Edge (1)
3	4	Siltstone Taconite	Lateral Edge (1) Tip (2) Base (1)
4	6	Gunflint Silica Siltstone Taconite	Base (1) Tip (1) Complete (1) Tip (3)
6	1	Taconite	Base (1)

Table 4.6.10C

Projectile Point Classification for South Recoveries following Markham (2013).

Type	Frequency	Material	Fragment	Description
A2	1	Taconite	Base	Constricting and Low
A3	2	Gunflint Silica	Base and Mid	Constricting and Straight
A4	4	Taconite	Base and Mid	Constricting and Convex

Nine items were potlidded with material ranging from taconite to gunflint silica.

Two potlidded projectile points were made from gunflint silica.

4.7 SUMMARY

Completing an academic study using CRM-derived data has its limitations. Methods in both the field and the laboratory are not always conducive to high resolution spatial data, and human error can contribute to an incomplete data set. However, some resolution remains, and value-added studies such as the geoarchaeological analysis aids in site interpretation. The large artifact assemblage from Mackenzie I permits researchers to analyze overall patterns, and seek to understand various processes that occurred during human occupation, including spatial organization. Section 4.6 demonstrates the wide range of recoveries including tool type and raw material from the designated study areas. Limitations discovered during this research are offset by the mixed-methods approach used for this spatial analysis.

CHAPTER FIVE

SPATIAL ANALYSIS: A THEORETICAL REVIEW

5.1 INTRODUCTION

Archaeological spatial analysis is a technique used to determine the organization of past populations; such studies can include both inter- and intra-site analyses (Bamforth et al, 2005; Burke 2006; De Bie et al. 2002c; Enloe et al. 1994; Fletcher 2008; Gibson 2001; Lavachery and Cornellisson 2000; Logan and Hill 2000; Mills 2007; Moyes 2002; Seeman 1994; Vaquero and Pasto 2001). Intra-site studies conduct artifact distribution analyses to locate clusters and infer the nature of specific activities. Such activities include lithic manufacturing, hide processing, food preparation, butchering, or other day-to-day events. This approach adds an important element to site interpretation as it enables a search for the existence of cultural patterns (Mills 2007).

Chapter 5 reviews both the use of spatial analysis within archaeology and the methods employed in intra-site studies. Methods employed by researchers include ethnoarchaeology, spatial statistics, and programs such as Geographic Information Systems (GIS) to display and query the data. Ethnoarchaeological and archaeological literature that address diagnostic patterns of activity are discussed in detail since they inform the Mackenzie I spatial analysis. Tool morphology is important for understanding tool function and, therefore, also aids interpretation of specific activity areas. Although this methodology has its limitations, the mixed methods approach undertaken here offsets uncertainties inherent in individual methods.

5.2 REVIEW OF ARCHAEOLOGICAL SPATIAL ANALYSIS

Intra-site spatial analysis is employed to study the spatial relationship between components of the artifact assemblage in order to understand specific site organization and the nature of human activity (Baales 2001; Bamforth et al. 2005; Carr 1984; Ives 1985; Kintigh 1990; Kroll and Price 1991; Mills 2007). The specific location at which a human event occurs is defined as an ‘activity area’, and these clusters can be recognized through an analysis of the patterning and constituent makeup of material culture, and through inferences deriving from ethnographic analogy (Kent 1984). Many researchers have successfully interpreted site function through the use of spatial analysis, and some of those studies will be reviewed in this section.

One of the initial questions raised when conducting spatial analysis is whether artifacts are spatially segregated, or if they are the result of natural processes. One common assumption is that artifacts associated with one another in the ground must be related. Uncritical use of this assumption prompted some researchers to caution that observable patterns may not represent actual activities (Odell 1980; Yellen 1977). Such caution is logical as multiple activities can occur in the same place, and one activity can be accomplished in several areas of the site. Conversely, some archaeologists have stated that “all human activities involving material objects have a spatial component” (Stapert and Street 1997, 173). Overall, human behaviour and activities undergo some level of compartmentalization and as ethnoarchaeological studies have suggested, patterns do exist (Binford 1978).

Methodologically, there are many ways to accomplish an intra-site spatial analysis. The basic analysis consists of plotting provenienced artifacts and applying simple statistics used in visual interpretation of the assemblage, which is sometimes referred to as a density-based spatial analysis (Orton 2002). Many researchers utilize a mixed methods approach through a combination of this density-based analysis with observations from ethnoarchaeological literature (Bamforth et al. 2005), a lithic refit analysis (Cahen and Keeley 1980; Seeman 1994), use-wear analysis (Odell 1980), and/or spatial statistics through GIS programs (Rigaud and Simek 1991).

Mills' (2007) research provides a valuable case study regarding a Late Middle Prehistoric site in Alberta. Spatial analytical techniques were applied to the assemblage from the Fincastle Bison Kill site (DIOx-5) to determine the efficacy of GIS on high density artifact clusters within a complex site. A different mixed methods approach was taken by Bamforth et al. (2005) with their extensive work on the Allen Site in Nebraska, a Paleoindian site occupied over a three thousand year span. Ethnoarchaeological literature on hunter-gatherer site structure was combined with evidence from vertical and horizontal lithic refits, size sorting of artifacts, and a density analysis. The excavation interpretation indicates that the area was used for secondary discard and refuse, tangential to the main domestic area (Bamforth et al. 2005). As these studies demonstrate, a mixed methods approach to intra-site spatial analysis contributes to a higher level of confidence to overall site interpretation.

5.2.1 Geographical Information Systems (GIS)

GIS's have been used by archaeologists since the 1970s and spatial statistics began evolving with the discipline shortly thereafter (Kintigh and Ammerman 1982; Mills 2007; Whallon 1984). ArcGIS, which is the program employed in this study, can be used to display, manipulate, and query archaeological data to determine artifact clusters and infer site activity (Wheatley and Gillings 2002). The spatial statistics within the program are used as a tool to define artifact clusters and test their significance.

Subsequent analysis into the nature of those clusters can then be undertaken (Hodder and Orton 1976). A number of recent studies have been heavily based in GIS and the spatial analytical approach (Mills 2007; Moyes 2002; Yvorra 2003), and many of the methods or tests employed in those studies have influenced the methodology of this research (see Chapter 6).

5.3 ETHNOARCHAEOLOGY

Ethnoarchaeology is the ethnographic study of an extant human population and their activities using a mix of ethnological and archaeological approaches (David and Kramer 2001). Directly observed human behaviour (and the associated material culture) is then used as a modern analog for the interpretation of archaeological deposits. Many studies such as Binford's (1978; 1983) work with the Nunamiut of Alaska, or Yellen's (1977) work with the !Kung in the Kalahari Desert were defining studies that transformed ethnoarchaeological research. Archaeologists can study modern population behaviour and artifact deposition practices under various circumstances to better infer possible behaviour in an archaeological context (O'Connell 1987). Ethnographic and

ethnoarchaeological literature has been used as a tool to infer general site layout, cultural patterns that affect artifact deposition, and more specifically, the diagnostic tool composition of specific activities.

For example, literature on the nature of hunter-gatherer camps is one aspect of the mixed methods approach used by Bamforth et al. (2005). Domestic areas consist of central hearths and shelters where cooking, hide-working, and other activities take place. These activity areas are well-maintained and kept free of most refuse. Periphery areas are generally used for more untidy, spacious, or malodorous activities (e.g. lithic reduction or hide processing). Hearths and secondary refuse piles will also be found in periphery areas, away from the main domestic centre (Bamforth et al. 2005).

Studies have also been used to develop hypotheses about the effect of behavioural patterns on artifact deposition (Binford 1983; Stevenson 1991). Binford proposed three modes of disposal around hearths based on his work with the Nunamiut in Alaska: the drop zone, where smaller pieces were left *in-situ*; larger more discrete refuse thrown away into the toss zone; and the collection of items to be disposed of together, in a distinctive aggregate toss zone (Binford 1983, 156). This and other ethnological studies have demonstrated that compartmentalized behavioural events can be revealed through the artifact patterning of archaeological sites.

These studies are also useful tools for compiling characteristic features and diagnostic patterns associated with a specific activity. On an inter-site scale, these studies have been used to substantiate the assumption that specialized sites (e.g. kill site) contain a specialized tool-kit. Alternately, an assemblage consisting of a wide variety of tool

forms is suggestive of a habitation site where many events occurred either simultaneously or in sequence (Andrefsky 1998; Kent 1984; Kooyman 2000). On an intra-site level, cluster composition can be analyzed to determine what specific activity took place. Different activities could include lithic reduction, lithic working, killing and butchering of animals, hide processing, hide working, food preparation, cooking, craftwork, etc. Each task requires a particular combination of tools to complete and thus, tool composition is used by researchers to infer human activity (Gibson 2001).

However, there are limitations to using ethnoarchaeological research and so it must be used with caution. From a theoretical standpoint, some researchers argue that there are no modern analogs for the archaeological populations that are studied (Stapert and Street 1997); therefore it is important to recognize that not all activities done in the past may be recognized today, although many archaeologists maintain the belief that analogs can be a useful proxy (Bamforth et al. 2005; Kooyman 2000; Odell 1980). There are also differences in the temporal scale of modern studies compared to archaeological sites which may have been occupied for thousands of years, and experienced a greater intensity of post-depositional transformation (Bamforth et al. 2005).

Both natural and cultural post-depositional processes may affect the final assemblage. However, there have been studies to test the spatial resolution and interpretability of patterns after various disturbance processes. Gregg et al. (1991) simulated three levels of disturbance on Yellen's (1977) !Kung data to test the effectiveness of spatial analytical tests in detecting patterns. The authors concluded that although the interpretive resolution continually declined, patterns were still visible after the maximum disturbance level tested (Gregg et al. 1991, 195).

In summary, ethnoarchaeological studies are used to understand site formation processes, potential behavioural contexts, and for diagnostic patterns of human activity. While there are limitations to this approach, it can be an effective means of interpretation when its general principles are combined with archaeological approaches. As Bamforth et al. (2005, 573) state: "...ethnoarchaeological contexts illuminate but do not replicate". Many of the researchers referenced here have successfully used this approach as a tool for added insight. Overall, this method is useful for site interpretation and the application of behavioural inferences, emphasizing the need for ethnoarchaeological literature within a spatial analysis of Mackenzie I.

5.4 DIAGNOSTIC PATTERNS AS INDICATORS OF ACTIVITIES

The methodology utilized for this research includes applying diagnostic patterns of lithic activities to assess whether those patterns are visible within the Mackenzie I study areas. Archaeological literature focusing on spatial analysis discusses two levels of information: the broad patterns visible through large scale artifact distribution across the site, and the small-scale cluster composition indicative of a specific activity. The first level includes insight into the general distribution of refuse piles, or middens. For example, a lack of lithic refits could suggest a midden rather than an *in-situ* primary deposition and thus may indicate the maintenance or cleanup of site areas (Bamforth et al. 2005; De Bie et al. 2002c).

Activities may be associated with certain areas of the site depending on the level of waste, or length of time it takes to complete the task. For example, flintknapping creates a lot of waste byproducts, butchering is 'messy', and hide working requires a

large work space. Therefore, these types of activities are likely found on the site periphery and away from central domestic areas (Binford 1983; Logan and Hill 2000). Furthermore, food preparation, cooking, and other activities are likely found close to a hearth in a main domestic area (Logan and Hill 2000). Artifact deposition patterns around a hearth may also indicate whether the activity took place within a shelter or in the open air (Stapert and Street 1997).

The next level of analysis includes the examination of small-scale cluster compositions that may be indicative of a specific activity. Diagnostic patterns of activities play a large role in cluster analysis and overall Mackenzie I site interpretation. The following information includes the by-products, general location, and depositional pattern for common activities, following Gibson (2001).

5.4.1 Lithic Reduction and Lithic Working

Lithic reduction is the process whereby cores are methodically reduced to create a multitude of formal tools, preforms, or flakes (Gibson 2001). Generally, a large amount of waste (debitage) is created and clusters will include cores and small amounts of microdebitage (Note: cluster composition refers to archaeological recoveries after various taphonomical and recovery methodologies have impacted the final assemblage). Hammerstones and decortication flakes also indicate primary lithic reduction (Carr 1984). Lithic reduction likely took place near a hearth for heat and light, and away from areas used for food preparation (Gibson 2001). Initially, by-products are deposited in the drop zone, however, larger pieces may be thrown into the toss zone (Binford 1983). Alternately, the majority of the by-products may be collected and tossed aside en masse

which Gibson (2001) refers to as Type 3 cluster discard. This terminology is a revised version of Binford's (1978, 1983) drop and toss model, and Stevenson's (1991) displacement model.

Lithic working coincides with Gibson's (2001) 'stone working' and refers to the final reduction into, or resharpening of, a completed tool. This results in a high amount of microdebitage which is usually associated with broken or incomplete tools, and lesser amounts of larger debitage. This activity would also occur close to a source of light and heat, either within or outside of a shelter. Clusters will predominately consist of microdebitage either within the drop zone, or amongst other refuse material after collection and dump into the toss zone (Gibson 2001).

5.4.2 Bone Working and Bone Breaking

Unfortunately, organic material is almost non-existent at Mackenzie I, although there are particular lithic patterns that may indicate the presence of bone working or bone breaking activities. Drills, awls, or knives could be indicative of bone working and this activity likely took place near a hearth, perhaps in a shelter (Gibson 2001).

Bone breaking on the other hand would likely be conducted near an open-air hearth (although there could be exceptions for small animal processing on a minimal scale). Small grinding stones, and large rocks used as anvils may indicate the presence of bone breaking activities (Gibson 2001).

5.4.3 Hide Preparation and Hide Working

Hide preparation consists of the “scraping, rubbing, smoking, and curing” of animal hide for domestic use (Gibson 2001, 77). Large end scrapers can be indicative of hide preparation and since this activity may require a large amount of space, the activity was likely completed in periphery areas away from domestic site use (Gibson 2001).

The creation and maintenance of hide clothing and other materials (i.e. hide working) can likely be inferred from the presence of formal tools such as awls, needles, and knives, or expedient tools like retouched flakes. Any tool employed with a generic scraping motion could likely have been used. Along with most other activities, hide working was likely completed near a hearth for heat and light, and away from activities like flint-knapping that produced a lot of sharp waste (Gibson 2001).

5.4.4 Butchering

The butchering of game would have required the use of choppers, hammerstones, bifacial tools and expedient tools. Secondary processing of larger game likely had to be completed along the site periphery, whereas smaller animals may have been processed near a hearth within the domestic sphere. Waste was likely deposited in a toss zone away from the hearth (Gibson 2001).

5.4.5 Food preparation/Cooking

Food processing could be done with many different tools (Odell 2003, 181), a number of which were likely expedient. Cooking would be done at a hearth in domestic areas, although incidental cooking might take place at activity areas around the periphery

as well. Fire-cracked rock (FCR) would likely be found in association with hearth activity. Waste could have been deposited within the hearth, or into the toss zone (Gibson 2001).

5.4.6 Ceremonial

Exotic raw material, or the presence and use of ochre may indicate some form of ceremonial activity (Gibson 2001). Hixton Silicified Sandstone for example, has been recovered from many Interlakes Composite sites but can only be found in west central Wisconsin (Ross 1995). This raw material has also been associated with a cremation burial in northeastern Wisconsin (Ives pers. comm., 2015; Mason and Irwin 1960). While interpretations of ceremonial activity are speculative, it is possible that they may have contributed to the spatial patterning of the Mackenzie I site.

5.5 SITE FORMATION PROCESSES

It is important to be mindful of the many processes of site formation, and the post-depositional factors (both natural and cultural) that affect the final assemblage excavated by archaeologists. It is crucial to understand the types of processes a site has undergone before making site interpretations. Culturally, site clean-up and maintenance will spatially alter an assemblage, whereas natural factors can include freeze and thaw action of the ground, tree throws, the consequences of forest fire, wind and water erosion, various faunal disturbances, and other factors. The depositional processes affecting Mackenzie I are discussed here to facilitate a better understanding of the spatial distribution of artifacts.

5.5.1 Cultural Processes

When a site is occupied extensively, such as Mackenzie I, clean-up and site maintenance will have an impact on activity area and refuse deposits (De Bie et al. 2002c; Keeley 1991). In domestic areas, particularly those produced by sustained occupation, the degree of clean-up is likely higher due to heavier use (De Bie et al. 2002c). Although large items are more likely to be discarded, small items such as microdebitage may be left behind and could be trampled into the sediment (Keeley 1991). Given these general principles, more microdebitage will likely be found in primary deposits, whereas a major portion of secondary refuse deposits will consist of bigger items (Healan 1995).

The waste collected throughout the site will accrue in middens or secondary refuse piles on the periphery of intensely used domestic areas. Middens will reveal a more heterogeneous make-up of debitage and tools representing a range of activities and functions (Bamforth et al. 2005; Keeley 1991). Furthermore, such cultural behaviour has been observed within the ethnoarchaeological literature (Binford 1983; Murray 1980). Clean-up and maintenance strategies, and particular disposal methods within the Nunamiut community, provided an ethnographic account of potential archaeological behaviour (Binford 1983, 189).

Such maintenance affects the interpretation of spatial data, but regardless, patterns exist within both primary and secondary depositions. As long as the researcher is transparent about any limitations or assumptions, then rigorous interpretations can be made.

5.5.2 Natural Processes

There are a multitude of natural disturbance processes that may affect an archaeological site, including but not limited to: floralturbation, faunalturbation, and cryoturbation (Schiffer 1987; Wood and Johnson 1978). Regionally, processes such as isostatic rebound impact topography, and aeolian or fluvial action influence deposition and erosion at the site. These processes can affect the vertical and horizontal placement of artifacts at the Mackenzie I site and must be considered during intra-site analysis.

Pedoturbation is the mixing of sediment that alters horizons and can move artifacts (Schiffer 1987, 206). Faunal-, floral-, and cryo-turbation all fall under the category of pedoturbation and are present at Mackenzie I. Faunalturbation is the reworking of sediments by burrowing and foraging animals. Artifacts tend to be displaced upwards due to burrowing and tunneling activity, although downwards movement can also occur when collapsed tunnels infill with sediment (Schiffer 1987).

On the other hand, floralturbation is used to describe disturbances through plant activity. This includes root action and tree throws, both of which are present at Mackenzie I, and can also displace artifacts. For example, tree throws create shallow depressions as the tree uproots, carrying sediment and artifacts within its root system. This uprooted sediment may form small mounds creating the ‘cradle-knoll’ microrelief seen often in forested environments (Schiffer 1987; Wood and Johnson 1978).

Cryoturbation is a disturbance process involving freeze-thaw action, within both seasonally frozen ground and permafrost environments. Such action can vertically displace artifacts and in some cases orient them along a vertical axis (Schiffer 1987).

5.6 FORM VS. FUNCTION

One assumption that continues to pervade archaeological interpretation is that tool morphology is directly related to the tool function. The form equals function debate is important to any spatial study since tool morphology is used to interpret activity area function. While tool morphology and function are important, experimental and ethnoarchaeological literature has demonstrated that this assumption does not always apply, and many archaeologists realize the difficulty inherent in such an approach.

Use-wear studies and residue analysis has improved archaeologists' understanding of tool function and illustrated that one tool type might be used for a variety of purposes, or multiple tools can accomplish the same task (Andrefsky 1998; Kooyman 2000). Such studies have shown that multiple tools – projectile points, knives, and scrapers – have been used in an expedient manner for purposes not attributed to a tool based solely on morphology (Andrefsky 1998). For example, projectile points have been used for cutting and butchering, alongside their traditional role as projectiles. Additionally, scrapers have shown wear from multifunctional use, such as graving or boring in addition to the hide scraping that is generally associated with these tools (Andrefsky 1998).

Although ethnoarchaeological research and use-wear studies have shown some limitations to the form equals function assumption, each tool was likely manufactured with a function (or multiple functions) in mind (Kooyman 2000). One solution to accommodate the limitations of the form equals function model is to analyze the assemblage as a whole, or intra-cluster membership, rather than just individual tools

(Bamforth et al. 2005). By looking at the complete pattern, models of activity areas and site function may still be inferred (Andrefsky 1998).

Individual and group style, and the use-life of a tool (including resharpening and re-hafting) can also alter the morphology of individual tools (Keeley 1991; Kooyman 2000). However, the continued use of ethnoarchaeological and experimental literature will contribute to a better understanding of tool function. Although use-wear on the Mackenzie I tool assemblage is beyond the scope of this research, such a study would be highly beneficial.

5.7 THEORETICAL SHIFT IN NORTHWESTERN ONTARIO

A spatial analysis of this scale has not been done in northwestern Ontario previously which marks a slight shift within the region from predominately culture-historical based studies to alternative styles of analysis (see also Langford 2015). Comprehensive studies have been completed to varying degrees in the region (Adams 1995; Hamilton 1996; Julig 1994) but many studies have been hindered by the financial and temporal restraints of CRM excavations. Additionally, many Plano sites in the region have comparably small diagnostic assemblages and so previous studies have focused more on overall distribution patterns and lithic analysis.

The high density of lithic recoveries from Mackenzie I allows for more in-depth analysis to be conducted. Some research has continued within the culture-historical framework to increase the understanding of Plano tool-kits and typology in light of these recent discoveries (see Bennett 2015; Markham 2013). Other ongoing research is incorporating a range of methodologies and utilizing site assemblages in ways that have

not been as extensively used on other regional sites (see Bouchard n.d.; Cook n.d.; Hodgson n.d.; Langford 2015).

5.8 SUMMARY

Archaeological spatial analyses have been successful worldwide and range from density-based approaches to multi-proxy studies incorporating numerous observations and spatial analytical tests. Methods include the use of GIS programs for the display and manipulation of spatial data as well as ethnoarchaeological literature to provide information about human behaviour and site formation. This allows for the development of diagnostic patterns in the lithic assemblage indicative of the nature and location of specific activity areas. Such information allows researchers to infer site use and spatial and social organization. Although a site undergoes multiple levels of formation and post-depositional events, the acknowledgment of factors specific to the Mackenzie I assemblage influences the chosen methodology and contributes to a better understanding of the site.

Prior to the excavation of the Mackenzie I site complex, the intra-site spatial analysis of Lakehead Complex assemblages was not possible. Studies such as the one presented here will help to supplement earlier regional research and studies focused on artifact morphologies by providing insight into site use and organization.

CHAPTER SIX

METHODS

6.1 INTRODUCTION

There are multiple techniques used for intra-site spatial studies, many of which were discussed in Chapter 5. The particular spatial analytical tests employed in this study were chosen based on the resolution of available data and their successful use within the literature (Bamforth et al. 2005). Chapter 6 will review the research process from initial data collection to the spatial analytical tests employed within ArcGIS, and final steps towards interpretation.

6.2 DATA COLLECTION

The Mackenzie I assemblage data was extracted directly from the ADEMAR-generated catalogue, and exported to an Excel file from which specific information could be manipulated to create additional files. For example, Excel files were created from the complete Mackenzie I catalogue for each of the six study areas. From these, additional files were created including but not limited to: all tools, all debitage, FCR, pit features, refit tools, and areas of disturbance. Detailed files were then imported into ArcGIS to create shape files, and manipulate and query the data.

Of note is the use of the randomizer function built into the ADEMAR program: if three-point provenience was unavailable for a tool or other catalogue entry, this function created a random Northing and Easting which was used for subsequent analysis. While

this spatial resolution is not ideal, the coordinate remained within the 50cm x 50cm quadrant in which the item was recovered.

6.2.1 Geographic Information Systems: ArcGIS

ArcGIS was chosen for this study due to its widespread use in archaeology, and for the spatial analytical tests included in the program. GIS itself is an invaluable tool for archaeologists as it allows the researcher to view artifact clusters in relation to each other and the site as a whole. After the data are entered into the program it is possible to organize them into various layers or themes which ultimately aid in the interpretation process (Wheatley and Gillings 2002, 18). After creating shape files, both visual and statistical tests were run to further the interpretation of human activity areas and to determine the presence and nature of artifact clustering.

6.3 VISUAL PATTERNS AND GENERAL DISTRIBUTION

After the data was imported to ArcGIS and maps were made, the artifact distribution was visually inspected. This allowed for the detection of possible patterns within the overall assemblage (Rigaud and Simek 1991) and was the basis for demarcating the six study areas that are the focus of this thesis.

6.3.1 Designating the Study Areas

Initially, the study areas were chosen based on the visual representation of lithic tool distribution. Potential clusters were defined by a buffer zone of relatively low artifact density suggesting the boundaries of each study area (Hivernal and Hodder 1984).

Additionally, these potential clusters were located in areas peripheral to the main artifact

recovery zones, which were noted for dense and expansive deposition, which are beneficial when working within a complex site (De Bie et al. 2002c; see Figure 4.2.1).

6.3.2 Horizontal Distribution

There are a variety of ways to analyze horizontal artifact distribution within the study areas. These techniques assess potential relationships between various artifact classes within the assemblage as well as the nature of disturbance processes. Initially, the horizontal distributions of all artifacts within the study areas were considered for potential clusters or patterns. Subsequently, the distribution of individual tool types, debitage, raw material, debitage types (i.e. primary, secondary, tertiary, or microdebitage) or debitage sizes (i.e. 0-2 mm, 2-6mm, 6-12mm, 12-25mm, 25-50mm, and 50+mm) was analyzed. As discussed in Section 4.5.1, debitage was batch cataloged within their level, quad, and flake size and type. Therefore, frequency was not always taken into account as one catalogue number could represent a frequency of one or 100.

More specific inquiries were also conducted including the location of bifaces according to stage (following Bennett 2015), and the location of individual projectile point morphological types as defined by Markham (2013). Additionally, debitage size sorting was considered as a means of determining whether natural reworking contributed to the assemblage distribution (Bamforth et al. 2005; Shultis 2013). Finally, shape files demonstrating the location of cataloged FCR or noted disturbance was plotted against artifact distribution in an effort to illuminate their potential influence on the nature of artifact clustering. Potential features were also discussed, although details regarding micro-stratigraphy, mapping, photos, etc. are lacking.

6.3.3 Vertical Distribution

The vertical distribution of artifacts was also considered to determine relationships between artifacts and to assess potential disturbance. Vertical size distribution was analyzed to detect the presence of post-depositional movement (Bamforth et al. 2005). Additionally, differences in the vertical distribution of different kinds of raw material were considered.

6.3.4 Kernel Density Estimation (KDE)

Kernel Density Estimation (KDE) is a test that can be performed within ArcGIS to generate a smoothed density contour map. Outputs from this test provide a visual assessment of potential cluster locations and areas of high density by placing a kernel (a probability density function) over observed data points. The observed and expected distances between points are compared, and the degree of clustering is determined (de Smith et al. 2007, 211; Mills 2007: 11, 61; Roberts and Parfitt 1999, 175). This method is commonly used by archaeologists and can later be compared to outputs from other statistical tests (Baxter and Beardah 1997).

6.4 REFIT ANALYSIS

A refit analysis was completed for the lithic tools recovered from the six study areas. Although an in-depth refitting analysis amongst all artifacts would be ideal, this had to be limited to the refits found during the cataloging process. Refit data was primarily provided by the Western Heritage catalogue. Subsequent refit data was added to the catalogue from two comprehensive studies on bifaces and projectile points (Bennett 2015; Markham 2013).

Both horizontal and vertical spatial components of refit tools were analyzed, including distribution and factors such as raw material (Rigaud and Simek 1991). Vertical patterns provide information about post-depositional movement or disturbance of artifacts (Bamforth et al. 2005; Le Blanc and Ives 1986). Furthermore, horizontal distribution patterns can suggest contemporaneity between clusters or site clean-up and maintenance (De Bie et al. 2002c; Seeman 1994).

6.5 SPATIAL ANALYTICAL TECHNIQUES

It is important to use a variety of statistical measurements in conjunction with one another in order to effectively assess whether the patterns observed in ArcGIS are statistically significant (Baales 2001; Hodder and Orton 1976; Mills 2007). Therefore, methodologically, this thesis incorporates multiple methods to gain a more accurate interpretation of the study areas. Initial visual patterning demonstrated potential patterns or clusters, while other basic distribution patterns (e.g. refit tools) contributed to an understanding of post-depositional disturbance.

Next, the following statistical tools were used to test the significance of observed patterns and the composition of those clusters. From these techniques, further interpretations were made regarding the nature of those clusters and inferred activity areas.

6.5.1 Nearest Neighbour and Ripley's K Function

Nearest Neighbour compares the average distance between a point and its nearest neighbour, with the distance one would expect from a random pattern (Mills 2007, 13).

The Nearest Neighbour output within ArcGIS provides a graph readout with a z-score that determines the likelihood that a pattern could be the result of random chance.

However, there are issues that arise with the use of this statistical test. Nearest Neighbour only tests a points' first nearest neighbour, and suffers from a boundary effect; the size of the study area may determine whether a pattern is deemed to be clustered (or not; Conolly and Lake 2006, 164; de Smith et al. 2007, 204). Ideally, Nearest Neighbour should be applied when the artifact count is high (de Smith et al. 2007, 204).

Ripley's K goes beyond the nearest neighbour and takes all point to point relationships into account (de Smith et al. 2007, 206). A circle of defined radius is placed over a point, and the observed versus expected number of neighbours within that circle is compared (Mills 2007, 17). A z-score is used to determine the significance of artifact clustering and the likelihood that the pattern is due to random chance. Using this technique in addition to Nearest Neighbour is valuable because it goes beyond the first nearest neighbour, resulting in the shape of the study area having less of an effect on the outcome (Conolly and Lake 2006, 166).

Used in tandem, these two statistical tests determined the presence or absence of statistically significant patterning within the six study areas. These tests were performed for distributions of all artifacts (debitage and tools), all debitage, and all lithic tools. Once clustering significance was tested, further investigation was needed to determine the nature of such clustering.

6.5.2 K-means (Pure Locational Clustering)

Once potential clusters within the study areas were deemed significant, K-means was used to explore the cluster number of best fit as well as the assemblage within each of those clusters (Yvorra 2003). This technique was completed using the SPSS (Statistical Package for the Social Sciences) program along with ArcGIS.

To perform a K-means analysis, the researcher determines the value of K (the number of clusters to be tested per study area), and then random point locations equal to the K value are placed within the study area as *seed points*. Each data point is then assigned to the cluster centre that it is closest to. New seed points are created from within this centre and the points are re-assigned. This process continues until the distance between points and their centre cannot be further reduced (Conolly and Lake 2006, 171; de Smith et al. 2007, 211). For each study area, $K2$ through $K10$ was tested, meaning that each study area was divided from two to ten clusters and membership within each cluster was determined.

After this process was complete and multiple cluster numbers were tested, the *optimal cluster solution* was determined. This was completed by calculating the $\% \log_{10}$ SSE (Sum of Squared Error) for each cluster number in Excel. These values were plotted in a line graph and “elbows” within the graph suggested which cluster number was significant and therefore also determined which cluster solution (K) to base interpretations on (De Bie et al. 2002c, 141). Once the optimal cluster solution was ascertained, cluster composition could be analyzed.

This spatial analytical technique is a useful addition to Nearest Neighbour and Ripley's K because it increases the level of information gained for each study area. K-means tests the spatial proximity of all artifacts, regardless of type, and does not suffer from the boundary effect, as seen in Nearest Neighbour (Kintigh and Ammerman 1982; Moyes 2002). However, the researcher defines the number of clusters to be tested (Mills 2007, 26). Regardless of these issues, analyzing a wide number of cluster solutions can limit researcher bias. Additionally, the results of the K-means tests were superimposed with KDE readouts to compare cluster location and provide a more detailed cluster distribution that may have been otherwise overlooked within the density contour maps (Baxter and Beardah 1997; Enloe et al. 1994).

6.6 CLUSTER COMPOSITION AND INTERPRETATION

The combination of the spatial analytical tests mentioned here established the presence or absence of significant clustering within each study area, determined the optimal number of clusters, and finally, the membership of each cluster. Cluster composition was then interpreted through the ethnoarchaeological literature, and diagnostic patterns of activity areas (as discussed in Chapter 5) were used in order to infer human activity. These statistical tests only provide so much information, but to actually "link these patterns to past human behaviour", one must turn to ethnoarchaeology (Enloe et al. 1994, 110).

6.7 SUMMARY

ArcGIS and the spatial analytical tests utilized for this research provided valuable tools to analyze each study area and the potential activity areas that occurred there.

Studies have shown the need to use multiple techniques to reflect a more accurate depiction of human behaviour. Many archaeologists have successfully demonstrated the validity of such methods for an intra-site spatial analysis and site interpretation (Baales 2001; Bamforth et al. 2005; Mills 2007; Odell 1980; Rigaud and Simek 1991). The methodology outlined here exemplifies this approach.

After an initial density analysis was performed through the visual representation of artifact distribution, specific factors such as vertical and horizontal distribution of tools, refits, and other assemblage characteristics were studied in order to assess potential clustering patterns. The significance of these clusters was determined through the use of spatial statistics in ArcGIS including Nearest Neighbour, Ripley's K, and K-means. This approach allowed the researcher to establish an understanding of local clustering within each study area.

CHAPTER 7

RESULTS

7.1 INTRODUCTION

Chapter 7 presents the results from the spatial analysis of Mackenzie I, following the outline provided in Chapter 6. The six study areas are discussed separately, with the output from each visual and statistical test undertaken. Cluster membership as defined from the K-means and SSE tests are also analyzed. Interpretations for these results are provided in Chapter 8.

7.2 NORTH

7.2.1 Visual Comparison

After the data was imported from ADEMAR into ArcGIS, shape files and maps were created to visually inspect the artifact distribution within each study area. The visual analysis includes both the horizontal and vertical distribution of individual tool types, raw material, debitage types (i.e. primary, secondary, tertiary, or microdebitage) or debitage sizes (i.e. 0-2 mm, 2-6mm, 6-12mm, 12-25mm, 25-50mm, and 50+mm) (see Section 6.3). Additional inquiries include the location of bifaces according to stage (following Bennett n.d.) and morphological projectile point categories (following Markham 2013). This technique allows for the recognition of potential relationships within the artifact assemblage. Furthermore, the technique may highlight the nature and extent of the post-depositional movement of artifacts.

Horizontal Distribution

The current topography reveals a fairly flat surface, with elevation varying between 246.5 and 246.75m asl (Figure 7.2.1). Overall artifact distribution is concentrated in the centre of the study area, with an area of secondary concentration extending to the northwest (Figure 7.2.1). A lack of linear size-sorting patterns within the debitage remains suggests limited post-depositional water re-working (Bamforth et al. 2005). It should be noted that artifacts from unit 541N/520E (in the very northeast corner) were not in the catalogue prior to analysis.

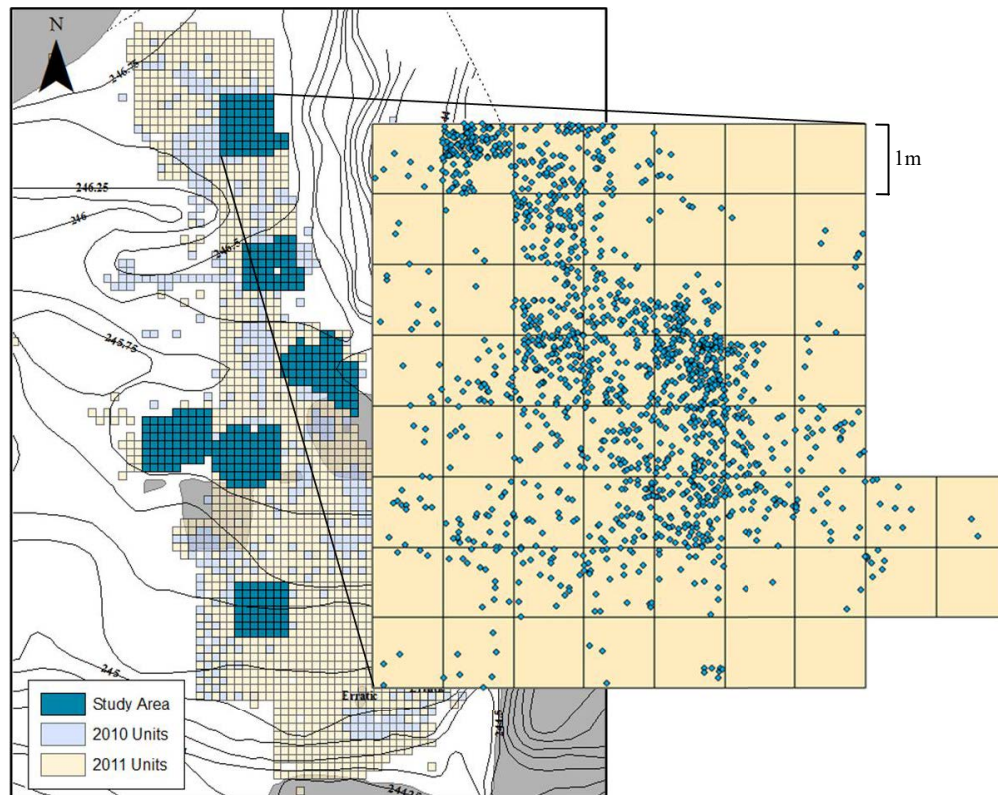


Figure 7.2.1: North study area topography within the Mackenzie I site. Inset: Overall artifact distribution pattern within the North study area.

Tool Distribution

There were 45 tools recovered from the North study area (Figure 7.2.2) of which 42% were bifaces (for a detailed list of tools present, see Chapter 4; Figure 7.2.3). Four retouched flakes were recovered in close horizontal association to two of the three complete cores within the study area. Three broken projectile point bases were recovered which represent constricting deep (n=2) and parallel deep (n=1) morphological shapes (Markham 2013). Additionally, three bifaces and two drills are preforms.

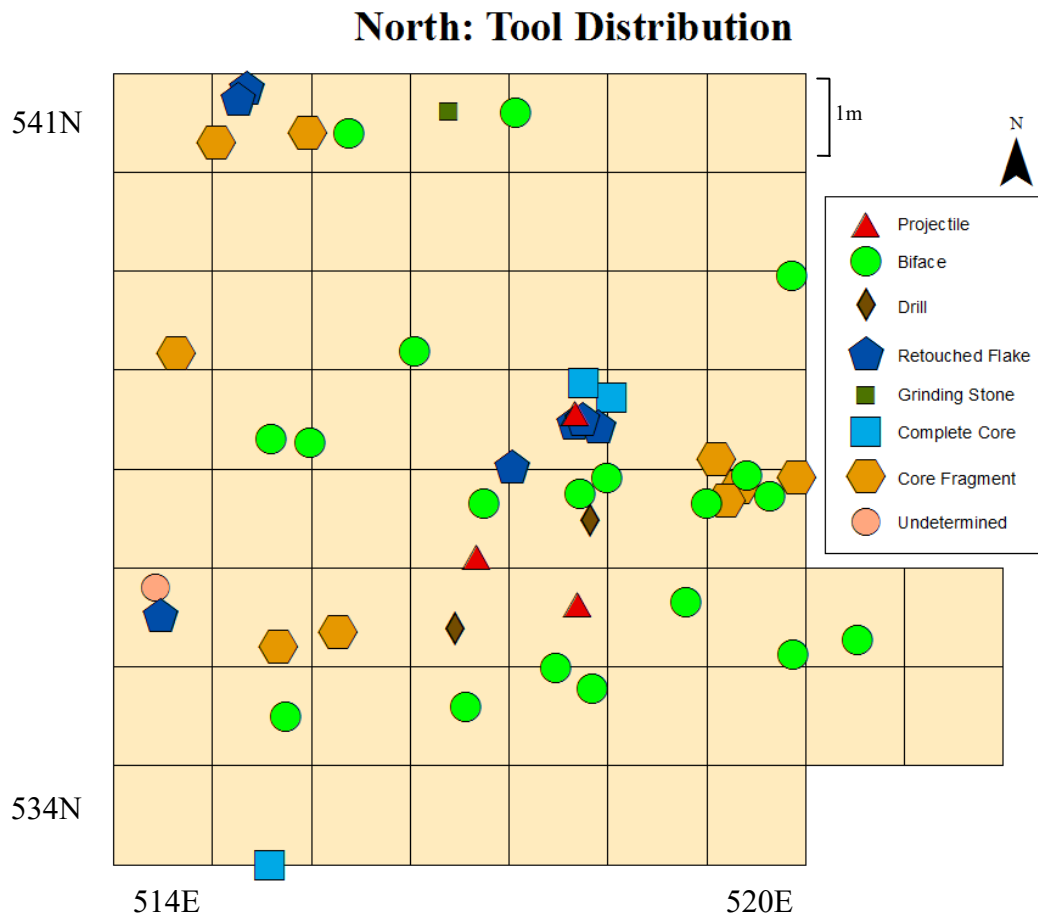


Figure 7.2.2: Lithic tool recoveries from the North Study Area.

Most of the tools were produced from Gunflint Formation material, predominately taconite, with the exception of the grinding stone, an undetermined tool type with no material designation, and three siltstone items. The siltstone biface, retouched flake, and drill were recovered in close proximity to siltstone debitage (Figure 7.2.4).

Biface Stage and Projectile Point Category

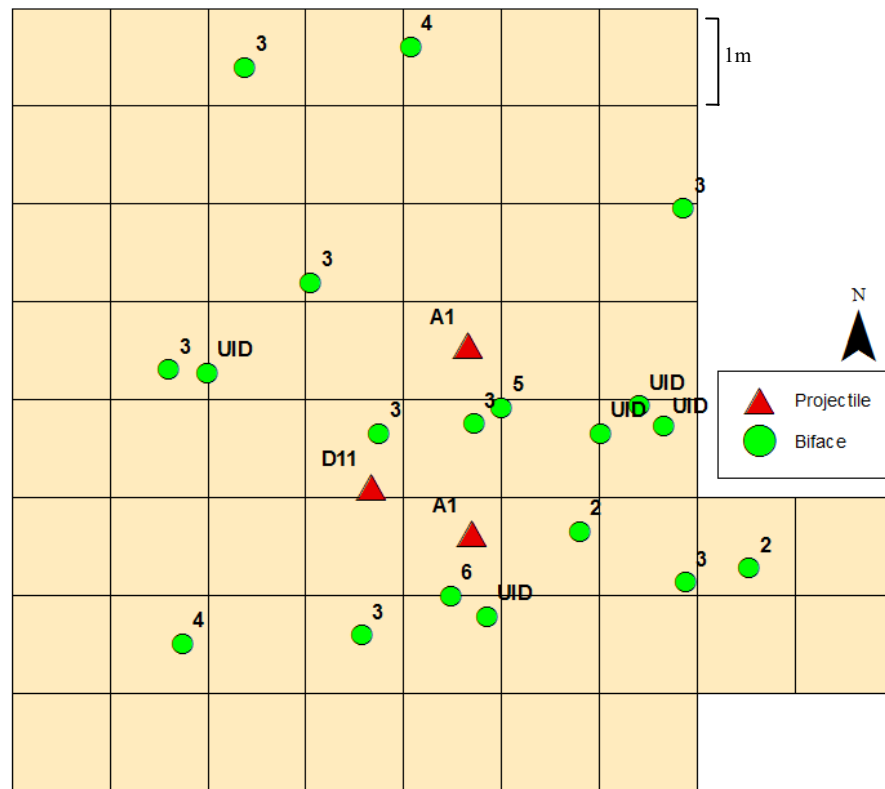


Figure 7.2.3: This map demonstrates the projectile point morphological shapes as defined by Markham (2013), and the biface stage as determined by Bennett (n.d.) for the North study area. Note: Numbers 2 through 6 indicate biface stage, while UID is an unidentified biface stage. Note: A1 refers to a Constricting Deep projectile point morphological shape, while D11 is a Parallel Deep shape. See Table 4.5.1 for a complete guide to the projectile point categories.

Debitage Distribution

Microdebitage (0-6mm) appears more concentrated in the north portion of the study area from the northwest to the southeast (Figure 7.2.5). The bulk of the debitage

assemblage consists of items ranging from 6mm to 25mm in size, while primary flakes and larger 25-50+mm debitage are clustered in the west around unit 538N/516E. Tools are found both within and along the periphery of these debitage concentrations. It is important to note that debitage is batch catalogued meaning frequency is not always taken into account (see Section 6.3.2). However, primary flakes, microdebitage, and large 25-50+mm debitage are plotted according to frequency in Figure 7.2.5.

Distribution of Siltstone Artifacts

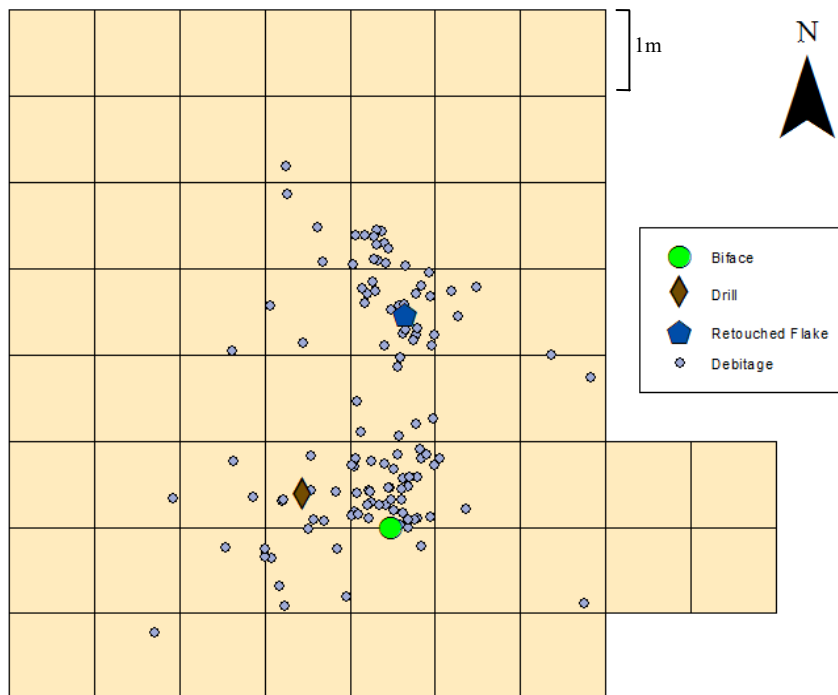


Figure 7.2.4: North distribution of siltstone tools in relation to siltstone debitage.

Taconite is the dominant raw material in this study area showing three distinct high density areas. There are noticeable concentrations for many different raw material types including chert, quartz, siltstone and gunflint silica; these raw materials are dense in the central east to southeast region around unit 537N/518E. Mudstone and Hixton

Silicified Sandstone are found to the south of this dense area (Figure 7.2.6). Interestingly, taconite frequency is relatively low in this area while dense taconite concentrations occur further to the north.

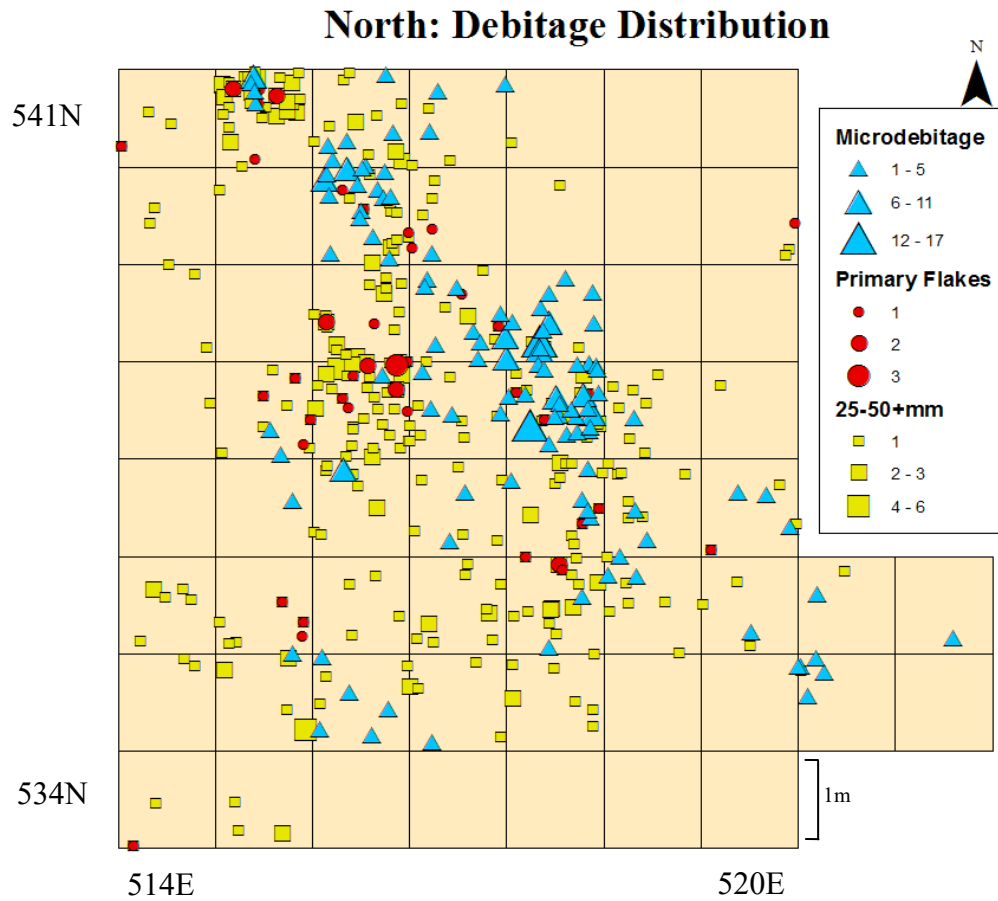


Figure 7.2.5: Distribution ofdebitage by type for the North study area. Note: This map excludes secondarydebitage (6-25mm) due to its intense frequency.

Vertical Distribution

Tools from the North study area were recovered from a number of different excavation levels, with the highest frequency from Levels 3 to 5 (10-25cm depth below surface, or dbs; Figure 7.2.7). Vertical distribution ofdebitage according to size demonstrates that most size categories follow a similar pattern, although microdebitage is sporadically distributed throughout the stratigraphy. A higher frequency of large 25-

50+mm debitage was recovered from Level 3. Lastly, all of the deeper units in this study area, from Level 7 to 9 (30-45cm dbs), are located north of the 537N line.

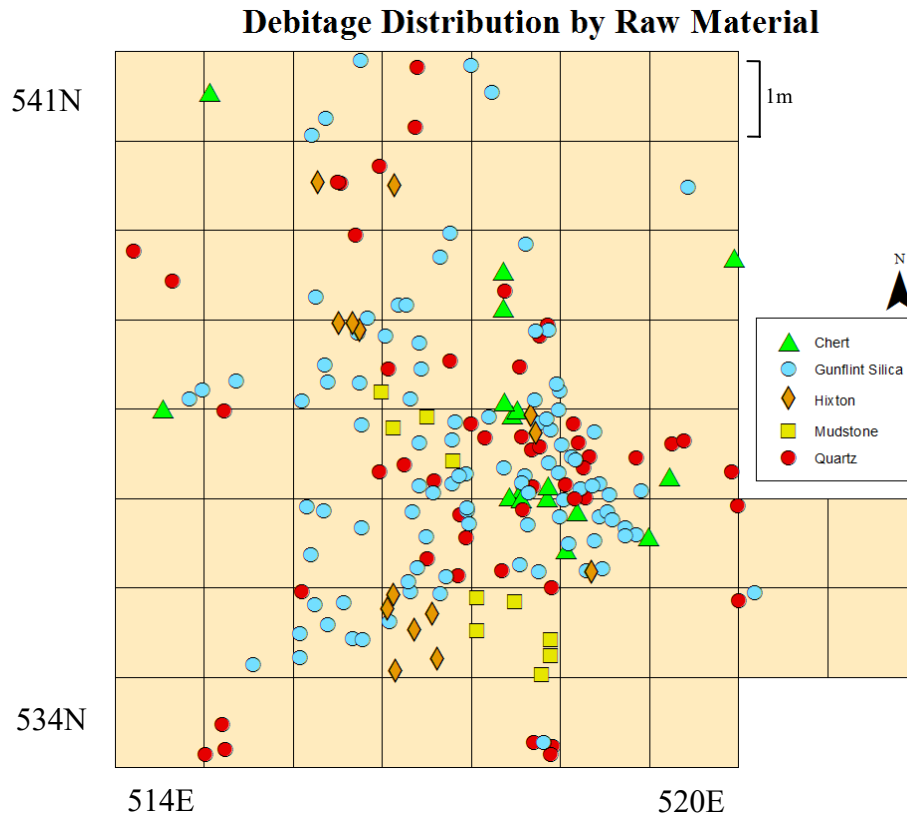


Figure 7.2.6: Map highlighting some of the different raw material types within the North. Each type has a distinct distribution; however there is a clear high density area around 537N/518E.

7.2.2 Refit Analysis

As discussed in Section 6.4, a refit analysis was conducted within each study area. This analysis incorporates tool refits from three sources: the Western Heritage catalogue, and two academic studies focusing on the biface and projectile point recoveries from the Mackenzie I site (Bennett n.d.; Markham 2013). Both the vertical and horizontal disparity between refits are studied as this provides information about post-depositional movement of artifacts and contemporaneity between clusters, respectively.

One tool refit (n=2) was discovered in the North study area. Unit 538N/515E contained a taconite biface tip which refit to a lateral edge from 535N/517E, 3m south and 2m east (Figure 7.2.8). This suggests significant vertical displacement, as the two items were found from Level 7 and 1, respectively.

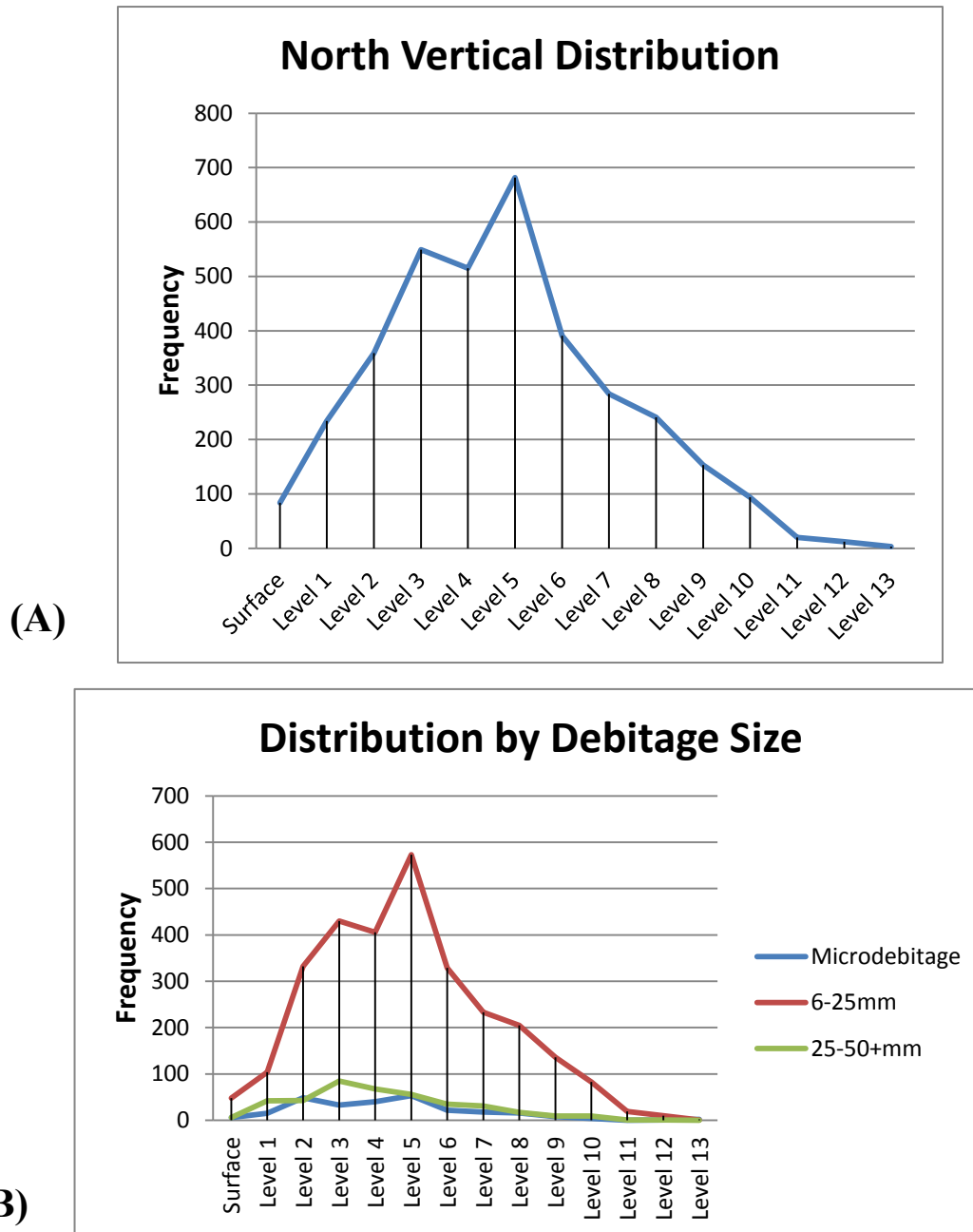


Figure 7.2.7: A) Vertical distribution of artifacts within the North study area. Note the two peaks at Level 3 and Level 5 (10-15cm and 20-25cm dbs). B) Vertical distribution ofdebitage by size.

North: Refit Tools

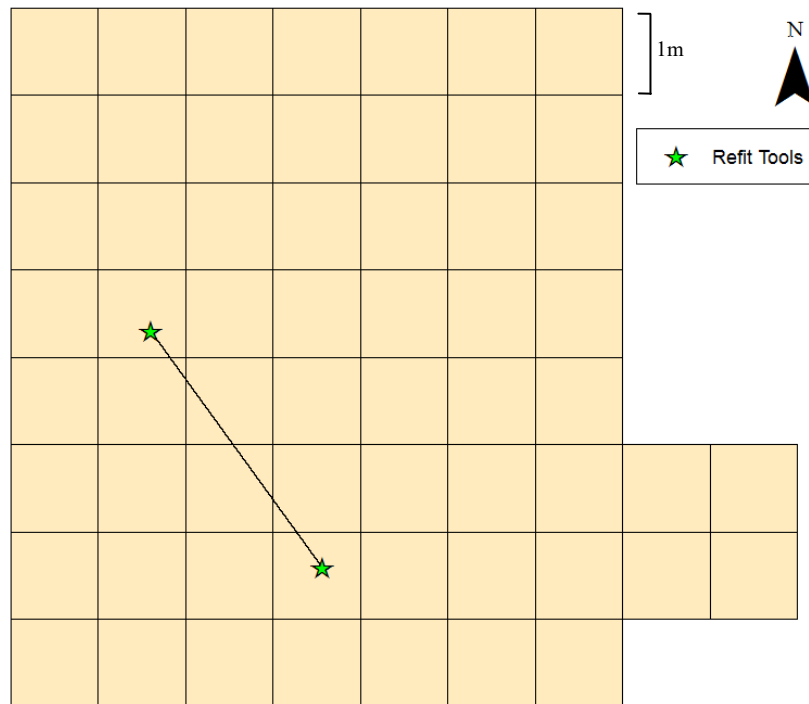


Figure 7.2.8: The sole refit tool from the North study area; a taconite biface tip with a lateral edge. This also provides evidence of vertical displacement as they were found six levels apart.

7.2.3 Spatial Analytical Results

The following spatial analytical tests are used for each study area in this analysis to test the statistical significance of observed patterns and determine the composition of each cluster. Multiple techniques are used to determine the validity of such patterns and minimize the limitations of each individual approach.

Kernel Density Estimation (KDE)

The Kernel Density Estimation (KDE) creates a visual assessment of clusters and areas of high artifact density. This output is later compared with the K-means results to determine cluster location. Within the North study area, the KDE smoothed density

contour map demonstrates two concentrations focused around units 541N/515E and 538N/518E. Tools are associated within, or along the periphery of, these and other high density locations (Figure 7.2.9).

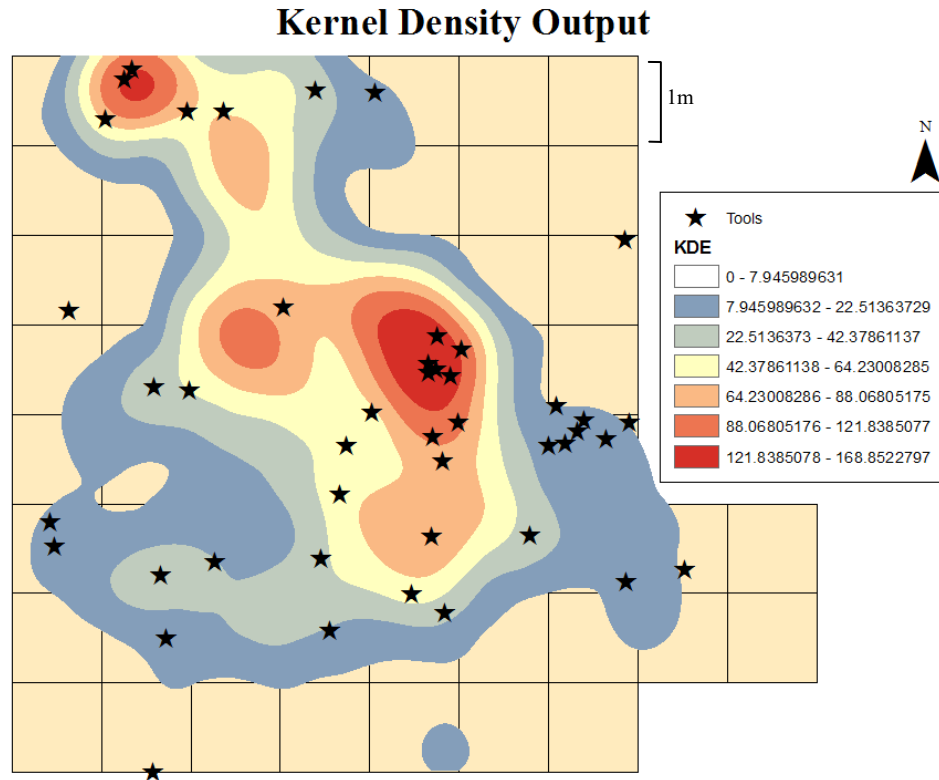
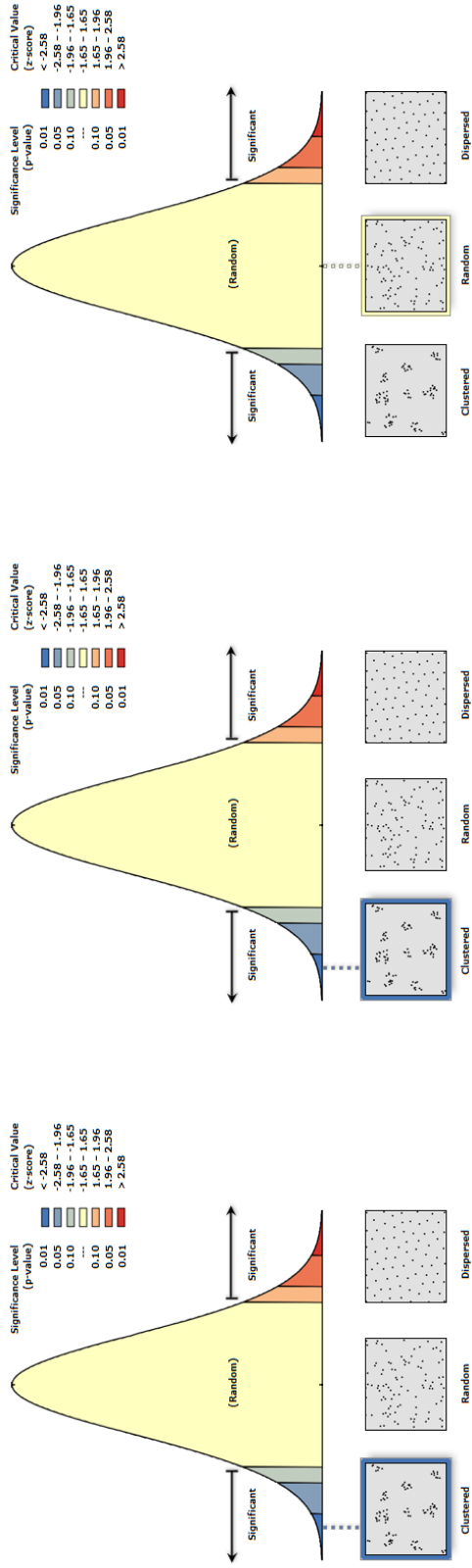


Figure 7.2.9: The smoothed density contour map, which highlights the most dense artifact clusters within the North study area. Tool distribution is within and around the periphery of these locations.

Nearest Neighbour

As outlined in Section 6.5.1, the Nearest Neighbour test is a method used to determine the presence or absence of statistically significant patterns. The test is run through ArcGIS and provides a graph readout and z-score to determine whether or not the pattern is the result of random chance.



Given the z-score of -0.77, the pattern does not appear to be significantly different than random.

Given the z-score of -22.79, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -23.37, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Figure 7.2.10: The Nearest Neighbour outputs for all artifacts, all debitage, and the tools, respectively. The analysis for this North study area suggests that debitage is clustered, and tools appear random.

Within the North study area, the Nearest Neighbour function was completed three times: for all artifacts (debitage and tools), all debitage (including shatter), and lithic tools. As indicated by the Nearest Neighbour output (Figure 7.2.10), all artifacts and all debitage demonstrate clustering, whereas the tools are considered random. The randomness of the tools is likely the result of small sample size.

Ripley's K Function

Ripley's K function analyses all point to point relationships to determine the presence or absence of statistically significant clustering (see Section 6.5.1). The output includes a graph to indicate the 'observed' level of clustering compared with the 'expected' level if the results were due to random chance. Ripley's K analysis was completed for all artifacts, all debitage, and tools. Each output demonstrates a clustered distribution (Figure 7.2.11).

K-means (Pure Locational Clustering)

A K-means analysis was then completed to determine the cluster number of best fit, and the resultant assemblage within each of those clusters. Cluster solutions from K2 to K10 (i.e. two to ten clusters) were tested for all debitage, as well as all tools. The optimal cluster solution was then determined by calculating the $\% \log_{10}$ SSE for each cluster number (see Section 6.5.2). These values were subsequently plotted on a line graph and "elbows" used to determine which cluster solution (K) to utilize.

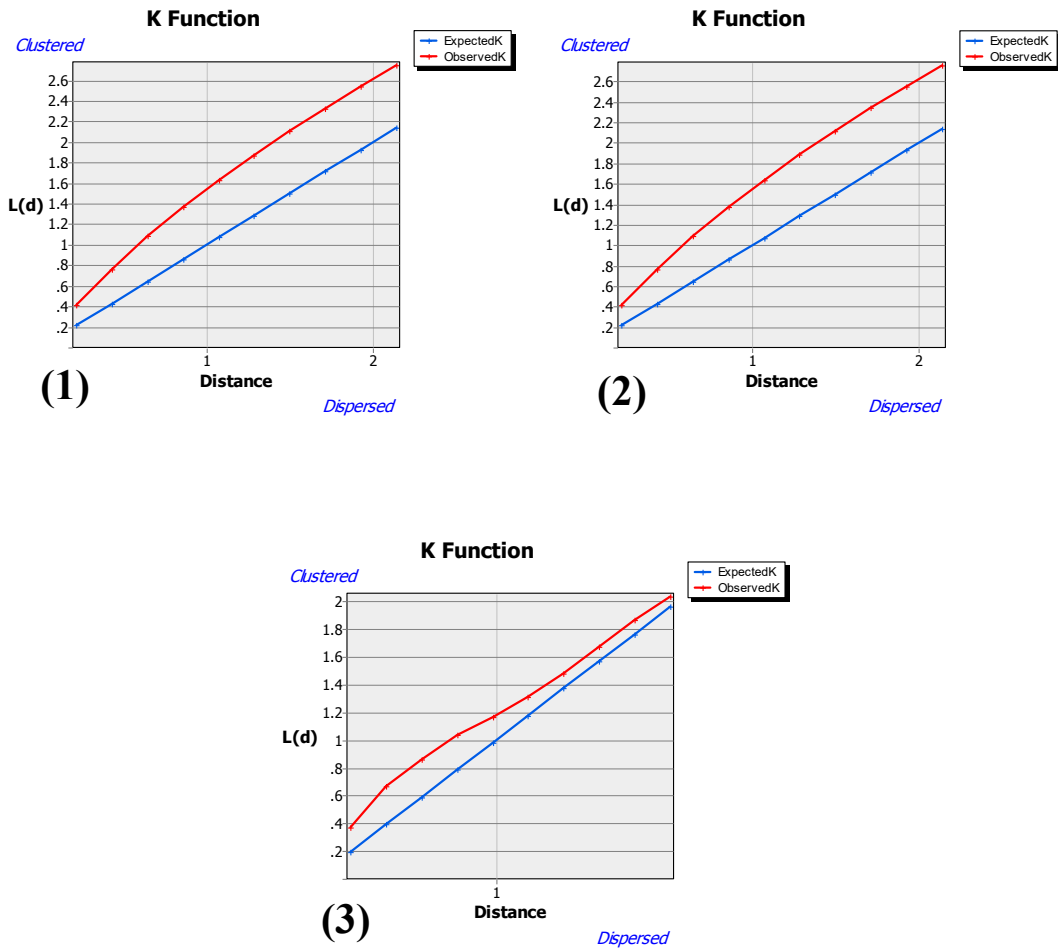


Figure 7.2.11: These three outputs from the Ripley's K analysis demonstrate clustering for North study area artifacts (1), debitage (2), and tools (3).

The $\% \log_{10}$ SSE graphs for the North study area suggests that K5, or five clusters, is the optimal cluster solution (Figure 7.2.12). Though other 'K' solutions are also implied by the K-means Tools graph, K5 for tools more closely matches K5 for debitage (with the exception of a tool cluster along the eastern border). This cluster solution was also compared to the KDE output (Figure 7.2.13). These five clusters are used for further analysis, and are referred to as North A to North E (see Figure 7.2.13).

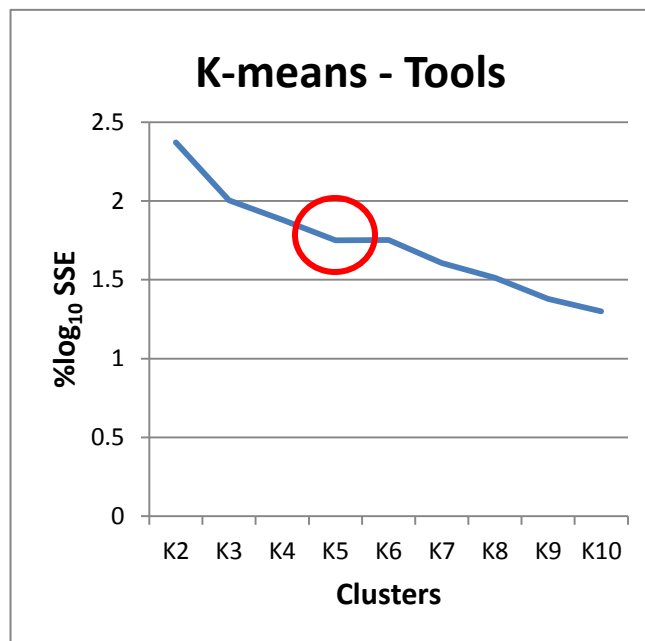
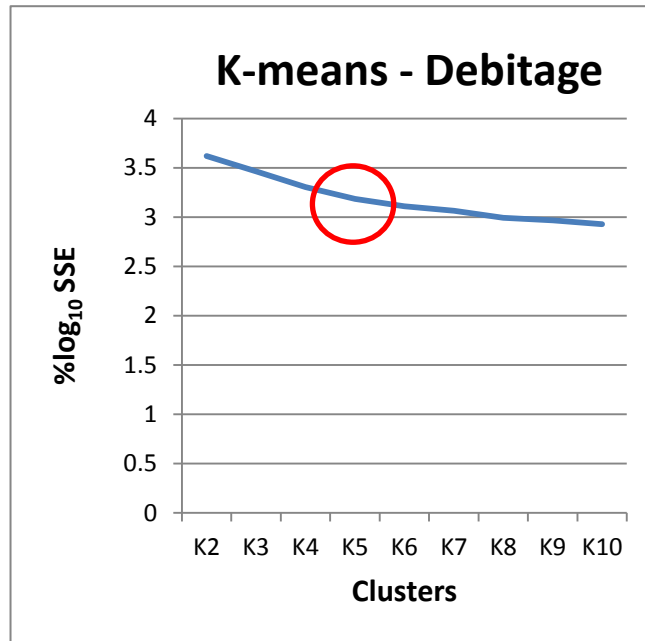


Figure 7.2.12: These graphs represent the %log₁₀ SSE outputs from the SPSS program. A bend, or “elbow” suggests an optimal cluster solution for the North study area. Here, K5 solutions for both debitage and tools were compared in ArcGIS and closely matched. Thus, five clusters were used for further exploratory analysis.

K-means: 5 Cluster Solution

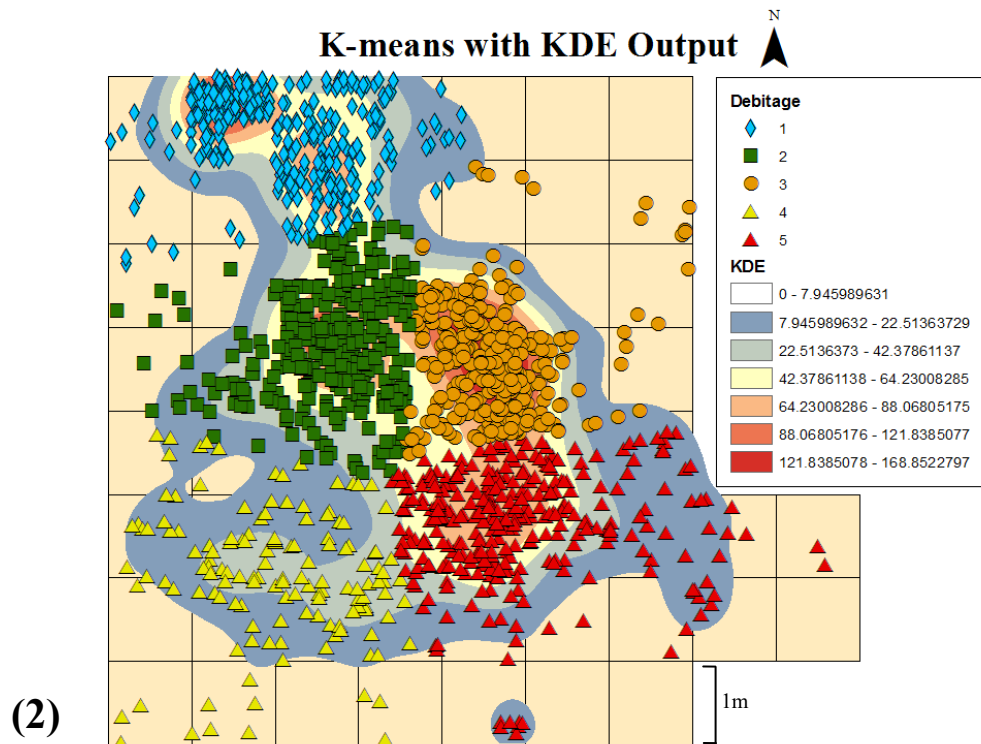
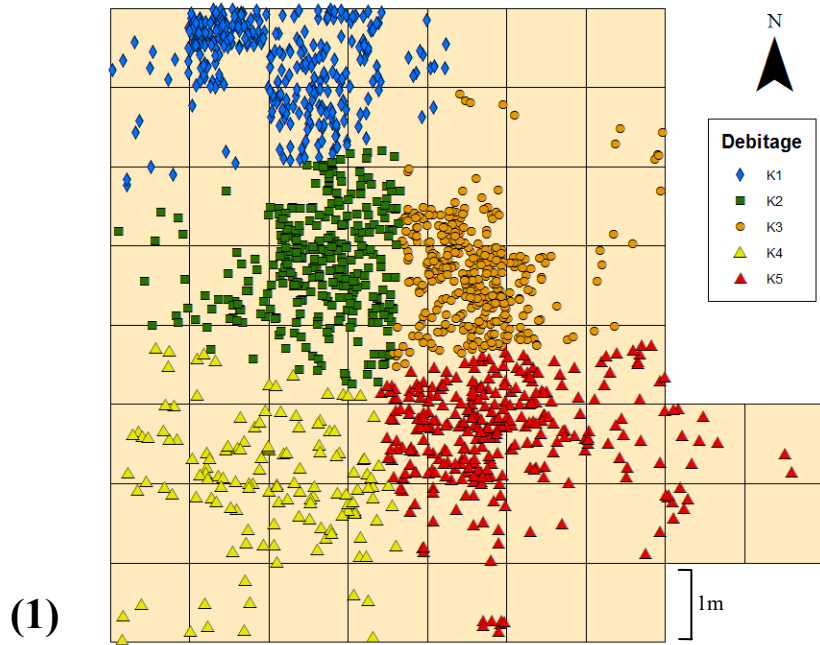


Figure 7.2.13: 1) This map demonstrates the five cluster solution for debitage recoveries, as determined through the $\% \log_{10}$ SSE tests; 2) This map displays the same five cluster solution superimposed on the KDE smoothed contour map, highlighting the clusters in relation to high density locations. Note: clusters K1 – K5 as shown here coincide with North Clusters A – E in section 7.2.4.

7.2.4 Cluster Composition

This section outlines the composition of the five clusters (North A to North E) determined in part, through the exploratory use of the K-means and SSE tests. These tests are used in tandem with KDE and visual comparisons to maximize the interpretation of potential clusters.

North A

Cluster A is located in the northwest section of the study area (Figure 7.2.14 A). Tool recoveries include two biface tips (Stage 3 and 4), two retouched flakes (including one waterworn specimen), one grinding stone, and two core fragments. With the exception of one grinding stone, all tools were manufactured from taconite. The core fragments, retouched flakes, and primary debitage were found in a discrete horizontal concentration, with many of these items recovered from Level 3.

A dense cluster of large debitage (25-50+mm), along with some primary flakes was excavated in close proximity to the core fragments and retouched flakes. Alternately, microdebitage was most dense within the northern quads of unit 540N/516E, to the southeast (Figure 7.2.14 B). Non-taconite items were sparse with the exception of a few quartz flakes.

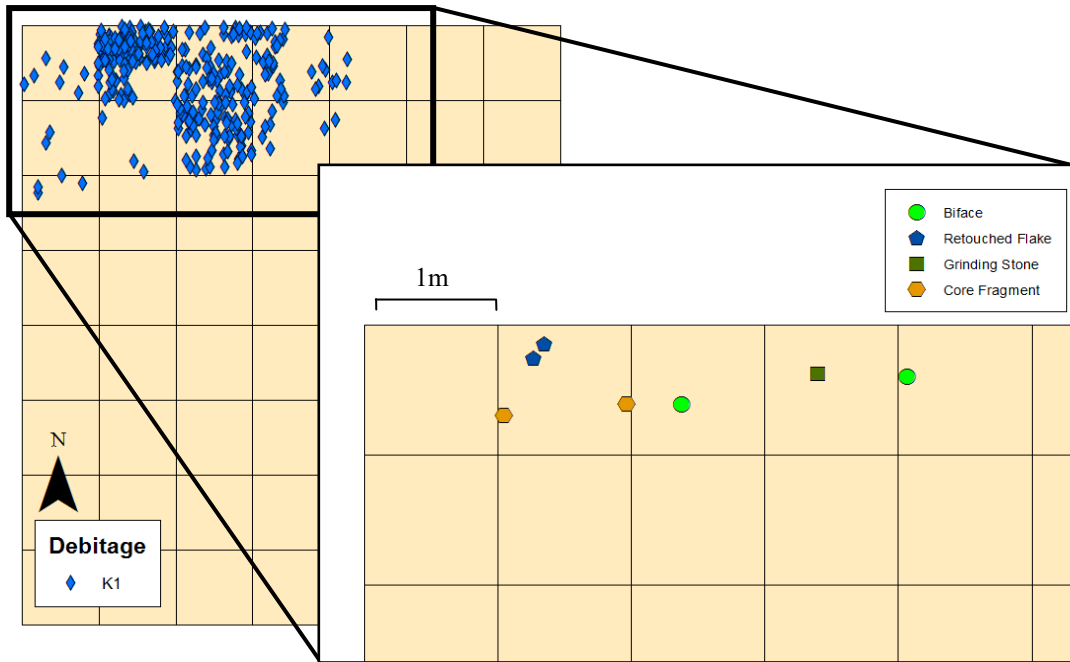


Figure 7.2.14A: Location of Cluster A within the North study area. Inset: Tool distribution within Cluster A.

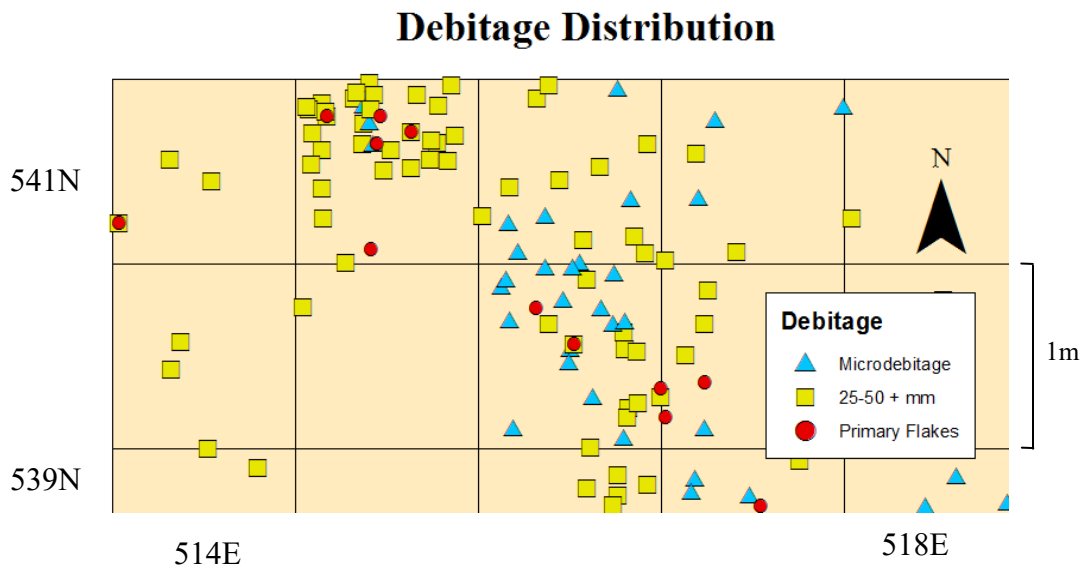


Figure 7.2.14B: This map for North A demonstrates the cluster of large debris in the northwest near the core fragments and retouched flakes. Conversely, microdebitage is found to the southeast of these tools.

Unit 541N/517E contained FCR in close horizontal proximity to the study area's sole grinding stone, although the FCR was recovered from Levels 4 to 6 and the grinding

stone from Levels 9 and 10 (bifaces were also deeper in Levels 7 and 8). Soil discoloration in Levels 9 and 10 was noted though the excavator suggested possible root burn as the cause. To the southeast in 540N/518E a possible hearth and adjacent stone measuring 20cm x 20cm was noted between Levels 8 and 10, with a charcoal sample taken in Level 10 (this sample has not been dated).

North B

This central-west cluster had a noticeable lack of formal tools (Figure 7.2.15 A). Recoveries include one biface base (staged as unidentified, or UID), two Stage 3 bifaces, and one core fragment. One Stage 3 biface refit to an item 3m south and 2m east. Tools within this area were recovered from a range of levels, from Level 5 to Level 11 (20-55cm dbs).

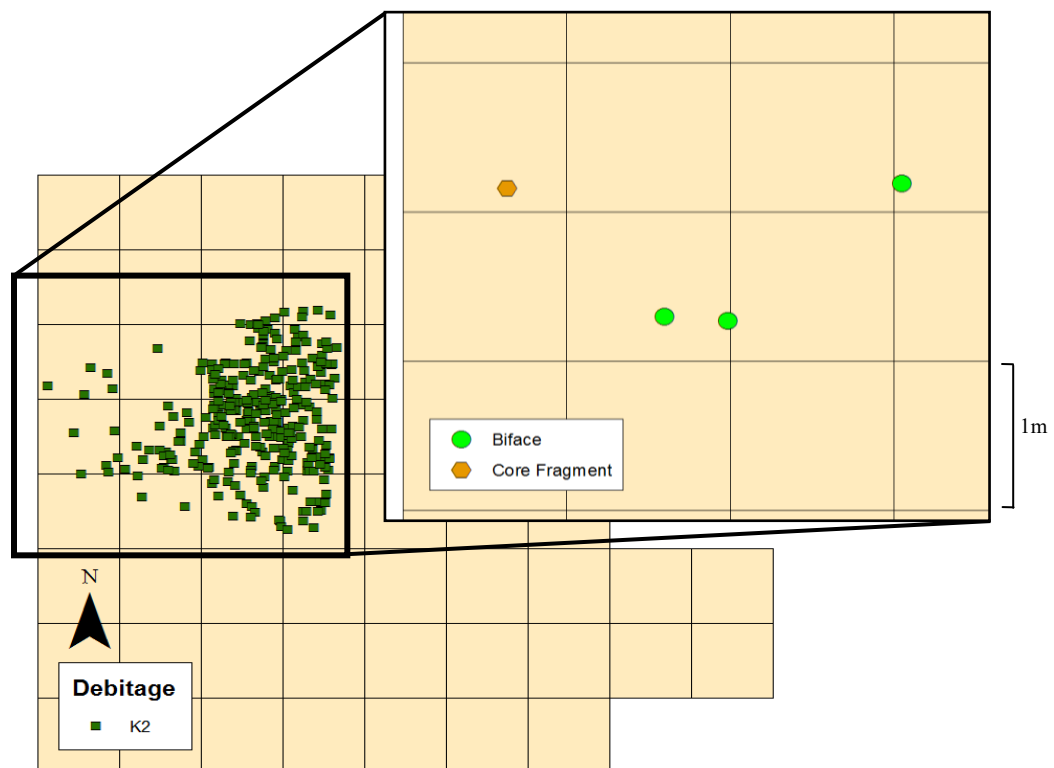


Figure 7.2.15A: Location of Cluster B within the North study area. Inset: Tool distribution within Cluster B.

Primary debitage, along with large (25-50+mm) debitage appeared to be concentrated in unit 538N/516E (Figure 7.2.15 B). There was a noticeable lack of microdebitage in North B. Additionally, the debitage concentration within this area included a variety of material types such as chert, Hixton Silicified Sandstone, quartz, amethyst, siltstone, and mudstone, though the frequency count for these items was low compared to taconite. These items were found along the eastern border of the cluster.

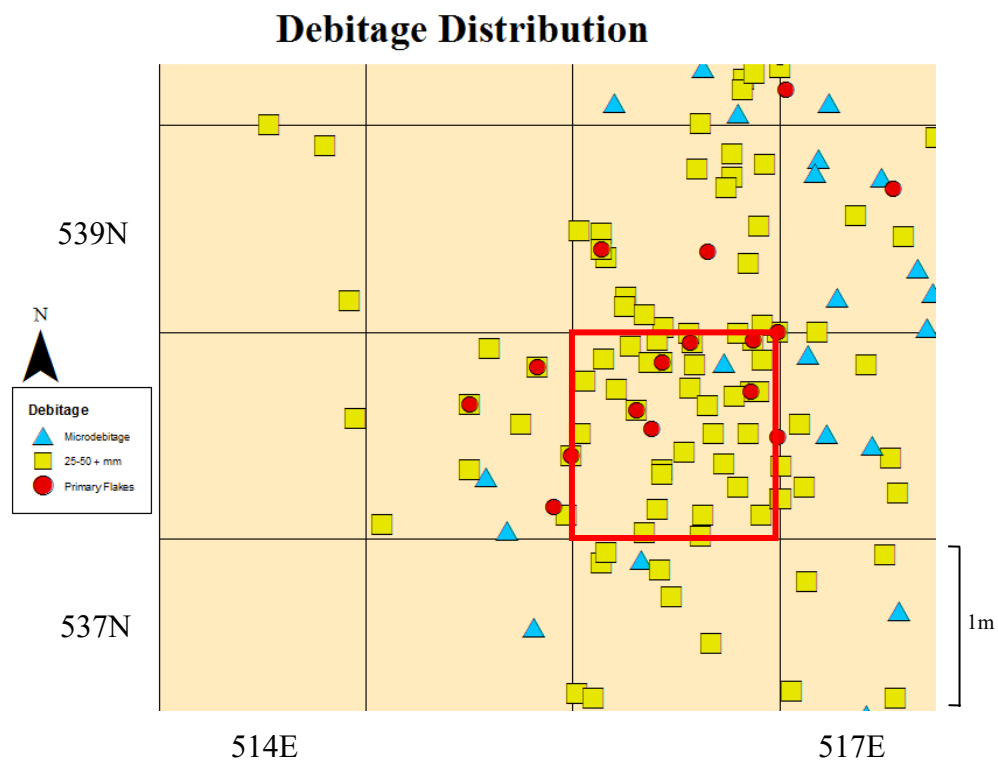


Figure 7.2.15B: This map demonstrates the location of specific debitage categories in North B. Note the low artifact count for microdebitage. Note: Red square highlights a unit discussed in more detail in section 8.2.1 in Chapter 8.

Though gravel was encountered around Level 3 in this area, it was not noted until deeper depths within the high density units surrounding 538N/516E. Artifacts within this cluster were generally associated with silty brown sand, in some cases to a depth of 50-60cm dbs. Unit 538N/516E contained a group of rocks within the NEQ from Levels 3 to

5, with charcoal from Levels 7 to 9, and most flakes concentrated within the northern quads (Figure 7.2.15 C). One unit to the west, FCR fragments and additional stones were recovered from Levels 5 and 6.

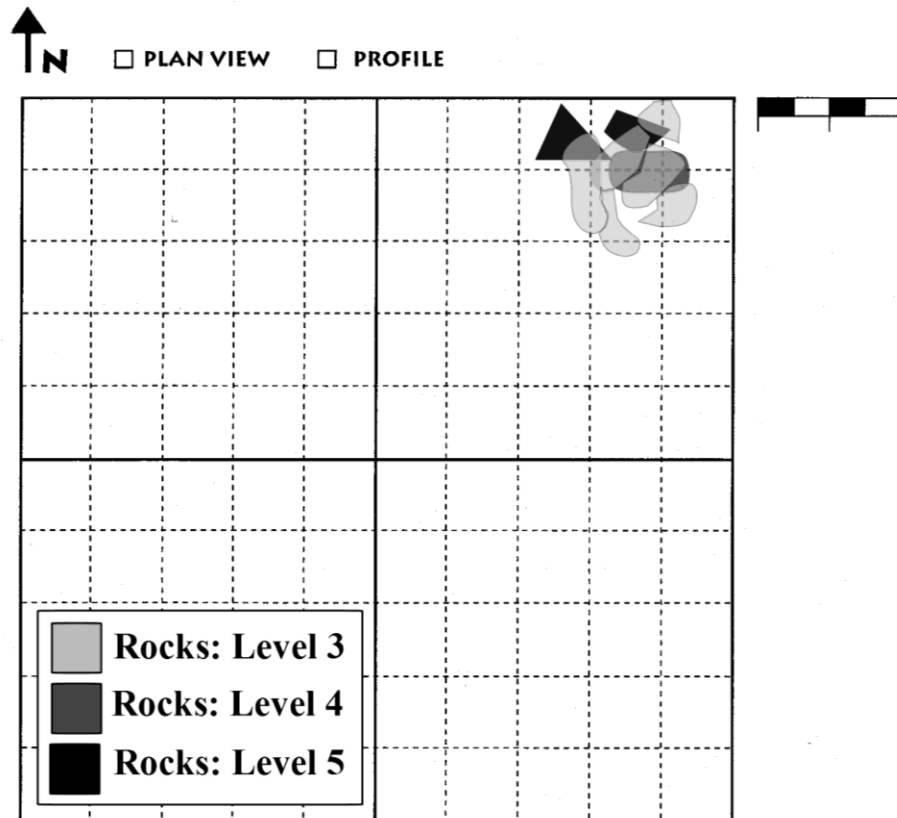


Figure 7.2.15C: Floor plan from unit 538N/516E depicting a rock cluster from Levels 3 to 5.

North C

The central-east cluster of North C is comprised of one projectile point (classified as constricting deep), four bifaces (three at Stage 3, and one Stage 5), four retouched flakes, and two complete cores (Figure 7.2.16 A). The majority of the tools were located within the discrete concentration in unit 538N/518E. Three bifaces were found just to the south of this cluster. One retouched flake was manufactured out of siltstone and one core

did not report the raw material in its catalogued entry; all other tools in North C were manufactured from taconite.

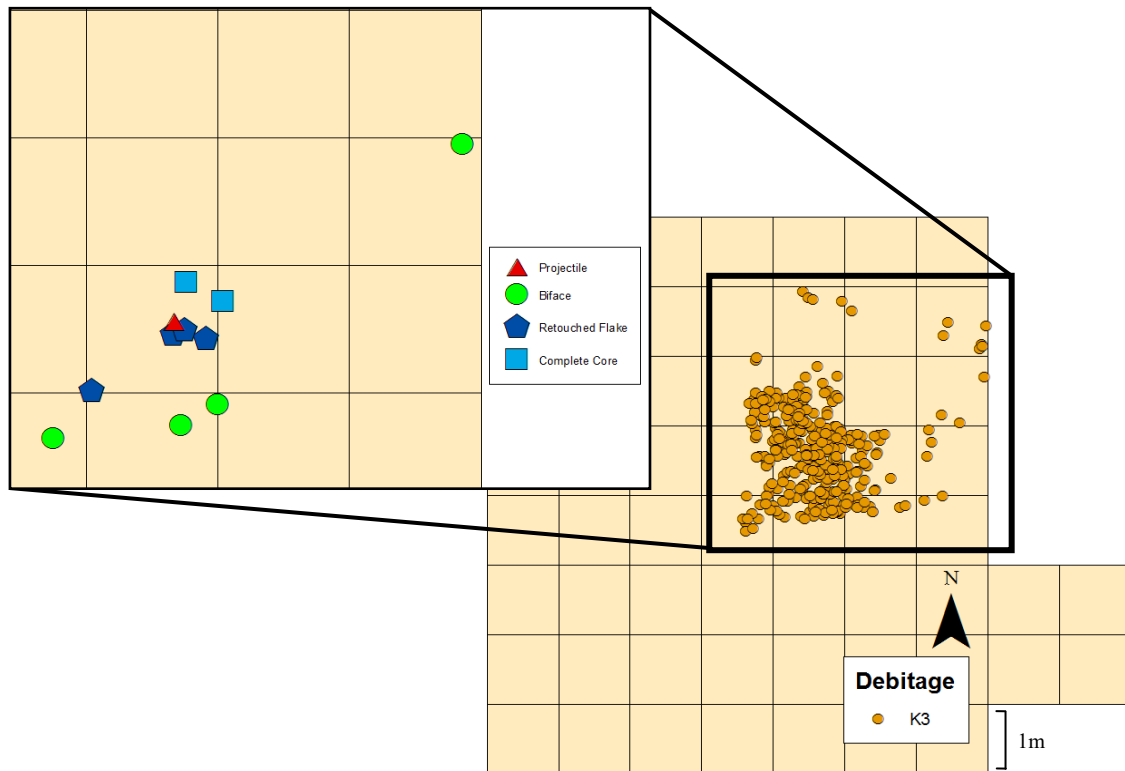


Figure 7.2.16A: Location of Cluster C within the North study area. Inset: Tool distribution within Cluster C.

Large debitage (25-50+mm) was clustered within and just south of 538N/518E, whereas the microdebitage was tightly clustered within this dense unit and slightly north (Figure 7.2.16 B). Though there were only a few primary flakes, they were found in close proximity to the cores. Three stumps surrounded this flake cluster, which likely affected the post-depositional movement of the artifacts.

Debitage Distribution

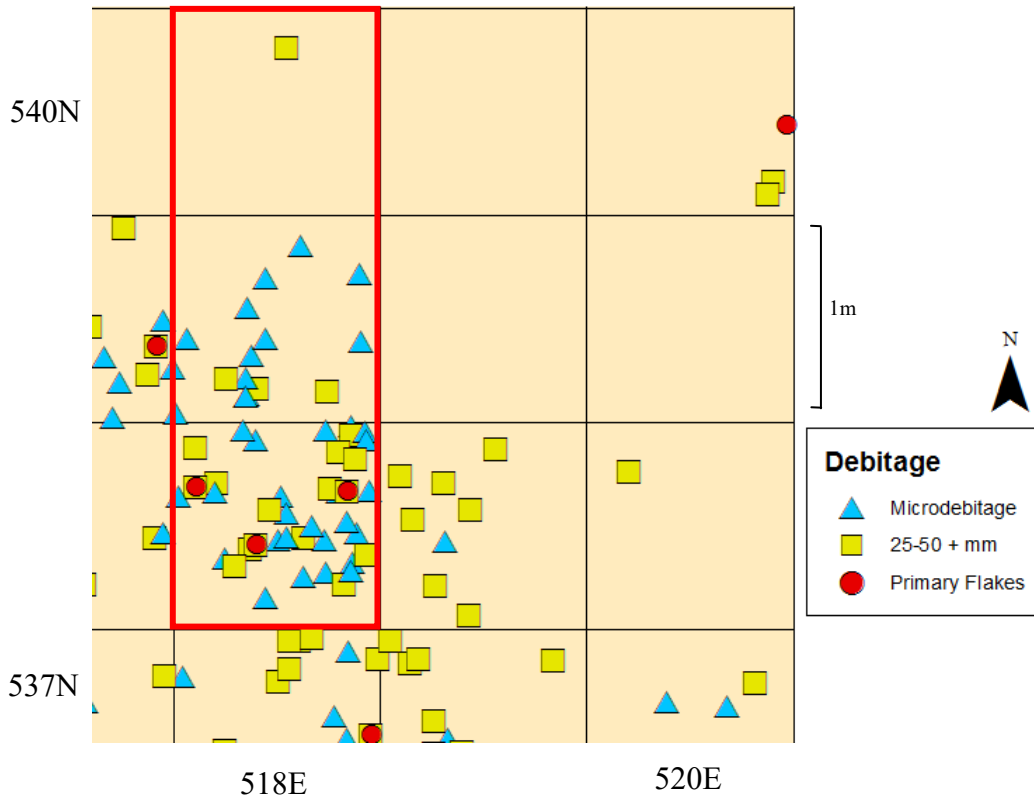


Figure 7.2.16B: Debitage distribution in North C focuses around one unit, though microdebitage scatters further north, and larger debitage to the south of this unit. Note: Red square highlights area discussed in more detail in section 8.2.1 in Chapter 8.

A number of large rocks with associated flake clusters and ochre were noted along the 518E line from 538N to 540N (Figure 7.2.16 C). Large rocks were excavated from the northern quads of 538N/518E and southern quads of 539N/518E between Levels 2 and 6, in association with dense flake clusters (one stone's depth extended from 21cm to 39cm dbs). Artifacts were found within a red sand matrix with some gravel. A stone slab with red ochre was recovered from Level 9 of 539N/518E, in association with a cluster of ochre. One metre north, a potential hearth feature was noted for the eastern quads of Levels 8 to 10, with a distinct lack of debitage throughout the unit (Figure 7.2.16 D). A charcoal sample was taken (though this has not been dated).

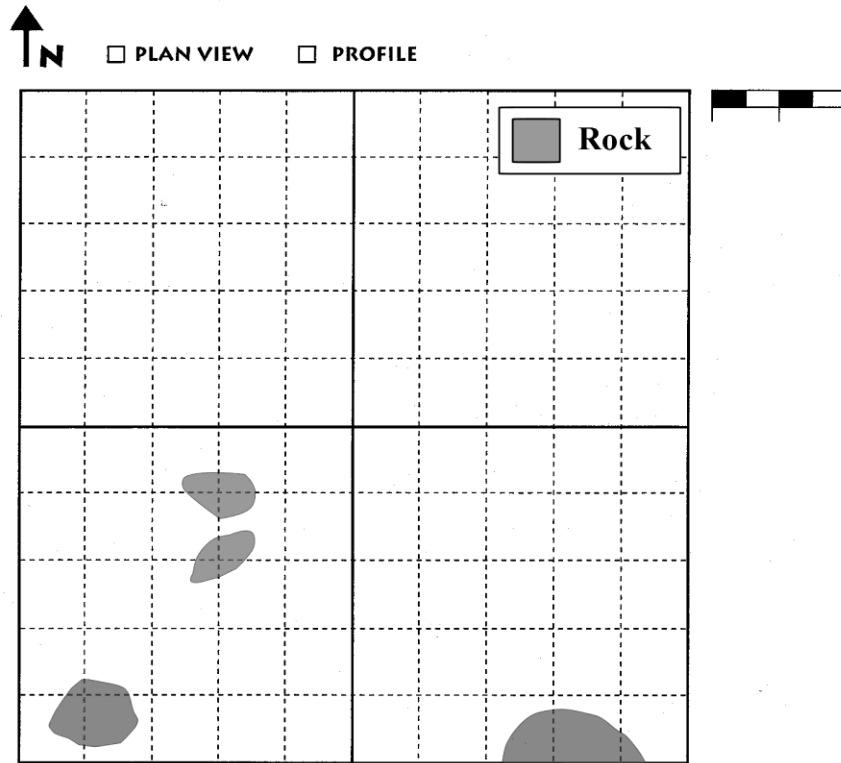


Figure 7.2.16C: Location of rocks noted for unit 539N/518E, Levels 5 to 9. Note: the slab-shaped item in the SEQ was visible from Levels 6 to 9. A flake concentration was noted in the SWQ.

North D

Tools in this southwestern cluster were relatively dispersed and include two core fragments, one complete core, one Stage 4 biface, one retouched flake, and one undetermined tool (Figure 7.2.17 A). The core fragments were found in close horizontal and vertical proximity to the primary debitage. In addition, a potential FCR cluster (n=13) was recovered from the third level of unit 534N/514E.

Debitage recoveries focus on units around the core fragments, with large (25-50+mm) debitage dispersed throughout. The only microdebitage from this area was a limited cluster within unit 535N/516E (Figure 7.2.17 B). Debitage distribution was likely

affected by the presence of three Stage 2 Assessment test pits, including: the SWQ of 535N/515E, the SEQ of 536N/514E, and the NWQ of 536N/515E.

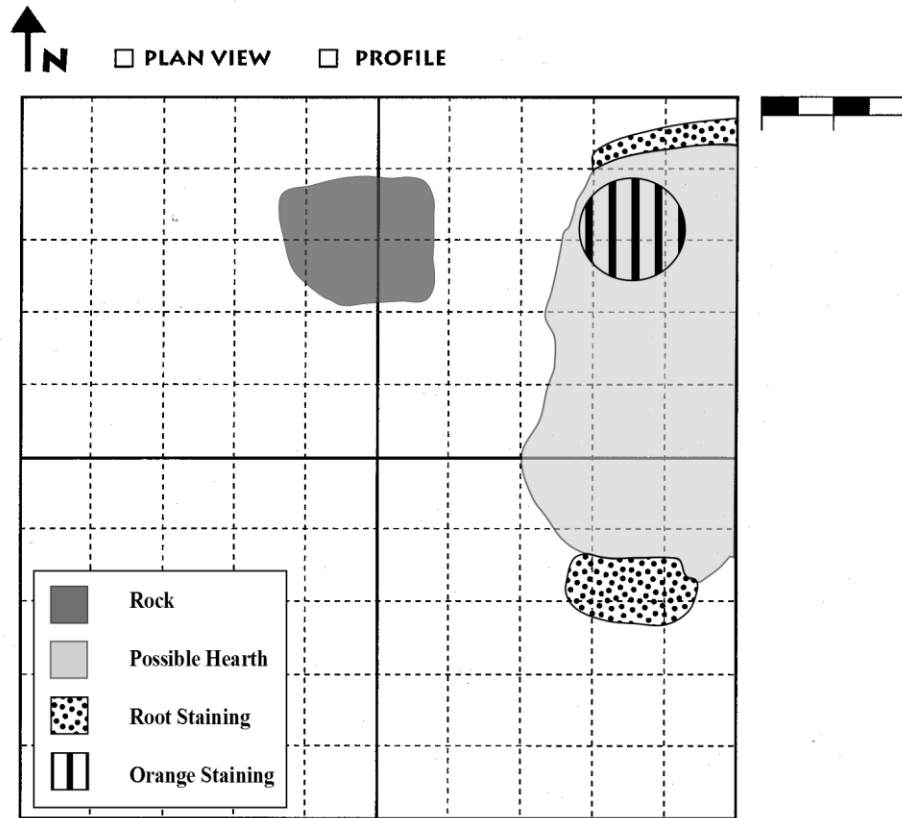


Figure 7.2.16D: Potential hearth from unit 540N/518E. Floor plan shown is from Level 9. Feature was visible until Level 10 at 50cm dbs. Note: the location of possible root staining.

Unit 534N/517E, two metres east of the FCR cluster, contained a grey and red soil discoloration in Level 5, however root burn was noted and large roots were found throughout the unit until the end of Level 7, when the unit was completed. Many units within this area noted coarse brown sand, with prominent gravel close to the surface (sometimes in Level 2). No unit was excavated past Levels 5 or 6, with many displaying signs of root burn and red coarse sand throughout.

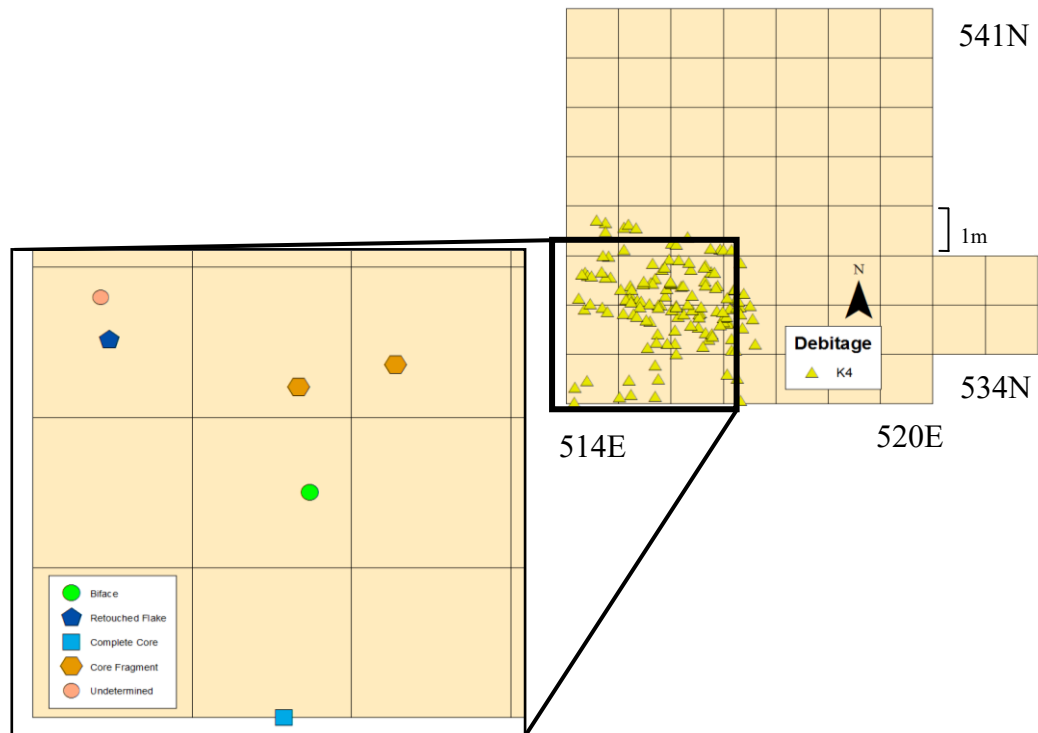


Figure 7.2.17A: Location of Cluster D within the North study area. Inset: Tool distribution within Cluster D.

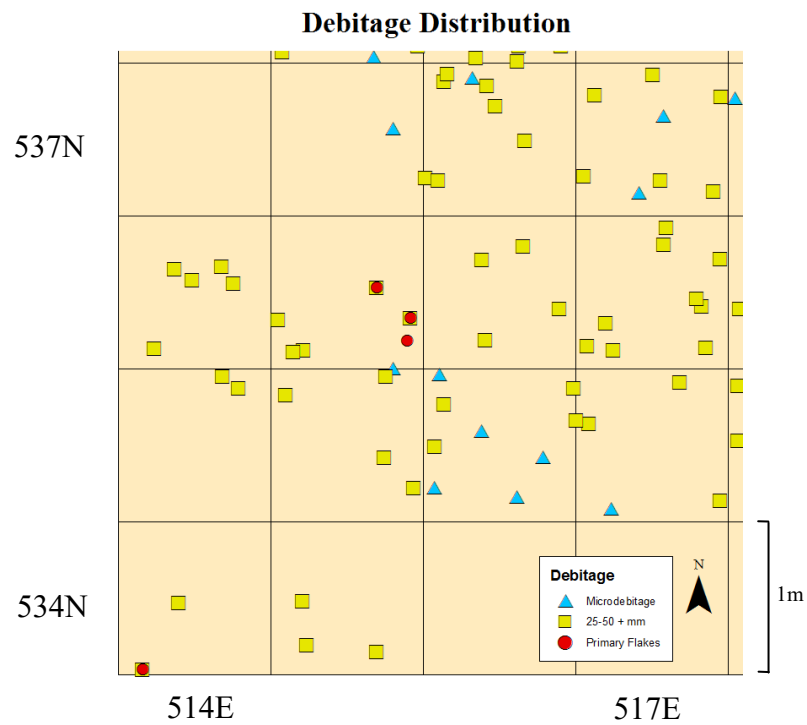


Figure 7.2.17B: Distribution of debitage by type, for Cluster D.

North E

This southeast cluster had a high artifact density in the northern half, specifically around the 518E line at 536N and 537N, along with an additional tool cluster to the east in unit 537N/520E. A total of 17 tools were excavated including two projectile point bases (classified as constricting deep, and parallel deep), nine bifaces, four core fragments, and two drills (Figure 7.2.18 A). Bifaces include four unidentified fragments (UID), two at Stage 2, one Stage 6, and two at Stage 3 (including the item that refits to a fragment from North B).

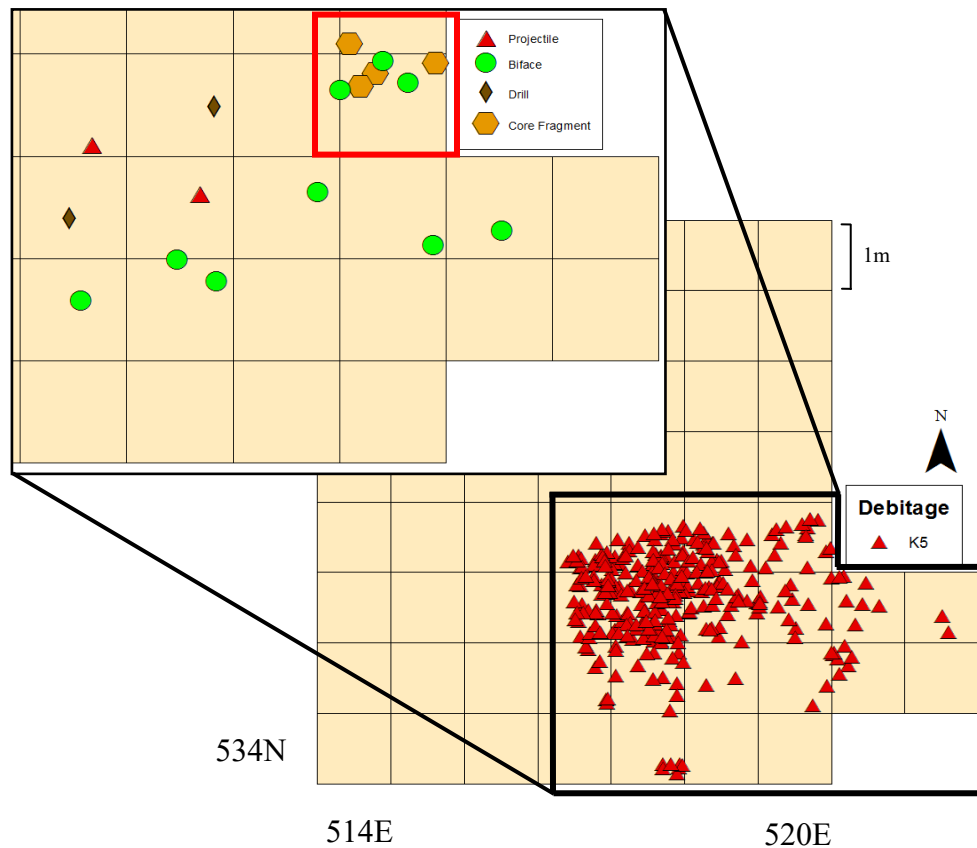


Figure 7.2.18A: Location of Cluster E within the North study area. Inset: Tool distribution within Cluster E. Note: Red square highlights an area discussed in more detail in section 8.2.1 in Chapter 8.

There is a significant lack of microdebitage within North E, and the few items that were recovered are constrained to the high density cluster in the northwest. Large debitage, including a few primary flakes, were more numerous and centred around unit 536N/518E (a tree stump was located in the NEQ). To the east and south of this main cluster, debitage recoveries were fairly limited (Figure 7.2.18 B). Gunflint silica and quartz debitage are scattered throughout the north, whereas the chert is found northeast of the siltstone cluster (Figure 7.2.18 C). Siltstone is tightly clustered within unit 536N/518E, with the siltstone drill and associated debitage between 0-10cm dbs (see Figure 7.2.4).

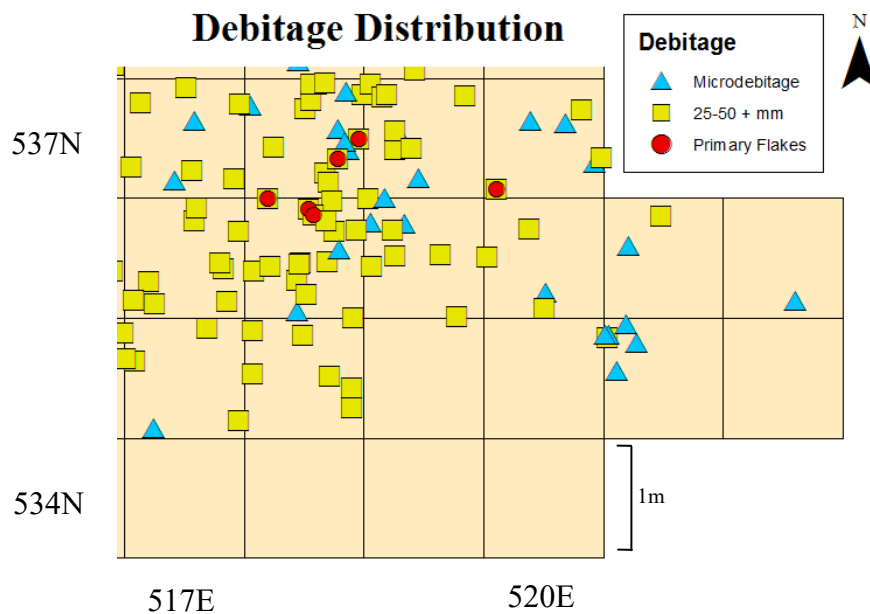


Figure 7.2.18B: Debitage distribution throughout North E. There is a distinct cluster in the northwest, as well as a low microdebitage count.

Debitage Distribution by Raw Material

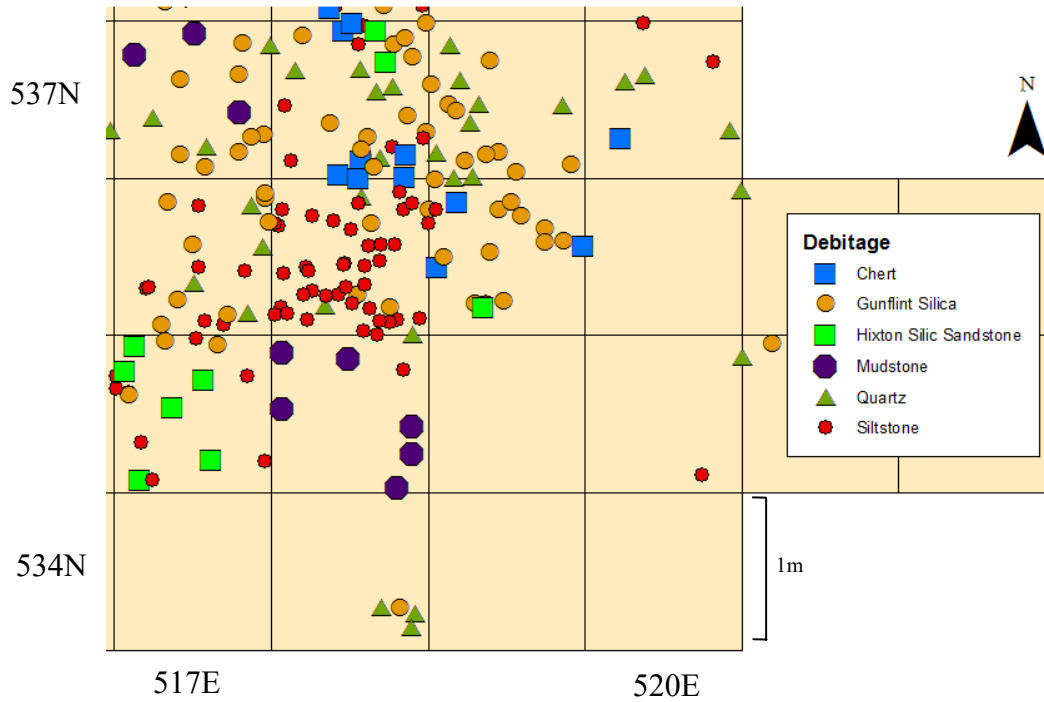


Figure 7.2.18C: Raw material from North E, excluding taconite. Although taconite is generally the predominant material throughout Mackenzie I, this area has a high frequency of other materials. Though there are a number of materials listed, the only non-Gunflint Formation tool in this area was manufactured from siltstone.

7.3 CENTRAL NORTH

7.3.1 Visual Comparison

Horizontal Distribution

Similar to the North study area, the Central North is a fairly flat low grading surface which slopes upwards towards the north between 246.25m and 246.5m asl. Immediately to the east of the study area is the break in slope downwards into the river gorge (Figure 7.3.1). Overall artifact distribution appears divided into four clusters, without linear size patterns suggestive of size sorting. According to the available information, unit 519N/521E was not excavated, while unit 519N/520E was not available in the catalogue at the time of this analysis.

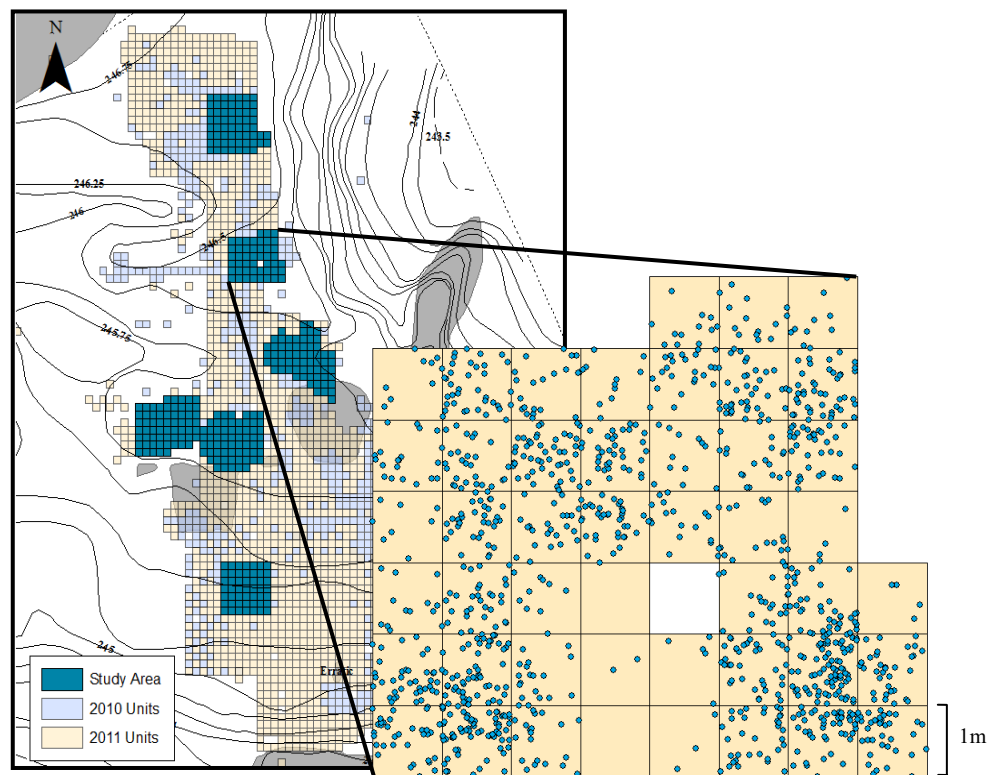


Figure 7.3.1: Central North study area topography within the Mackenzie I site. Inset: Overall artifact distribution pattern within the Central North study area.

Tool Distribution

A total of 35 tools were recovered from this study area, including 14 core fragments, six bifaces, four projectile points, seven retouched flakes (one with a frequency of two), two scrapers, one preform, and one burin (Figure 7.3.2). The Central North contained the fewest bifaces, and second lowest number of recorded projectile points within the six study areas (Figure 7.3.3). Meanwhile, core fragments account for 41% of the study area tool assemblage. Aside from one generic preform (unidentifiable as a tool type), one of the projectile points is also described as a preform.

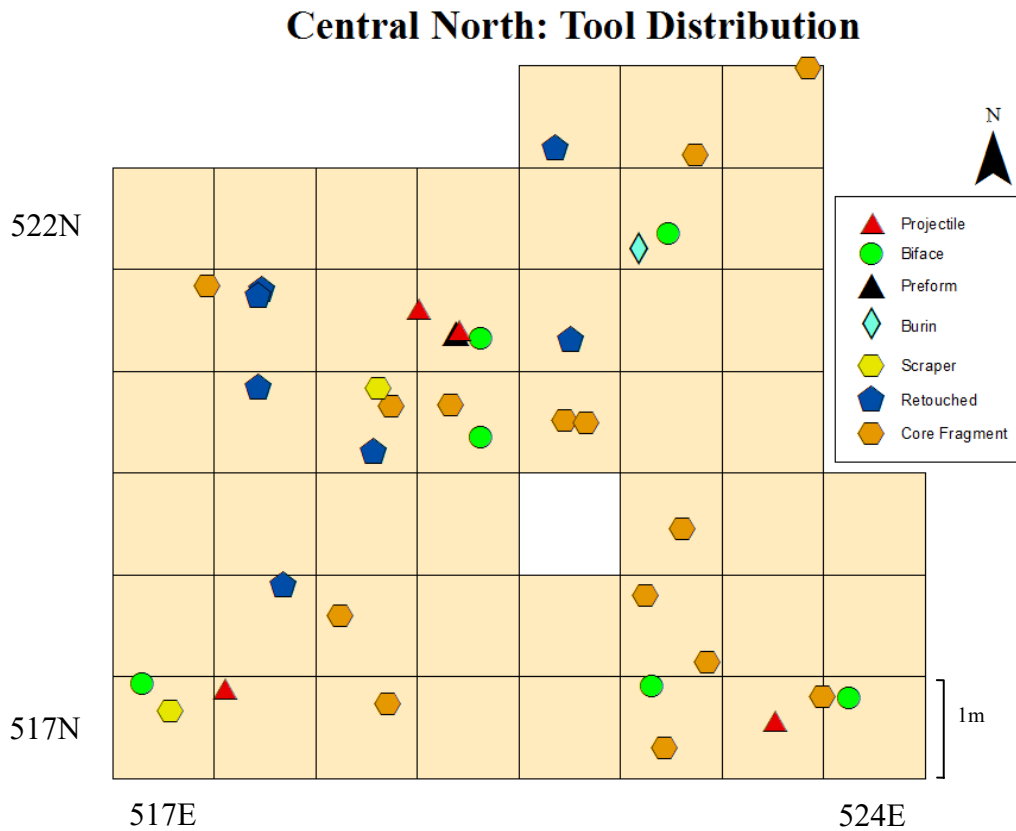


Figure 7.3.2: Lithic tool distribution throughout the Central North study area.

Unfortunately, one tool (the unidentified preform) was catalogued without a raw material description. Aside from one gunflint silica core fragment and one quartz core fragment, the remaining tools were manufactured from taconite.

Biface Stage and Projectile Point Category

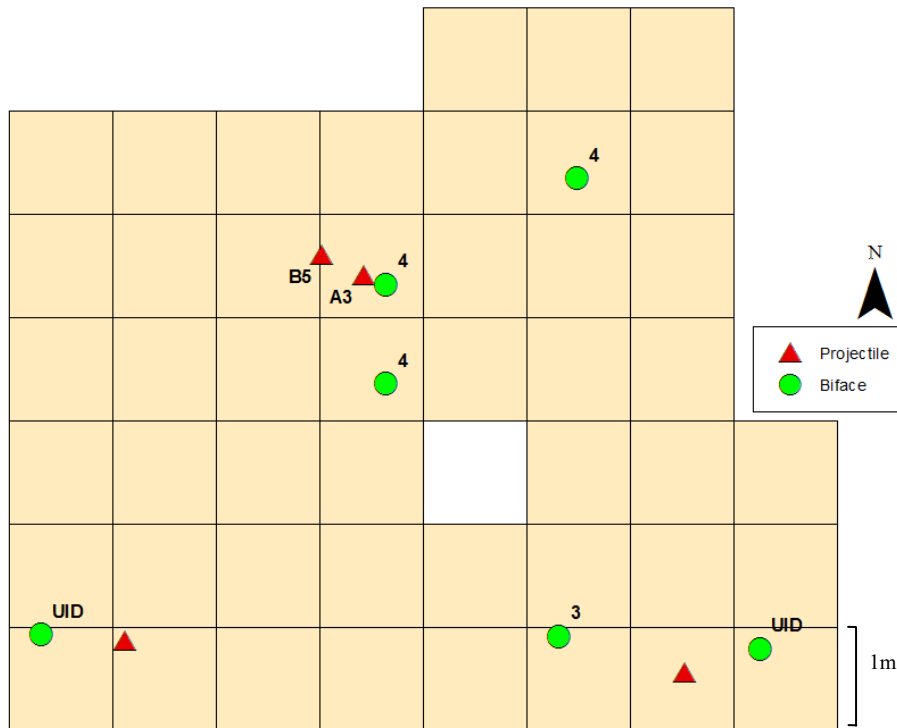


Figure 7.3.3: This map demonstrates the projectile point morphological shapes as defined by Markham (2013), and the biface stage as determined by Bennett (n.d.) for the Central North study area. Note: A3, Constricting Straight; B5, Eared Deep. See Table 4.5.1 for a guide to the projectile point categories.

Debitage Distribution

Debitage, including primary flakes, are clustered into four separate high density areas. Recoveries include a large number of microdebitage items anddebitage sized 25-50+mm (Figure 7.3.4). Raw material of non-Gunflint Formation derivation consists of quartz recovered from the north end of the study area, while amethyst and rhyolite specimens were recovered from the southwest cluster. Gunflint silica was found throughout the study area, although it was more dense in the southeast (Figure 7.3.5).

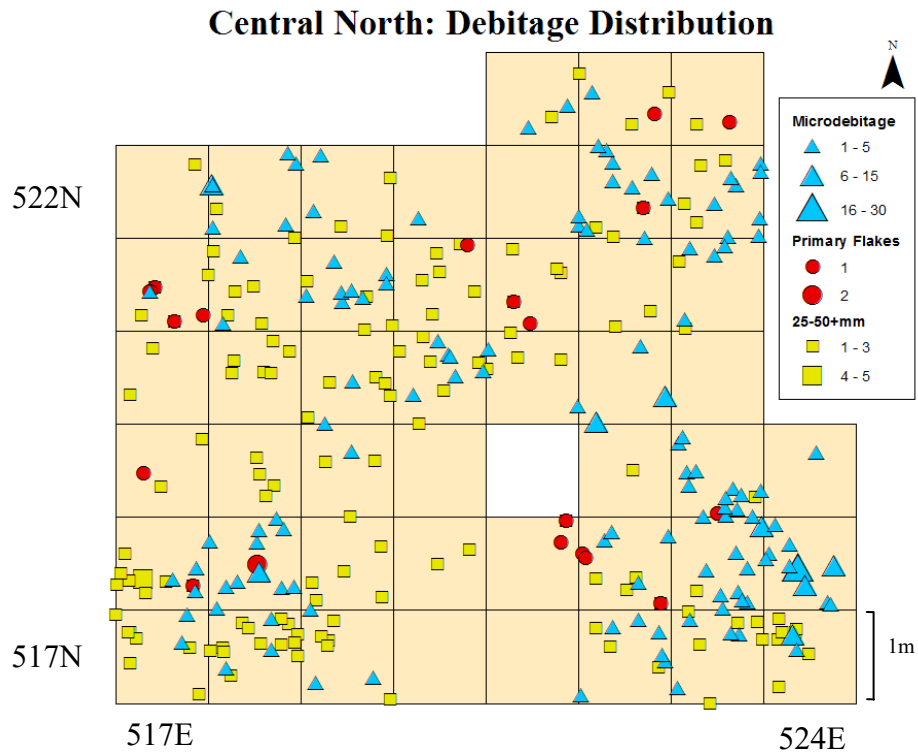


Figure 7.3.4: Debitage distribution by type for the Central North study area. Note: This map excludes secondary debitage (6-25mm) due to its intense frequency.

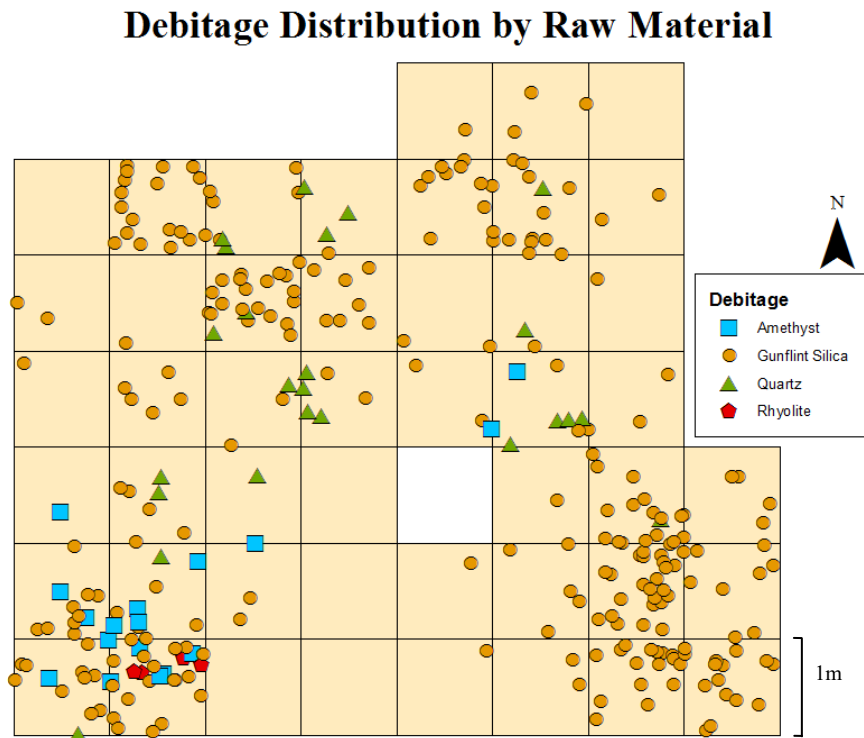


Figure 7.3.5: Distribution of some of the non-taconite artifacts within the Central North study area.

Vertical Distribution

Overall, the majority of artifacts were recovered from Level 3 (10-15cm below surface; Figure 7.3.6). Vertical distribution by flake size demonstrates that microdebitage (0-6mm) and large debitage (25-50+mm) occur in highest frequencies around Level 2-3 and 3-4, respectively.

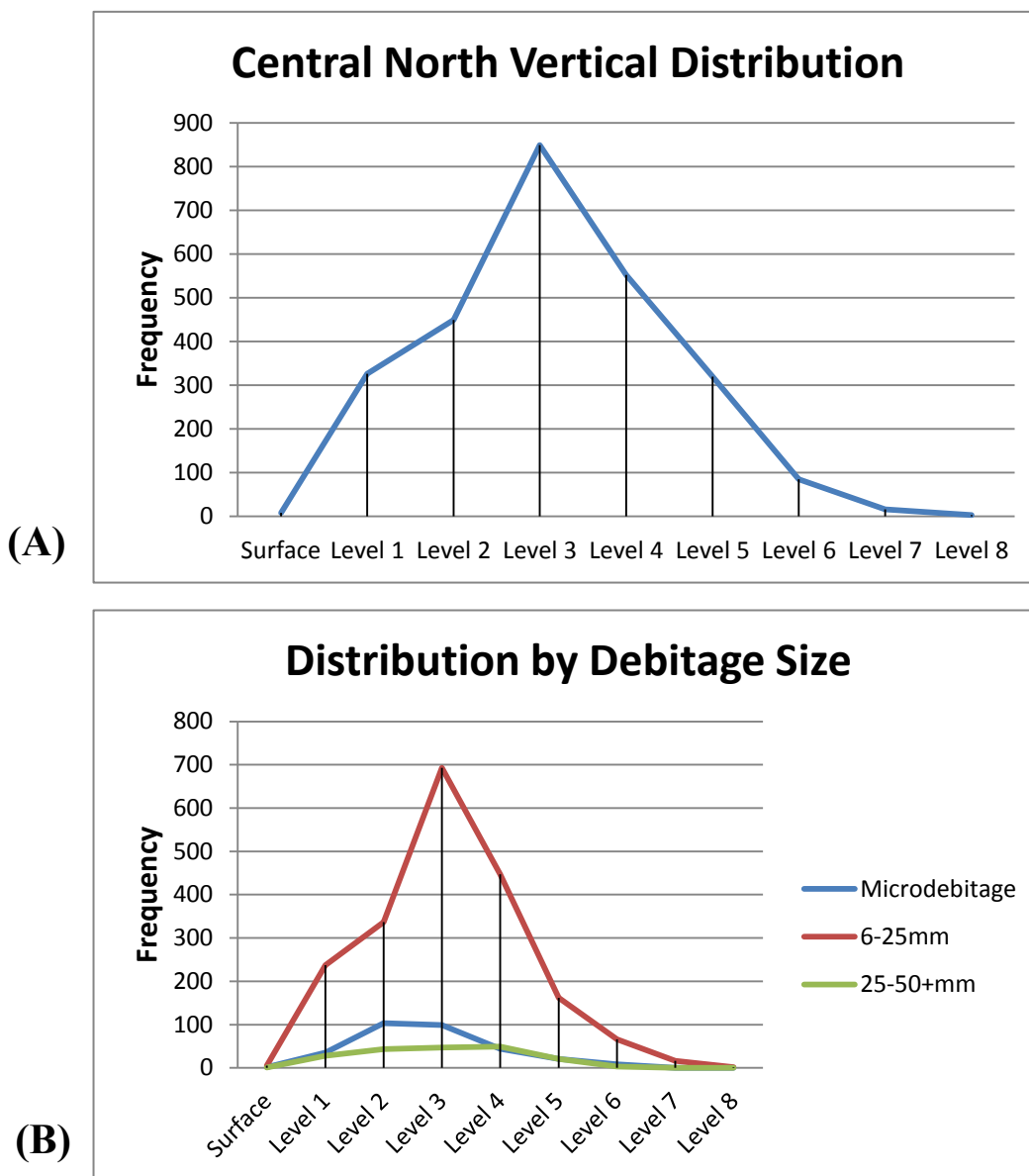


Figure 7.3.6: A) Vertical distribution of the Central North artifacts. Note the peak at Level 3 (10-15cm db); B) Vertical distribution by debitage size.

7.3.2 Refit Analysis

One refit (n=2) was excavated from the second level of unit 521N/518E. This refit tool was the lateral edge of a taconite retouched flake (Figure 7.3.7).

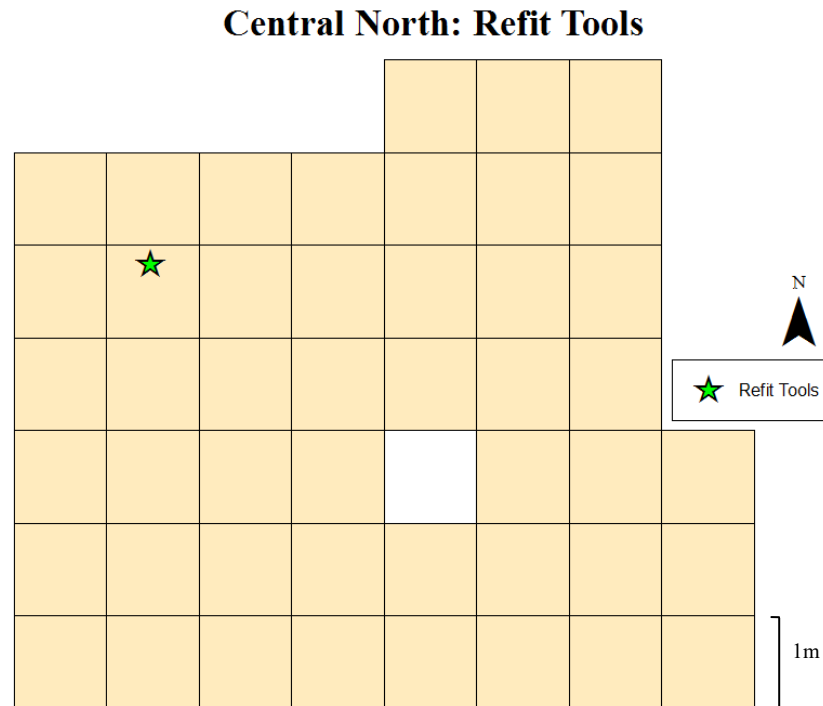


Figure 7.3.7: The one refit within the Central North study area consists of a lateral edge from a taconite retouched flake (Level 2).

7.3.3 Spatial Analytical Results

Kernel Density Estimation (KDE)

The KDE smoothed density contour map demonstrates four distinct clusters, although the unexcavated unit may have affected the output. The highest density focuses on the SE and SW corners around units 518N/523E, and 517N/518E. Many of the tool recoveries are located around the periphery of these high density areas (Figure 7.3.8).

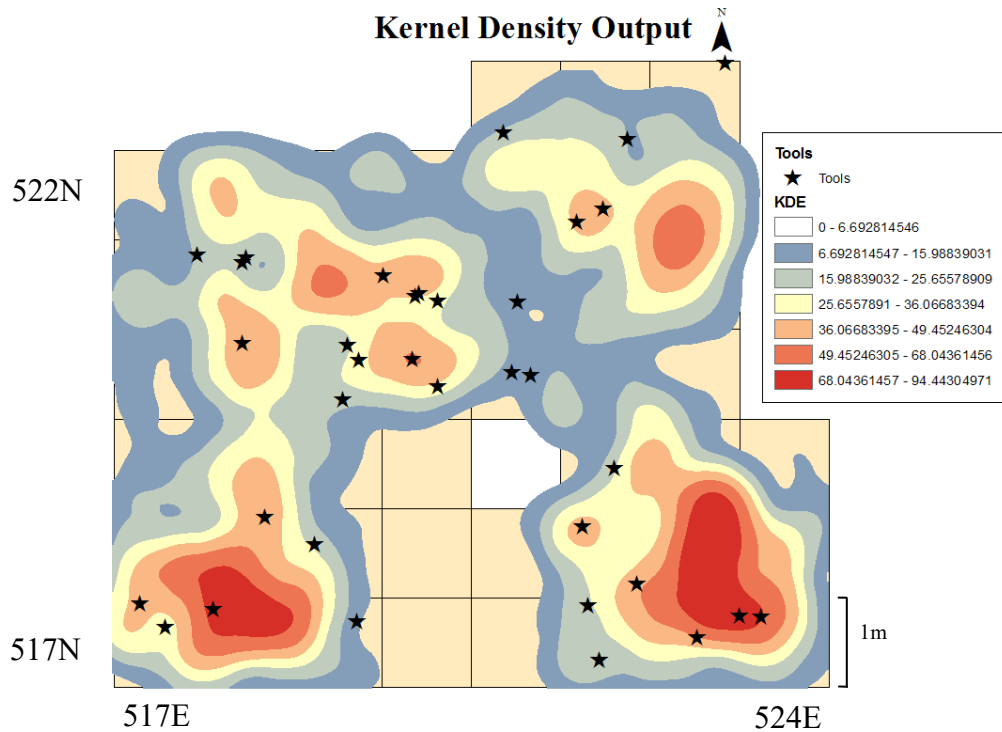


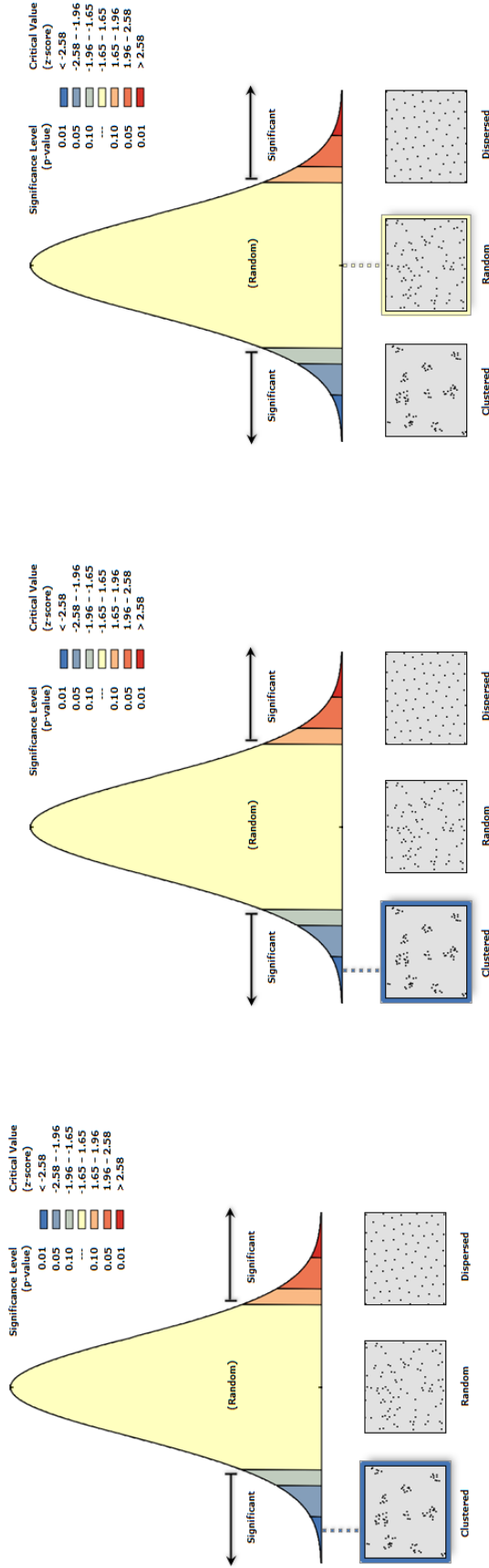
Figure 7.3.8: The smoothed density contour map, which highlights the four corner clusters in the Central North. Tool distribution is within and around the periphery of these locations. Note that both an unexcavated unit, and a unit not in the available catalogue are located in the centre of the study area; thus, the incomplete information impacts the KDE output.

Nearest Neighbour

The Nearest Neighbour function in ArcGIS was completed three times: for all artifacts (debitage and tools), all debitage (including shatter), and the lithic tools. All artifacts and all debitage demonstrate clustering, whereas the tools are considered random (Figure 7.3.9).

Ripley's K Function

Ripley's K analysis was completed for all artifacts, all debitage, and tools. Each output demonstrates clustering, though the tool output suggests that tools are only clustered to a certain extent, and are not clustered if looking at the study area as a whole (Figure 7.3.10).



Given the z-score of -10.87, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -10.76, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -1.47, the pattern does not appear to be significantly different than random.

Figure 7.3.9: The Nearest Neighbour outputs for all artifacts, all debitage, and the tools, respectively. The analysis for this Central North study area suggests that debitage is clustered, and tools appear random.

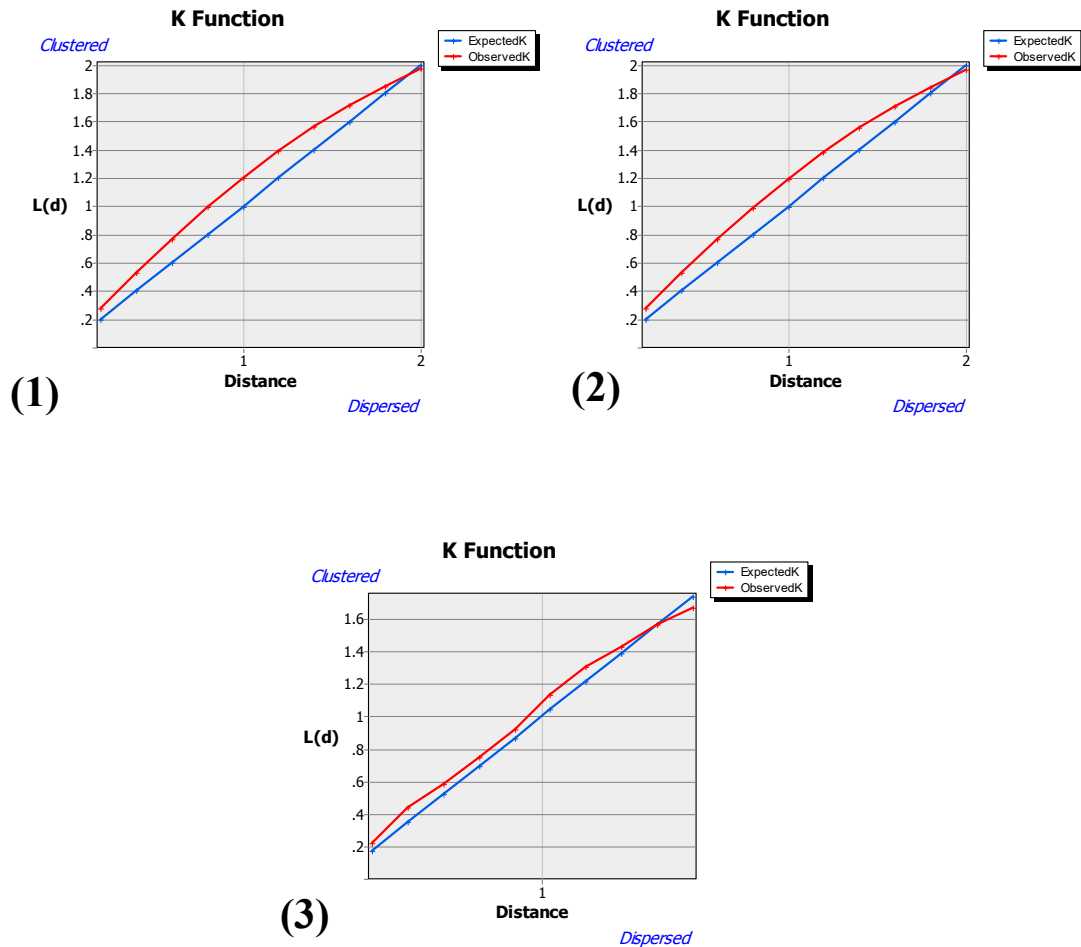


Figure 7.3.10: These three outputs from the Ripley’s K analysis demonstrate clustering for Central North study area artifacts (1), and debitage (2), whereas tools are clustered until the analysis distance increases (and goes under the ‘expected’ line (3)).

K-means (Pure Locational Clustering)

K2 to K10 was tested for all debitage, and all tools. The $\% \log_{10}$ SSE graphs suggested that K4, or four clusters, was the optimal solution for the Central North study area (Figure 7.3.11). Though other ‘K’ solutions are also implied by the K-means Tools graph, K4 for tools more closely matches K4 for debitage. This output was also compared with the KDE contour map (Figure 7.3.12). These four clusters are used for further analysis and are referred to as Central North A to Central North D.

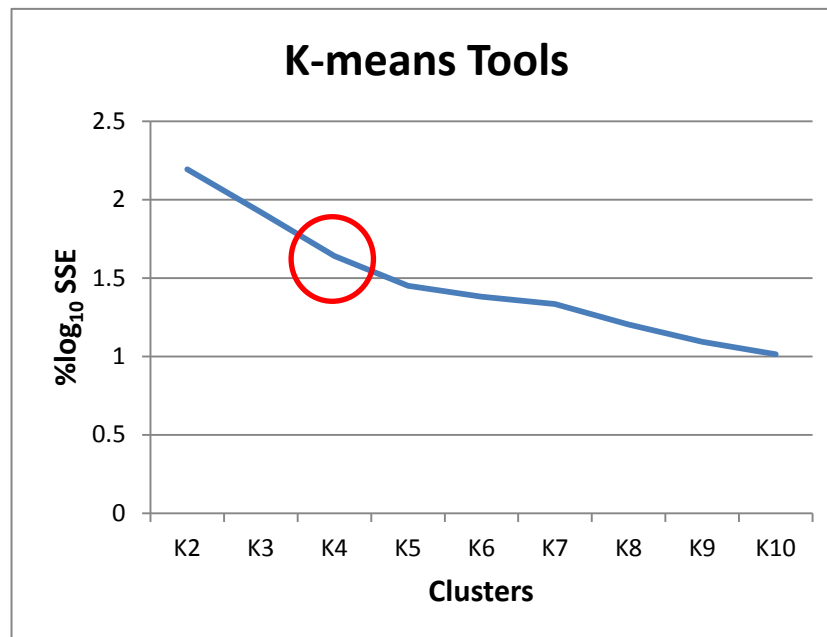
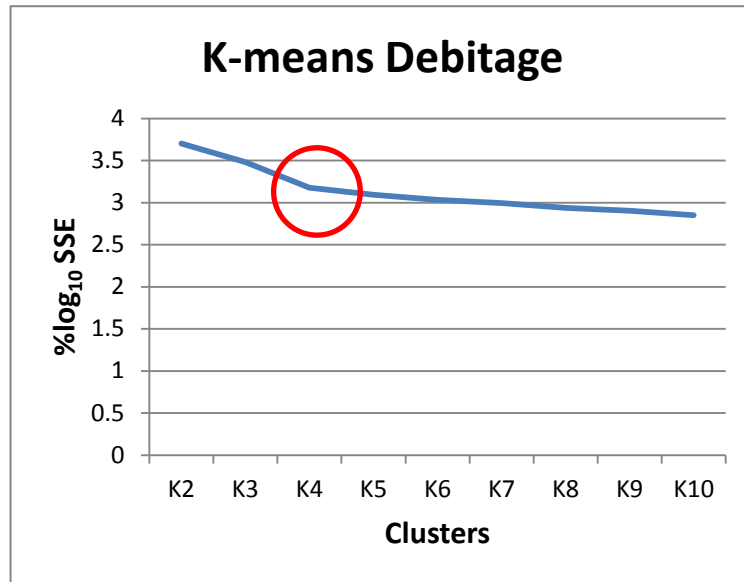
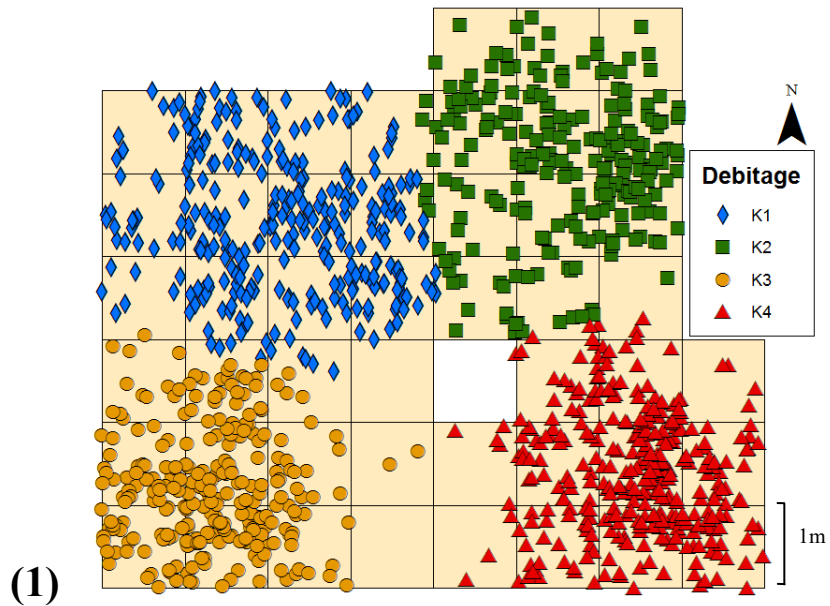


Figure 7.3.11: These graphs represent the %log₁₀ SSE outputs from the SPSS program. A bend, or “elbow” suggests an optimal cluster solution for the Central North study area. Here, K4 solutions for both debitage and tools were compared in ArcGIS and closely matched. Thus, four clusters were used for further exploratory analysis.

K-means: 4 Cluster Solution



K-means with KDE Output

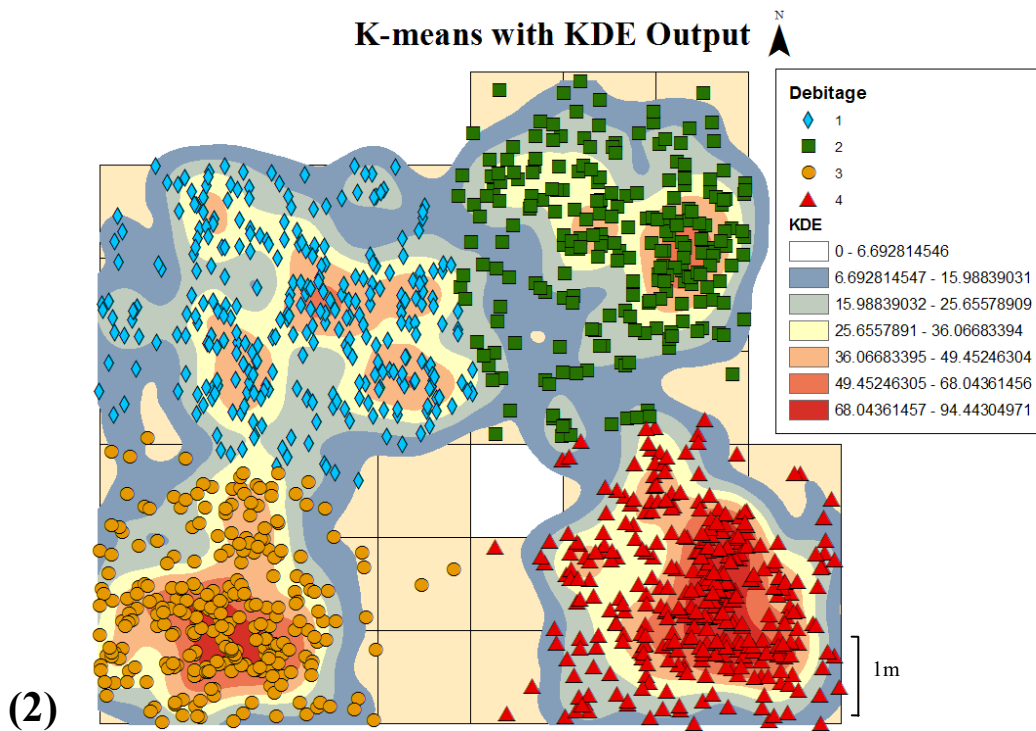


Figure 7.3.12: 1) This map demonstrates the four cluster solution for debitage recoveries, as determined through the $\% \log_{10}$ SSE tests; 2) This map displays the same four cluster solution superimposed on the KDE smoothed contour map, highlighting the clusters in relation to high density locations. Note: clusters K1 – K4 as shown here coincide with Central North Clusters A – D in section 7.3.4.

7.3.4 Cluster Composition

This section outlines the composition of the four clusters (Central North A to Central North D) determined in part, through the exploratory use of the K-means and SSE tests. These tests are used in tandem with KDE and visual comparisons to maximize the interpretation of potential clusters.

Central North A

Central North A is located in the northwest corner of the study area. This cluster includes two projectile points (classified as constricting straight, and eared deep), two bifaces (both Stage 4), four retouched flakes (one has a frequency of two), one scraper, one preform, and three core fragments (Figure 7.3.13 A). With the exception of two tools without a raw material designation, there was one quartz core while the remaining tools were manufactured out of Gunflint Formation taconite.

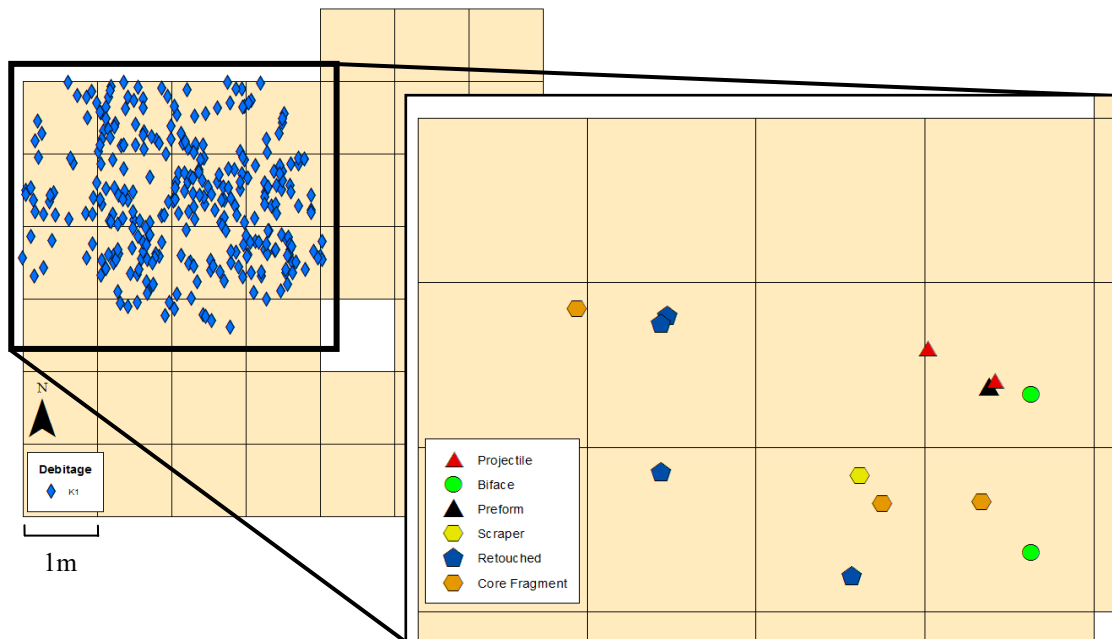


Figure 7.3.13A: Location of Cluster A within the Central North study area. Inset: Tool distribution within Cluster A.

Primary debitage is sparsely distributed in the west of the cluster while microdebitage was recovered west of the bifaces and projectile points. Large debitage (25-50+mm) was the most numerous, and scattered throughout Cluster A (Figure 7.3.13 B). Gunflint silica debitage is abundant, and concentrated to the west and northwest of the projectile points. The only non-Gunflint Formation debitage of note is quartz, somewhat near the quartz core fragment, although the artifact count is limited.

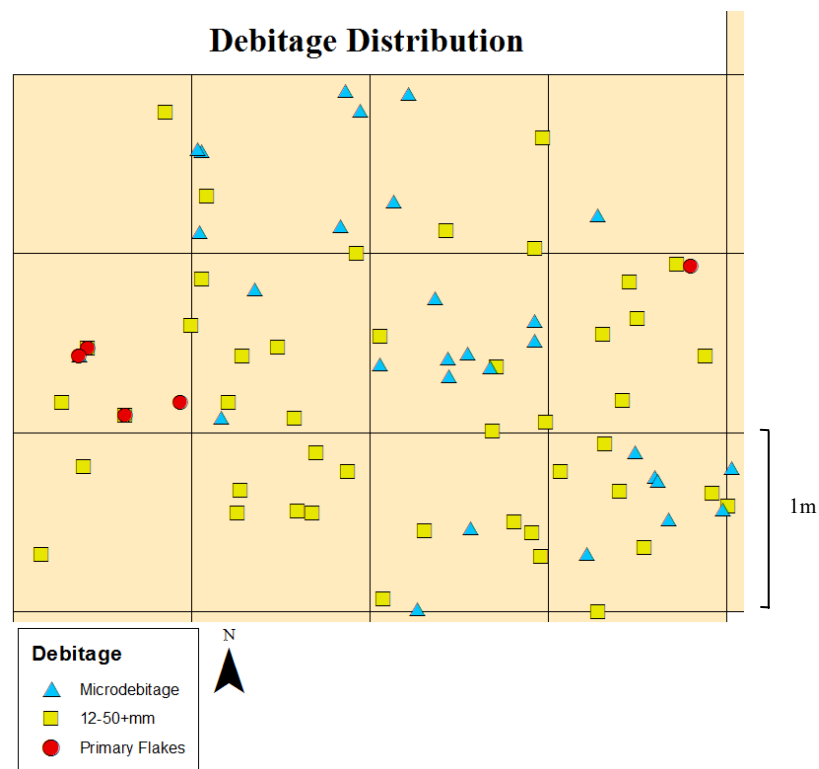


Figure 7.3.13B: Debitage distribution throughout Central North A.

Central North B

Within this northeast cluster, artifacts are focused around four units in close proximity to the FCR and charcoal samples (see below). Tools include four core fragments, two retouched flakes, a biface tip (Stage 4), and a broken burin tip (Figure

7.3.14 A). There is an area of low density between the FCR cluster, and surrounding tools.

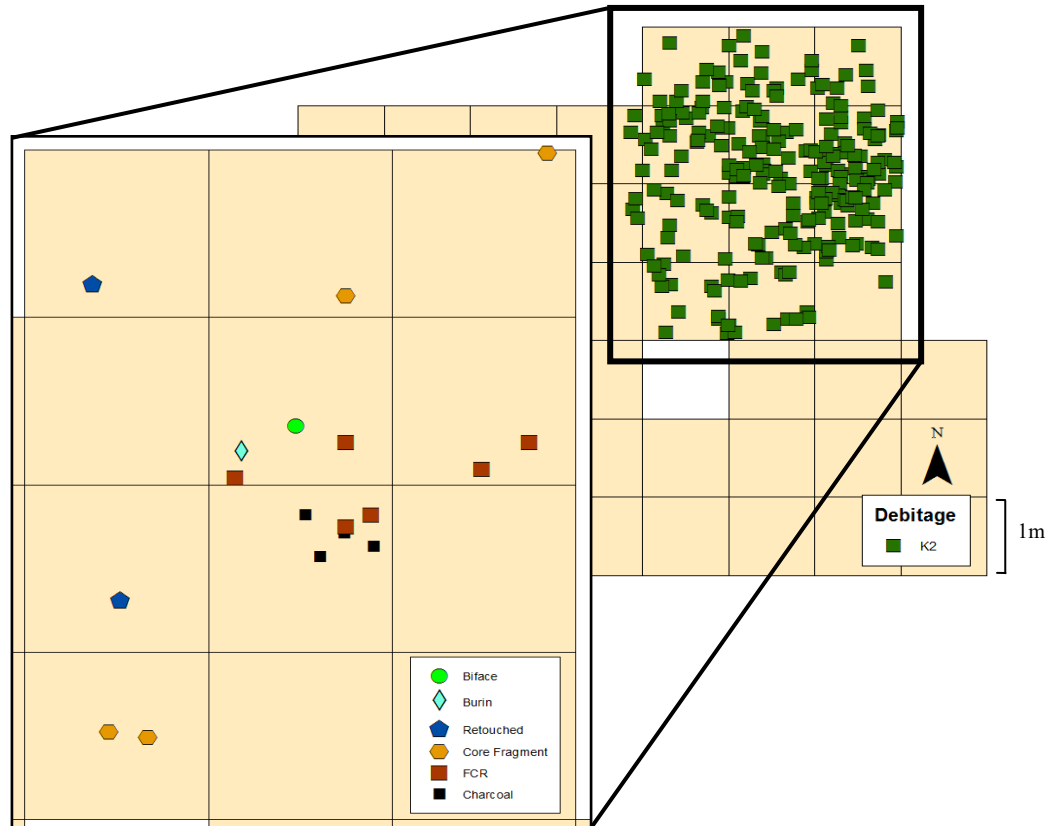


Figure 7.3.14A: Location of Cluster B within the Central North study area. Inset: Tool distribution within Cluster B.

Primary flakes are limited and found north and southwest of the FCR cluster, while the sparse 25-50+mm debitage is found throughout the dense units. Microdebitage on the other hand forms a discrete concentration within units 522N/523E and 522N/522E (Figure 7.3.14 B). Regarding the nature of the raw material recoveries, gunflint silica debitage was concentrated in the north near the gunflint silica core fragment (Figure 7.3.14 C).

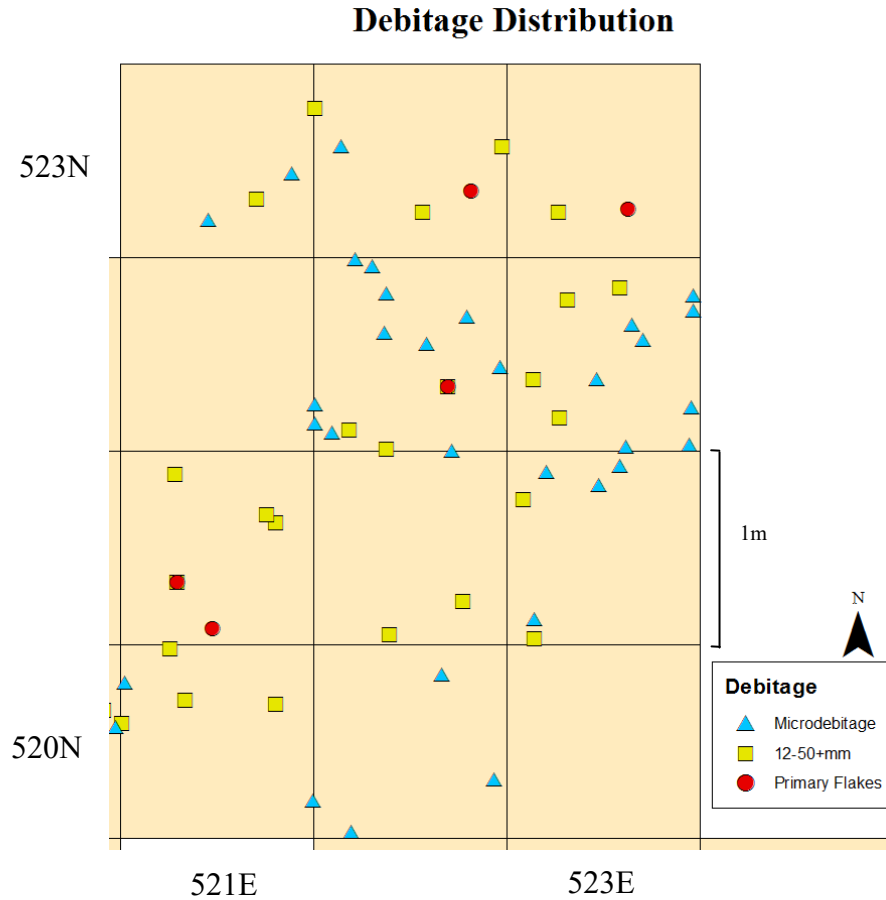


Figure 7.3.14B: Debitage distribution for Central North Cluster B.

In unit 521N/522E, a 12cm x 6cm flat rock was recorded in the NEQ of Level 5 but not kept. A possible hearth and one piece of FCR was recorded in the same quad of Level 6, with charcoal appearing in Level 7. While most of this unit was composed of gravel, the NEQ consisted of reddish brown sand. In unit 522N/522E an extension of the possible hearth feature was recorded in the SE corner of Levels 4 and 5 in association with FCR fragments in Levels 5 and 6 (n=4), and a large rock in Level 7 (Figure 7.3.14 D). To the northeast of this potential feature, some soil discoloration was recorded in the SWQ from Levels 3 to 6, along with FCR at 19cm dbs. The feature consisted of fine-

grained sand, with few roots and little gravel, whereas low artifact frequency was associated with a gravelly matrix.

Distribution of Gunflint Silica Artifacts

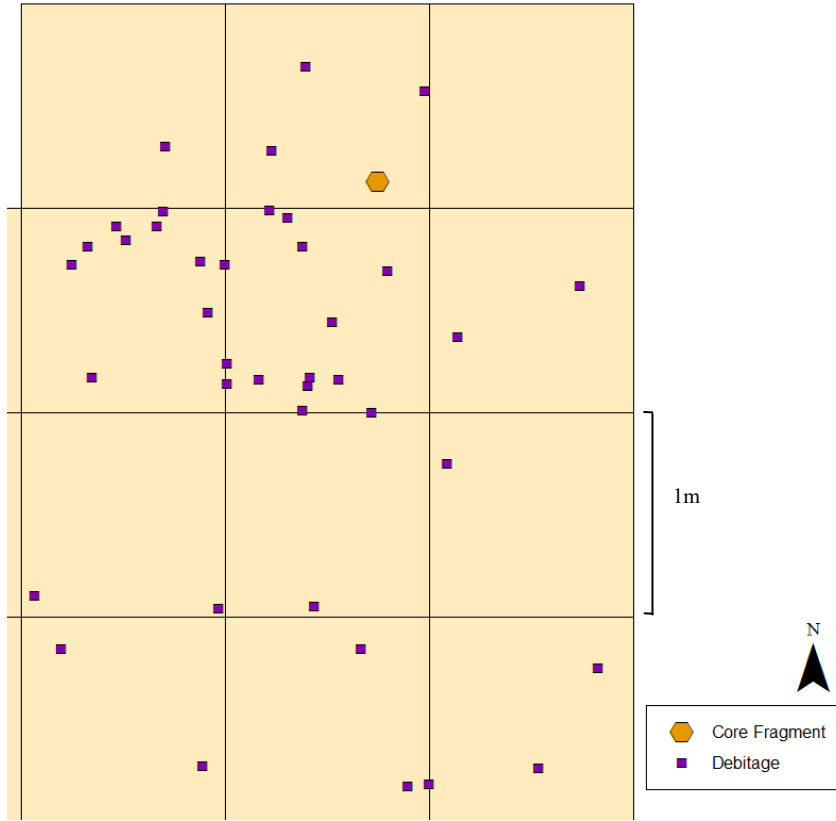


Figure 7.3.14C: Distribution of gunflint silica debitage and core fragment, in Central North Cluster B.

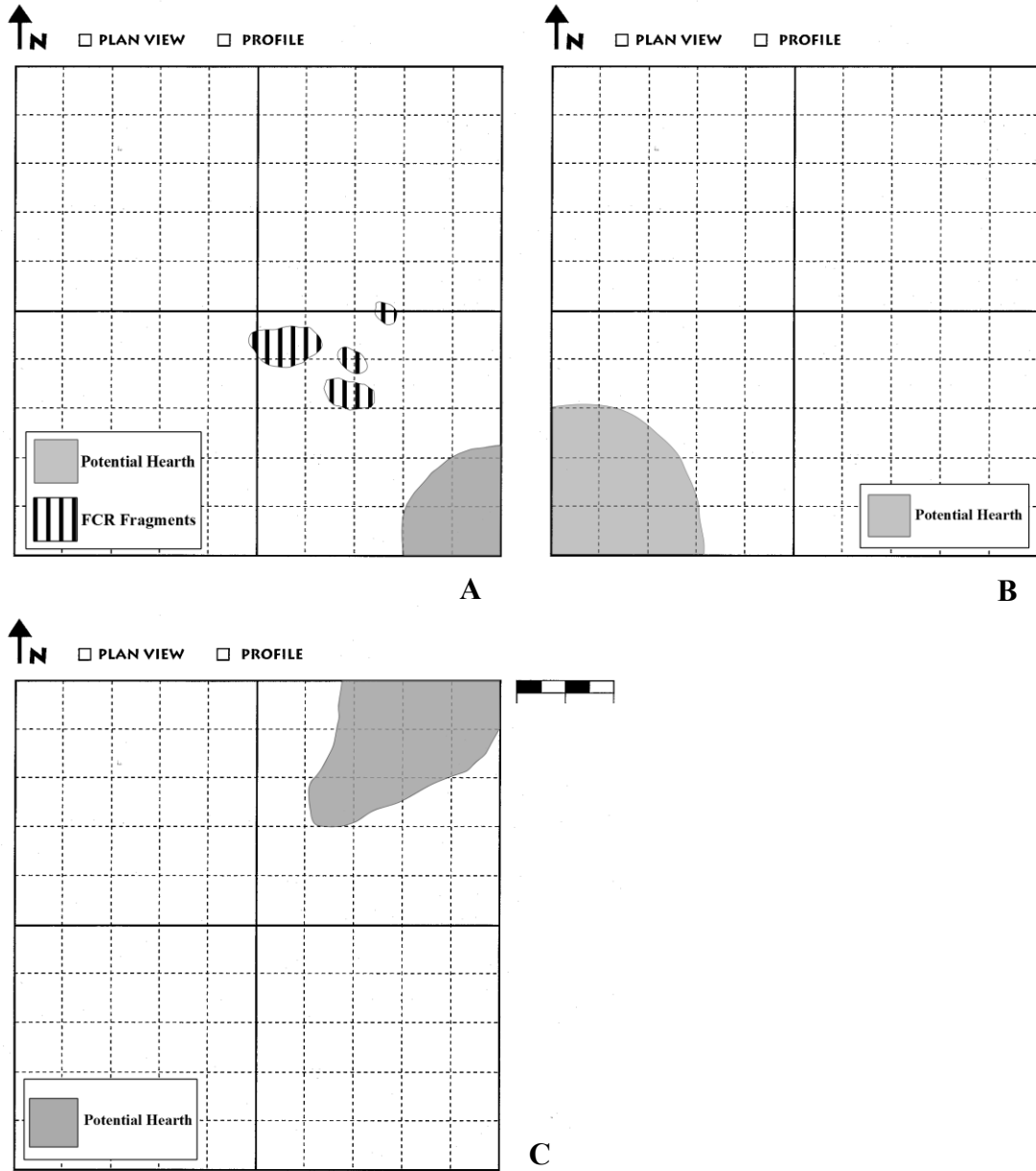


Figure 7.3.14D: Potential hearth distribution as seen from the Level 4 and 5 maps of unit 522N/522E (A); Level 5 of unit 522N/523E (B); and Level 6 from unit 521N/522E (C).

Central North C

This southwest cluster contains one projectile point, one biface (Stage UID), a complete scraper, a retouched flake, and two core fragments (Figure 7.3.15 A).

Microdebitage is clustered around unit 518N/518E, whereas the larger debitage (25-

50+mm) is spread within the northern quads of the 517N line (Figure 7.3.15 B). Artifacts were limited in the east part of Cluster C, where two large FCR fragments were recovered between two units (Figure 7.3.15 C).

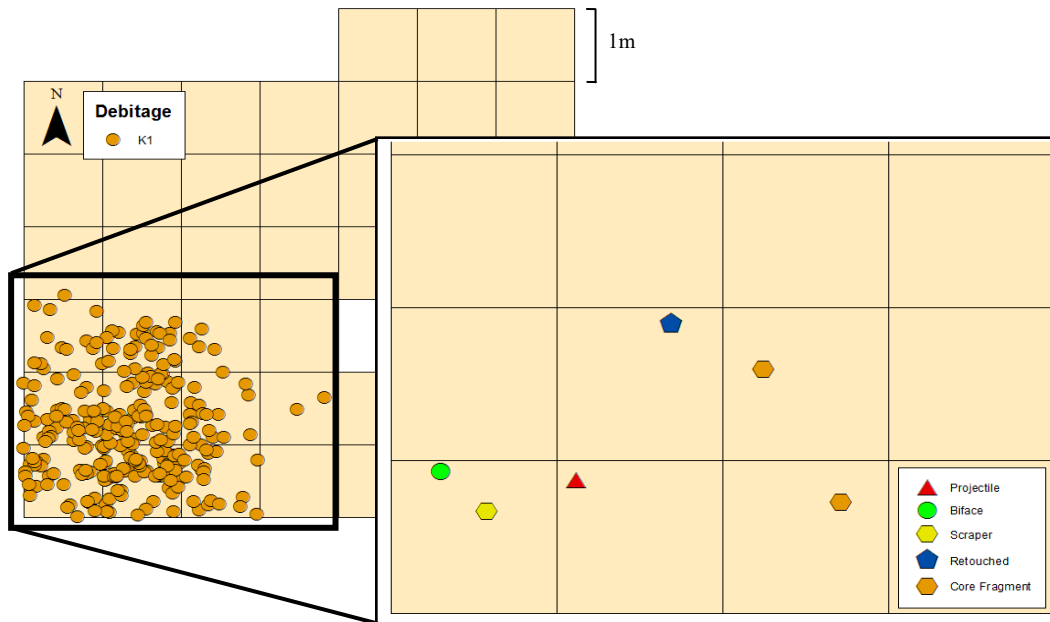


Figure 7.3.15A: Location of Cluster C within the Central North study area. Inset: Tool distribution within Cluster C.

Four rhyolite artifacts were excavated within the northern quads of unit 517N/518E, while the gunflint silica and amethyst debitage was recovered from the four southwestern quads (Figure 7.3.15 D). Many artifacts, however, were likely displaced due to large root systems and two stumps in the southern portion.

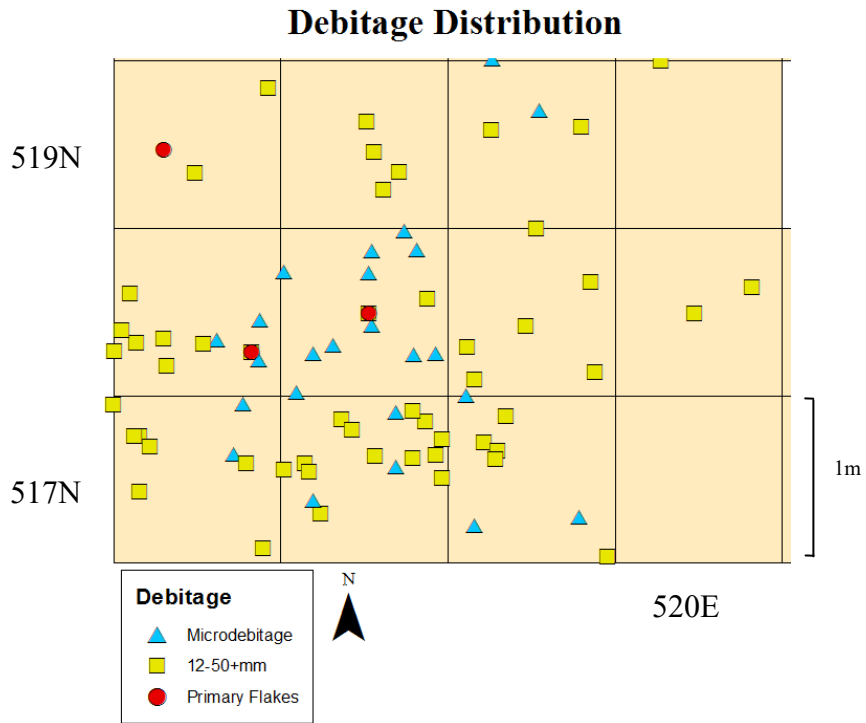


Figure 7.3.15B: Debitage distribution within Central North C.

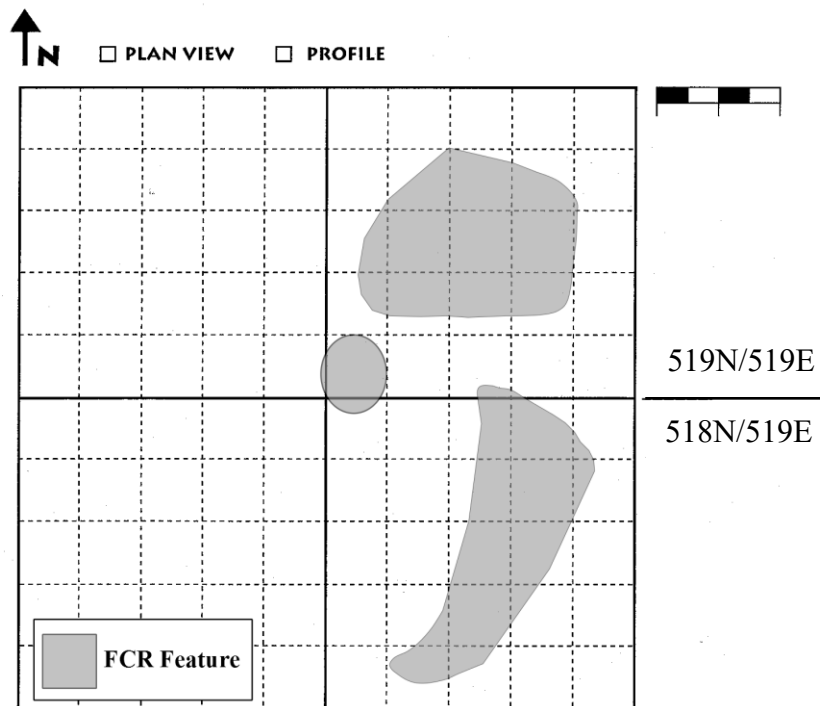


Figure 7.3.15C: FCR feature mapped for Level 3 between unit 519N/519E (SEQ) and unit 518N/519E (NEQ).

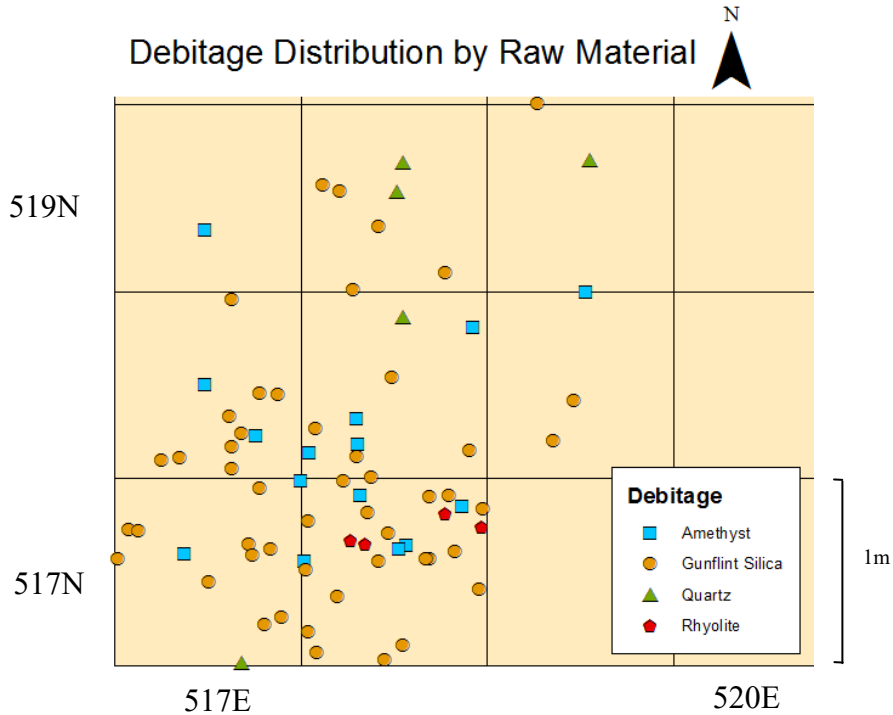


Figure 7.3.15D: Debitage distribution distinguished by raw material (excluding taconite) in Central North C.

Central North D

Tool recoveries from within the southeast cluster of Central North D include one projectile point, two bifaces (Stage 3, and UID), and five core fragments (one has a frequency of two; Figure 7.3.16 A). The projectile point and bifaces are fragmentary, and all tools and debitage were manufactured from Gunflint Formation material.

The debitage appeared clustered around 518N/523E and surrounding units, with tools distributed in the southwest (Figure 7.3.16 B). Microdebitage was recovered along the eastern edge of the cluster. Conversely, large debitage (25-50+mm) is focused further south around the 517N line. It is likely that this concentration was affected by a large stump at the apex of four units. A small cluster of primary flakes were found near the western core fragments.

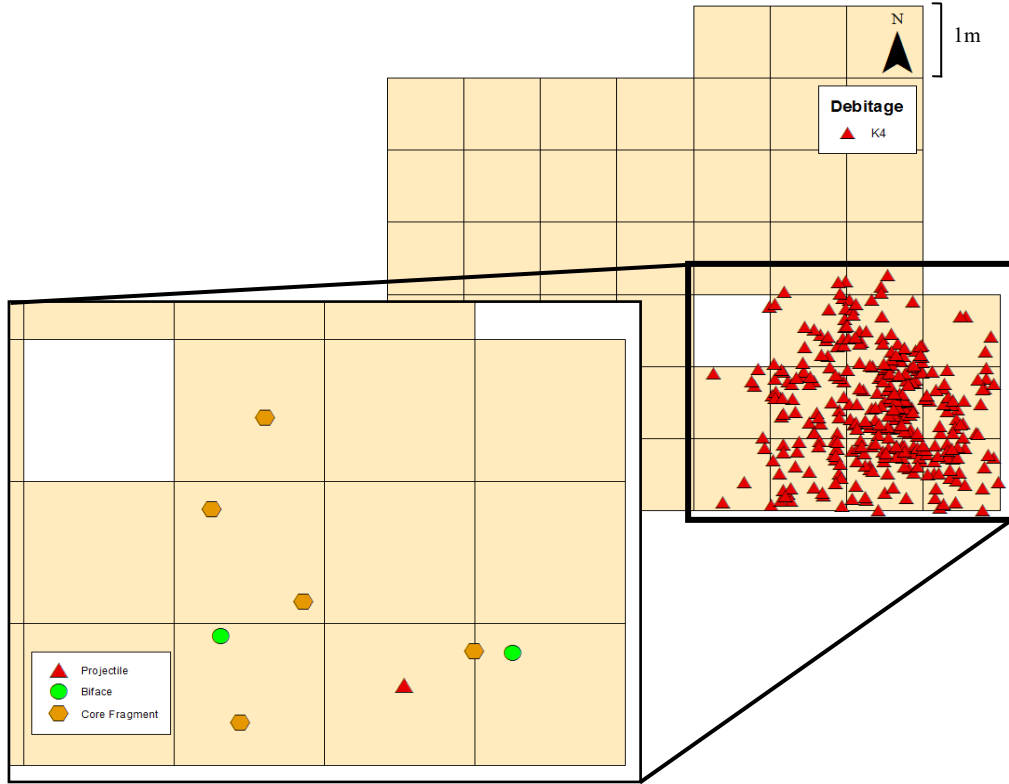


Figure 7.3.16A: Location of Cluster D within the Central North study area. Inset: Tool distribution within Cluster D.

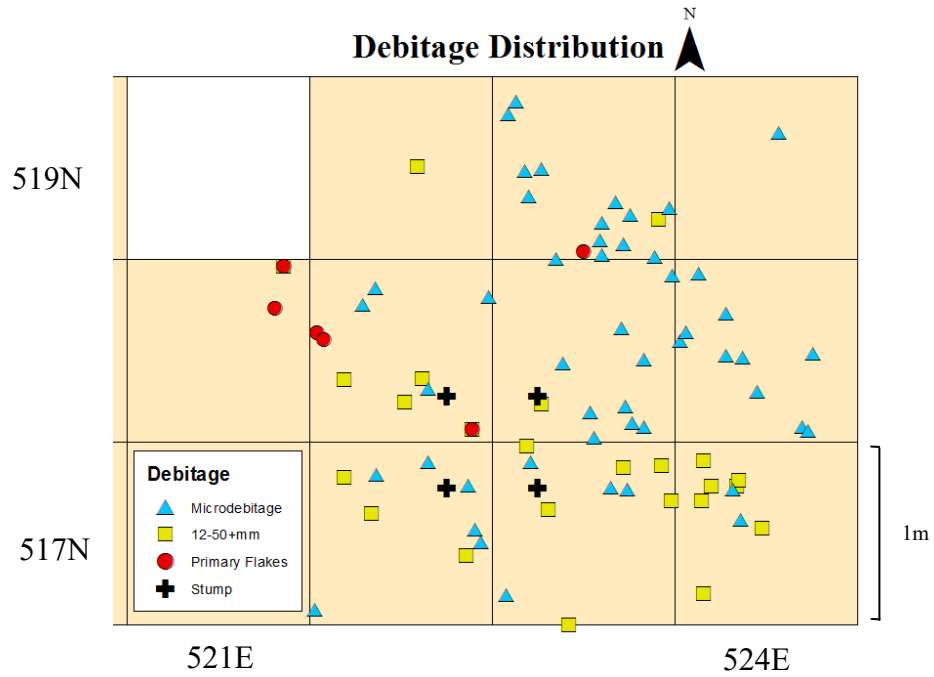


Figure 7.3.16B: Debitage distribution throughout Central North D. Note the large stump(s) at the apex of four units, which may have affected post-depositional movement of artifacts.

7.4 WEST

7.4.1 Visual Comparison

Horizontal Distribution

The West study area is located along a fairly flat surface at 246m asl with a gradual slope down towards the south of the study area (Figure 7.4.1). Within the main high density cluster, debitage sizes are distributed in the same general artifact pattern, therefore there is limited evidence for post-depositional size sorting. A pit feature was identified in unit 497N/506E and was subsequently analyzed by Shultis (2013) and Gilliland et al. (2012). A more detailed analysis of individual units is located in section 7.4.4.

Unfortunately, some unit information within this study area is not available at the time of this analysis. The following units only contain information on the recovered tools: 499N/506E, 499N/509E, 496N/504E, 496N/508E, 496N/512E, 494N/506E, and 494N/507E. Five units are altogether not in the catalogue and include: 500N/512E, 498N/508E, 497N/512E, 496N/510E, and 494N/505E (Figure 7.4.1 depicts both categories of missing information). Therefore, certain statistics are not completed on the debitage of this study area, thus some interpretations rely on the visual comparison. Spatial analytical tests are still used in an exploratory manner for the tools.

Tool Distribution

There were 73 tools from the West study area (Figure 7.4.2), with projectile points contributing to 47% of the assemblage (n=34; Figure 7.4.3). Noticeable is the lack of complete cores and limited number of core fragments. Alternatively, this study area contains the most recovered drills (n=7).

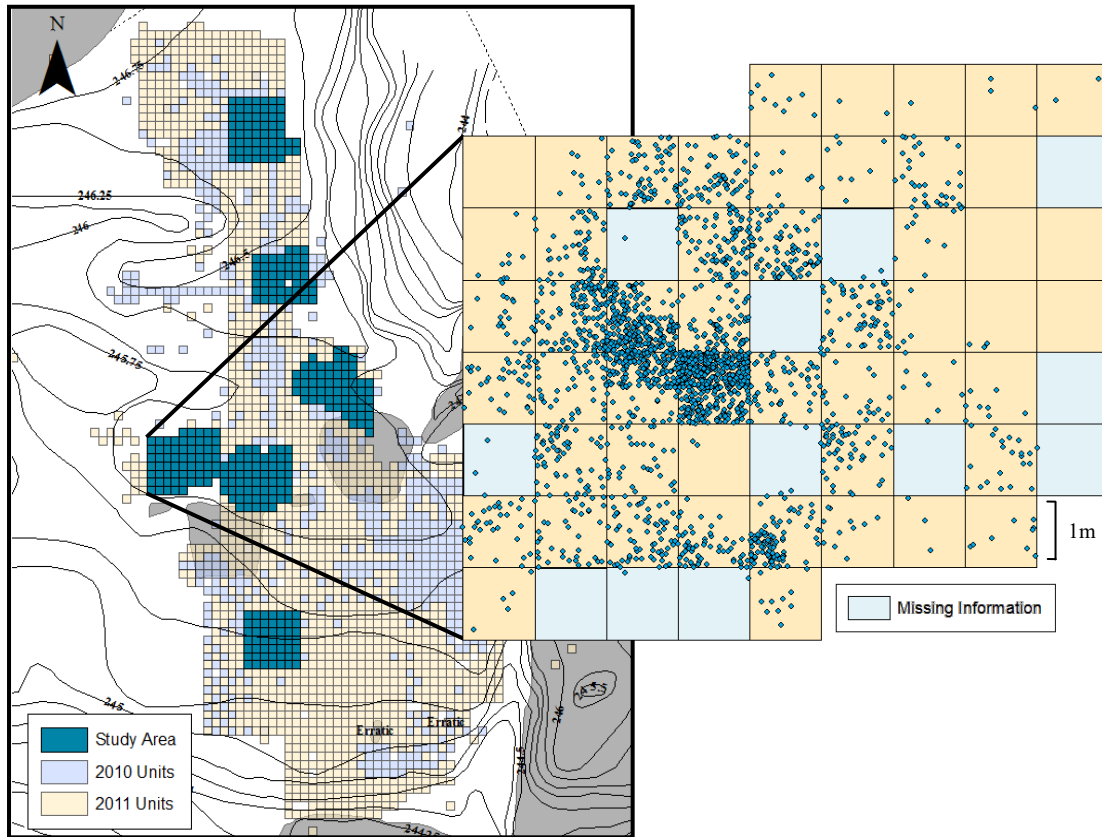


Figure 7.4.1: West study area topography within the Mackenzie I site. Inset: Overall artifact distribution pattern within the West study area. Note the units with missing artifact information.

Only 14 tools (19%) were complete, while many of the projectile point fragments were tips. Eleven of these projectile points were analyzed by Markham (2013), and with the exception of one stemmed specimen, each projectile displayed a constricting base (see Table 4.5.1). In total, seven points, one perforator, and two bifaces are preforms.

Tools are generally dispersed throughout the debitage distribution, with projectile points clustered in the northwest of the study area. The perforator, two complete scrapers, and drills were recovered in close horizontal association. Additionally, all three core fragments were recovered within a metre of the hammerstone, and the unidentifiable tool type.

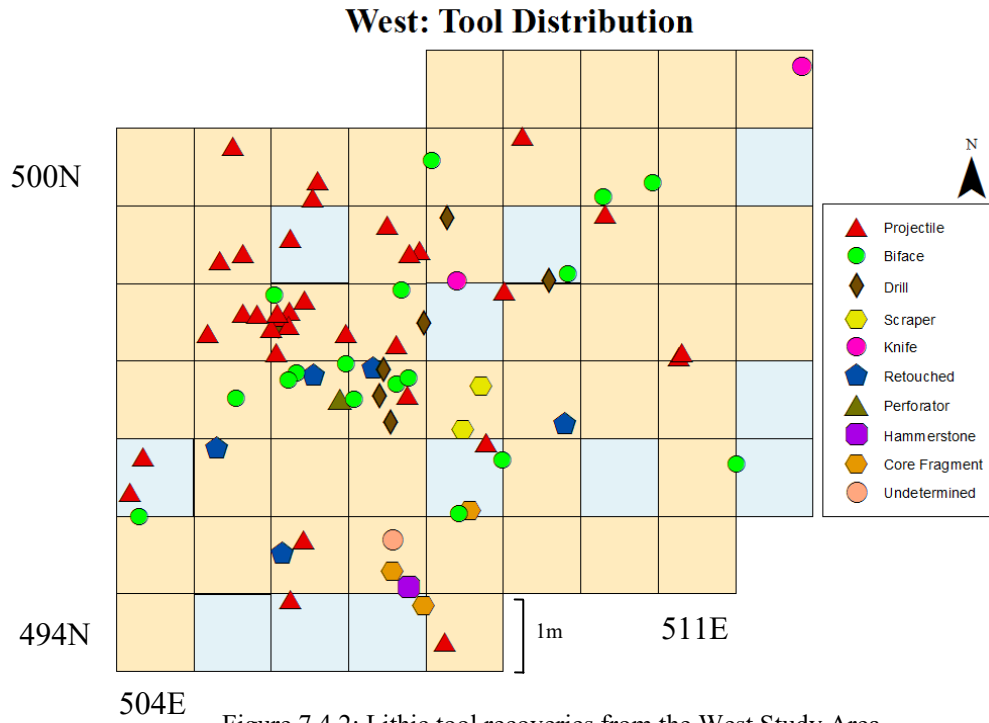


Figure 7.4.2: Lithic tool recoveries from the West Study Area.

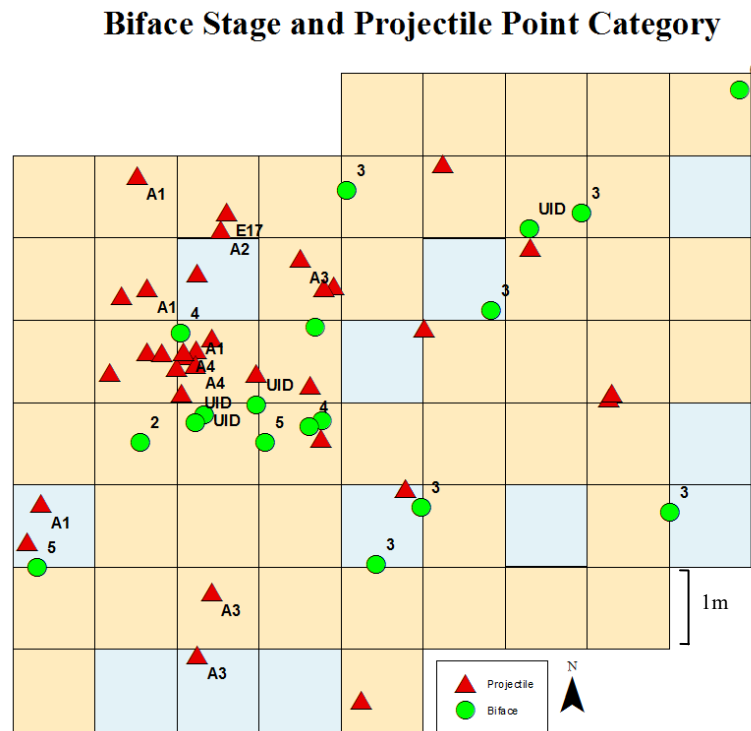


Figure 7.4.3: This map demonstrates the projectile point morphological shapes as defined by Markham (2013), and the biface stage as determined by Bennett (n.d.) for the West study area. Note: A1, Constricting Deep; A2, Constricting Low; A3, Constricting Straight; A4, Constricting Convex; E17, Stemmed Straight. See Table 4.5.1 for a guide to the projectile point categories.

The majority of the tools were produced from Gunflint Formation material, predominately taconite, with the exception of three bifaces (two mudstone, one quartz), two quartz core fragments, the hammerstone, a siltstone knife, a possible agate projectile point, a quartz retouched flake, a quartz scraper, and the unidentified tool (Figure 7.4.4).

Debitage Distribution

Microdebitage is distinctly clustered around unit 497N/507E with a high frequency spreading west from this unit (Figure 7.4.5). Though it is difficult to ascertain debitage distribution patterns due to the incomplete data set, high density areas are still clear. Larger, 25-50+mm debitage is also clustered within unit 497N/507E, as well as unit 498N/509E (which is associated with a lack of microdebitage). Both large debitage and primary flakes occur in the south in association with the core fragments and hammerstone, with a concentration of primary debitage in the centre of the study area.

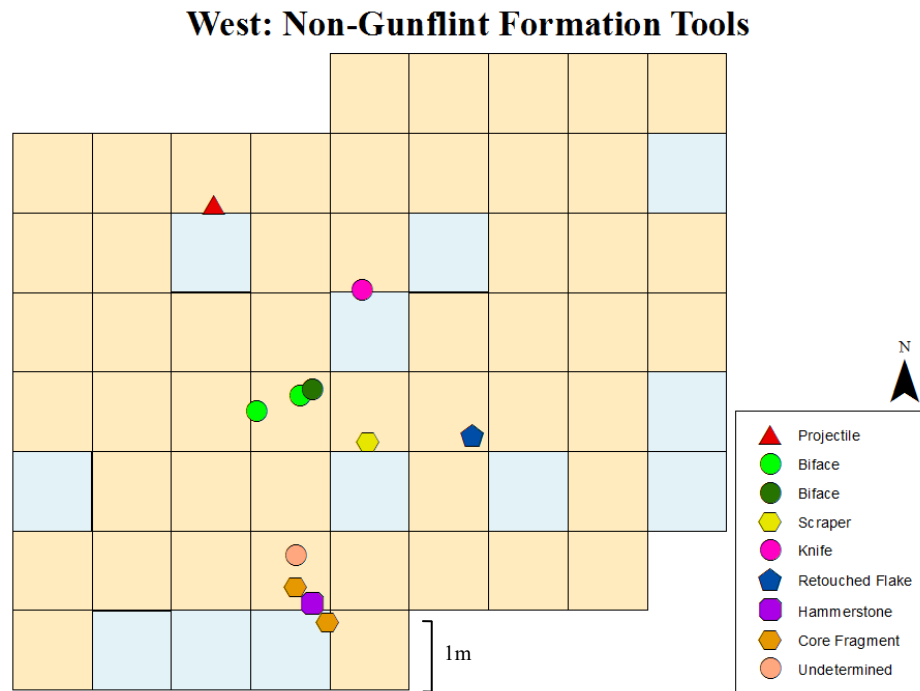


Figure 7.4.4: Distribution of non-Gunflint Formation tools, including two mudstone bifaces, a siltstone knife, the agate projectile point, and the unspecified hammerstone and unidentifiable tool. Quartz tools include one biface, two core fragments, a retouched flake, and a scraper (see previous page).

Taconite comprises the vast majority of debitage recoveries though it still appears clustered north and east of the pit feature in unit 497N/506E. Gunflint silica is more contained, with a cluster near the gunflint silica core fragment. Chert debitage is focused around the pit feature, with another small cluster in unit 495N/508E. A distinctive cluster of quartz debitage was also recovered in association with the quartz tools. Noticeable is the lack of mudstone debitage. Lastly, siltstone debitage is clustered just northeast of the pit feature near the siltstone knife (Figure 7.4.6).

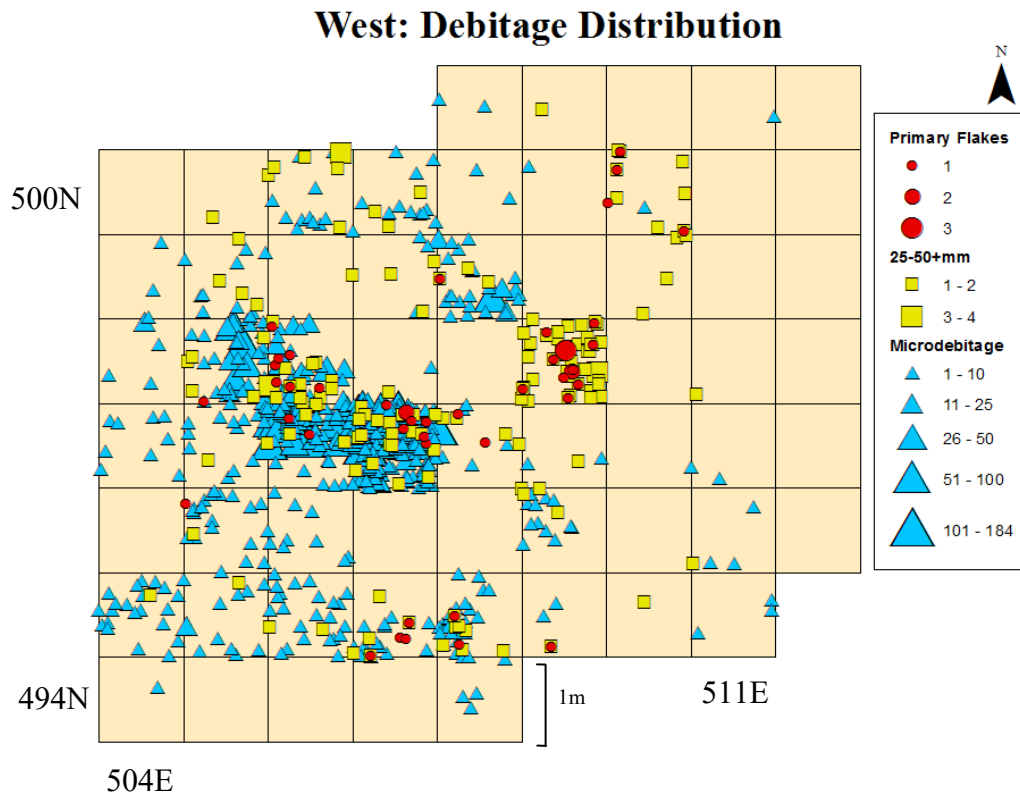


Figure 7.4.5: Distribution of debitage by type for the West study area. Note: This map excludes secondary debitage (6-25mm) due to its intense frequency.

Distribution of Quartz and Siltstone Artifacts

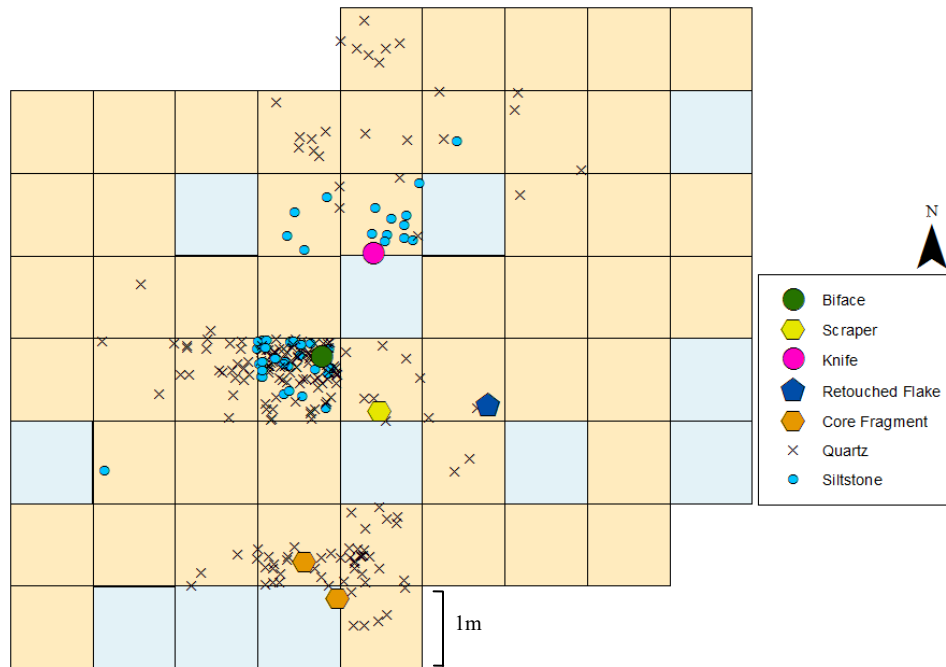


Figure 7.4.6: Distribution of quartz and siltstone tools, in relation to their respective debitage.

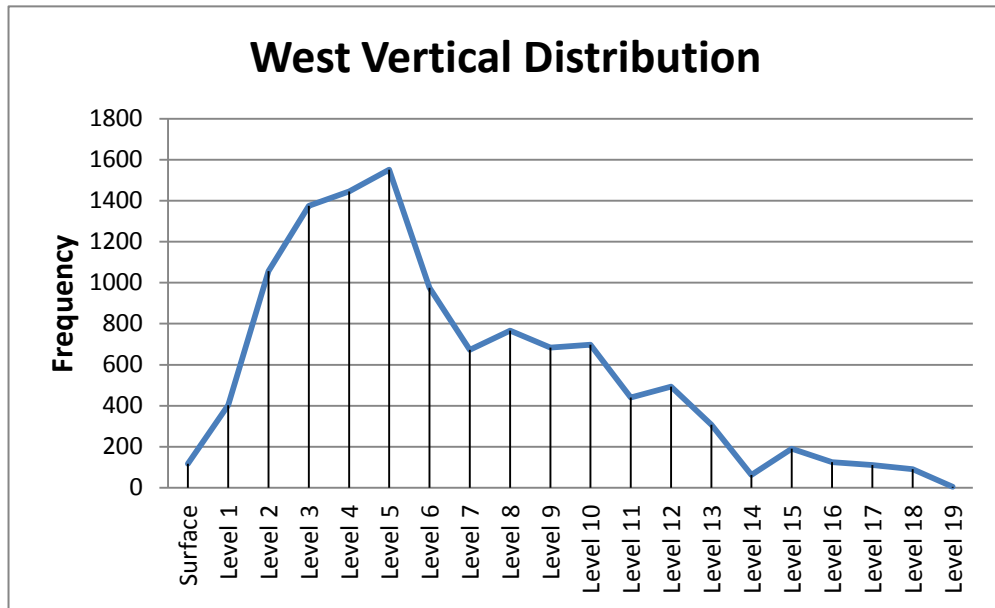
Vertical Distribution

The vertical distribution of all artifacts within the West study area demonstrates a high frequency recovered from Levels 4 and 5 (15-25cm db; Figure 7.4.7). The high density of recoveries from the pit feature (which reaches 70cm db), and the adjacent unit of 497N/507E (85cm db), affect the vertical distribution and is responsible for the small peak around Level 15. Microdebitage peaks at Levels 5 and 10, while large (25-50+mm) debitage peaks at Level 3.

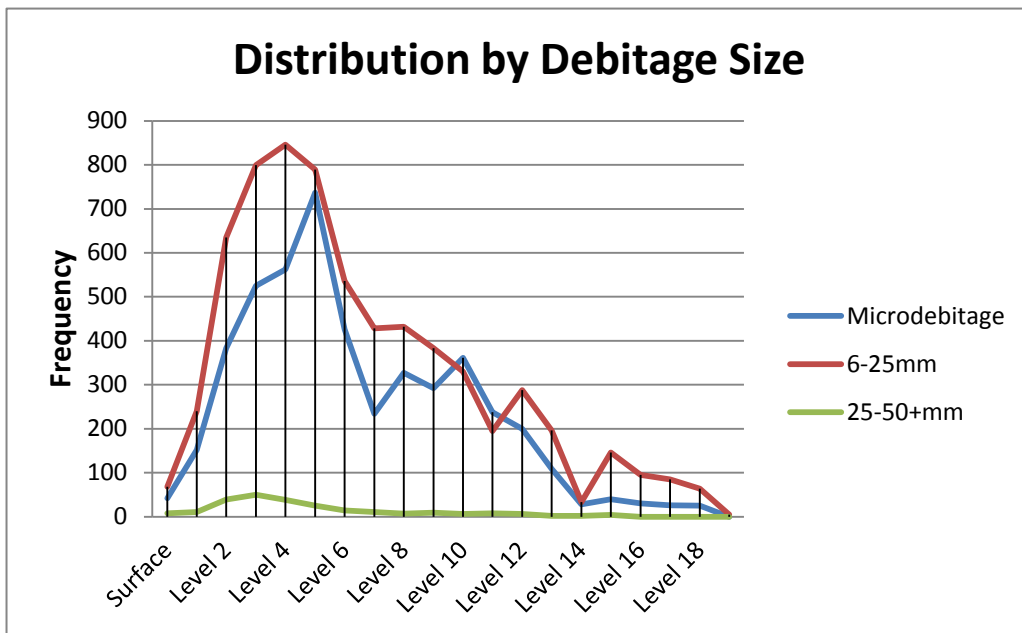
7.4.2 Refit Analysis

Two refits were found within the West study area (n=5). Three taconite projectile point fragments from unit 498N/506E refit, including a midsection from Level 2, and a midsection and tip from Level 7. Another taconite projectile point tip from unit

499N/507E, refit with a base from the NEQ of unit 493N/549E; three levels apart, and 6m south and 42m east of this study area unit (Figure 7.4.8).



(A)



(B)

Figure 7.4.7: A) Vertical distribution of West artifacts, which peaks at Level 4 and 5 (15-25cm dbs). Units which reach to a depth of up to 85cm dbs account for smaller peaks at deeper levels. B) Vertical distribution by debitage size.

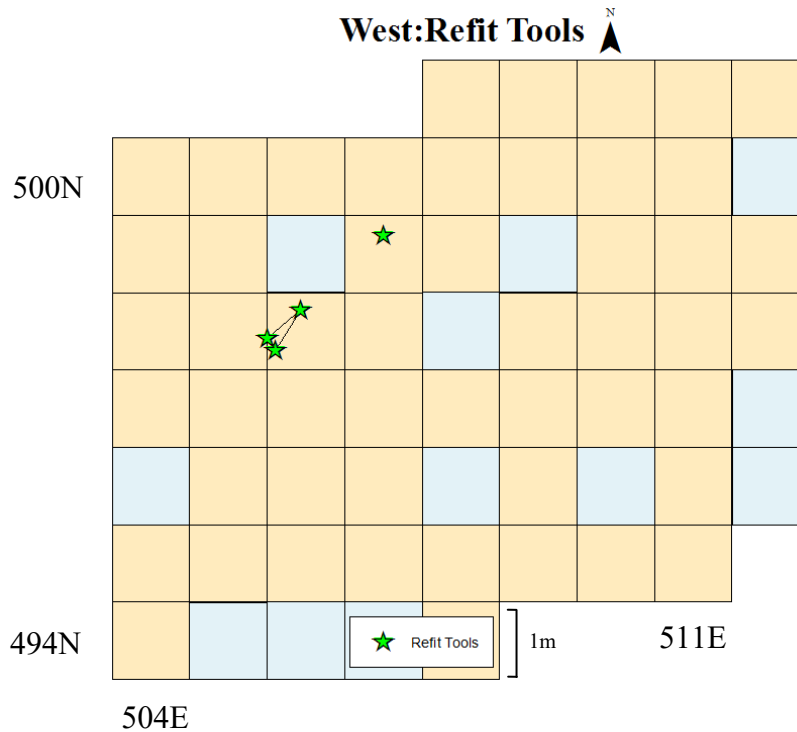


Figure 7.4.8: There were two refits within the West, including three taconite projectile point fragments from the same unit. These pieces were recovered from Level 2 and 7. To the northeast, the projectile point tip refit to a base from 6m south and 42m east.

7.4.3 Spatial Analytical Results

Kernel Density Estimation (KDE)

The KDE smoothed density contour map clearly highlights the pit feature in unit 497N/506E as well as the associated deep unit in 497N/507E (Figure 7.4.9). It also illuminates the implications of missing catalogue information for interpretation of the spatial configuration of recoveries.

Nearest Neighbour

Due to the incomplete nature of the data set the Nearest Neighbour function in ArcGIS was only completed for the lithic tools, which are considered clustered (Figure 7.4.10).

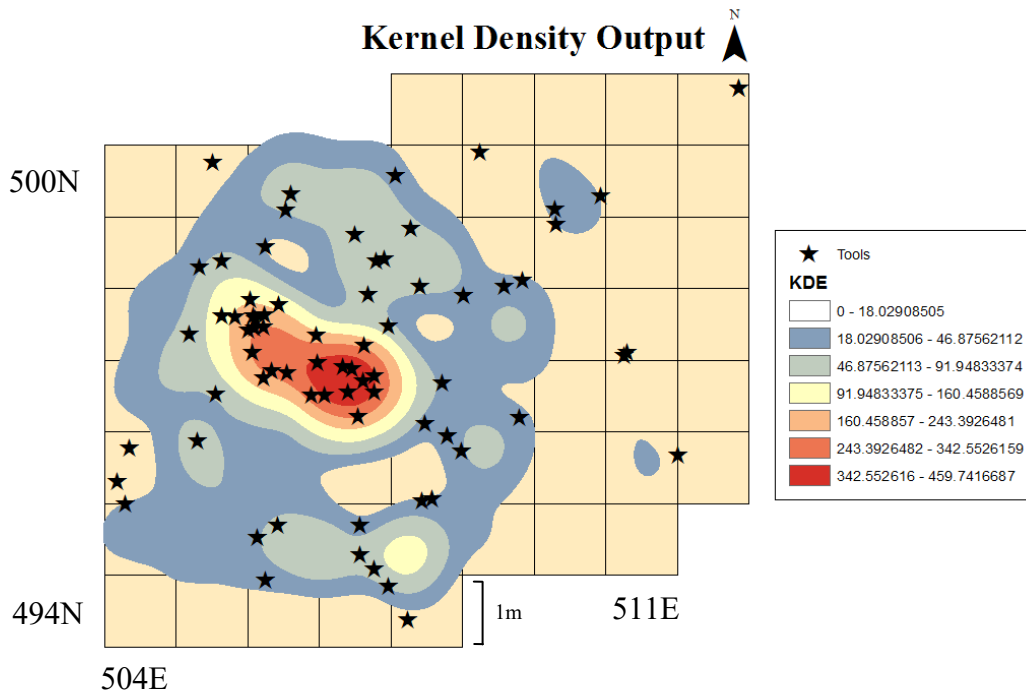


Figure 7.4.9: The smoothed density contour map, which highlights the most dense artifact clusters within the West study area.

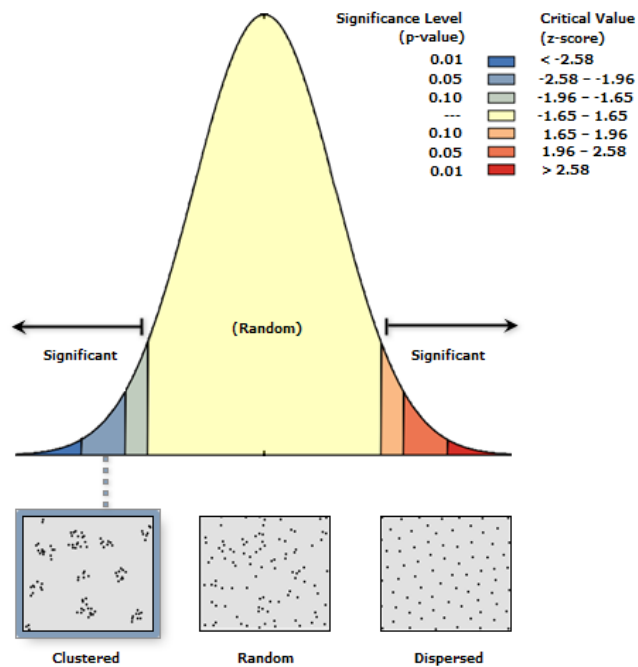


Figure 7.4.10: The Nearest Neighbour analysis was performed for tools only, due to the missing catalogue information. This analysis stated that given the z-score of -1.99, there is a less than 5% likelihood that this clustered pattern could be the result of random chance.

Ripley's K Function

Ripley's K analysis was completed for the West tools, and as with Nearest Neighbour, the output demonstrates clustering (Figure 7.4.11). This function was not performed for the debitage distribution due to missing data.

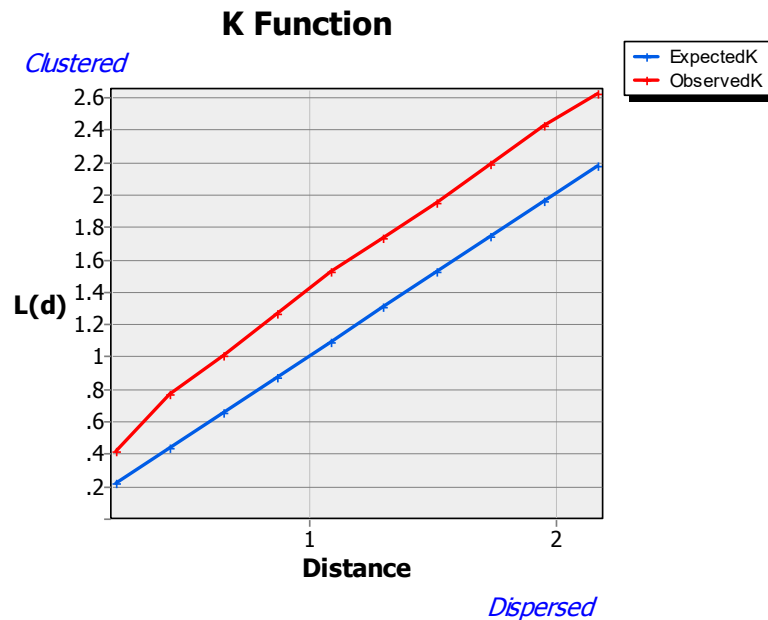


Figure 7.4.11: The output for Ripley's K Function suggests that tools within the West study area are clustered.

K-means (Pure Locational Clustering)

K2 to K10 was tested for all debitage and all tools, and the $\% \log_{10}$ SSE graph used to determine the optimal cluster solution. For the West study area debitage was not further statistically analyzed but rather, visually considered in relation to the statistical results from the tool clusters.

The $\% \log_{10}$ SSE graph suggests that K4 (four clusters) is the optimal cluster solution for tools in the West (Figure 7.4.12). Though an "elbow" is also found at K5, K4

better matches the KDE and visual comparisons (Figure 7.4.13). These clusters are referred to as West A to West D.

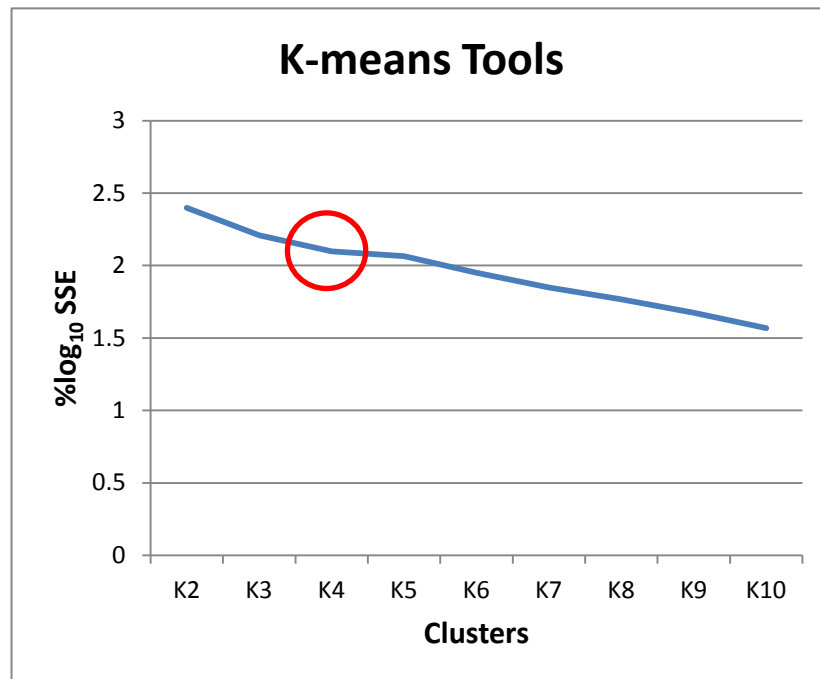
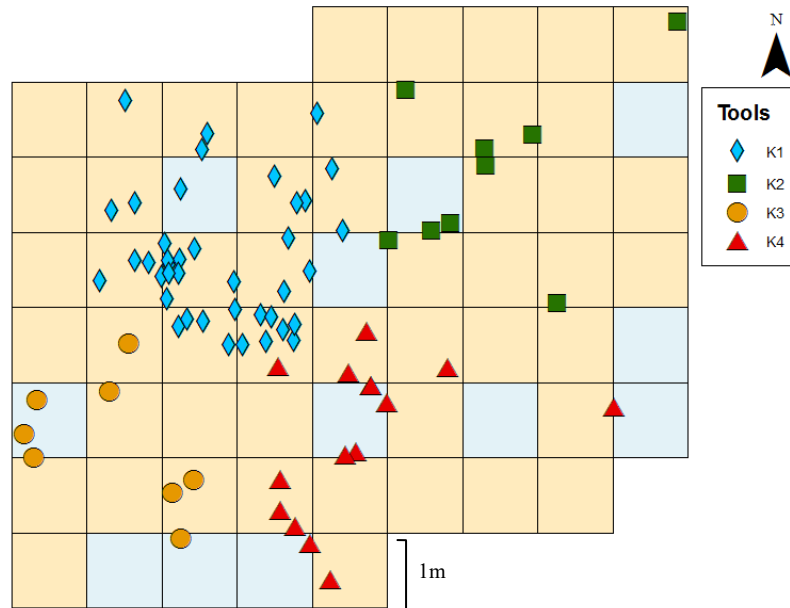


Figure 7.4.12: This graph represent the %log₁₀ SSE output from the SPSS program. A bend, or “elbow” suggests an optimal cluster solution for the West study area. Here, the four cluster solution was used for further exploratory analysis.

7.4.4 Cluster Composition

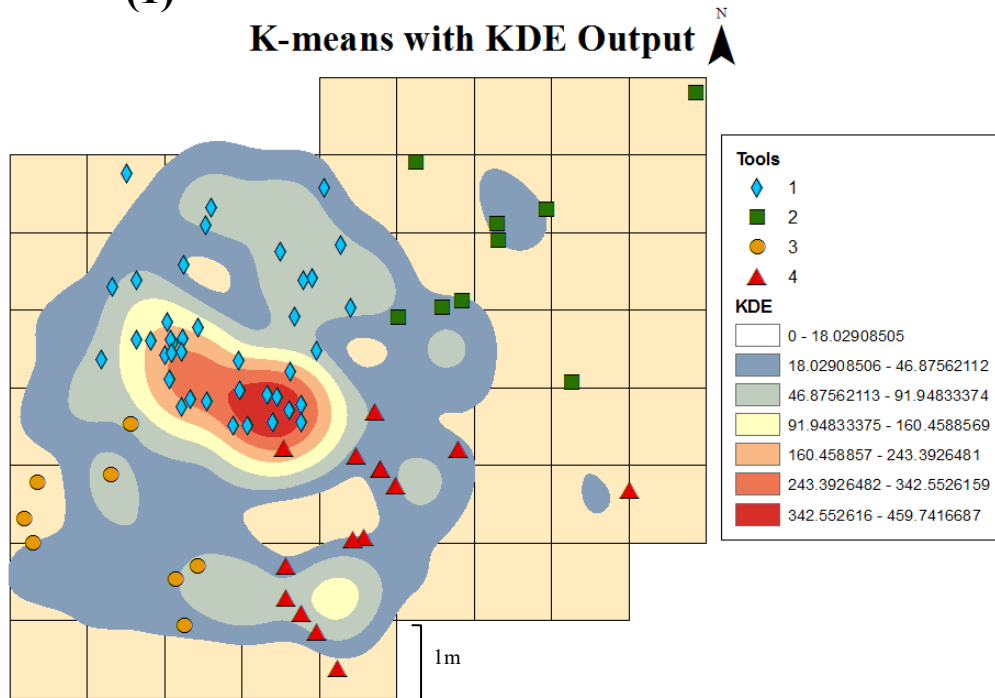
This section outlines the composition of the four clusters (West A to West D) determined in part, through the exploratory use of the K-means and SSE tests. This analysis is used in tandem with KDE and visual comparisons to maximize the interpretation of potential clusters, regardless of missing information. Though this results in a more subjective view of the data, it was completed in order to determine any patterns that may still exist.

K-means: 4 Cluster Solution



(1)

K-means with KDE Output



(2)

Figure 7.4.13: 1) This map demonstrates the four cluster solution for tool recoveries, as determined through the $\% \log_{10}$ SSE tests; 2) This map displays the same four cluster solution superimposed on the KDE smoothed contour map, highlighting the clusters in relation to high density locations. Note: clusters K1 – K4 as shown here coincide with West Clusters A to D in section 7.4.4.

West A

Cluster A is located in the northwest section of the study area and includes the pit feature at 497N/506E and associated deep excavation in unit 497N/507E. Both refits were also located in Cluster A. Tool recoveries include 22 of the 34 projectile points, nine bifaces, six drills, one knife, two retouched flakes, and one perforator (Figure 7.4.14 A). Seven of the nine bifaces were staged and include three UID, one Stage 3, two at Stage 4, and one Stage 5. Of the projectile points analyzed by Markham (2013), seven represent the constricting category, while there is one stemmed straight specimen. Five tools were manufactured out of non-Gunflint Formation material: the agate projectile point, two mudstone bifaces, one quartz biface, and one siltstone knife.

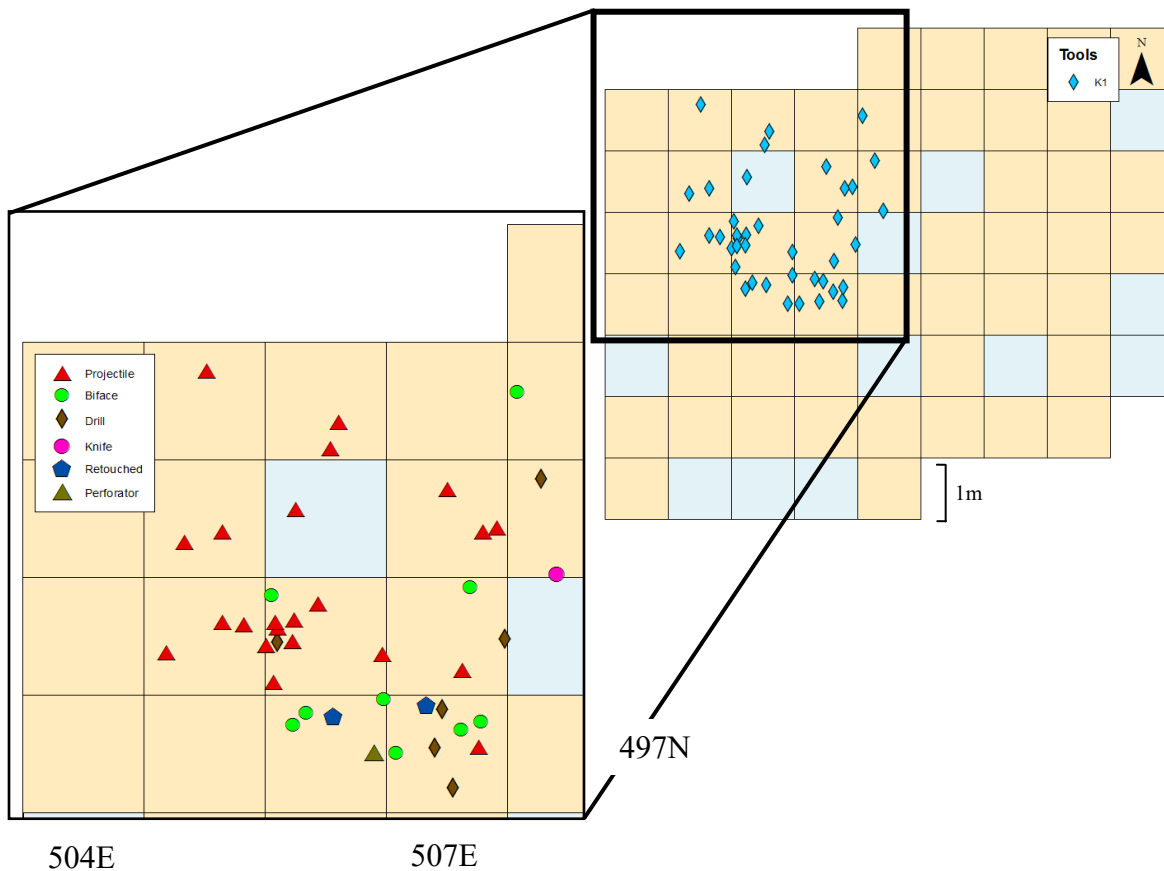


Figure 7.4.14A: Location of Cluster A within the West study area. Inset: Tool distribution within Cluster A.

Both large debitage (25-50+mm) and primary flakes were recovered from just north and east of the pit feature. Microdebitage is highly clustered within unit 497N/507E with an abrupt decrease to the north and east (Figure 7.4.14 B). Many of the non-Gunflint Formation materials, including chert, quartz, and siltstone were recovered from within this unit as well. Of interest is the smaller cluster of siltstone to the northeast, located near the siltstone knife (see Figure 7.4.7).

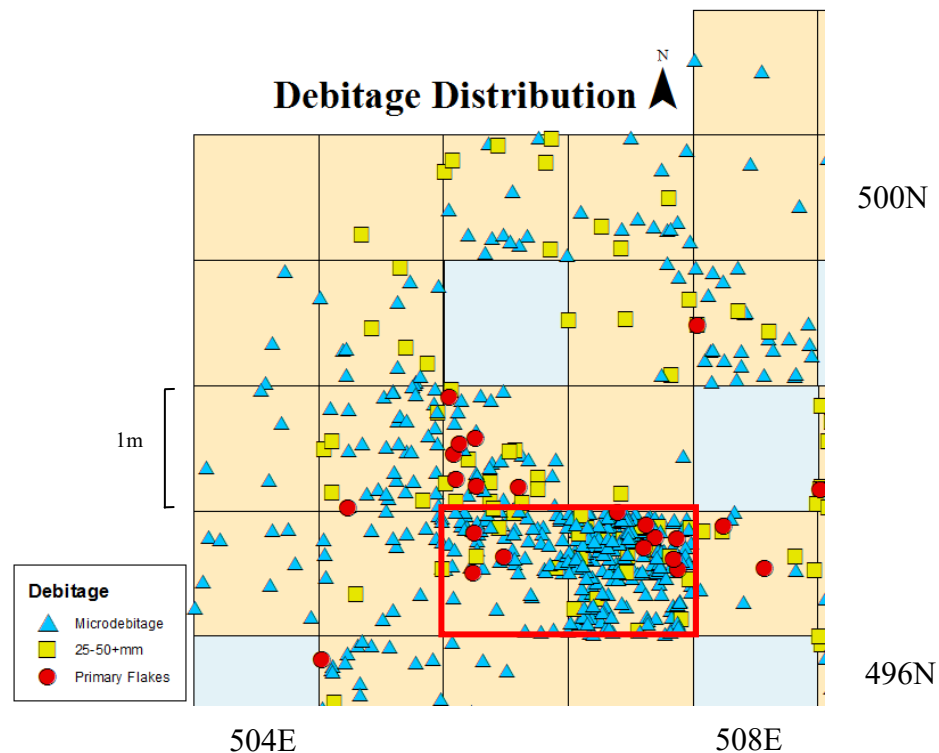


Figure 7.4.14B: Debitage distribution throughout West Cluster A. Note: Red square highlights an area discussed in more detail in section 8.2.3 in Chapter 8.

The east and south walls of the pit feature in 497N/506E were analyzed by Shultis (2013) in an effort to understand its causation (Figure 7.4.15). Artifacts were found throughout the entire unit with a focus on the northern quads, though the pit fill was “massive and poorly sorted” suggesting some type of disturbance (Shultis 2013, 244). Artifacts were uncovered as deep as Level 14 (70cm dbs) in the NEQ. Several samples

were taken for dating, including a charcoal sample taken at ~40cm dbfs that was subsequently dated to 3,550 +/- 30 ¹⁴C (3,910-3,820 cal) yrs BP (BETA 301998) (Shultis 2013, 244). Additional OSL sampling was completed in the east wall, into unit 497N/507E though to date, these have not been analyzed (Gilliland et al. 2012; see also Section 3.5).

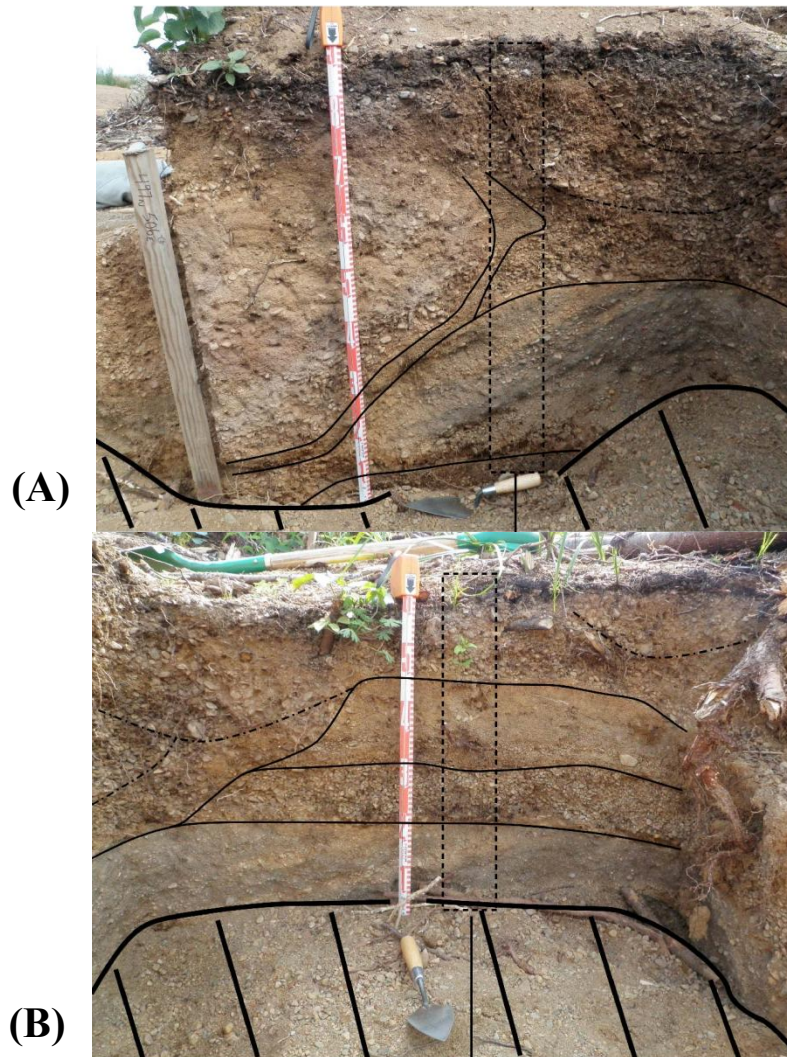


Figure 7.4.15: Wall profiles demonstrating A) East wall and, B) South wall from pit feature in unit 497N/506E. Modified from Shultis (2013).

Just to the northwest, the southeast corner of unit 498N/505E revealed fine silty brown sand with a red tinge, and higher concentrations of potential FCR. Additionally,

unit 498N/506E directly north of the pit feature, was excavated to Level 17 (80cm dbs). Two charcoal samples were taken within this unit; however, the level forms were not available at the time of analysis and so in-depth information regarding the catalogue data is lacking.

East of the pit feature, unit 497N/507E was excavated to a depth of Level 18 (85cm dbs). This unit contained the highest artifact density of Cluster A, and was also associated with reddish brown silty sand. Charcoal was noted through Levels 10 to 13 and included two charcoal samples from Level 11 and a sample from the NWQ of Level 12. These samples have not been dated. The majority of artifacts from this unit were contained to the silty sand in the northern quads, specifically the NWQ. In lower levels, the southern quads transitioned from the fine-grained silty brown sand to coarse beach sand and magnetite-rich sand.

West B

West B cluster is located within the northeast region of the study area (Figure 7.4.16 A). Tool recoveries are noticeably lacking and include one knife, one drill, three bifaces (two at Stage 3 and one UID), and five projectile points (including a preform); all manufactured out of taconite.

When the vertical placement of tools is considered, the projectile points are all within Levels 3 and 4, while the two bifaces in unit 500N/510E are from Level 6. However, this unit contained a children's dinosaur toy that was discovered in the NWQ of Level 7, along with continual root disturbance. The near surface tools in unit 499N/509E may be due to further root disturbance as evidenced by a stump which was prominent until Level 5.

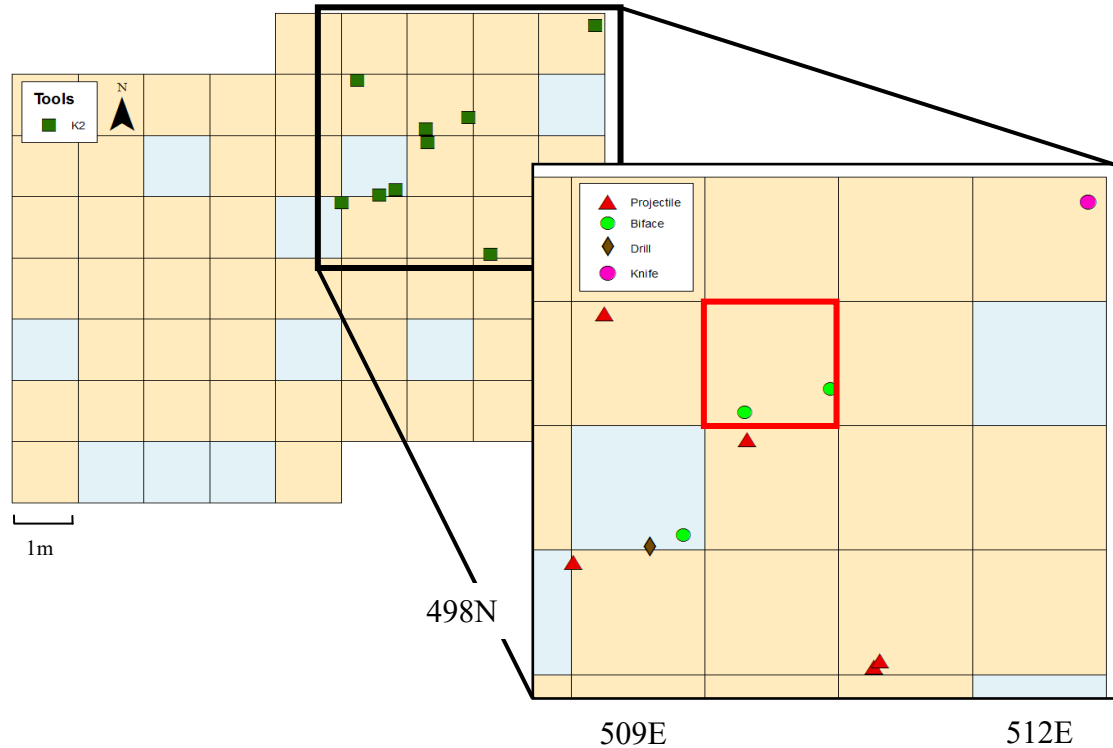


Figure 7.4.16A: Location of Cluster B within the West study area. Inset: Tool distribution within Cluster B. Note: Red square highlights an area discussed in more detail in section 8.2.3 in Chapter 8.

Debitage is tightly clustered in the west towards the high density area of Cluster A. Primary flakes and large debitage (25-50+mm) are discretely clustered in unit 498N/509E, although two units adjacent to this have no information on the debitage distribution. The eastern half of this area is devoid of large debitage with the exception of the disturbed unit containing the children's toy. Of note is the absence of microdebitage (Figure 7.4.16 B). The entire assemblage of this cluster consists of Gunflint Formation material, with the exception of six quartz flakes.

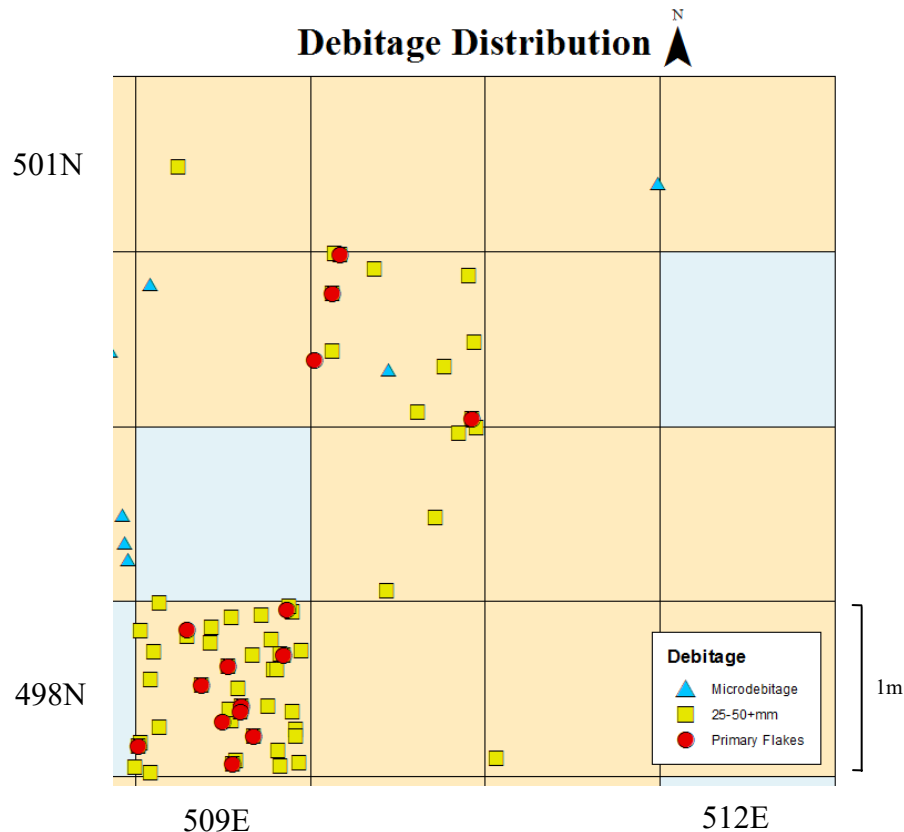


Figure 7.4.16B: This map demonstrates the distribution of certain debitage types within West Cluster B.

West C

Cluster C is located in the SW corner of the study area, and contains eight tools: two retouched flakes, two bifaces (one Stage 5, and one Stage 2), and four projectile points (three bases and a preform). The projectile points include both constricting deep (n=1), and constricting straight (n=3) morphological shapes. All the tools were broken, and vertically dispersed from Levels 3 to 9 (10-45cm below surface). The only non-taconite tool was a gunflint silica retouched flake tip (Figure 7.4.17 A).

Debitage is evenly distributed throughout this cluster with no obvious high density area (Figure 7.4.17 B). Primary and large debitage (25-50+mm) are almost completely absent (the dense cluster in the northeast is part of Cluster A). In contrast,

microdebitage is numerous and spread throughout. With the exception of two chert flakes, one siltstone, and one Hixton Silicified Sandstone flake, the assemblage consists of Gunflint Formation material.

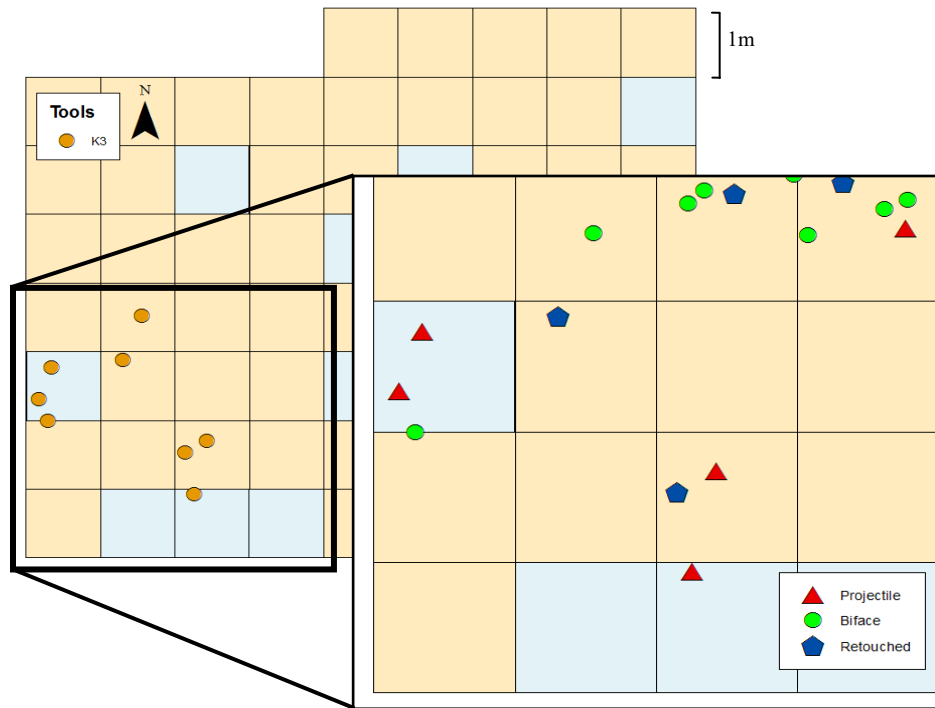


Figure 7.4.17A: Location of Cluster C within the West study area. Inset: Tool distribution within Cluster C. Note: the nine tools visible in the northeastern corner belong to Cluster A.

This area seems previously and extensively disturbed. Stumps, intrusive large roots, and mechanical pushover affected at least the following units: 494N/506E, 495N/505E, 495N/506E, 496N/504E, 496N/505E, and 496N/506E. For example, in 496N/504E large roots were invasive and root rot was found as deep as Level 10 (50cm below surface). Previously moved large tree trunks had compressed units 495N/505E and 495N/506E before being dragged away for the Stage 4 block excavation. Due to this level of disturbance, a comprehensive spatial analysis of this cluster was not undertaken.

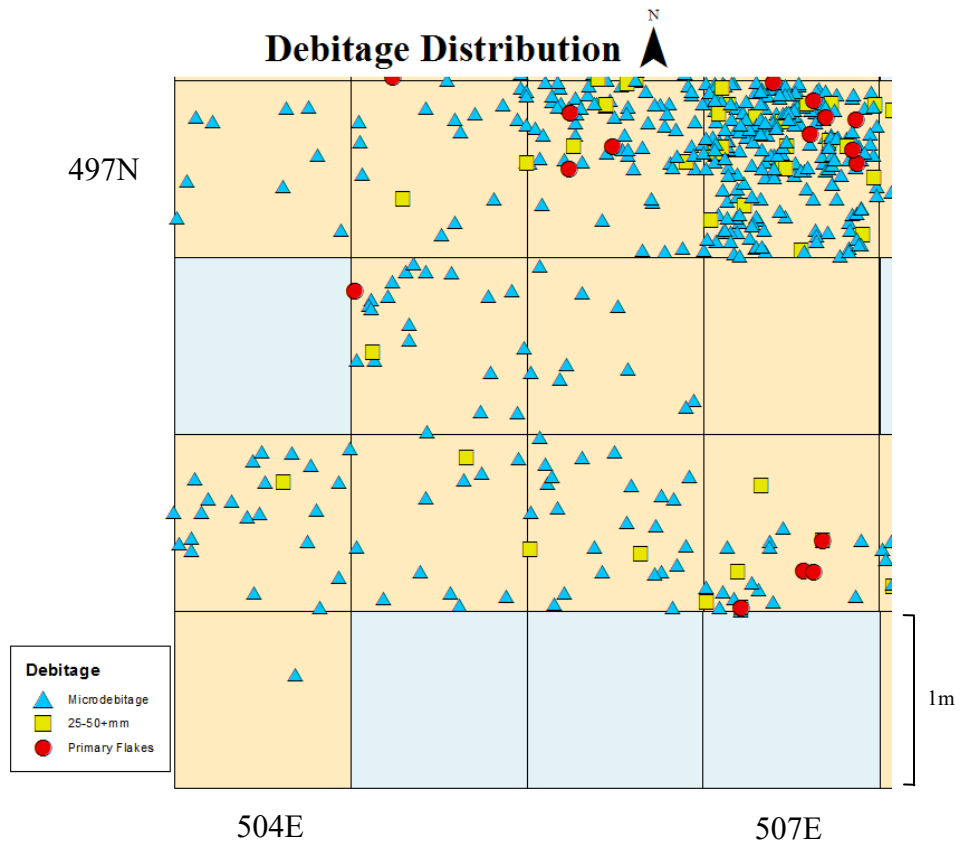


Figure 7.4.17B: Location of specific debitage types throughout West Cluster C. Note: the two most northeastern units are a part of West Cluster A.

West D

West D is located southeast of the high density clusters of the West study area (Figure 7.4.18 A). The east and south walls of unit 496N/508E and the west wall of 497N/508E were analyzed in detail by Shultis (2013, 134), as they illustrate the typical stratigraphy of the site.

Tool recoveries include two complete scrapers, three projectile points (including a preform), one hammerstone, three core fragments, three Stage 3 bifaces, one retouched flake, and an undetermined waterworn tool. Two core fragments, one retouched flake, and one scraper were manufactured from quartz. Of note is the location of the

hammerstone and core fragments. Vertical distribution on the other hand, varies greatly from surface to Level 9 (0-45cm below surface).

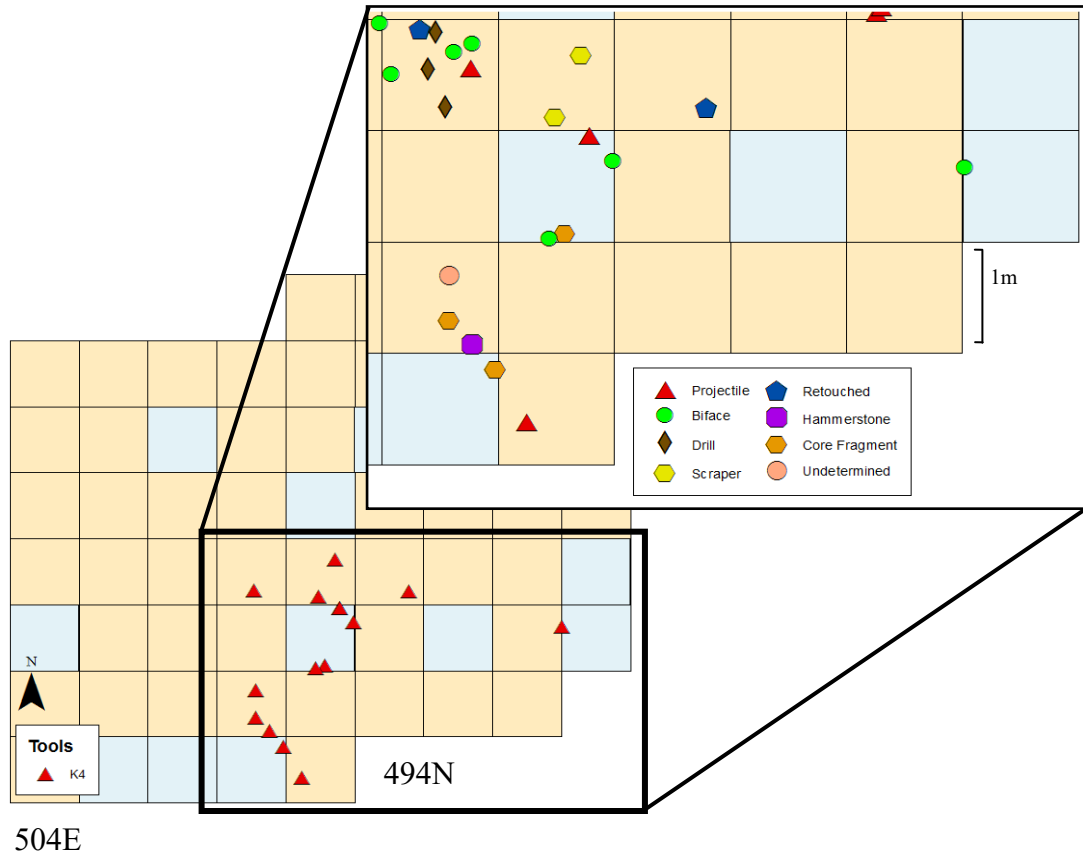


Figure 7.4.18A: Location of Cluster D within the West study area. Inset: Tool distribution within Cluster D. Note: the tools visible in the northwestern corner belong to Cluster A.

Primary flakes, microdebitage, and large debitage (25-50+mm) appears clustered around the core fragments and hammerstone in the south (Figure 7.4.18 B). Additionally, the small amount of chert, gunflint silica, and quartz are clustered within this small area. Of interest is the distribution of quartz debitage along with the quartz tools (see Figure 7.4.6).

Although there are some intriguing distributions when considering horizontal relationships, there is evidence for significant vertical displacement. In the south, a large

stump removed during clear cutting had been sitting on, and compacting, unit 494N/508E. One metre to the northwest, a stump impacted excavation, and a glove from the previous year was found in a rodent hole in Level 2. Rotted roots were found as deep as Level 9, with large roots running along the floor of Level 10. Other units to the east were also impacted by debris left from clear cutting prior to excavation. Many artifacts in this cluster were discovered within root mats or underneath large roots.

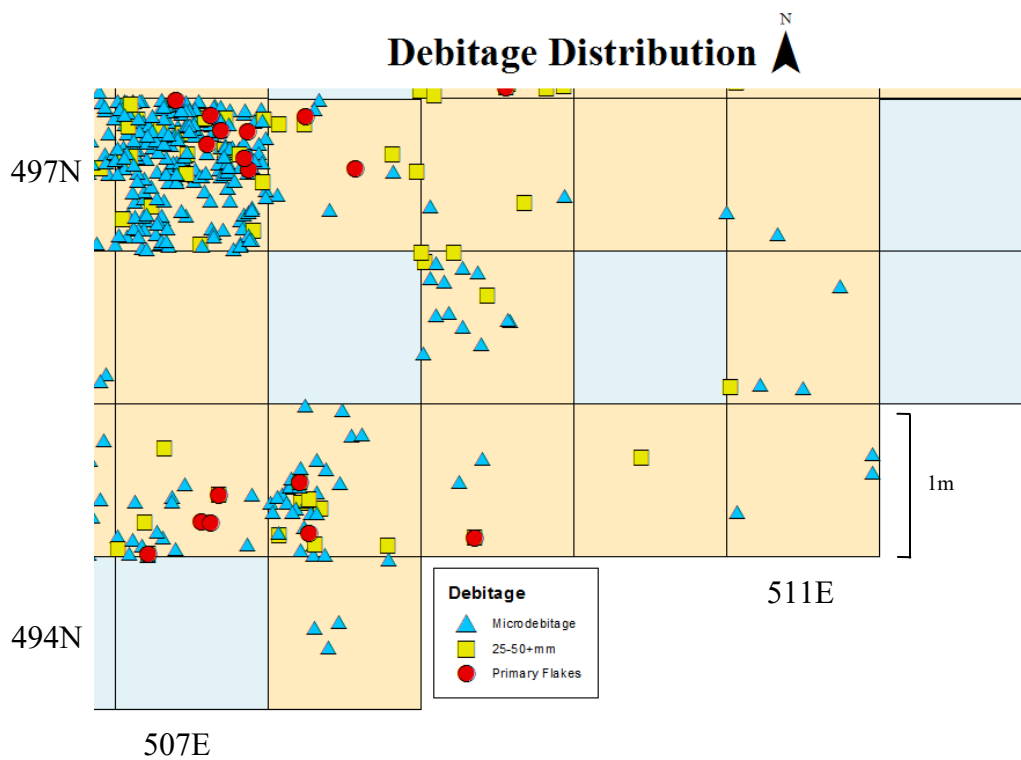


Figure 7.4.18B: Location of specific debitage types throughout West Cluster D. Note: the most northwestern units are a part of West Cluster A.

7.5 CENTRAL WEST

7.5.1 Visual Comparison

Horizontal Distribution

The Central West study area is located on the same broad, flat area as the West study area, at 246m asl (Figure 7.5.1). The southern border of the study area includes some areas of disturbance due to engineer soil sampling prior to the salvage excavation. All debitage sizes are distributed in the same general artifact pattern; thus there is limited evidence for post-depositional, horizontal size sorting. Additionally, unit 499N/519E along the northern boundary was not excavated.

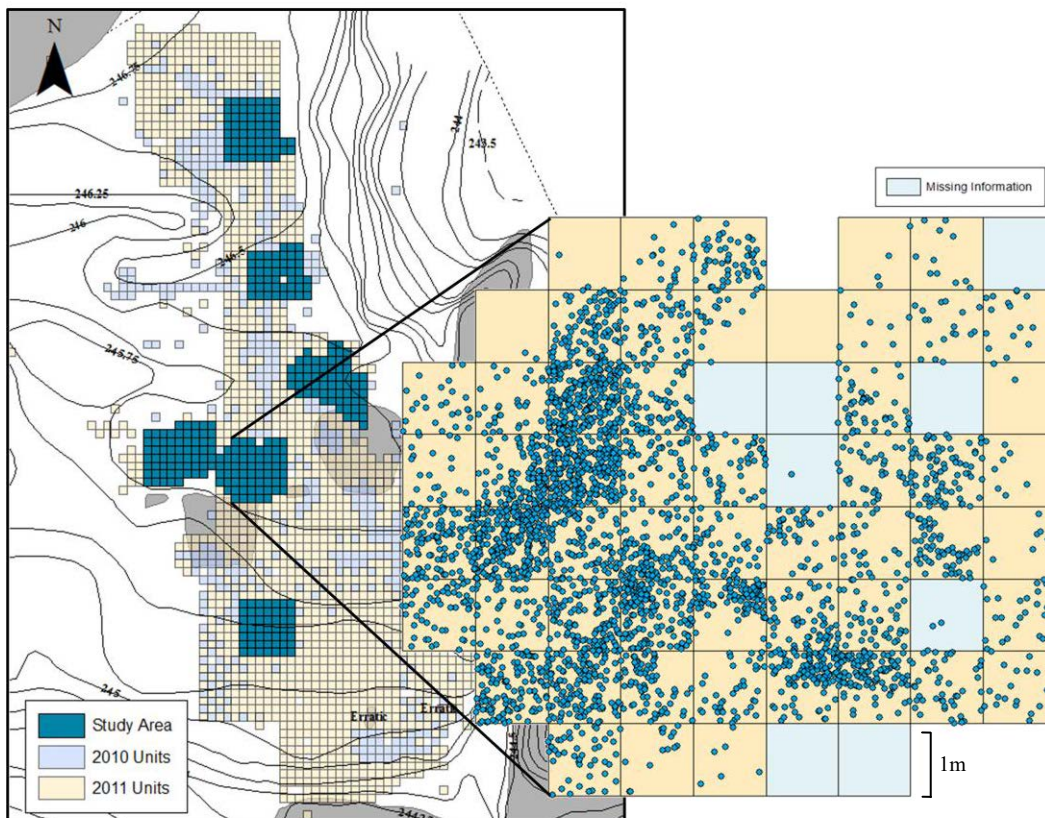


Figure 7.5.1: Central West study area topography within the Mackenzie I site. Inset: Overall artifact distribution pattern within the Central West study area.

Unfortunately, the available catalogue is missing some or all recovery information from eight units. Units with only tool recoveries recorded include 496N/518E and 494N/520E. The following units are not in the system in their entirety: 499N/521E, 497N/517E, 497N/518E, 497N/520E, 492N/518E, and 492N/519E.

Tool Distribution

A total of 66 tools were recovered from the Central West study area, including 24 bifaces (36% of the assemblage; Figure 7.5.2). Ten of the 17 projectile points were analyzed by Markham (2013) and contain constricting, parallel, and eared varieties (Figure 7.5.3).

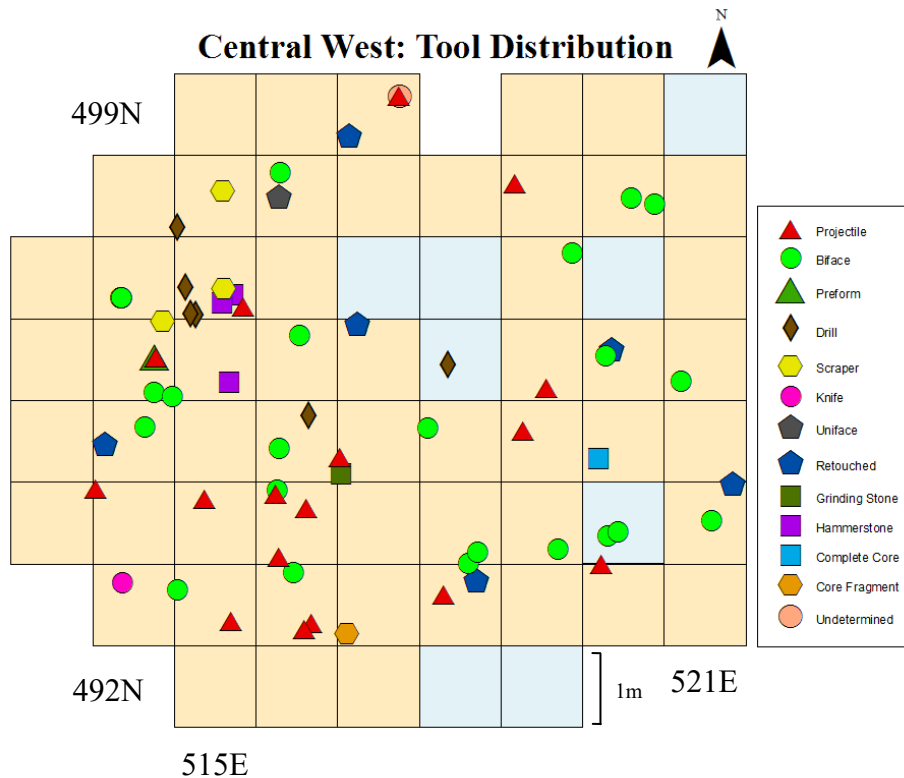


Figure 7.5.2: Tool distribution throughout the Central West study area. Note: there are three bifaces in unit 497N/514E that were found in close proximity, thus only one point is visible in this map.

Other tool recoveries include scrapers (n=3) and drills (n=6), which were some of the highest recoveries between the six study areas, as well as the least amount of core fragments (n=1). Nine tools are preforms, including the generic preform (with no identifiable tool type), the undetermined tool, one biface, two projectile points, three drills, and one scraper. A significant number of tools were broken, including ten projectile point bases, and 12 biface tips.

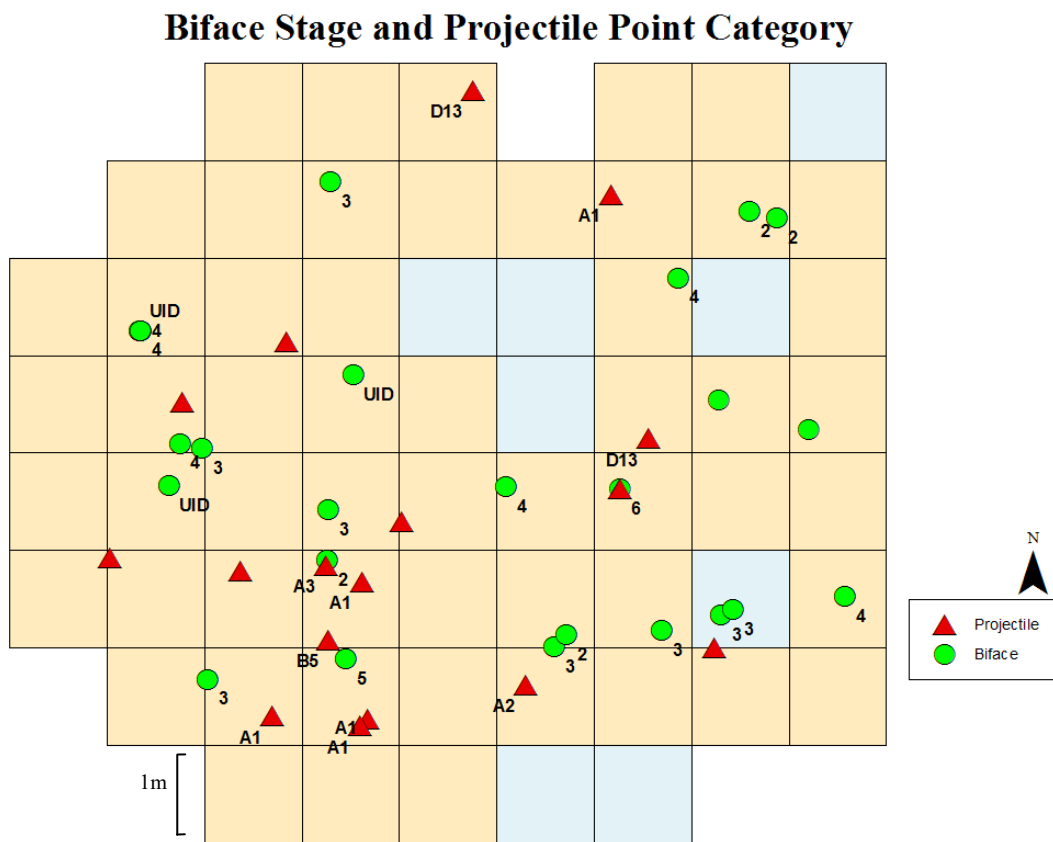


Figure 7.5.3: This map demonstrates the projectile point morphological shapes as defined by Markham (2013), and the biface stage as determined by Bennett (2015) for the Central West study area. Note: A1, Constricting Deep; A2, Constricting Low; A3, Constricting Straight; B5, Eared Deep; and D13, Parallel Straight. See Table 4.5.1 for a guide to the projectile point categories.

A variety of tool raw materials were recovered from the Central West and include two gunflint silica bifaces, one mudstone projectile point, one unspecified grinding stone,

one gunflint silica scraper, three unspecified hammerstones, one chert drill, and one amethyst uniface (Figure 7.5.4). Of note is the cluster of drills, scrapers, and hammerstones within unit 497N/515E, as well as the location of chert debitage and tools, and mudstone debitage and tools (see Figure 7.5.6, below).

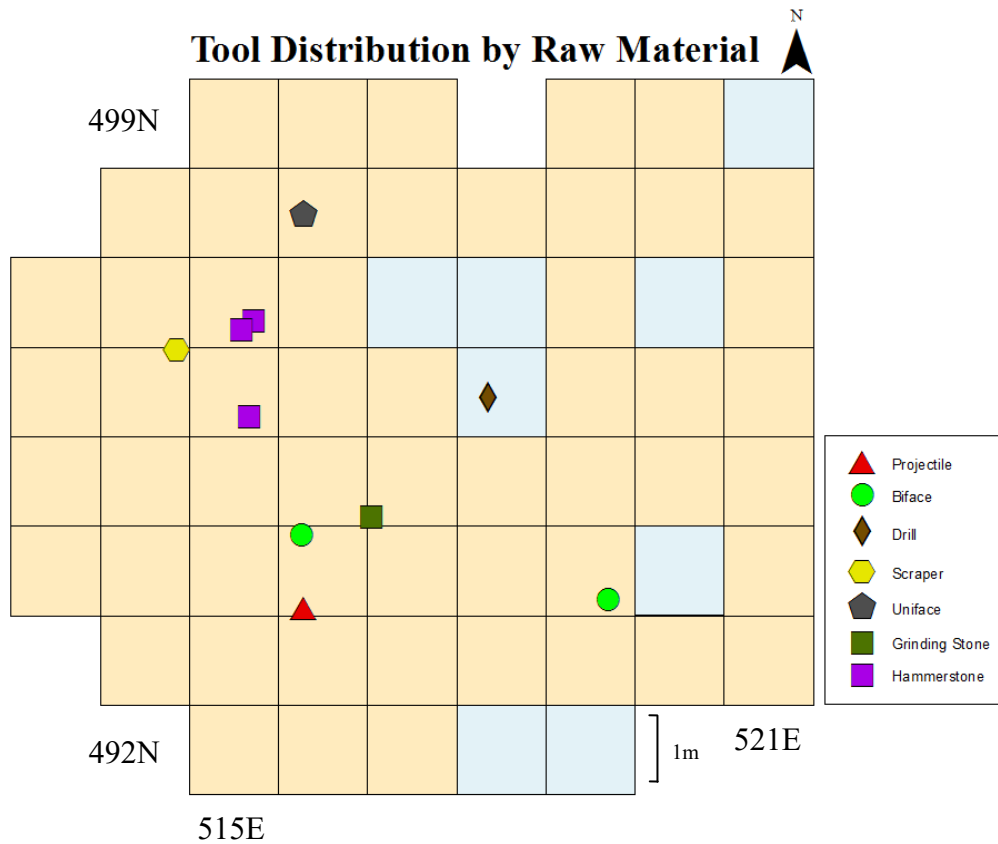


Figure 7.5.4: Distribution of tools by raw material type, excluding taconite. This includes the unspecified grinding stone and hammerstones, an amethyst uniface, gunflint silica bifaces and scraper, a mudstone projectile point, and a chert drill.

Debitage Distribution

Primary debitage is distributed throughout the high density areas in the west, with another distinct cluster in the east around unit 495N/520E (Figure 7.5.5). Microdebitage is dense and mostly located in the western side of the study area. Larger 25-50+mm debitage on the other hand, is more widespread and includes larger flakes and shatter of

siltstone, quartz, mudstone, chert, and amethyst. Many of these non-Gunflint Formation materials appear clustered, although within the main distribution pattern (Figure 7.5.6).

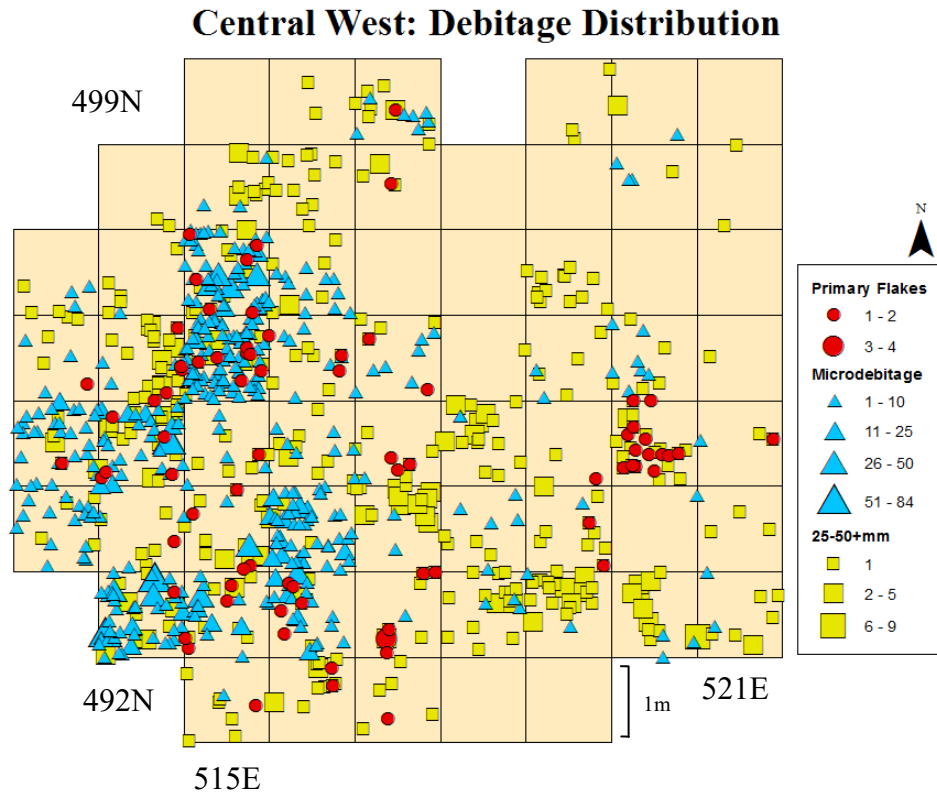


Figure 7.5.5: Debitage distribution by type for the Central West study area. Note: This map excludes secondary debitage (6-25mm) due to its intense frequency.

Vertical Distribution

Vertical distribution of the assemblage shows a unimodal distribution with the highest recovery occurring in Level 3 (10-15cm dbs; Figure 7.5.7). Additionally, examination of the vertical distribution of each size category indicates consistent clustering in Level 3.

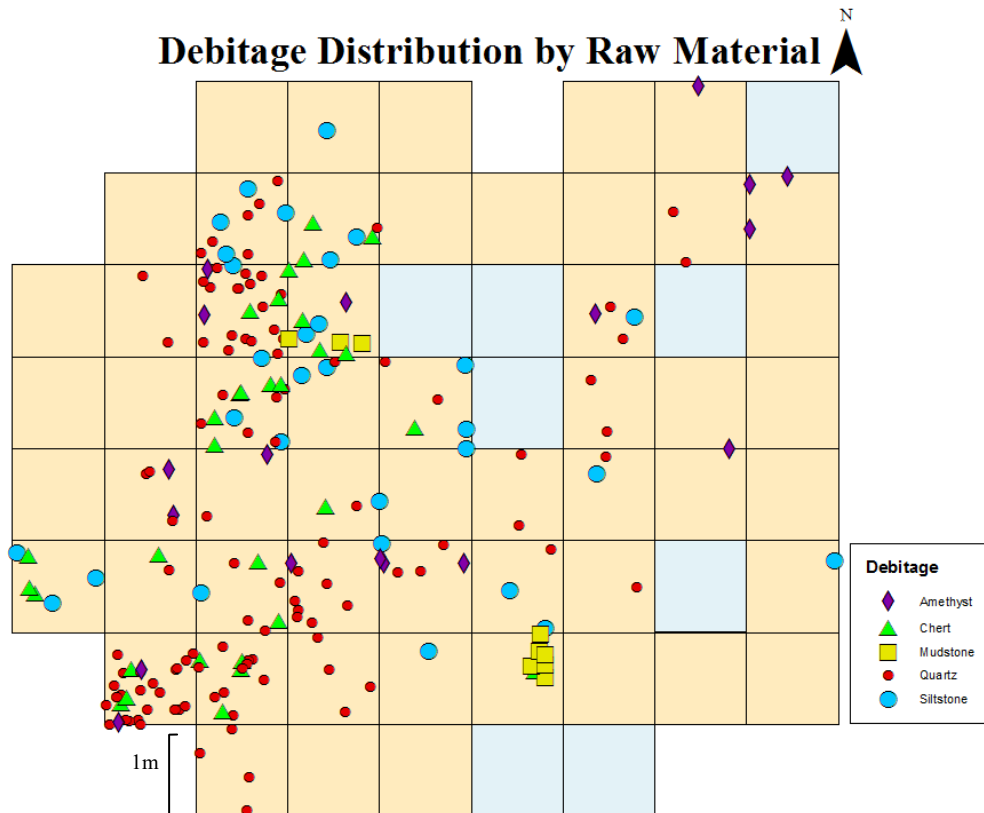
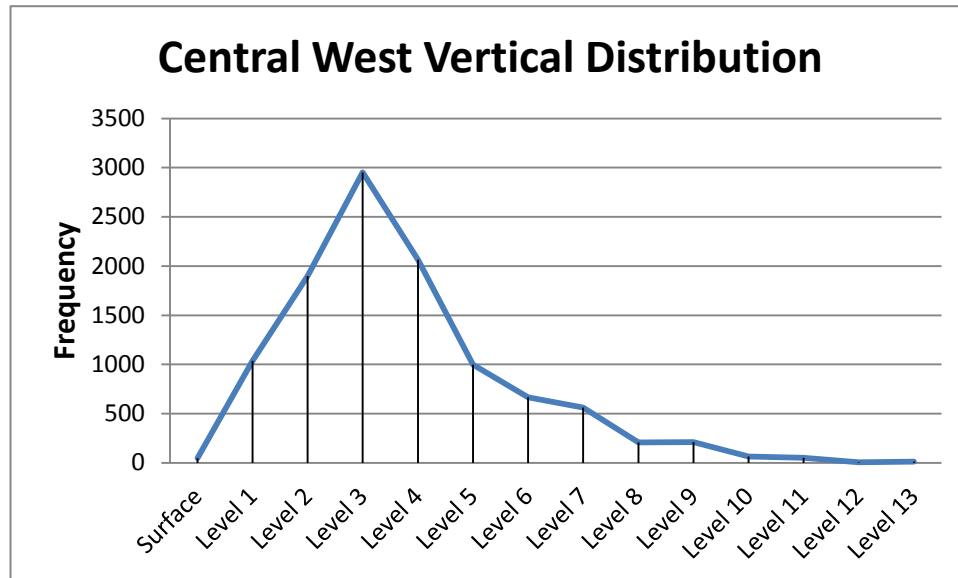


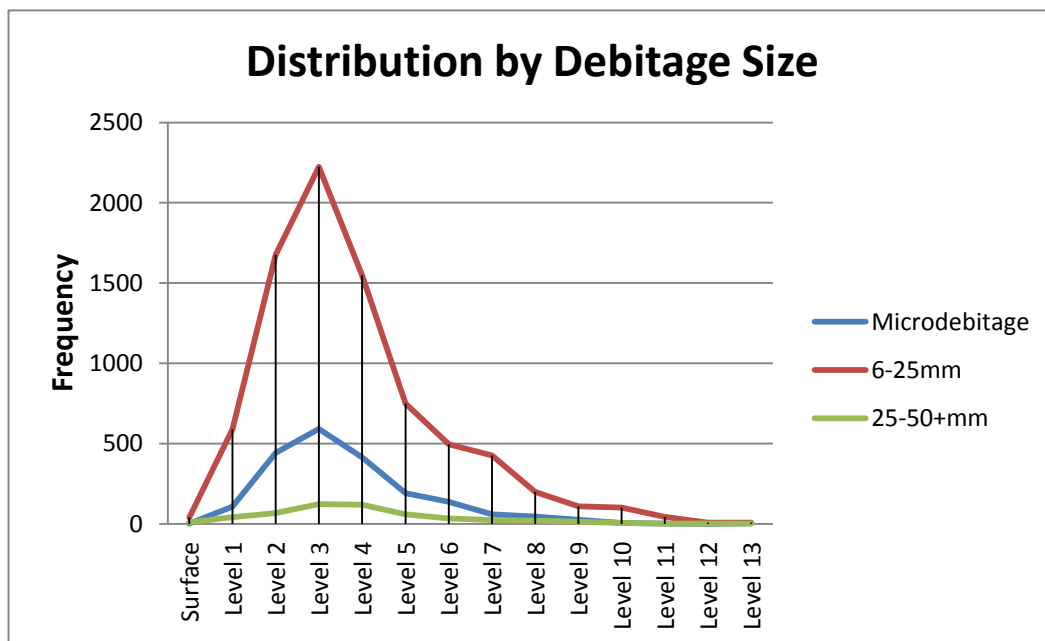
Figure 7.5.6: Distribution of non-Gunflint Formation material within Central West.

7.5.2 Refit Analysis

A total of eight refits (n=18) were recovered from the Central West study area (Figure 7.5.8). Near the south boundary of this study area, a taconite projectile point base from Level 1 refit with a midsection from Level 2, within the same SEQ. In the NWQ of the same unit, a taconite biface tip (n=2) was recovered from Level 4. To the west in 497N/515E, a midsection from a taconite drill preform (n=2) was uncovered. A biface preform tip and lateral edge (n=3) were discovered in the southeast of the study area, in two adjacent units, three levels apart. Two taconite biface tips refit from the fourth level of 497N/514E. Lastly, a taconite biface tip and lateral edge (n=2) refit to the midsection from the same quad in 498N/520E; these were found one level apart.



(A)



(B)

Figure 7.5.7: A) Vertical distribution of all artifacts within Central West demonstrates a fairly unimodal distribution with the highest frequency of artifacts from Level 3 (10-15cm dbs). B) Vertical distribution by debitage size.

Two tools from the Central West had refits outside of the study area boundaries. A taconite projectile preform base from unit 496N/514E, refit to a tip from 490N/535E (6m south and 21m east). Lastly, a Level 1-2 taconite projectile point base from the north edge of the study area refit with a Level 4 tip, one unit to the north. With few exceptions, the close proximity of refitted items suggests minimal artifact displacement.

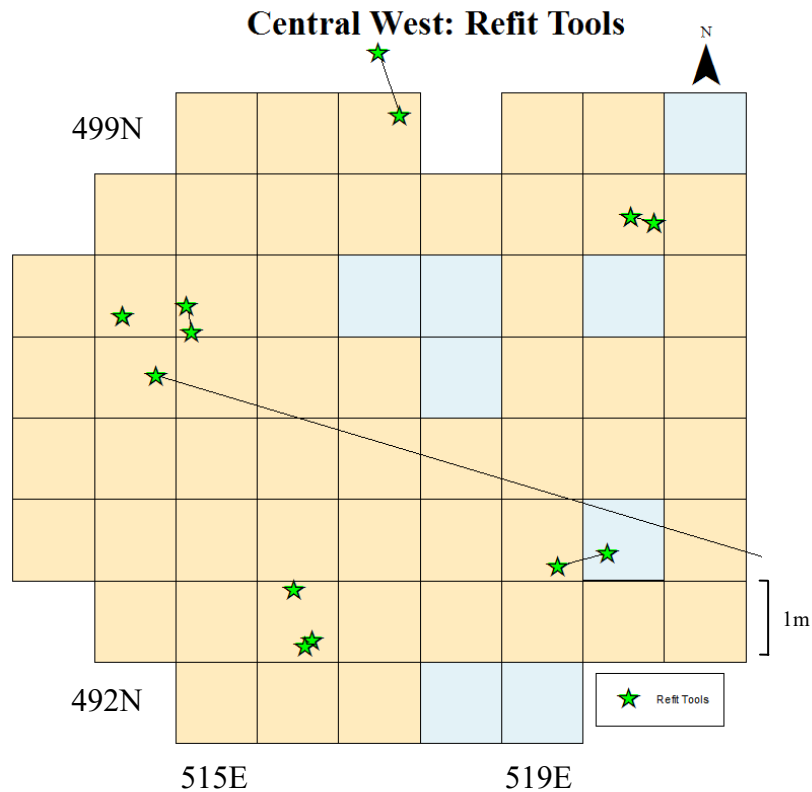


Figure 7.5.8: Refit tools within Central West, including one projectile point base that refit to a tip found 6m west and 21m east. Most other refits are found in close horizontal proximity, but vary vertically up to three levels apart.

7.5.3 Spatial Analytical Results

Kernel Density Estimation (KDE)

The KDE smoothed density contour map demonstrates three distinct clusters, including an area of high density in the northwest of the study area. Many of the tools are

found within or around these clusters (Figure 7.5.9). Though many units are lacking information, these tests were still performed, as distinct high density areas are still visible.

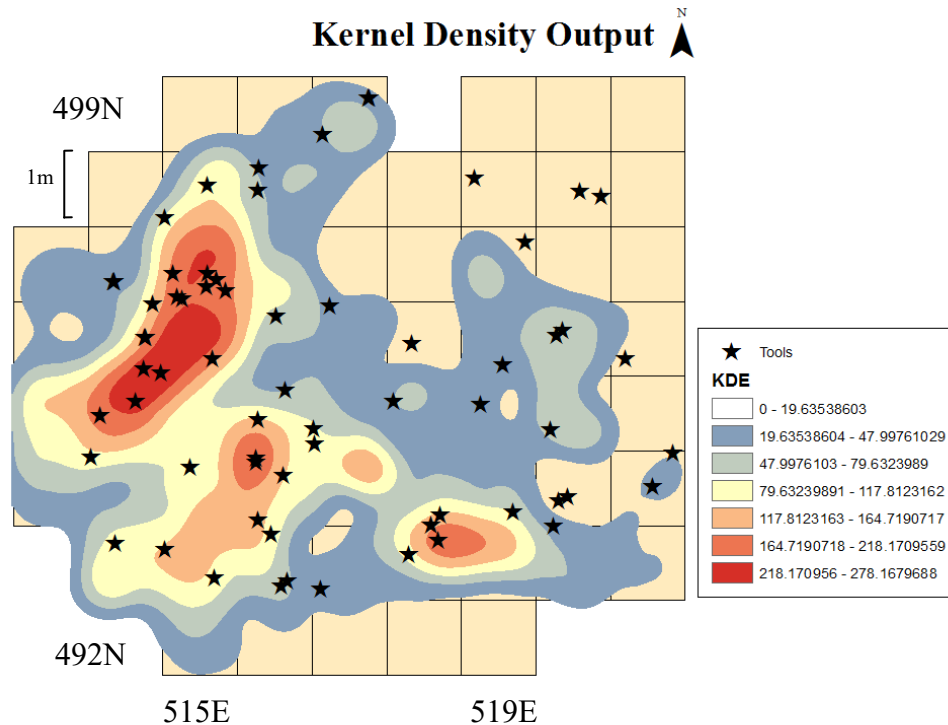
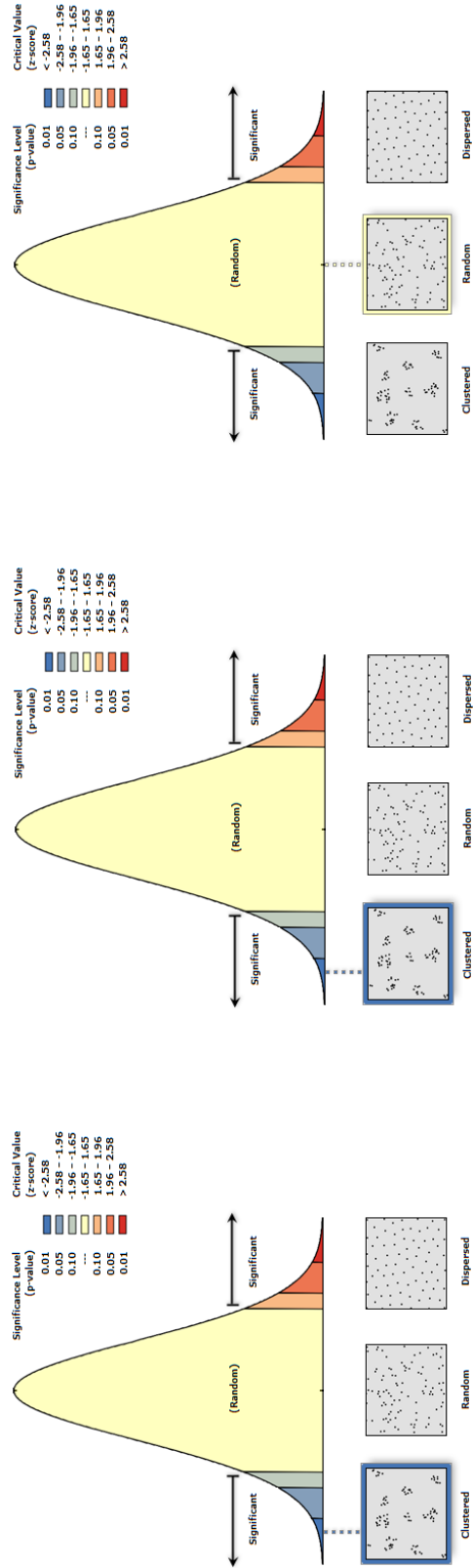


Figure 7.5.9: The smoothed density contour map, which highlights the most dense artifact clusters within the Central West study area. Tool distribution is within and around the periphery of these locations. This map also demonstrates how missing data affects the output, as exemplified by the southeast corner.

Nearest Neighbour

The Nearest Neighbour function in ArcGIS was completed three times: for all artifacts (debitage and tools), all debitage (including shatter), and the lithic tools. All artifacts and all debitage demonstrate clustering, whereas the tools are considered random (Figure 7.5.10).



Given the z-score of -1.29, the pattern does not appear to be significantly different than random.

Given the z-score of -24.00, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -24.38, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Figure 7.5.10: The Nearest Neighbour outputs for all artifacts, all debitage, and the tools, respectively. The analysis for this Central West study area suggests that debitage is clustered, and tools appear random.

Ripley's K Function

This function was used for all artifacts, all debitage, and tools. All three outputs demonstrate a degree of clustering, although tools only appear weakly clustered (Figure 7.5.11).

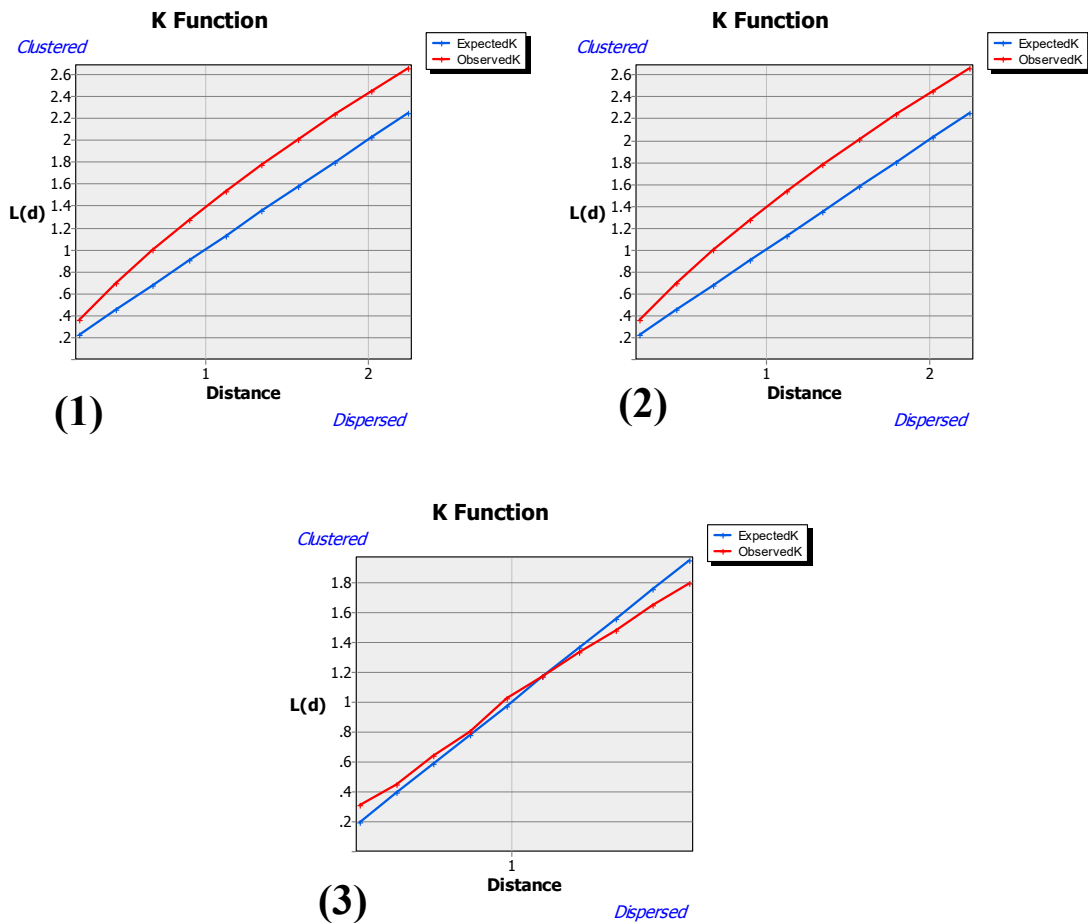


Figure 7.5.11: These three outputs from the Ripley's K analysis demonstrate clustering for Central West study area artifacts (1), and debitage (2). Conversely, tools (3) only appear clustered up to a certain distance.

K-means (Pure Locational Clustering)

K2 to K10 was tested for all debitage, and all tools. The $\% \log_{10}$ SSE graph suggests that K5, or five clusters, is the optimal cluster solution for the Central West study area (Figure 7.5.12). However, the graphs also highlight other cluster solutions, and there are some inconsistencies between the five cluster solution for 'debitage' and the five cluster solution for 'tools'. Thus, K5 was used as a general guideline for the interpretation of clusters in tandem with the KDE output (Figure 7.5.13), and visual comparisons of the artifact distribution. These clusters are referred to as Central West A to Central West E.

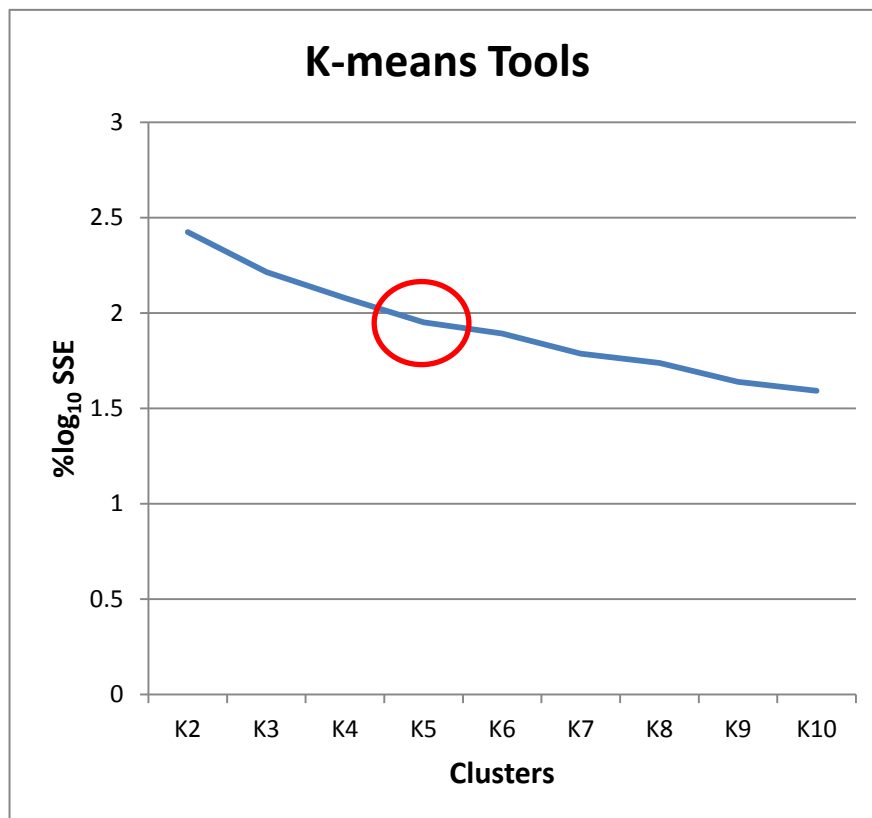
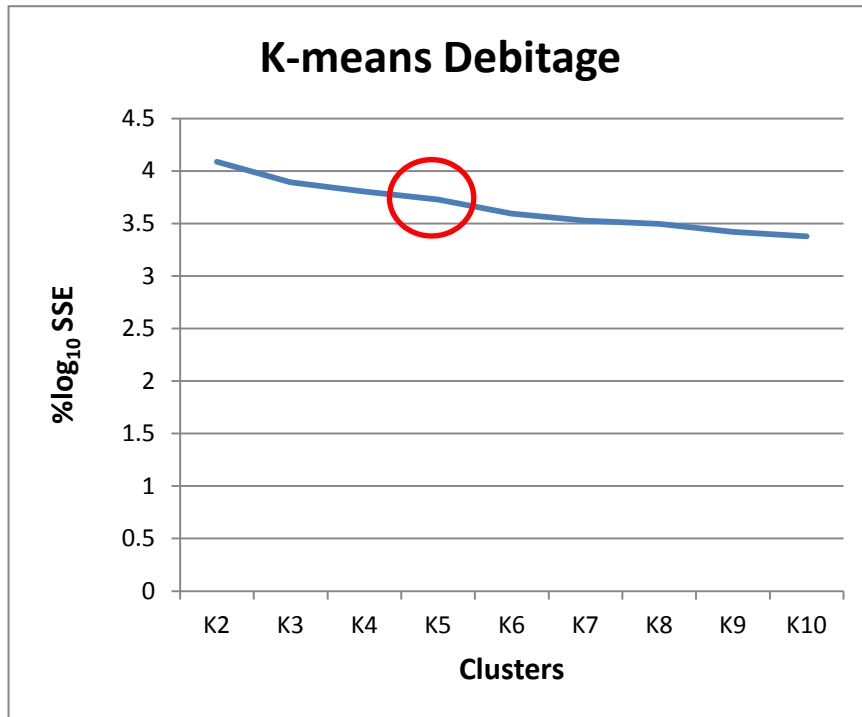


Figure 7.5.12: These graphs represent the $\% \log_{10}$ SSE outputs from the SPSS program. A bend, or “elbow” suggests an optimal cluster solution for the Central West study area. Thus, five clusters were used for further exploratory analysis.

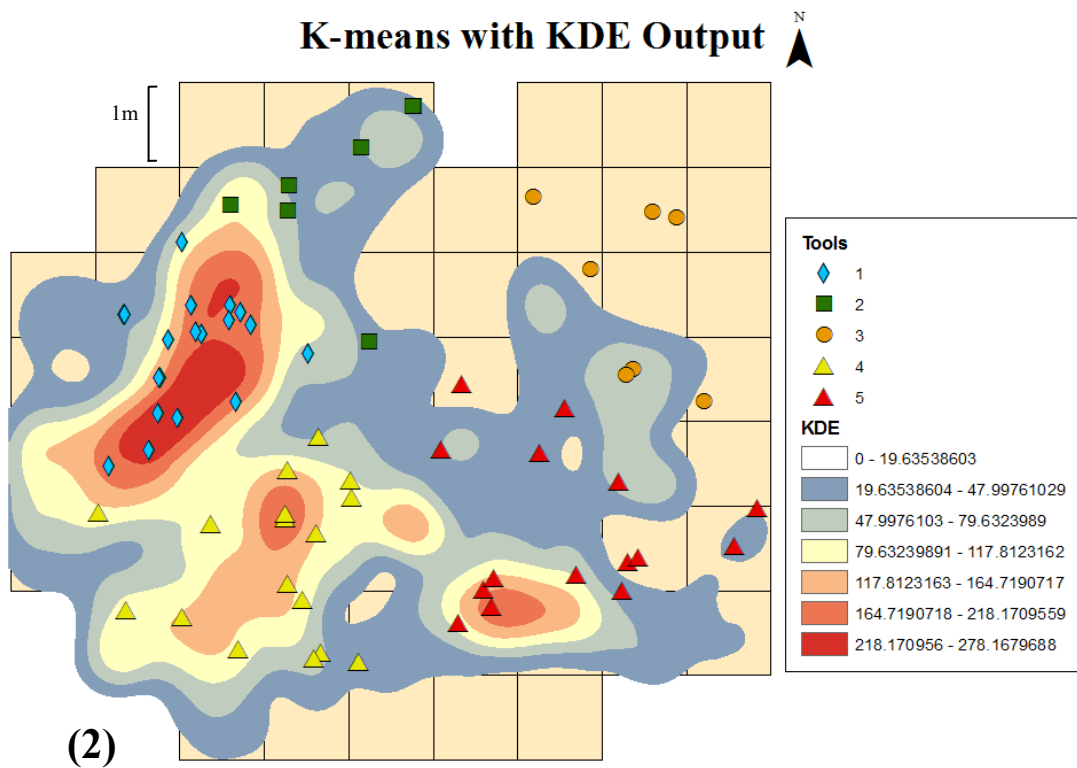
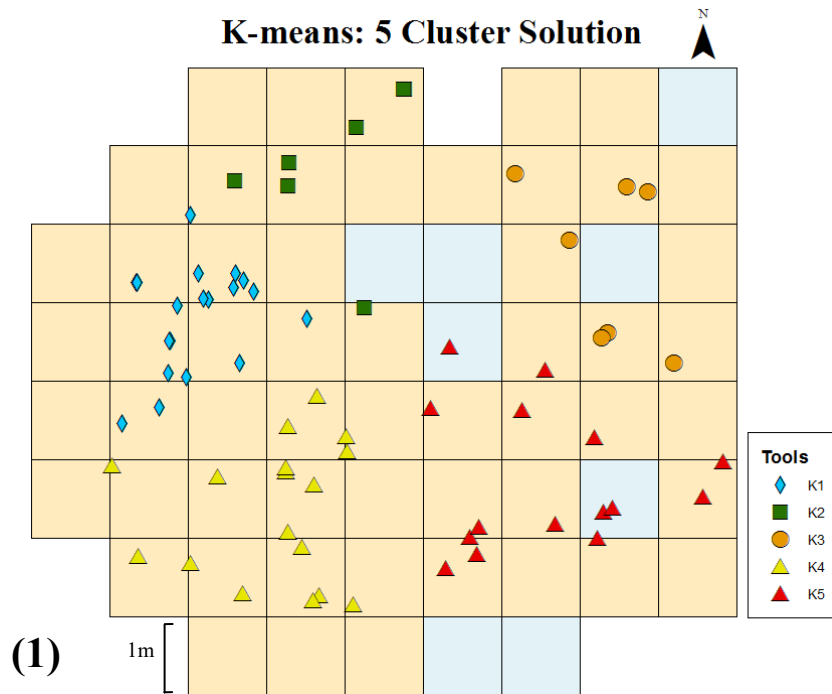


Figure 7.5.13: The map on the top (1) demonstrates the five cluster solution for tool recoveries, as determined through the $\% \log_{10}$ SSE tests. The map on the bottom (2) displays the same five cluster solution superimposed on the KDE smoothed contour map. Note: clusters K1 – K5 as shown here coincide with Central West Clusters A to E in section 7.5.4.

7.5.4 Cluster Composition

This section outlines the composition of the five clusters (Central West A to Central West E) determined through a combination of K-means and SSE tests, as well as visual comparison and the KDE analysis.

Central West A

This northwest cluster contains the majority of tool recoveries from the Central West (Figure 7.5.14 A). There are a total of 21 tools, including three refits. Tool recoveries include three projectile points, seven bifaces, four drills, one preform, two scrapers, one retouched flake, and three hammerstones.

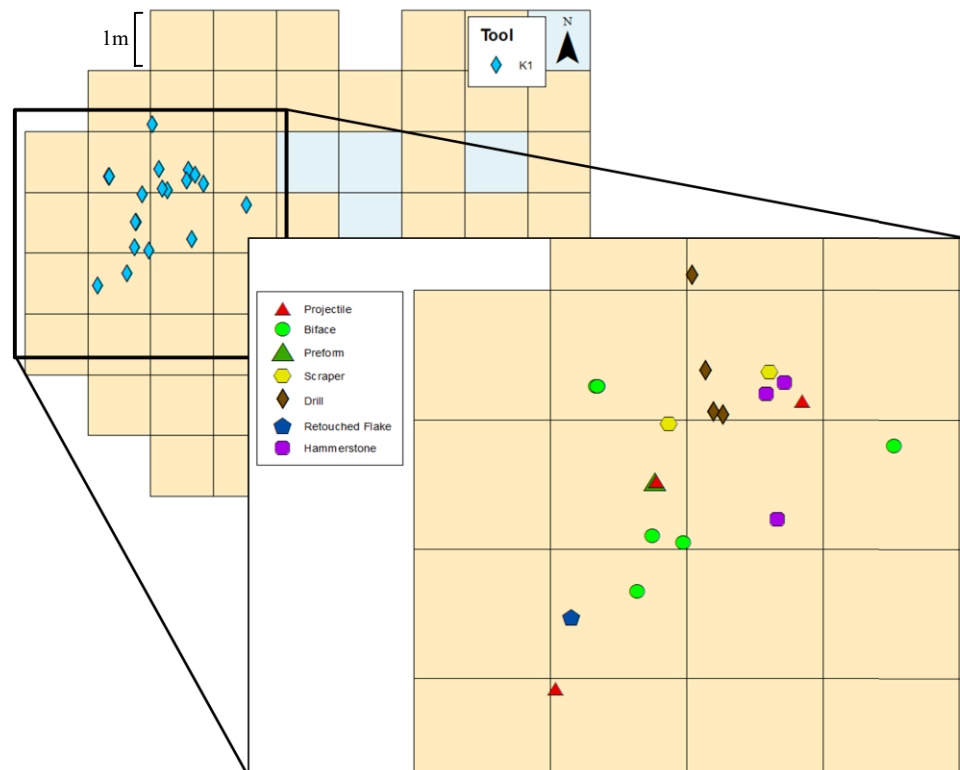


Figure 7.5.14A: Location of Cluster A within the Central West study area. Inset: Tool distribution within Cluster A.

Staged bifaces include three UID, three at Stage 4, and one at Stage 3. All tool recoveries aside from hammerstones and scrapers are broken. Additionally, the majority of preforms within the study area are located in Cluster A including one preform, one scraper, one projectile point, and three drills. Aside from the hammerstones and one gunflint silica scraper, all tools were manufactured out of taconite.

Microdebitage is highly clustered within units 497N/515E and 496N/515E. This exhibits a SW to NE pattern, similar to the overall debitage distribution pattern (Figure 7.5.14 B). Level forms indicate that a large percentage of the microdebitage within unit 497N/515E consisted of finishing flakes. Primary flakes are sparse but generally found within the primary cluster area. Conversely, large debitage (25-50+mm) is scattered throughout much of this area. Interestingly, non-Gunflint Formation material including chert, mudstone, and quartz are tightly clustered within and just south of 497N/515E.

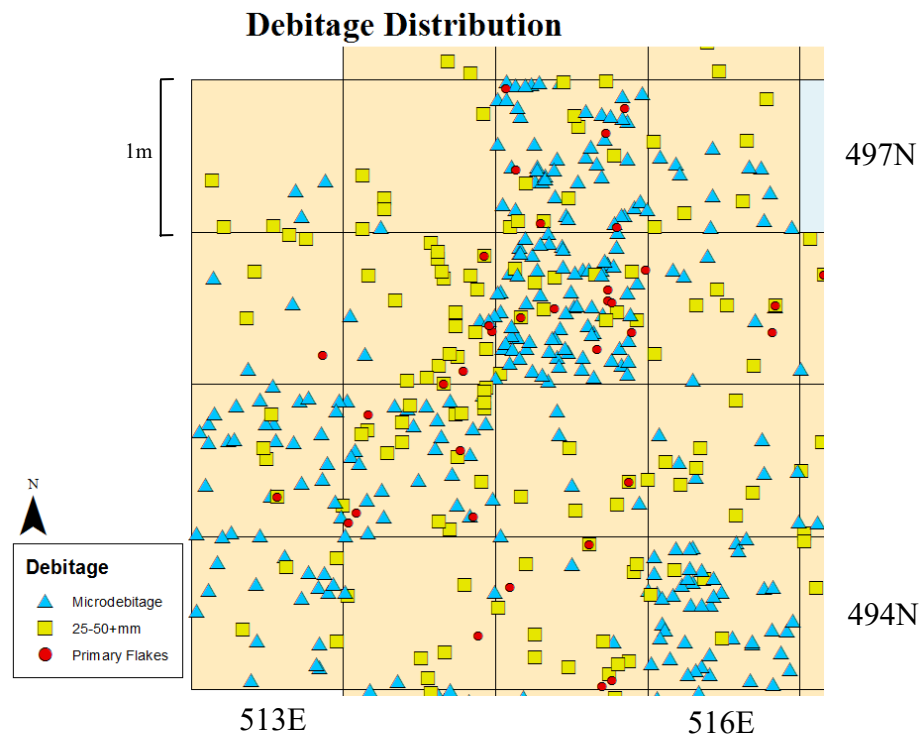


Figure 7.5.14B: Debitage distribution throughout Central West Cluster A.

High artifact density was associated with large rocks in units 496N/514E and 496N/515E. A number of rocks were uncovered between these two units, especially in the southern quads (n=4 in Levels 2 and 3, and n=2 in Levels 5 and 6). Though these units consisted of sand with small gravel, especially in the west, the size of these rocks is noteworthy (for example, 32cm x 9cm or 14cm x 16cm). Therefore, these rocks were likely not part of the natural deposition and thus, suggest a cultural cause.

Stump disturbance was noted towards the east which caused some wall collapse during excavation, and could not be removed until Level 6. Level forms indicate that some units along the western boundary had sloping surfaces which would affect the vertical interpretation of arbitrary levels.

Central West B

This cluster is located to the northeast and east of the high density Cluster A (Figure 7.5.15 A). Missing data along the 497N line creates a void between this cluster, and Cluster C to the east, splitting the tools into two groups, while the debitage is considered one cluster. Due to the information gap, this analysis followed the tool clusters, splitting this area into Cluster B and Cluster C.

There are a total of seven tools within Cluster B, including one refit. This refit is a parallel projectile point base that refits to an item to create the complete specimen. The biface (Stage 3), scraper, and one of the retouched flakes are also complete which differs from the lack of completes in Cluster A. Other tool recoveries include one uniface, one undetermined tool, and a second retouched flake. The amethyst uniface is the only tool manufactured out of non-Gunflint Formation material.

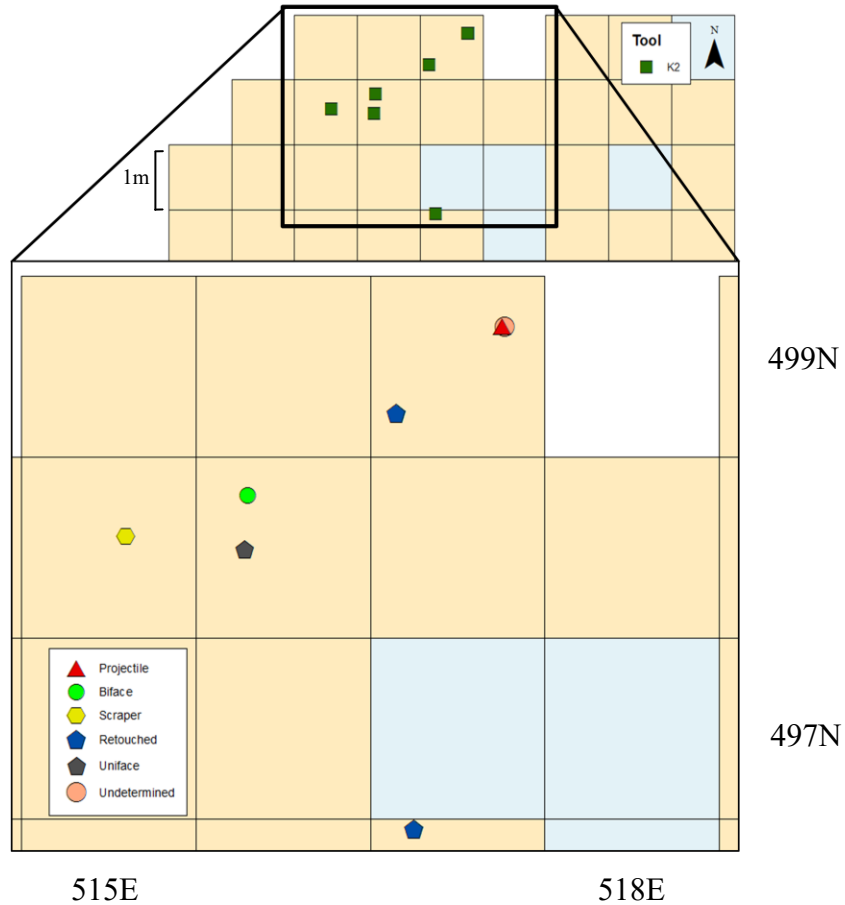


Figure 7.5.15A: Location of Cluster B within the Central West study area. Inset: Tool distribution within Cluster B.

Of note is the almost complete lack of primary debitage, and microdebitage within this cluster. Larger 25-50+mm sized debitage is more numerous but dispersed, perhaps from the high density cluster to the southwest (Figure 7.5.15 B).

The presence of soil staining and charcoal suggests a potential area of interest in Cluster B. Unit 499N/516E recorded FCR for Levels 2 to 5, with ochre found throughout. In unit 498N/515E, a potential hearth feature was recorded when FCR appeared in the southern quads of Levels 5 and 6. Charcoal concentrations were found throughout Level 7 and the northern quads of Level 8, while a charcoal sample was taken from Levels 8

and 9 (Figure 7.5.15 C). Charcoal concentrations were surrounded by grey silty sand and orange silty sand which continued until Level 11. The charcoal sample has not been dated.

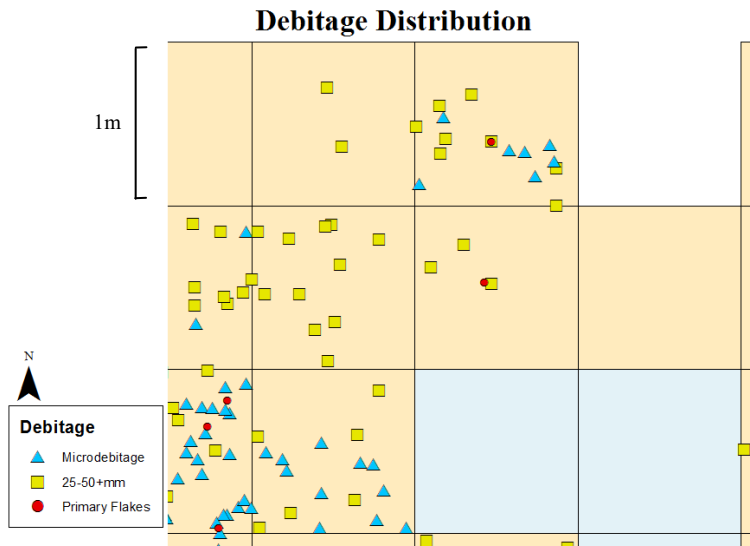


Figure 7.5.15B: Debitage distribution for Central West Cluster B.

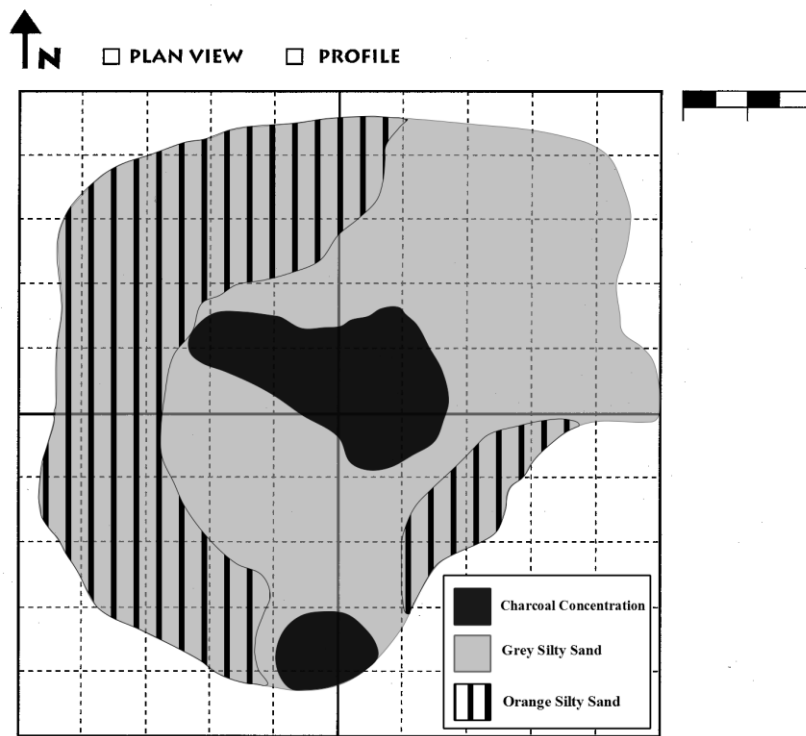


Figure 7.5.15C: Potential hearth as mapped in Level 9 of unit 498N/515E.

Central West C

The cluster in the northeast of the study area includes one refit (a Stage 2 biface). All seven tools were manufactured from taconite, including one projectile point base (constricting and deep), five bifaces, and one complete retouched flake (Figure 7.5.16 A). Bifaces include two at Stage 2, and one Stage 4; two items were not staged. Although two units were not in the catalogue, it is evident that primary and microdebitage was almost completely absent. Large debitage (25-50+mm) was noted in the southwest between the two missing units at 497N/519E, although these recoveries are also sparse (Figure 7.5.16 B).

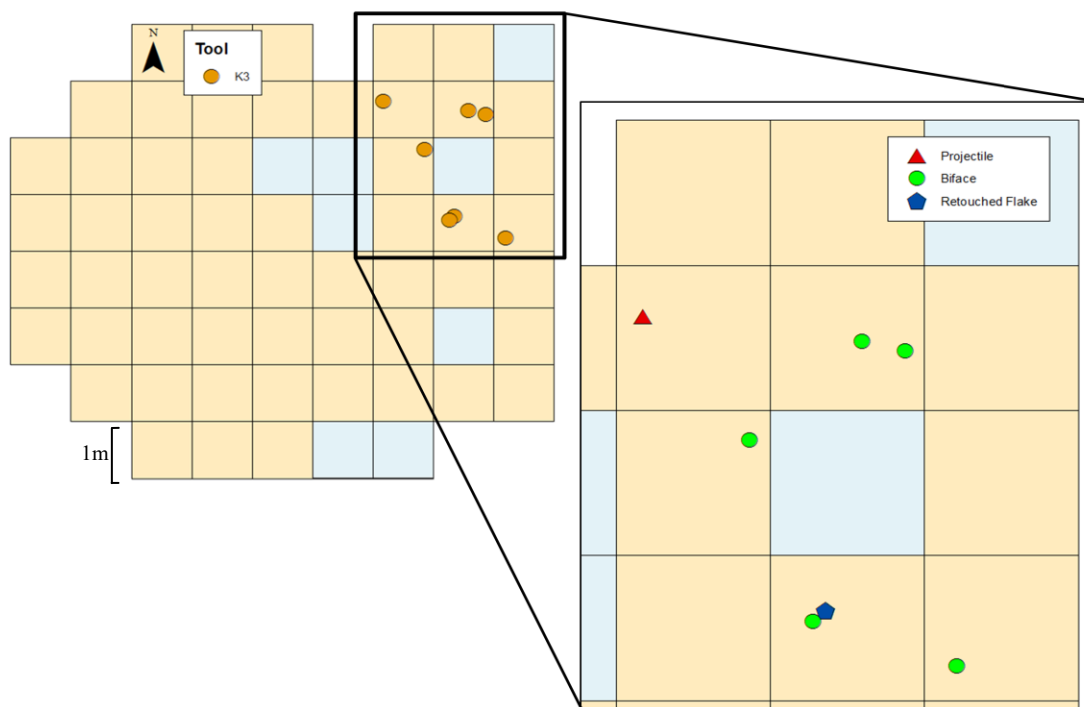


Figure 7.5.16A: Location of Cluster C within the Central West study area. Inset: Tool distribution within Cluster C.

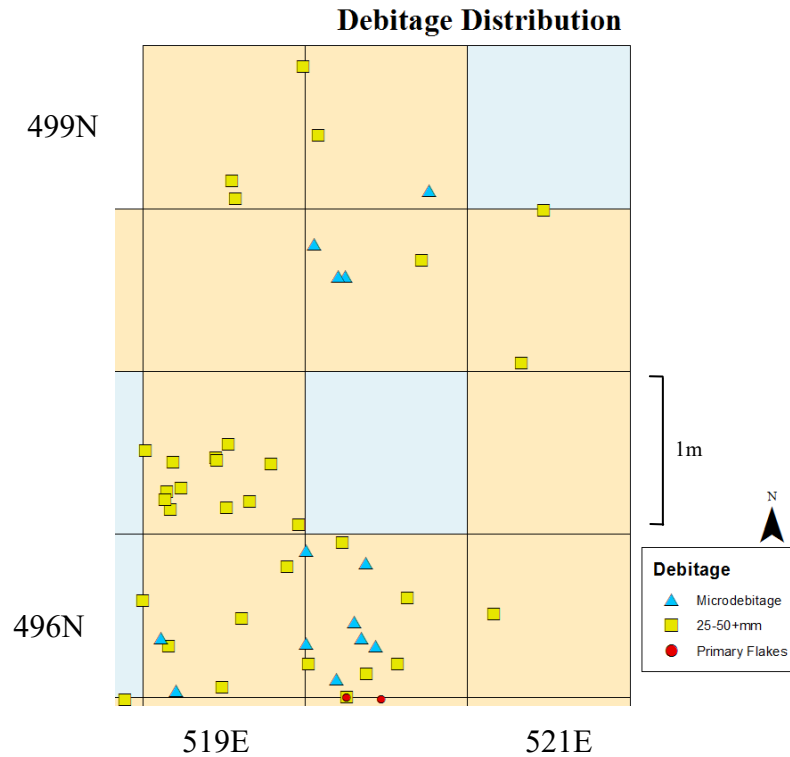


Figure 7.5.16B: Distribution of particular debitage types within Central West Cluster C.

These debitage clusters were likely affected by a stump located in the east. Two units contained rotten wood down to Levels 4 and 5. Rotten wood and roots were a prominent theme in many level notes. A number of ochre items and charcoal samples were found in unit 497N/518E although the two large stumps in the western quads created ample root disturbance.

Central West D

This southwestern cluster contains a total of 16 tools, ranging from Level 1 to 5, although most were recovered from within Level 2 (5-10cm dbs). Tool recoveries include eight projectile points (including constricting and eared morphological shapes), four bifaces, one knife, one grinding stone, one drill, and one core fragment. Staged bifaces include one Stage 2, two at Stage 3, and one Stage 5 (with a frequency of 2). Six of the

eight projectile point fragments are bases, whereas the rest of the assemblage consists mostly of tip fragments, and no complete specimens. One gunflint silica biface tip was recovered, as was a mudstone projectile point, and one unspecified grinding stone (Figure 7.5.17 A).

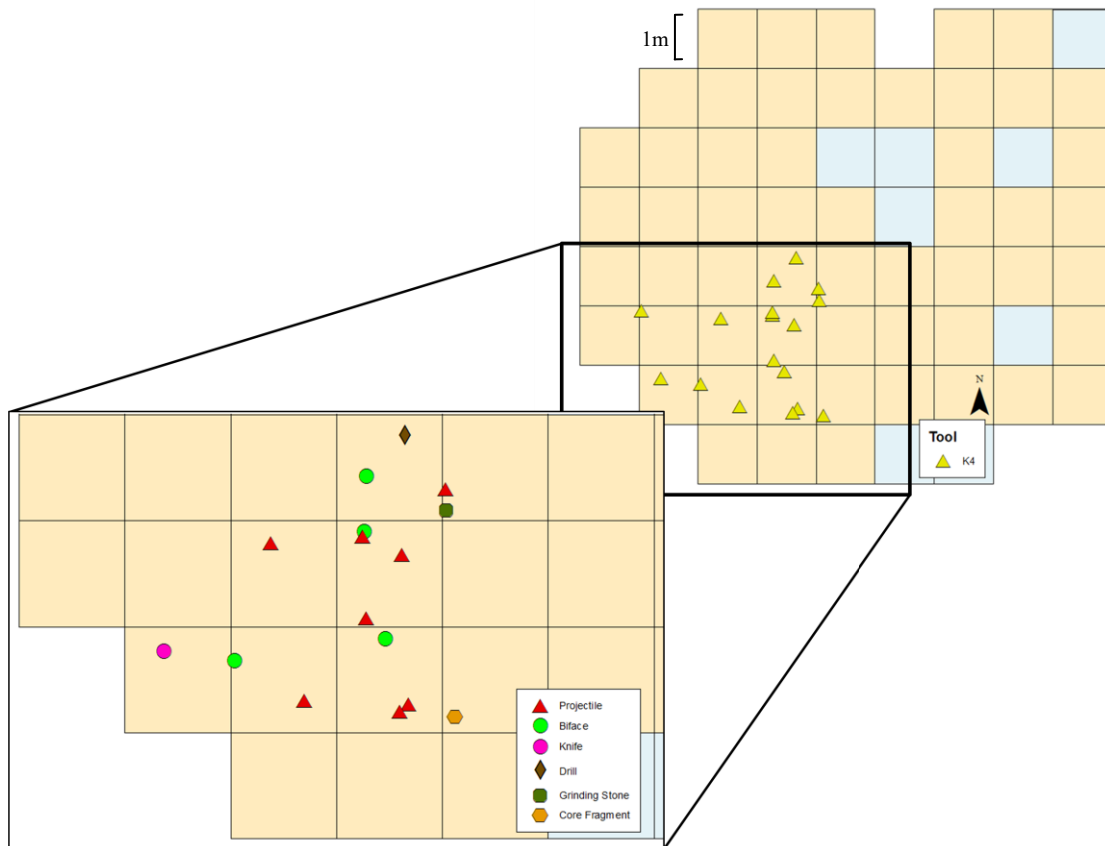


Figure 7.5.17A: Location of Cluster D within the Central West study area. Inset: Tool distribution within Cluster D.

Microdebitage appears clustered within units 493N/514E and 494N/516E, whereas large debitage (25-50+mm) is scattered throughout Cluster D. Primary flakes appear more frequently in the southern portion of the cluster (Figure 7.5.17 B). Raw material distribution demonstrates both chert and quartz clusters in the southwest, with the most dense gunflint silica distribution in unit 494N/516E with the gunflint silica

biface. Though a mudstone projectile point was recovered, no mudstone debitage was recorded.

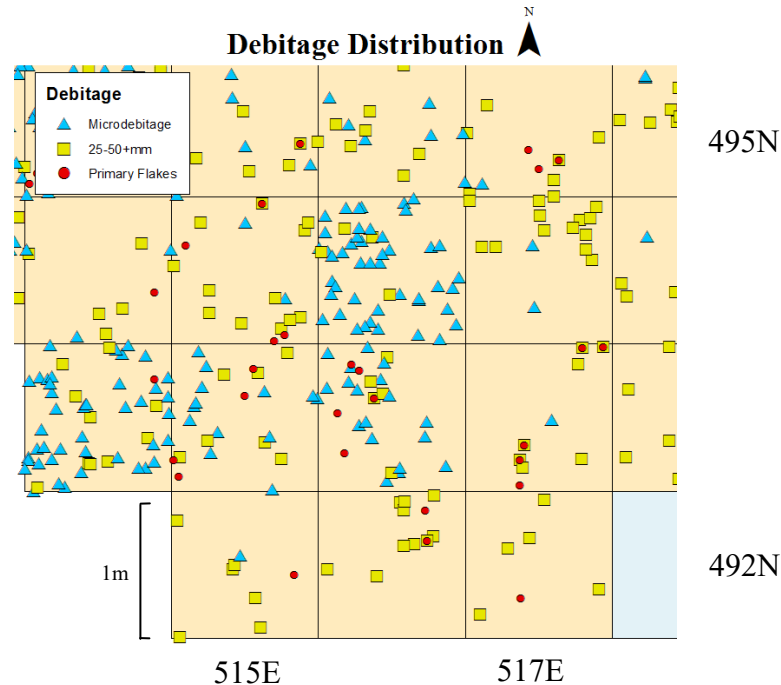


Figure 7.5.17B: Distribution of particular debitage types within Central West Cluster D.

Some disturbance was noted including 10-15cm of overburden from Ministry of Transportation (MTO) soil sampling in the southern quads of unit 493N/515E. A Stage 2 Assessment test pit was recorded for the NEQ of unit 493N/516E, and the adjoining NWQ of 493N/517E. The SEQ of unit 495N/517E also contained a Stage 2 test pit to a depth of ~20cm dbs.

Large rocks were again noted adjacent to dense artifact recoveries in the eastern quads of unit 494N/514E (measuring 15cm x 10cm, and 14cm x 16cm). A potential feature was noted 2m east of this within an area of high artifact density. Dark silty sand appeared in Level 6 of unit 494N/516E, with FCR in Level 7 (Figure 7.5.17 C). One unit to the east contained a large flat rock (30cm x 20cm x 6cm) in the NEQ of Level 4 and

associated with a large flake cluster. The majority of artifacts were contained to the northern quads (with a Stage 2 Assessment test pit in the SEQ). FCR was also found in the northern quads of unit 494N/517E from Levels 9 to 11 (Figure 7.5.17 D).

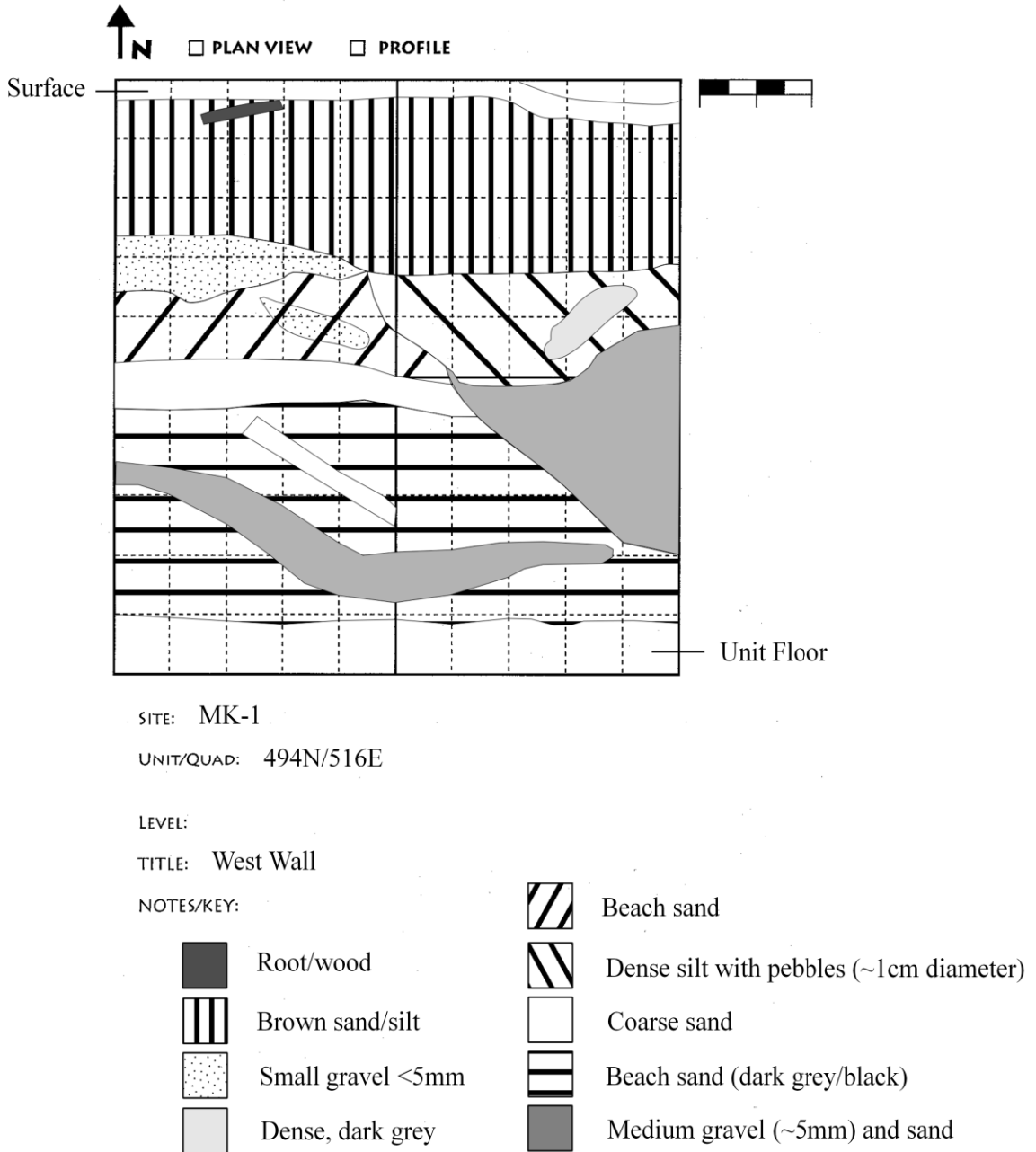


Figure 7.5.17C: Western wall profile of potential pit feature in unit 494N/516E.

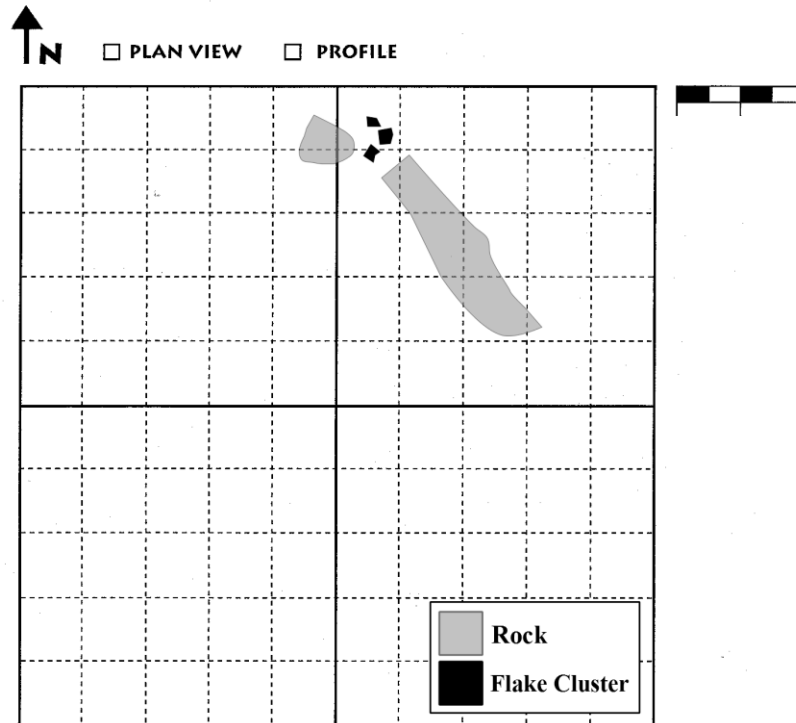


Figure 7.5.17D: Floor plan of Level 5 from unit 494N/517E. Note: large rock in NEQ was present from Levels 3 to 8. Flake cluster located on map included three large refit flakes.

Central West E

Fifteen tools were identified within this cluster, all of which are broken except for one complete core and one complete retouched flake (Figure 7.5.18 A). Other recoveries include four projectile points (including constricting, and parallel morphological shapes), seven bifaces, one drill, and a second retouched flake. Staged bifaces include one Stage 2, three at Stage 3 (one with a frequency of 2), and two at Stage 4; the Stage 6 biface was later interpreted as a projectile point (Bennett 2015). All tools were made of taconite aside from one biface tip that was manufactured out of gunflint silica and one drill tip manufactured from chert. The southeast cluster contains one refit (n=3) located less than a metre apart.

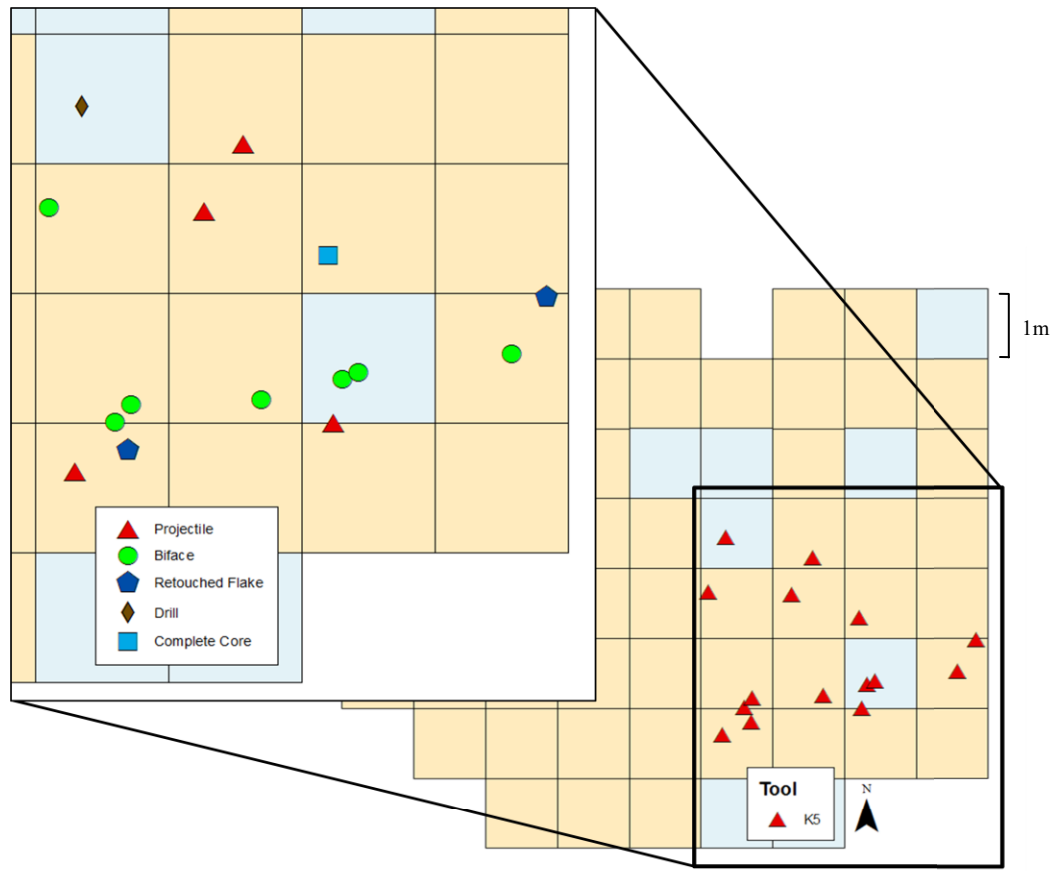


Figure 7.5.18A: Location of Cluster E within the Central West study area. Inset: Tool distribution within Cluster E.

Large debitage (25-50+mm) was clustered along the 493N line, with an additional cluster containing numerous primary flakes near the complete core. Two units in this area were affected by Stage 2 Assessment test pits including the NEQ of unit 493N/521E and the eastern wall of unit 495N/520E. Few microdebitage flakes were recovered from this area (Figure 7.5.18 B). Unit 493N/518E contained a small cluster of mudstone debitage, specifically in the NEQ.

Interesting features were noted within high density units 493N/518E and 493N/519E. Artifacts in unit 493N/518E were recovered from within a gray sand layer, the bottom of which coincided with artifact sterility at ~55cm dbs (Level 11). Directly to

the east in unit 493N/519E, a possible rock feature consisting of three stone slabs was uncovered from Level 3 to 5 in the SEQ, with an associated flake cluster in the northern quads (Figure 7.5.18 C).

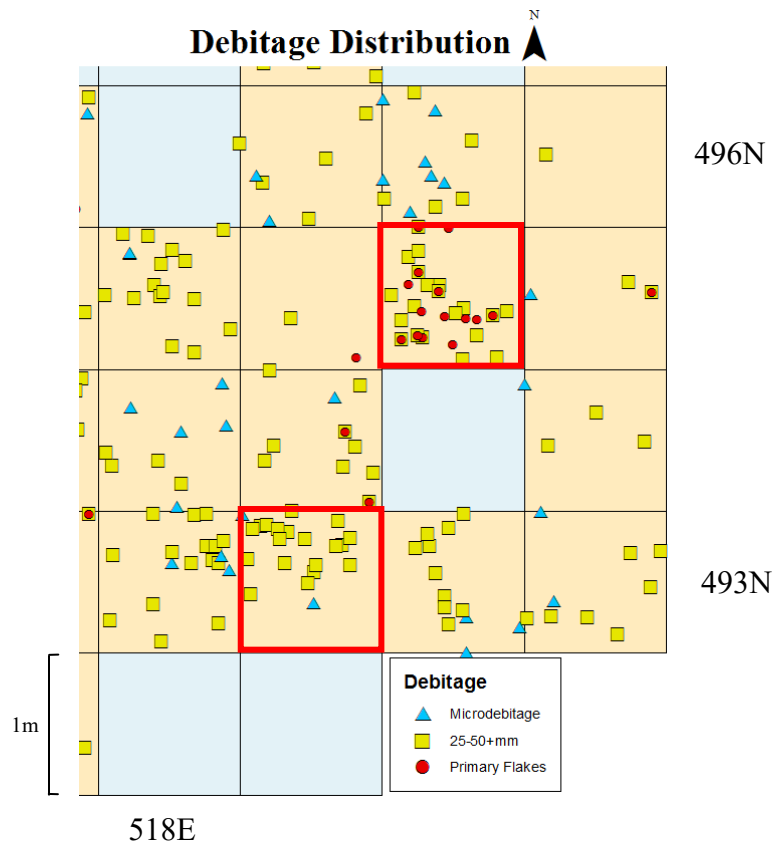


Figure 7.5.18B: Distribution of particular debitage types within Central West Cluster E. Note: Red squares highlight areas discussed in more detail in section 8.2.4 in Chapter 8.

Also of note are units 495N/520E and 495N/521E. Unit 495N/520E contained one complete core, and numerous 50+mm and primary flakes, as well as large rocks in the east measuring 15cm x 12cm and 23cm x 23cm. Potential FCR was recovered in unit 495N/521E through Levels 2 and 3.

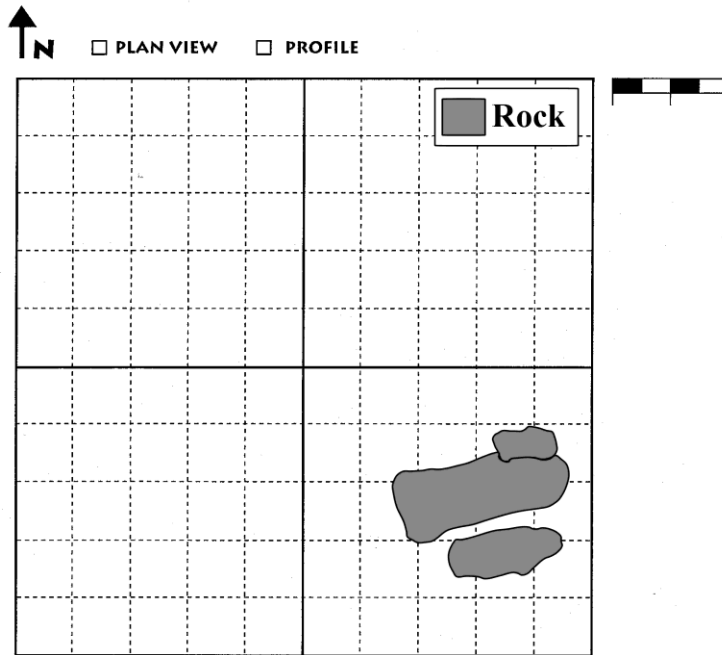


Figure 7.5.18C: Possible rock feature mapped in Level 4 of unit 493N/519E.

7.6 EAST STUDY AREA:

7.6.1 Visual Comparison

Horizontal Distribution

Modern topography demonstrates a relatively flat area at 246m asl, that slopes down towards the river gorge immediately east of the block (Figure 7.6.1). A large bedrock exposure begins around ten metres to the east. Engineer soil sampling that was completed prior to excavation occurred along the southern border of this study area, potentially impacting some of those units. A lack of linear patterns between debitage sizes suggests limited post-depositional, horizontal size sorting. Additionally, recorded FCR appears to fall in two distinct clusters around units 506N/526E and 509N/528E.

Five units are not in the catalogue, including units 507N/531E, 511N/527E, 510N/524E, 509N/523E, and 507N/529E.

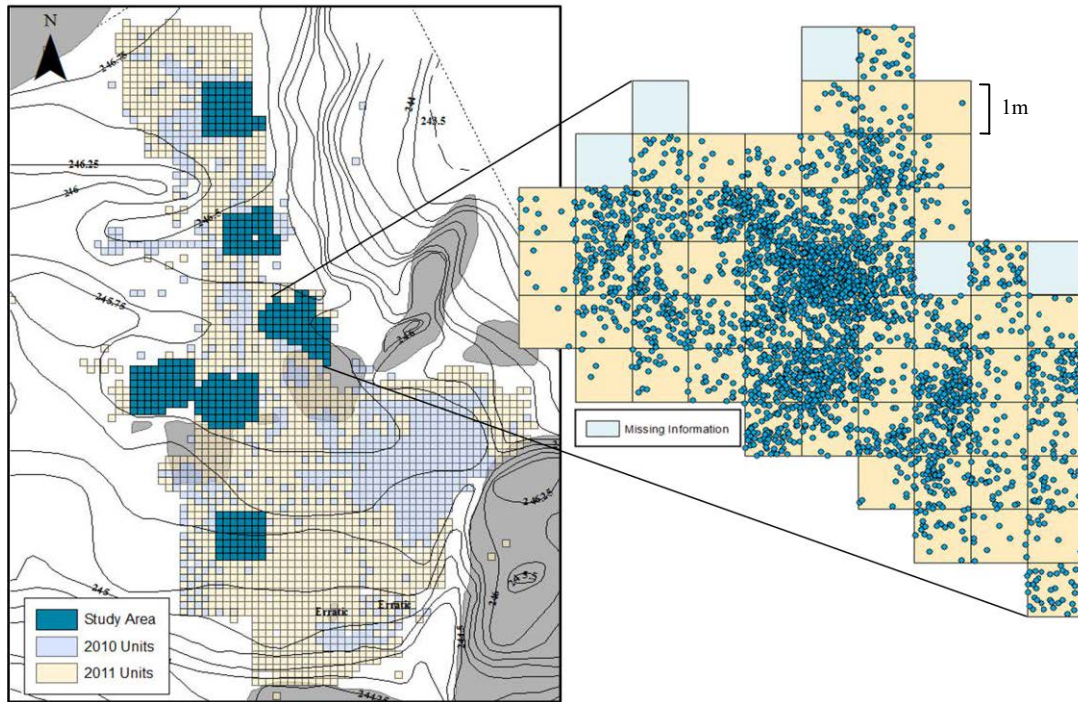


Figure 7.6.1: East study area topography within the Mackenzie I site. Inset: Overall artifact distribution pattern within the East study area.

Tool Distribution

There were 101 tools recovered from the East study area (Figure 7.6.2), with projectile points contributing to 33% of the assemblage (n=34). This study area also includes the greatest number of complete cores (n=7), grinding stones (n=2), retouched flakes (n=13), scrapers (n=5), and the only two reworked tools in this analysis. Of note is the large percentage of unidentified biface fragments (n=12), and the close association of scrapers and drills. As in other study areas, the tools follow the same general distribution as debitage.

One Stage 6 biface may have functioned as a chopping tool, while three Stage 6 bifaces were classified as projectile points and included in the projectile point count (Bennett 2015). Thirteen projectile points within this study area were analyzed by

Markham (2013) and reveal nine distinct morphological shapes including constricting, eared, and parallel varieties (Figure 7.6.3).

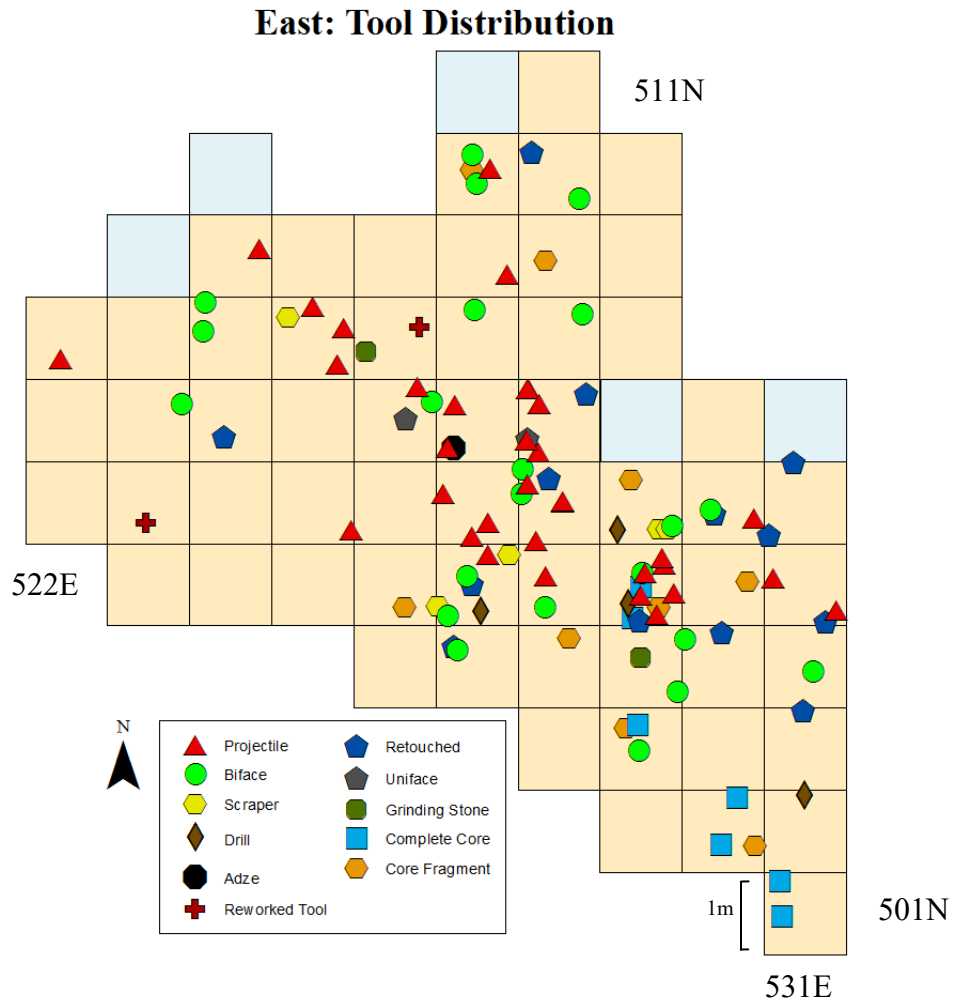


Figure 7.6.2: Tool distribution throughout the East study area. Note: there is an obscured projectile point in unit 506N/528E, as well as unit 507N/528E.

When considering raw material, there were five tools made from gunflint silica, including one projectile point, one retouched flake, and three bifaces. There were three siltstone projectile points, along with two bifaces, one adze preform, and a grinding stone. Other material includes an unspecified grinding stone, and unspecified retouched flake. Siltstone tools were found in close association to siltstone debitage (Figure 7.6.4).

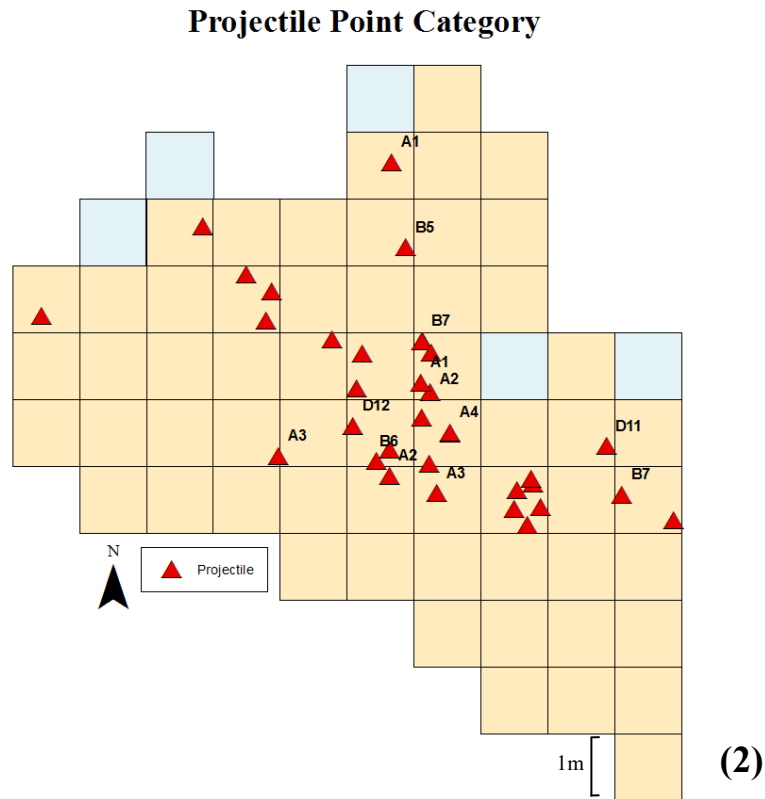
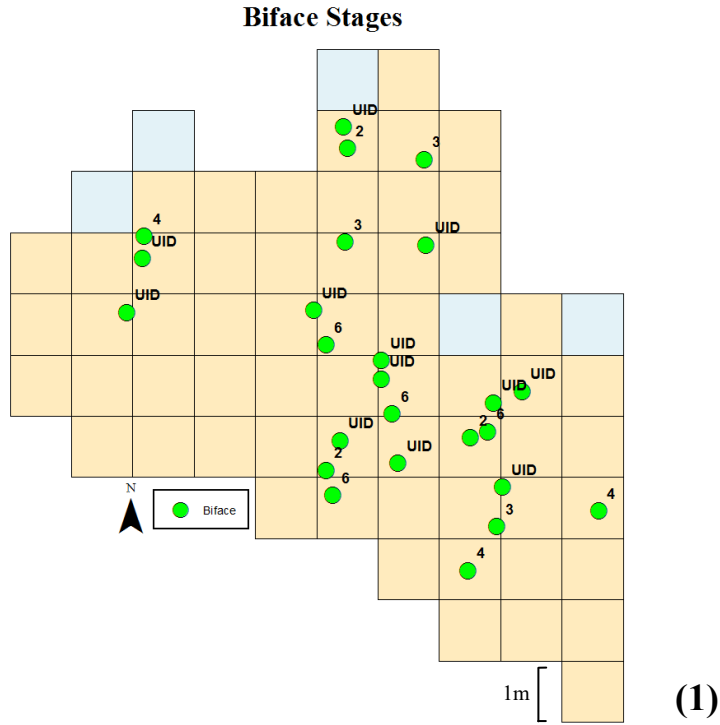


Figure 7.6.3: (1) The biface stages after Bennett (2015); (2) projectile point classification as determined by Markham (2013). Note: unlabelled items were not classified. Three Stage 6 bifaces were classified as projectile points and so included in the projectile point count. The fourth Stage 6 is a potential chopping tool. See Table 4.5.1 for a guide to the projectile point categories.

Distribution of Siltstone Artifacts

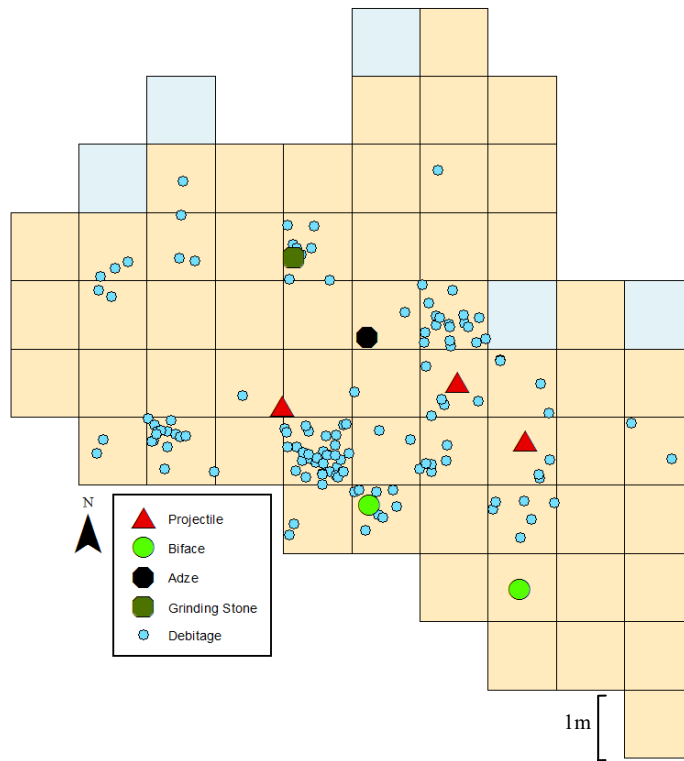


Figure 7.6.4: This map demonstrates the close horizontal proximity of siltstone tools to siltstone debitage.

Debitage Distribution

Primary flakes are dense within the main central cluster, with another small cluster to the southeast. A third cluster is located in the very southeast corner of the study area (Figure 7.6.5). Microdebitage is densest within the centre of the study area, with an additional cluster to the west, and a tightly clustered group along the east border. Larger debitage is fairly dispersed, although the 50+mm fragments are tightly clustered within the southeast corner (some of which are primary flakes).

Many of the non-Gunflint Formation raw materials such as chert, Hixton Silicified Sandstone, siltstone, rhyolite, and quartz are all distinctly clustered in the central to central-east part of the study area (Figure 7.6.6).

East: Debitage Distribution

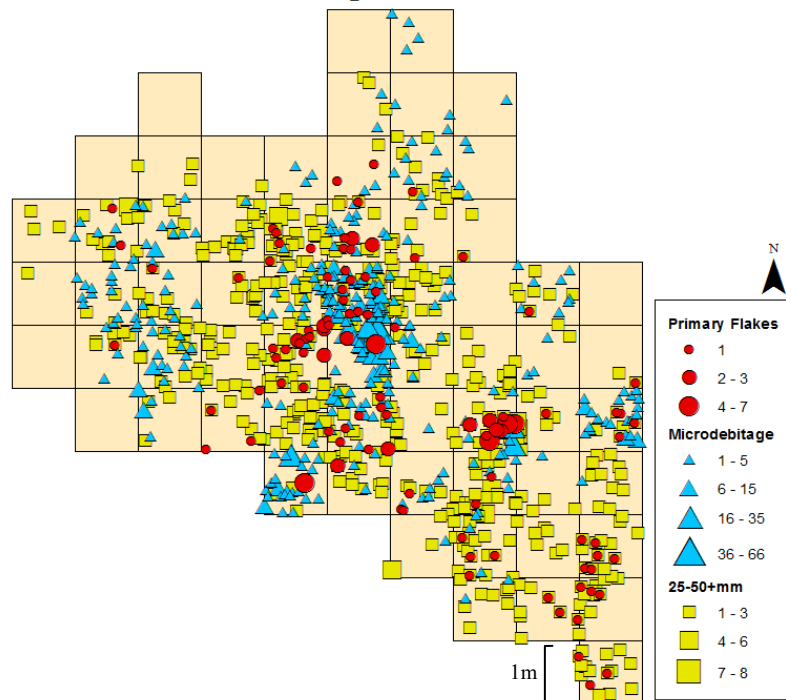


Figure 7.6.5: Distribution of particular debitage types within the East study area. Note: This map excludes secondary debitage (6-25mm) due to its intense frequency.

Debitage Distribution by Raw Material

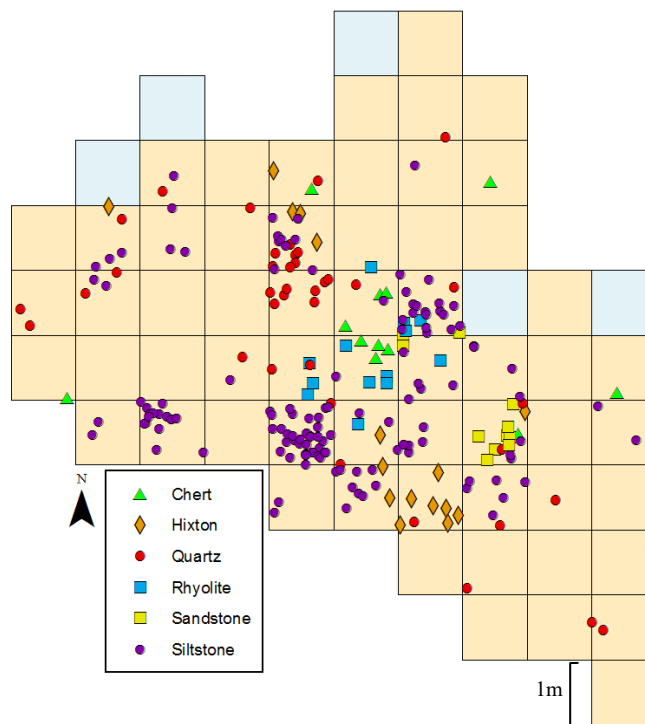


Figure 7.6.6: Distribution of non-Gunflint Formation material within the East study area. While they are all focused around the main density cluster, each material appears distinctly clustered.

Vertical Distribution

Tools recovered from the East study area were recovered from a number of different excavation levels, in part due to the deep pit in unit 505N/529E (Level 18), and 508N/526E (Level 12). Overall, artifacts were recovered in greatest quantities from Levels 3 and 4 (10-20cm dbs; Figure 7.6.7). The greatest frequency of microdebitage occurred in Level 2.

7.6.2 Refit Analysis

There were a total of five refits (n=10) in the East study area (Figure 7.6.8). In Level 5 of unit 508N/526E, two pieces of a grinding stone refit. A taconite projectile point base from Level 4 of unit 506N/528E, refit to the tip from Level 7, one metre south and one metre east. Unit 505N/529E also included two refit taconite midsections from the eastern quads of Level 2. Two taconite projectile point midsections were recovered from Levels 11 and 13 in unit 508N/525E. Lastly, a taconite biface tip along the eastern border refit with a fragment from Stage 2 Assessment excavations, roughly coinciding with unit 479N/515E (25m south and 16m west).

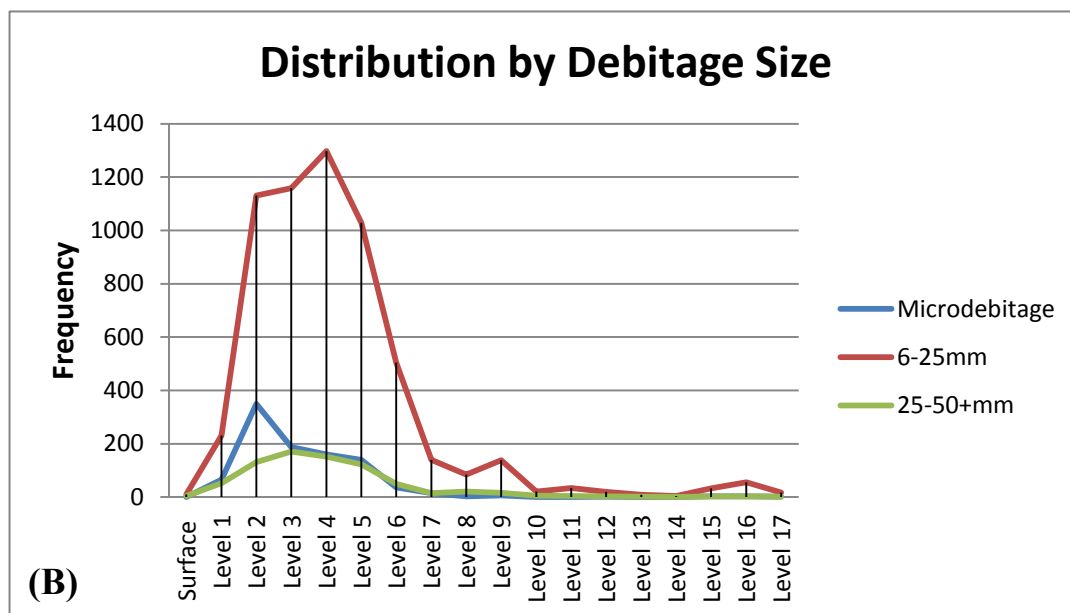
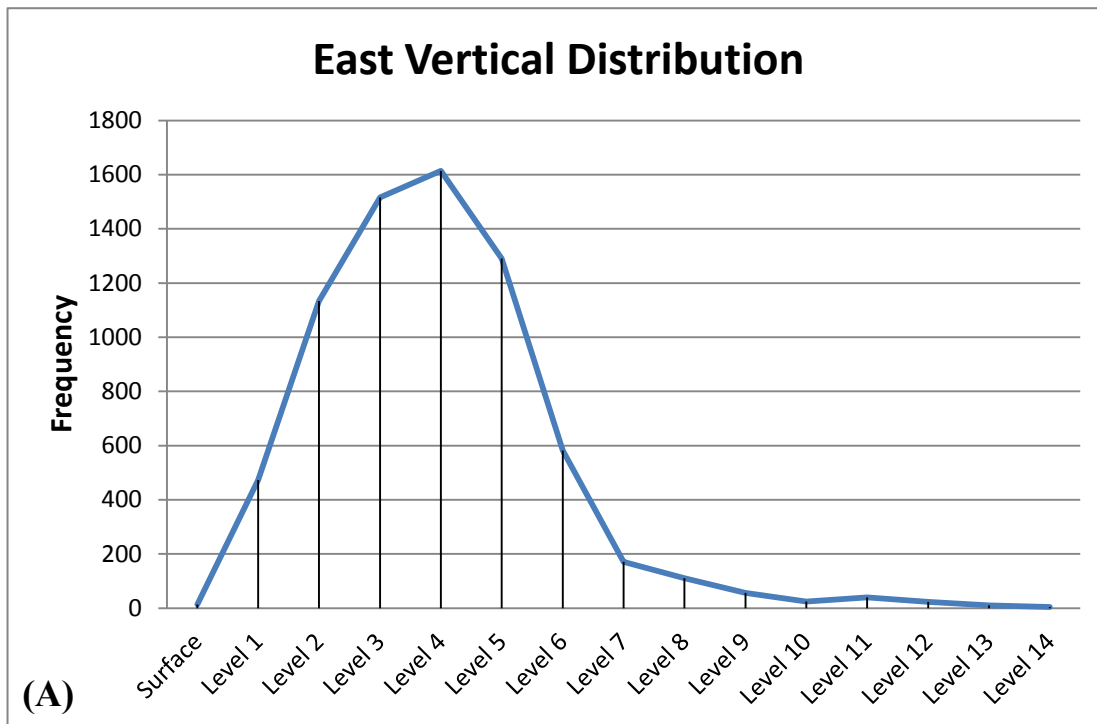


Figure 7.6.7: A) Vertical distribution for artifacts in the East study area, highlighting a peak at Levels 3 and 4 (10-20cm dbs). This chart does not include artifacts recovered from the deep pit in 505N/529E as frequency per level could not be established. Debitage from the eastern quads were bagged together for Levels 2-14, while the SWQ had combined debitage for Levels 5-7, 8-10, and 11-15 (see Cluster East D in section 7.6.4). B) Vertical distribution per debitage size.

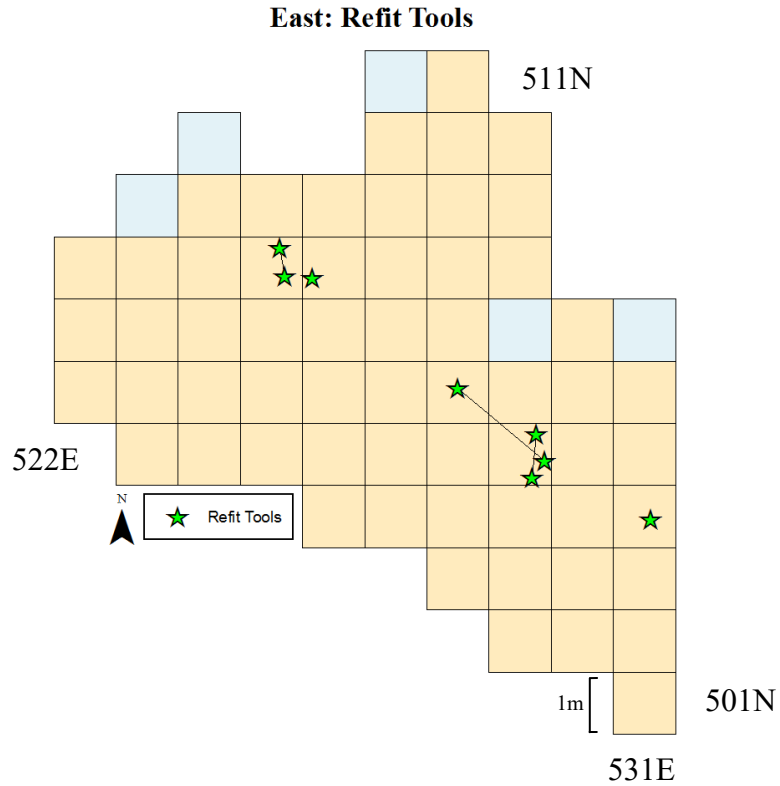


Figure 7.6.8: Refit tools within the East study area. These refits were found within close vertical and horizontal proximity. The biface tip along the eastern boundary, refit to a recovery from the Stage 2 project. This roughly coincides with unit 479N/515E (25m south and 16m west).

7.6.3 Spatial Analytical Results

Kernel Density Estimation (KDE)

The KDE smoothed density contour map demonstrates multiple areas of high artifact frequency (Figure 7.6.9). Although a high density area is centrally located, a particularly heavy recovery of artifacts was uncovered from unit 505N/529E that coincided with a deep excavation.

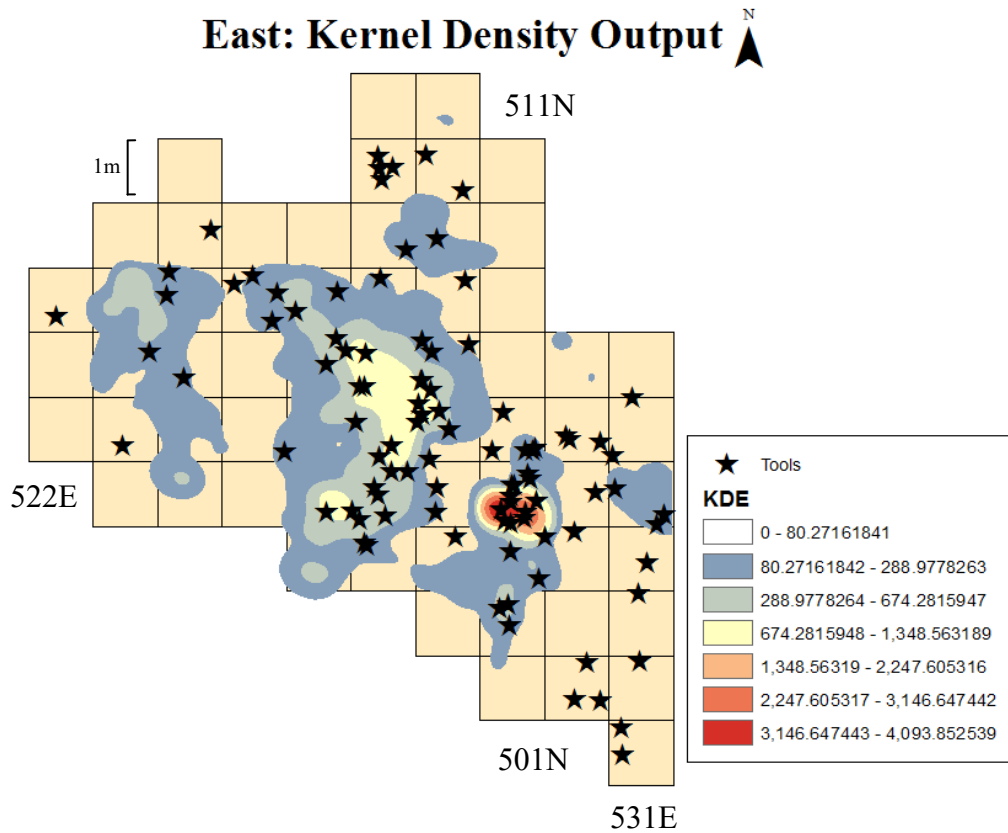


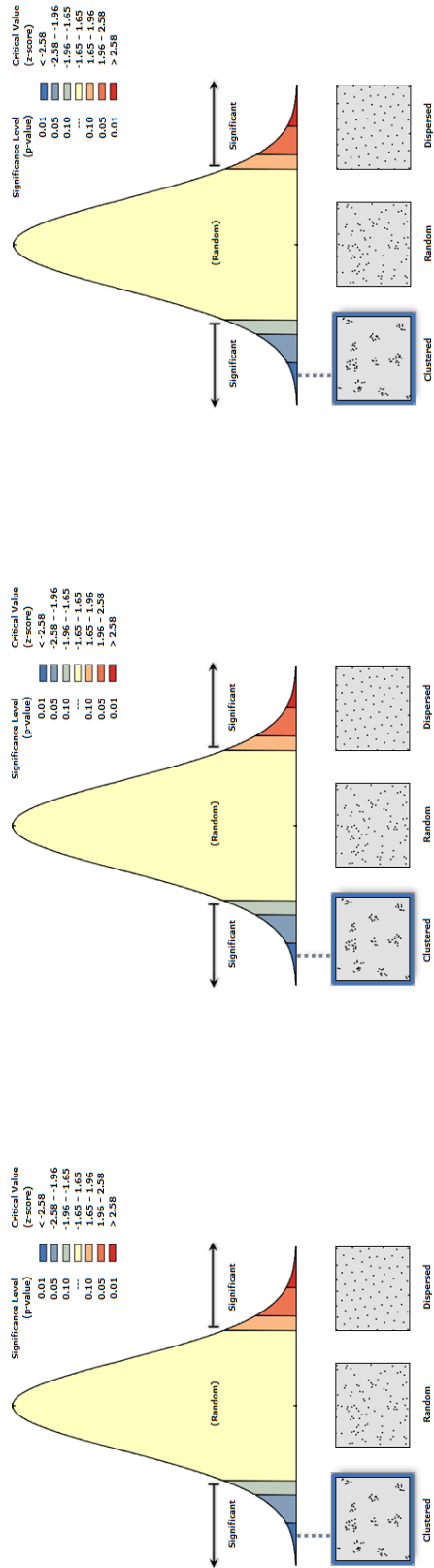
Figure 7.6.9: The smoothed density contour map, which highlights the most dense artifact clusters within the East study area. Tool distribution is within and around the periphery of these locations.

Nearest Neighbour

The Nearest Neighbour function was completed three times: for all artifacts (debitage and tools), all debitage (including shatter), and lithic tools. All three demonstrate clustering (Figure 7.6.10).

Ripley's K Function

This analysis was completed for all artifacts, all debitage, and tools. All three outputs demonstrate a clustered distribution (Figure 7.6.11).



Given the z-score of -30.84, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -30.47, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -4.02, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Figure 7.6.10: The Nearest Neighbour outputs for all artifacts, all debitage, and the tools, respectively. The analysis for this East study area suggests that all three appear clustered.

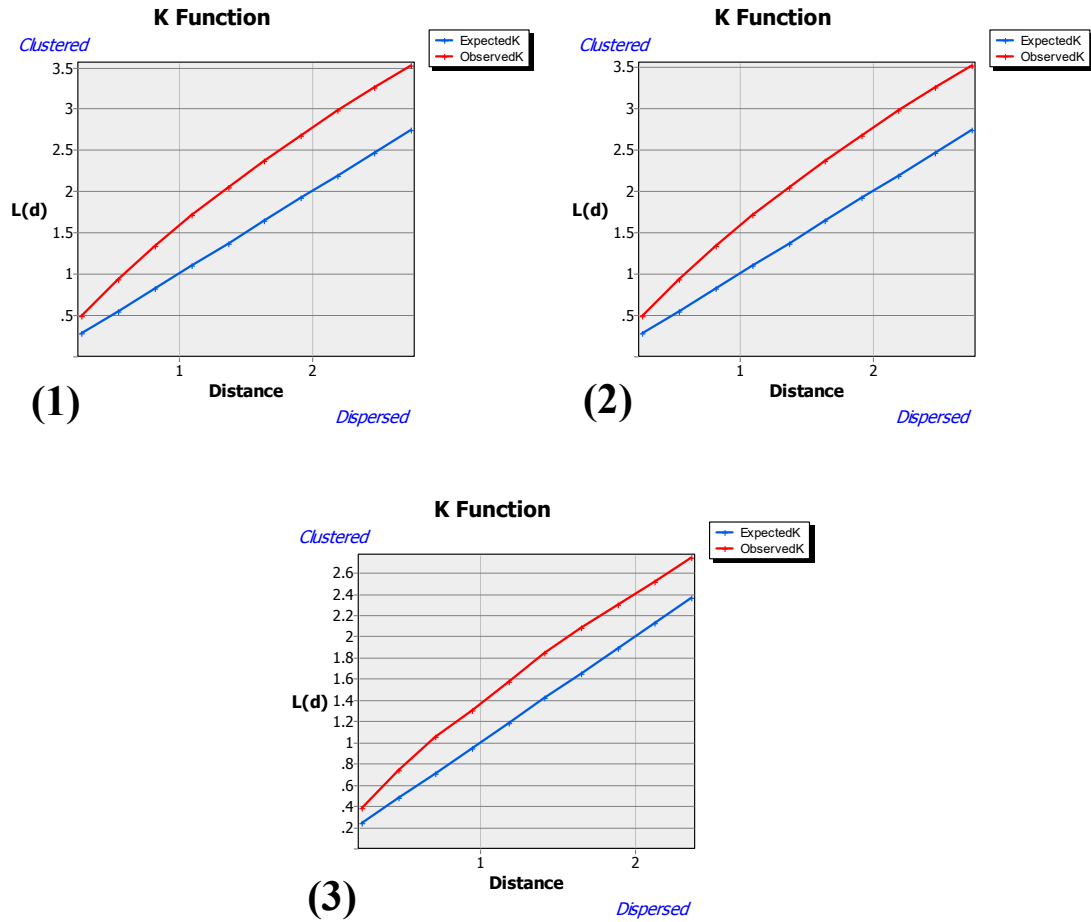


Figure 7.6.11: These three outputs from the Ripley's K analysis demonstrate clustering for East study area artifacts (1), debitage (2), and tools (3).

K-means (Pure Locational Clustering)

K2 to K10 was tested for all debitage, and all tools. The $\% \log_{10}$ SSE graph suggests that K5, or five clusters, is the optimal cluster solution for tools, whereas K4 is optimal for the debitage distribution (Figure 7.6.12). Both pair well with the KDE output, and follow each other relatively closely (Figure 7.6.13). The biggest disparity is the SE debitage cluster, where the tools are split into two. This analysis utilizes the five cluster solution, and split the fourth debitage cluster into two (East A to East E).

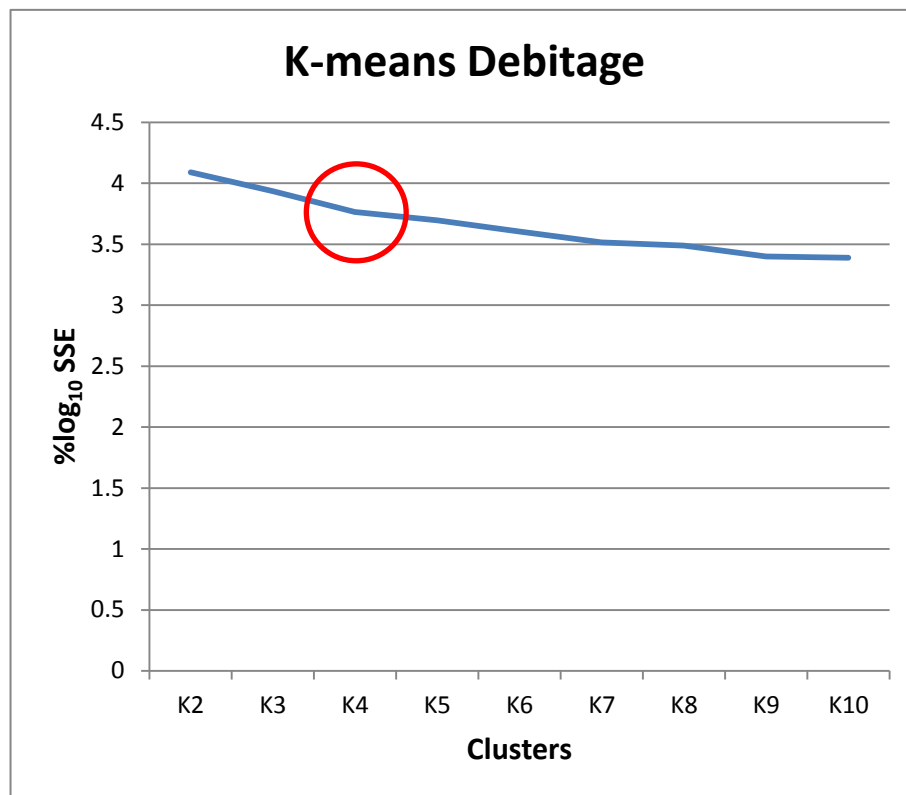
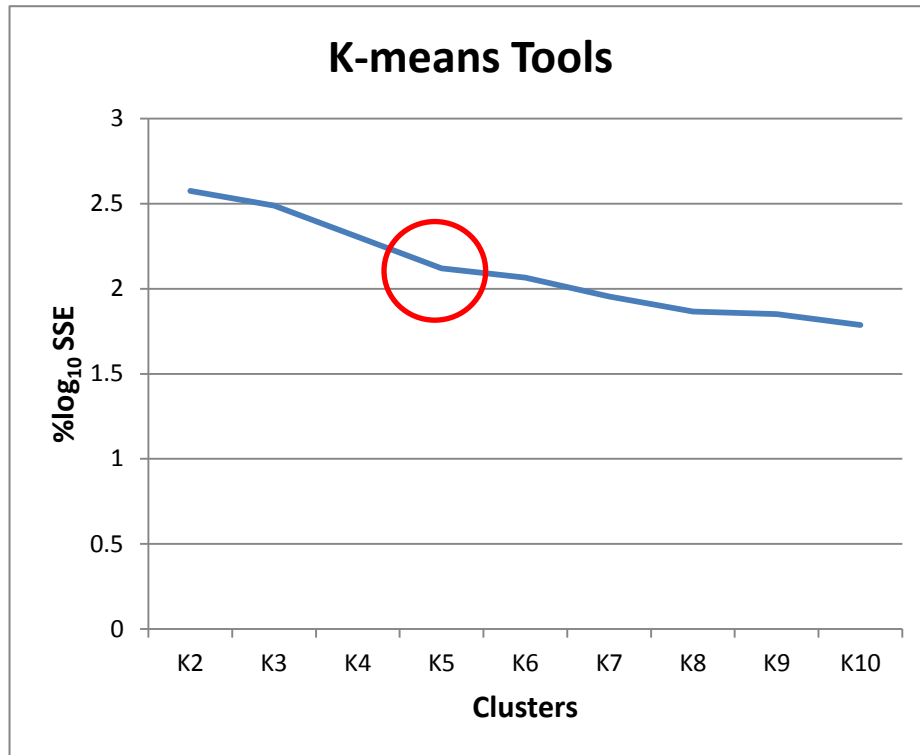
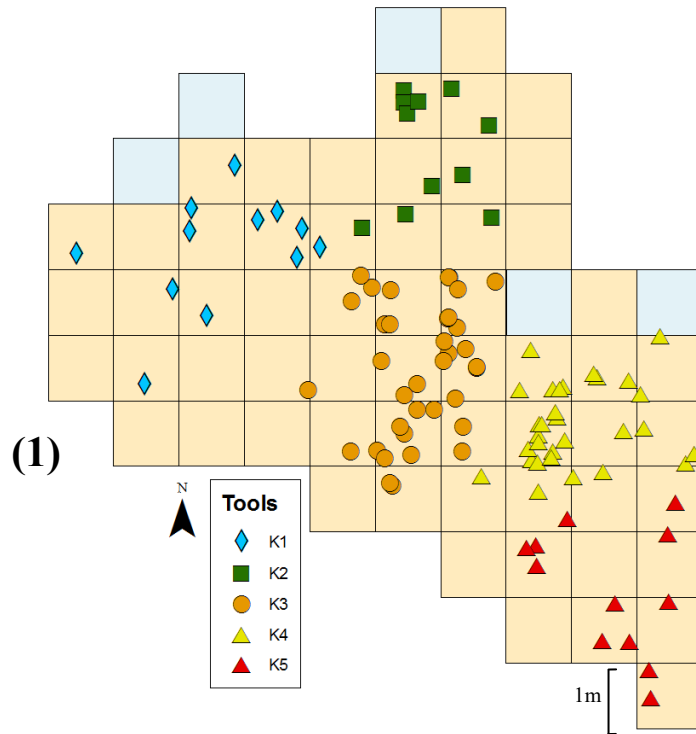


Figure 7.6.12: These graphs represent the $\% \log_{10}$ SSE outputs from the SPSS program. A bend, or “elbow” suggests an optimal cluster solution for the East study area. Here, K5, or five clusters, was the optimal cluster solution for tools, whereas K4 was optimal for the debitage distribution. This analysis utilized the five cluster solution.

K-means: 5 Cluster Solution



K-means with KDE Output

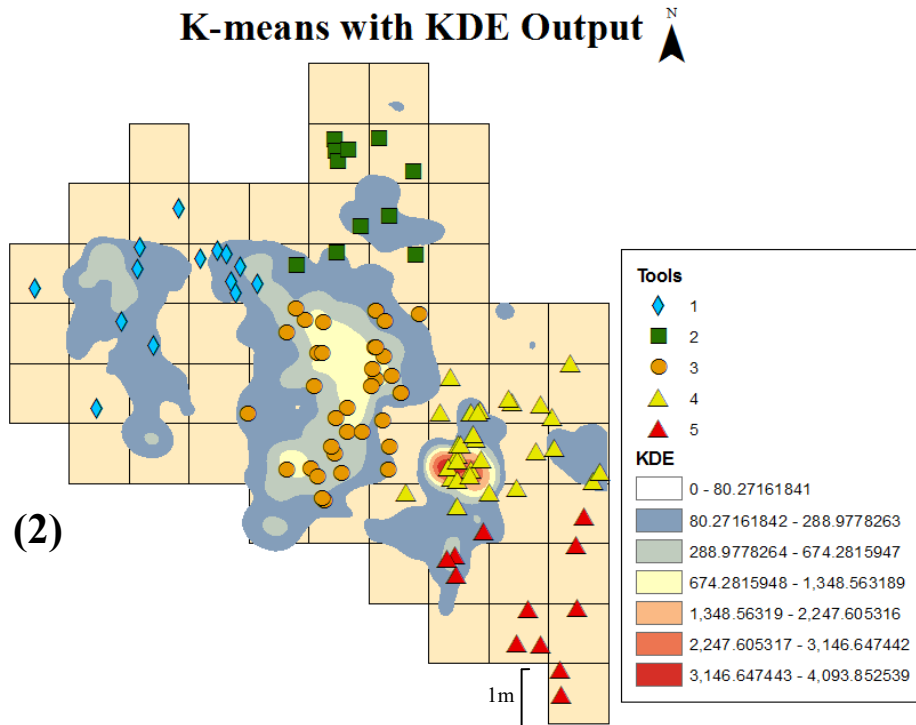


Figure 7.6.13: The top map (1) demonstrates the five cluster solution for tool recoveries, as determined through the $\% \log_{10}$ SSE tests. The bottom map (2) displays the same five cluster solution superimposed on the KDE smoothed contour map, highlighting the clusters in relation to high density locations. Note: clusters K1 – K5 as shown here coincide with East A to E in section 7.6.4.

7.6.4 Cluster Composition

This section outlines the composition of the five clusters (East A to East E) determined in part, through the exploratory use of the K-means and SSE tests. These tests are used in tandem with KDE and visual comparisons to maximize the interpretation of potential clusters.

East A

The northwest cluster contains two refits ($n=4$) within unit 508N/525E. Many of the tools recovered from this area were also located within, or around, this pit feature (Figure 7.6.14 A). The 13 tool recoveries include five projectile points, three bifaces (one Stage 4, and two UID), one scraper, one grinding stone ($n=2$), one retouched flake, and one reworked tool.

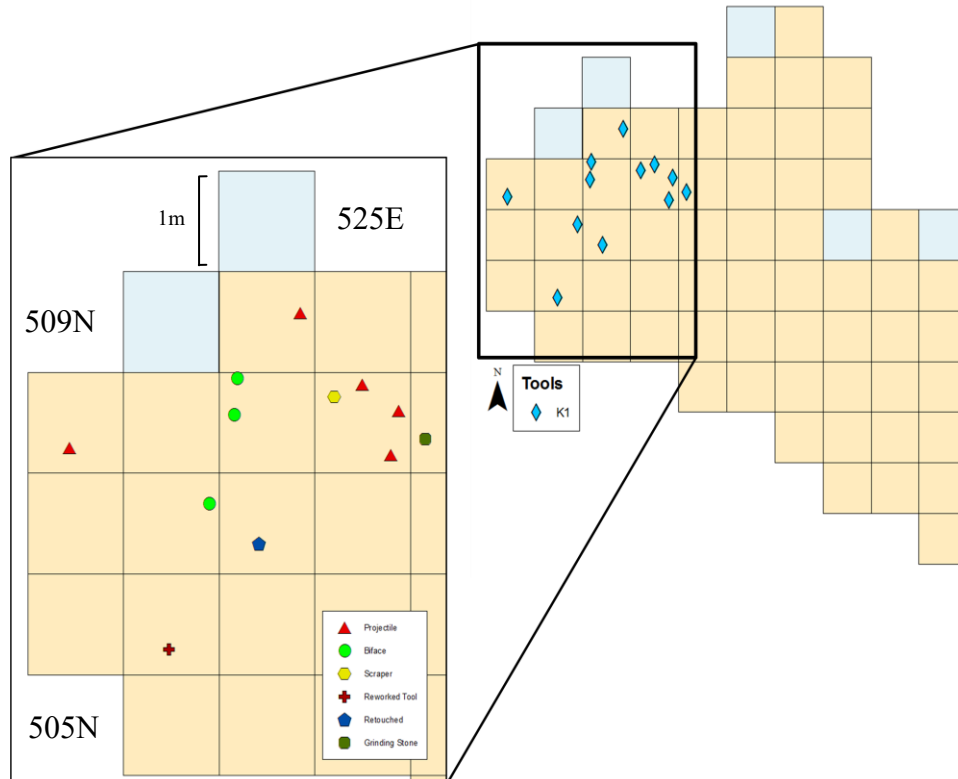


Figure 7.6.14A: Location of Cluster A within the East study area. Inset: Tool distribution within Cluster A.

One complete projectile point preform was recovered along the western periphery, while most of the projectile points within the cluster are midsections. Two of the three bifaces were complete, including one manufactured out of gunflint silica. The only non-Gunflint Formation tool was a siltstone grinding stone recovered in close association with siltstone debitage (see Figure 7.6.4).

The reworked tool in Cluster A is one of only two reworked tools identified within all six study areas, both of which were found in the East. This tool is a bifacially worked tip from Level 3, with a thick cross-section. The distal end was reworked into a scraper, with possible hinge fractures resulting from use.

Artifact distributions drop off sharply along the western edge of this study area (Figure 7.6.14 B). Large debitage (25-50+mm) is dense within the pit feature in unit 508N/525E, and towards the south, whereas microdebitage is clustered to the southwest of the pit feature. Primary flakes are few and dispersed throughout the cluster. Siltstone debitage is clustered within the east end of the pit feature near the grinding stone, and the NWQ of unit 505N/524E.

There is some missing information from Stage 2 Assessment test pits in East A. The relative low density space visible between the NEQ of unit 507N/524E and the NWQ of unit 507N/525E is the result of the Stage 2 test pits, although unit 507N/525E yielded a low amount of artifacts regardless. This test pit also affected the SEQ of unit 508N/524E and was still present between Levels 6 and 7 (25-35cm dbs).

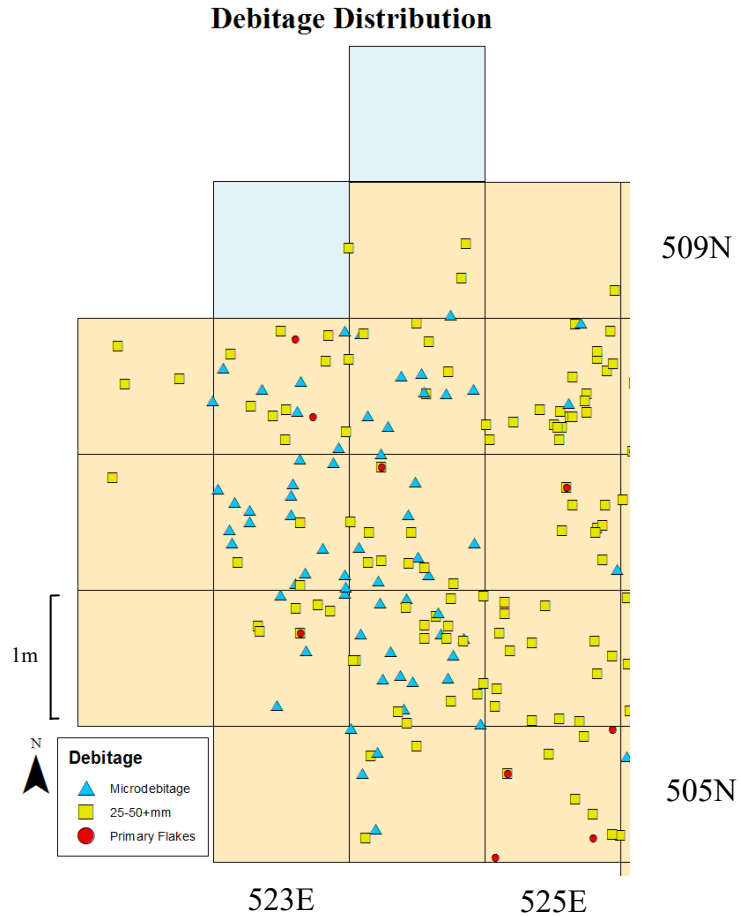


Figure 7.6.14B: Debitage distribution for Cluster A within the East study area.

A potential hearth feature was excavated within unit 508N/525E and the western quads of unit 508N/526E (Figure 7.6.14 C). The gravel matrix transitioned to sand in Level 7, with the feature uncovered in Level 8 (35-40cm dbs) of unit 508N/525E. Charcoal samples were taken in Level 11, and in both units artifacts were found in direct association with the sandy matrix. In unit 508N/526E the feature was first noted in Level 6. Three large rocks were uncovered in Levels 10 and 11 of this unit, which would have been located along the periphery of the feature (Figure 7.6.14 D). Large stones and FCR fragments were also recorded between Levels 4 and 6 in the surrounding units of 508N/524E and 509N/524E.

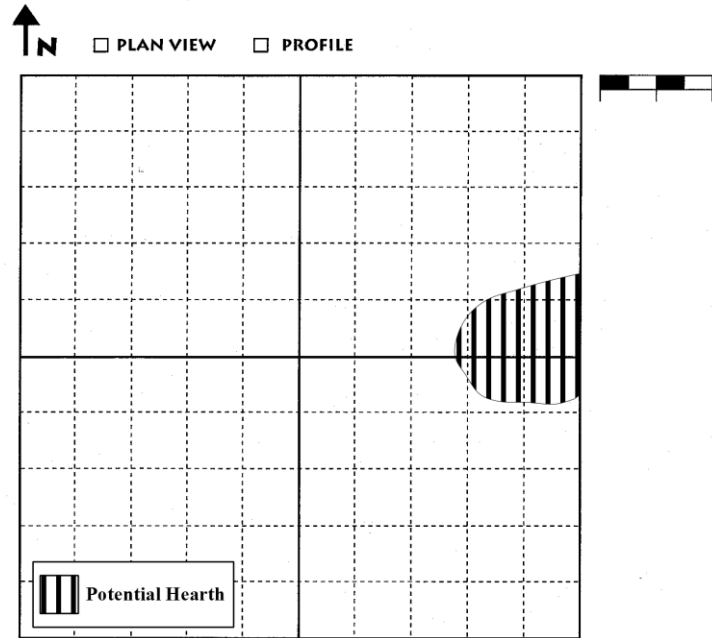


Figure 7.6.14C: Potential hearth as mapped in the Level 9 plan view of unit 508N/525E. Notes indicate possible hearth but minimal charcoal.

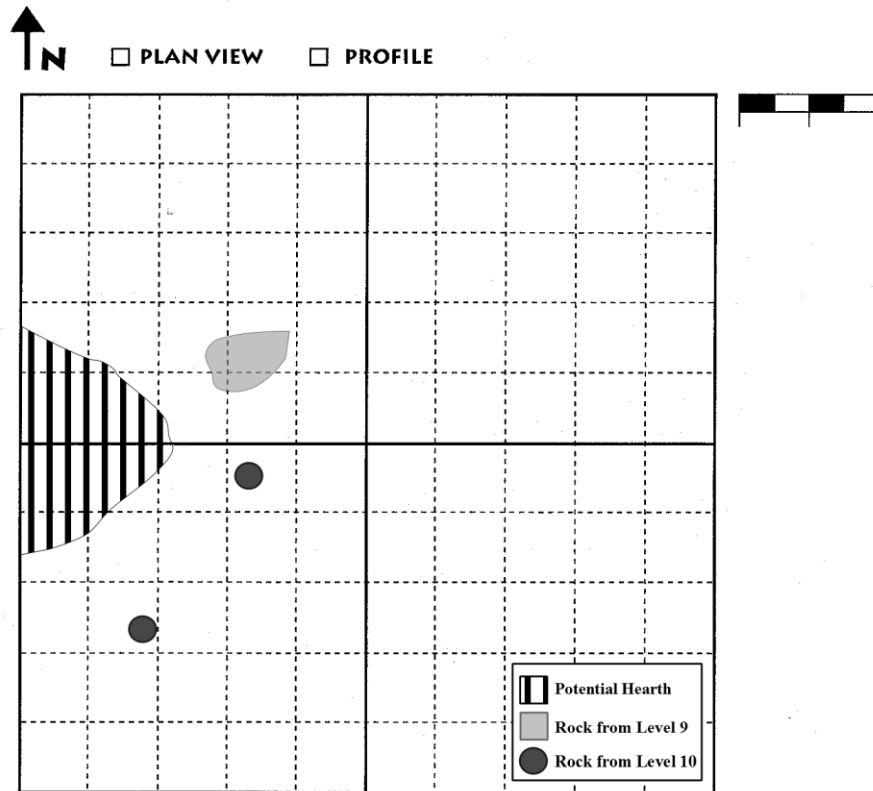


Figure 7.6.14D: Potential hearth continues into unit 508N/526E. Hearth and large rock in NWQ were mapped in floor plan for Level 9, while two rocks were noted in Level 10. Note: comments on level form indicate that only the centre of rocks from Level 10 were mapped and are not demonstrative of actual size.

East B

The northeast cluster contained 11 tools, including two core fragments, one reworked tool, one retouched flake, two projectile points, and five bifaces (Figure 7.6.15 A). The two point bases represent the constricting deep and eared deep categories. Bifaces include two UID fragments, one Stage 2, and two at Stage 3. Many of the tools were broken, likely during manufacture as suggested by the presence of fault planes or hinge fractures. Additionally, all tools were manufactured out of Gunflint Formation material.

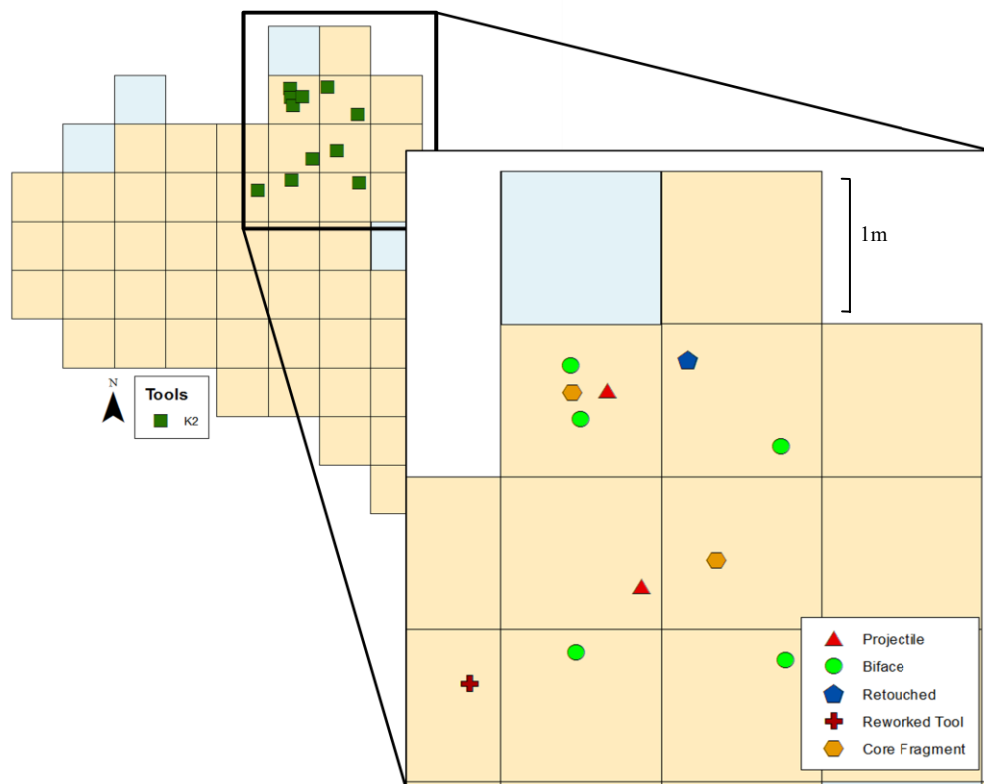


Figure 7.6.15A: Location of Cluster B within the East study area. Inset: Tool distribution within Cluster B.

Debitage was more densely distributed in the south end of Cluster B alongside the FCR recoveries, with both microdebitage and large debitage (25-50+mm) focused to the southwest (Figure 7.6.15 B). Primary flakes were sparse, although generally recovered

from the southern edge of Cluster B. With the exception of a few amethyst, chert, siltstone, and quartz items, the debitage assemblage consists of Gunflint Formation material.

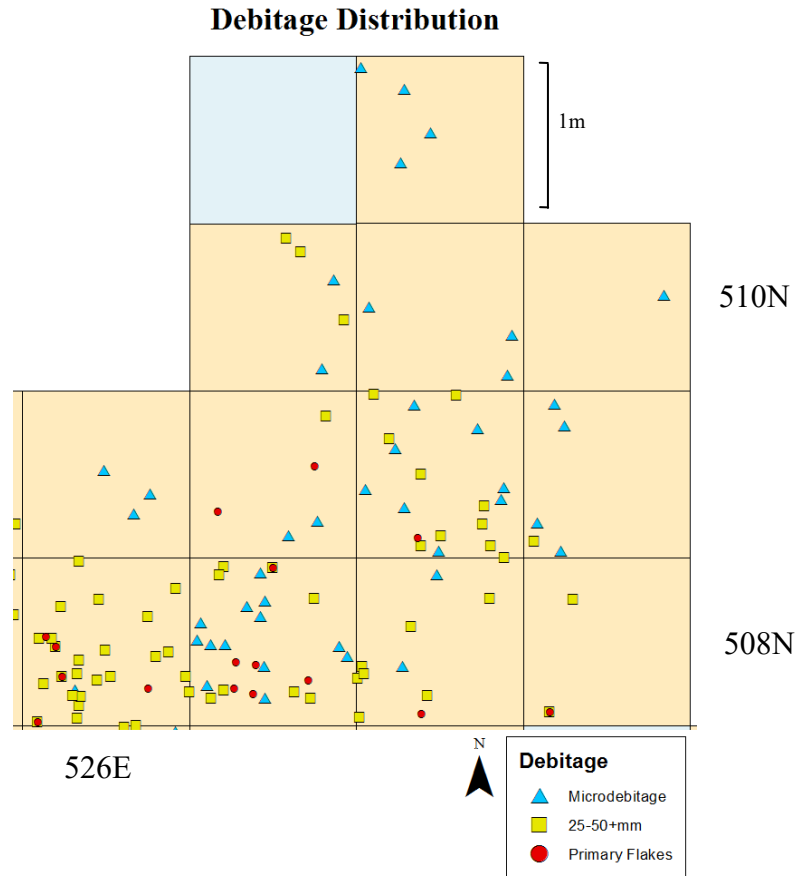


Figure 7.6.15B: Distribution of particular debitage types in cluster East B.

There was a lack of recorded stump or large root disturbance in this area though a few level forms discussed the possibility of rodent holes, including the southern quads of unit 508N/527E. More rodent disturbance was noted for the eastern quads of units 508N/528E, and 509N/527E. Many units also contained an ashy-grey sand matrix anywhere from Level 1 to Level 4. However, in unit 511N/528E, the ash-like layer

followed the same sloping contours as the heavy organic layer, suggesting a natural occurrence.

In unit 510N/527E a large “heat-altered rock” was uncovered in the NE corner measuring 30cm x 44cm alongside a projectile point and FCR fragments (Figure 7.6.15 C). Interestingly, the numerous samples of FCR and large rocks were found in close vertical and horizontal association with the tool and debitage distribution.

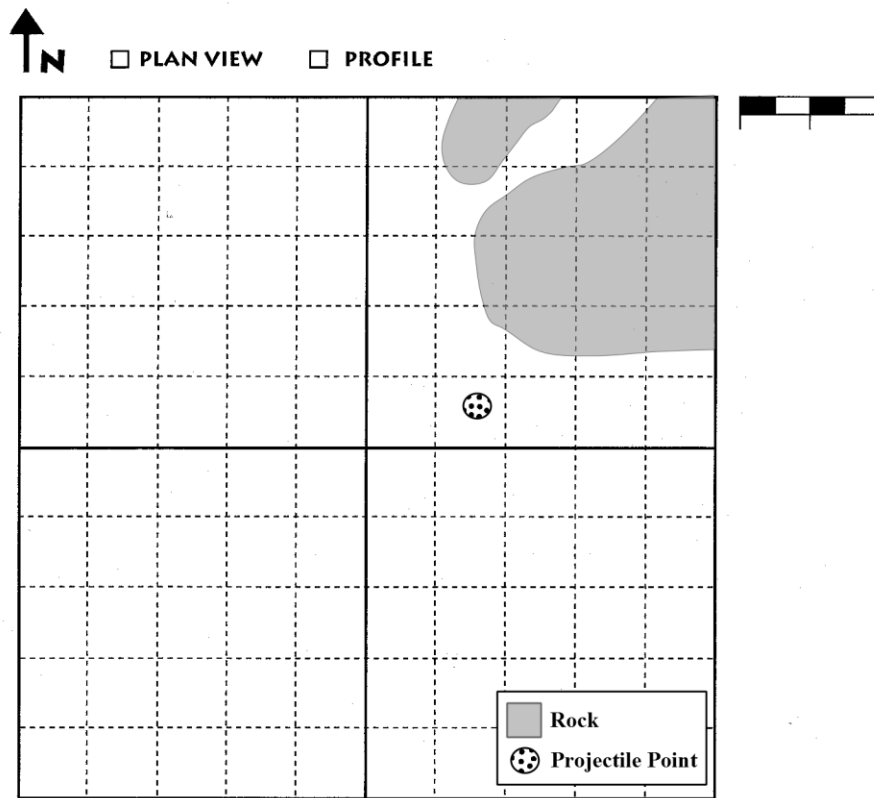


Figure 7.6.15C: Two large “heat-altered stones” from the Level 4 floor plan of unit 510N/527E.

East C

Cluster C consists of a large central cluster within the East study area (Figure 7.6.16 A). The KDE output demonstrates two discrete high density areas, with many of

the tools and potential FCR recoveries around the periphery. Most of the waterworn artifacts (n=4) were recovered within this central area.

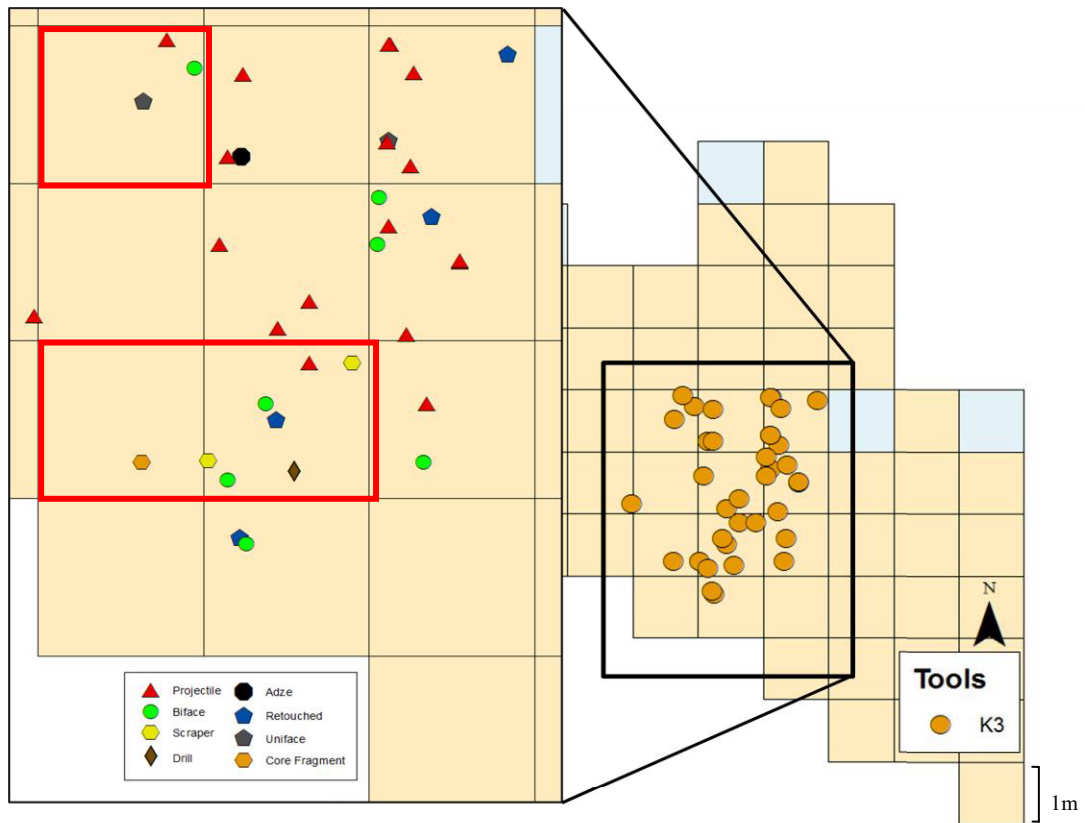


Figure 7.6.16A: Location of Cluster C within the East study area. Inset: Tool distribution within Cluster C.
Note: Red squares highlight units discussed in more detail in section 8.2.5 in Chapter 8.

This cluster has a total of 36 tools, consisting primarily of projectile points (n=18; one with n=2), and bifaces (n=7). Other tool recoveries include four retouched flakes, one adze, two uniface, two scrapers, one drill, and one core fragment. Of the recovered projectile points, eight bases and three complete specimens were placed into eight different morphological categories; most of which were recovered in close proximity to one another. Staged bifaces include five UID, one Stage 2, and one Stage 6 that was later interpreted as a potential chopping tool (Bennett 2015). Along with the drill tip, two projectile points, and one adze are considered preforms. Although there are some

complete tools, the majority of the assemblage consists of fragments. Hinge fractures and other flaws were noted for many of the preforms.

Siltstone was utilized for a number of tools including two projectile points, one biface, and the adze. The remaining tool assemblage was manufactured out of Gunflint Formation material.

Overall debitage distribution is widespread in this cluster, although the densest area appears in the north around unit 507N/527E (Figure 7.6.16 B). Large debitage (25-50+mm) is numerous along the western and southwestern units, whereas primary flakes are concentrated in the northwest. Alternatively, microdebitage is most dense within unit 507N/527E and units south of there (to the east of most large debitage).

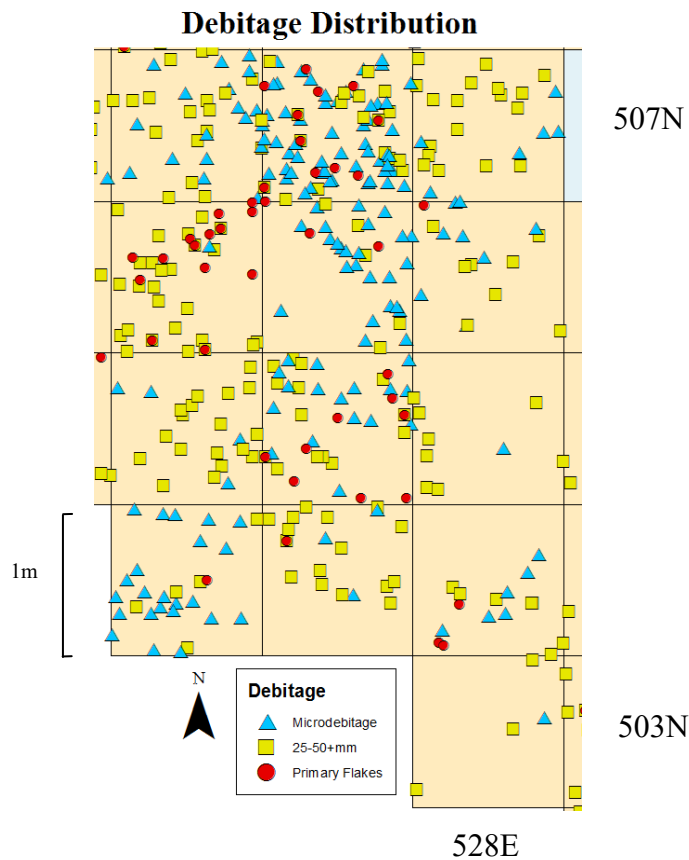


Figure 7.6.16B: Distribution of particular debitage types in cluster East C.

Gunflint silica, quartz, and rhyolite debitage appears somewhat clustered, with siltstone recoveries distinct in units 505N/526E and 507N/528E (see Figure 7.6.6). Each siltstone cluster is associated with two siltstone tools (see Figure 7.6.4).

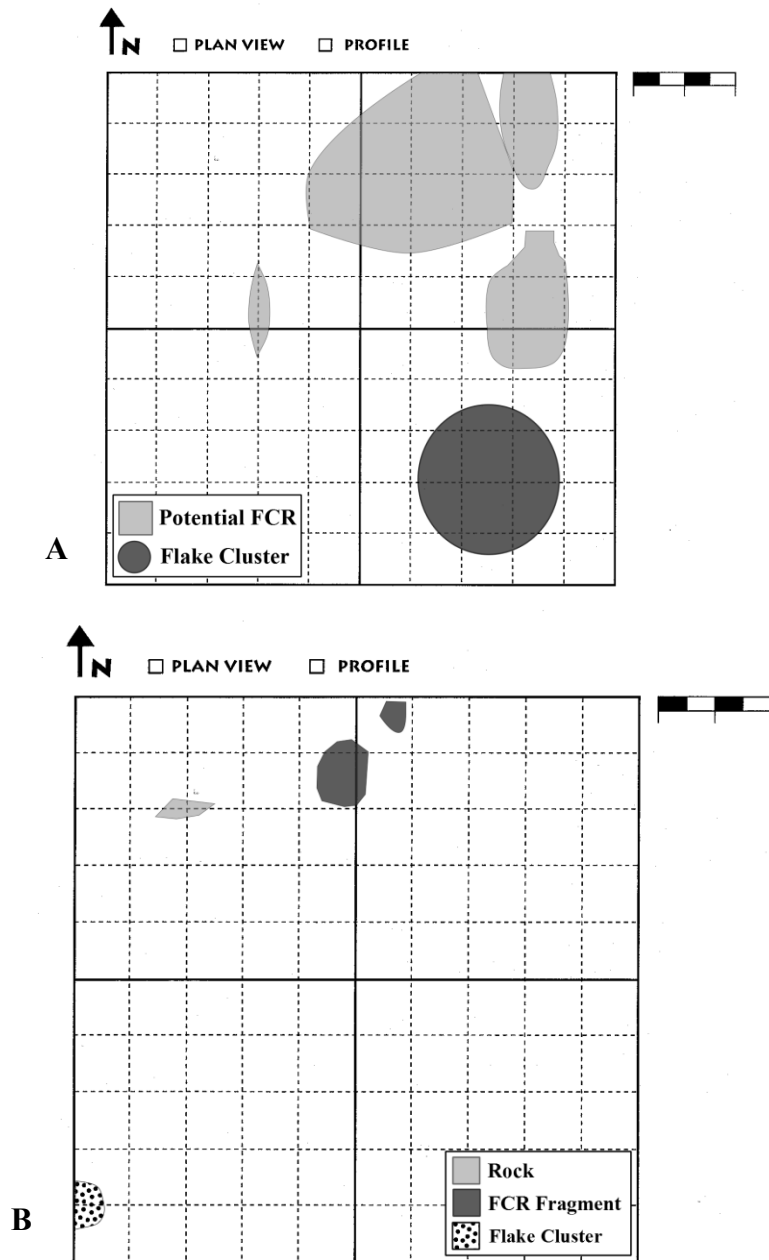


Figure 7.6.16C: Potential feature from units 505N/526E and 505N/527E with association between flake clusters, potential FCR fragments and large stones. A) Unit 505N/526E floor plan from Levels 3 and 4; B) Unit 505N/527E floor plan from Levels 4 and 5.

The highest debitage frequency in this area was located in unit 507N/527E. A grey ash-like soil was described for the northern quads and part of the SEQ from Levels 3 to 7, and was described as brittle and compacted. There appears to be an association between potential FCR fragments or large stones, and a high artifact count (such as unit 505N/526E, unit 505N/527E, and two units north; Figure 7.6.16 C). Another potential feature was recorded for units 505N/526E and 505N/527E. These units contained large FCR fragments associated with dense flake clusters between Levels 2 and 5. However, no soil discoloration was noted within these units.

East D

This cluster contained 30 tools, many of which were excavated within a deep pit feature in unit 505N/529E, the highest density cluster identified by the initial KDE analysis (Figure 7.6.17 A; for KDE see Figure 7.6.9). Tool recoveries include nine projectile points (with one parallel deep, and one eared straight specimens), four bifaces (three UID, and one Stage 2), two scrapers, two drills, six retouched flakes, one grinding stone, two complete cores, and four core fragments. Four out of nine projectile points were preforms, as were two drill tips. Of note is the location of drills and scrapers. A total of 24 tools were fragmentary.

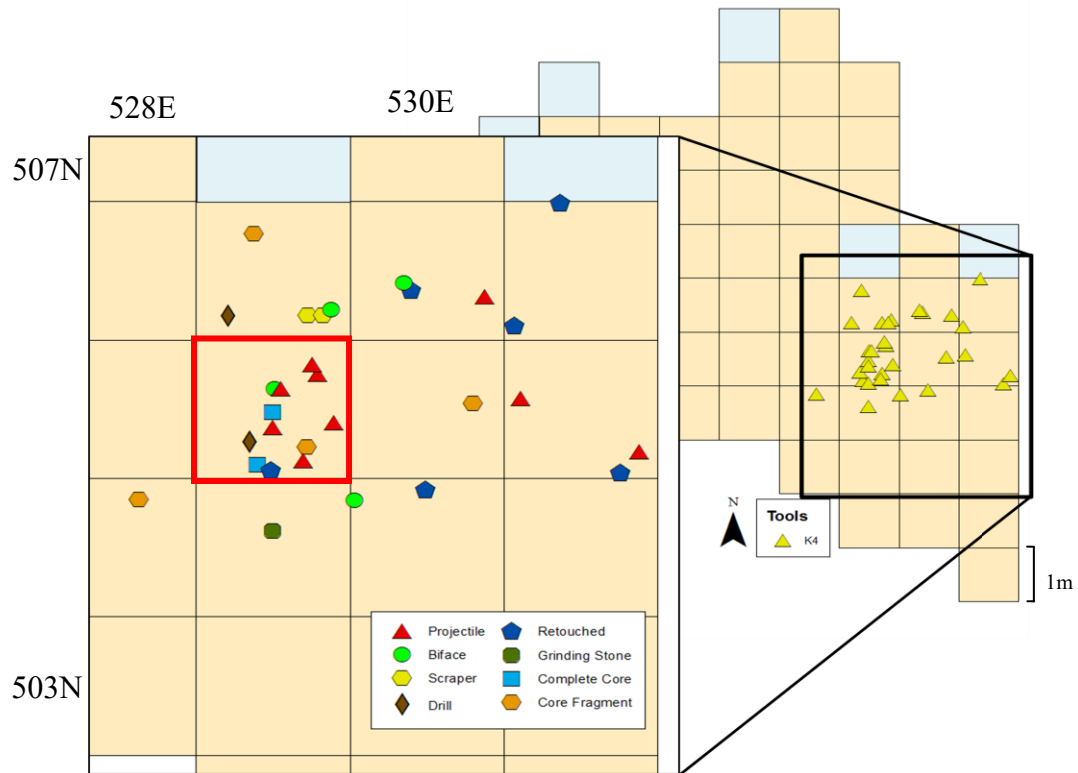


Figure 7.6.17A: Location of Cluster D within the East study area. Inset: Tool distribution within Cluster D. Note: Red square highlights pit feature discussed in more detail in section 8.2.5 in Chapter 8.

In regards to raw material use, siltstone was used for the production of one projectile point, while gunflint silica was used for one projectile point and one biface tip. The remaining tools were produced from taconite. The recovered grinding stone was cataloged as possible sandstone, however this is not confirmed.

Debitage distribution was focused around the pit feature in unit 505N/529E. Primary flakes and large debitage (25-50+mm) are densest around the pit feature, whereas microdebitage is most numerous towards the east in unit 505N/531E (Figure 7.6.17 B). A number of sandstone fragments were recovered from within the pit feature, just north of the grinding stone. Additionally, most of the siltstone was excavated from unit 504N/529E, just south of the siltstone projectile point (see Figure 7.6.4).

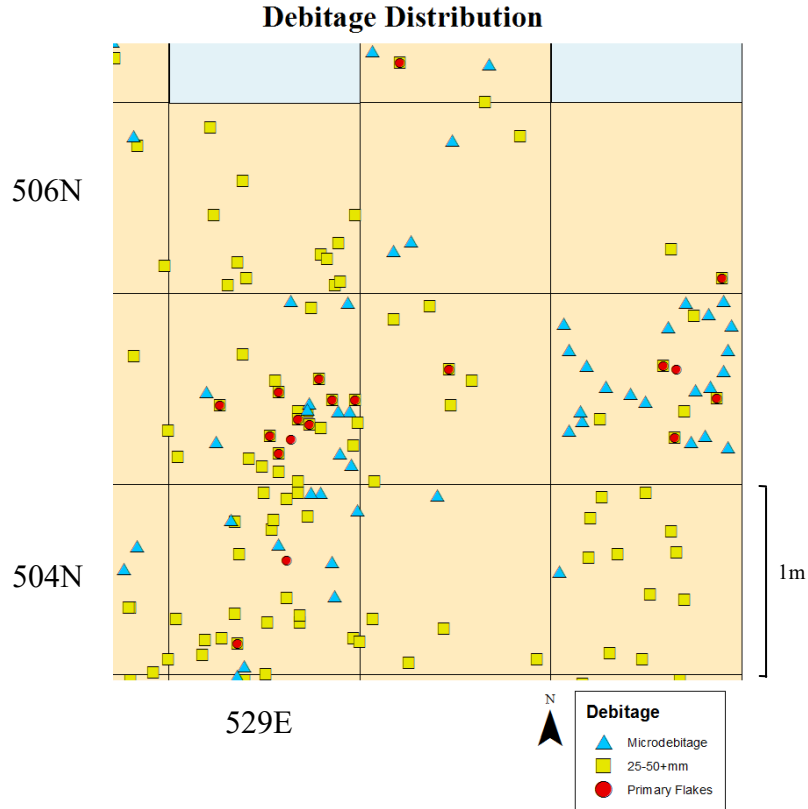


Figure 7.6.17B: Distribution of particular debitage types within cluster East D.

There are a few episodes of disturbance to be noted, including a Stage 2 Assessment test pit affecting the NEQ of unit 506N/529E as well as the SWQ of unit 507N/530E. In addition to the Stage 2 test pit, large root disturbance associated with tree stumps was noted as far as Level 7 to the west and south of the pit feature. These stumps likely affected the excavation process of the pit feature in unit 505N/529E.

The pit feature was excavated to a depth of 90cm (Level 18), though the NWQ could not be removed until Level 15 due to the presence of the stump. The Eastern quads yielded the highest frequencies, however, the debitage was bagged together for Levels 2 to 14. The SWQ had combined debitage for Levels 5-7, 8-10, and 11-15 limiting the

vertical interpretability of the recoveries. The matrix consisted of brown sand with the exception of some small gravel in the very south beginning ~30cm dbs.

FCR fragments were recorded beginning in Level 10, while the potential hearth feature was uncovered in Level 15 (Figure 7.6.17 C). A large charcoal lens in the centre of the unit was framed by an FCR cluster along the southwest edge and an ash matrix in the northeast corner. The inner matrix was compacted dark brown/orange sand with charcoal, and associated flakes. Both soil and charcoal samples were taken. Although less numerous, artifacts were recorded for Levels 16 and 17, while the last level was sterile. The charcoal samples have not been dated.

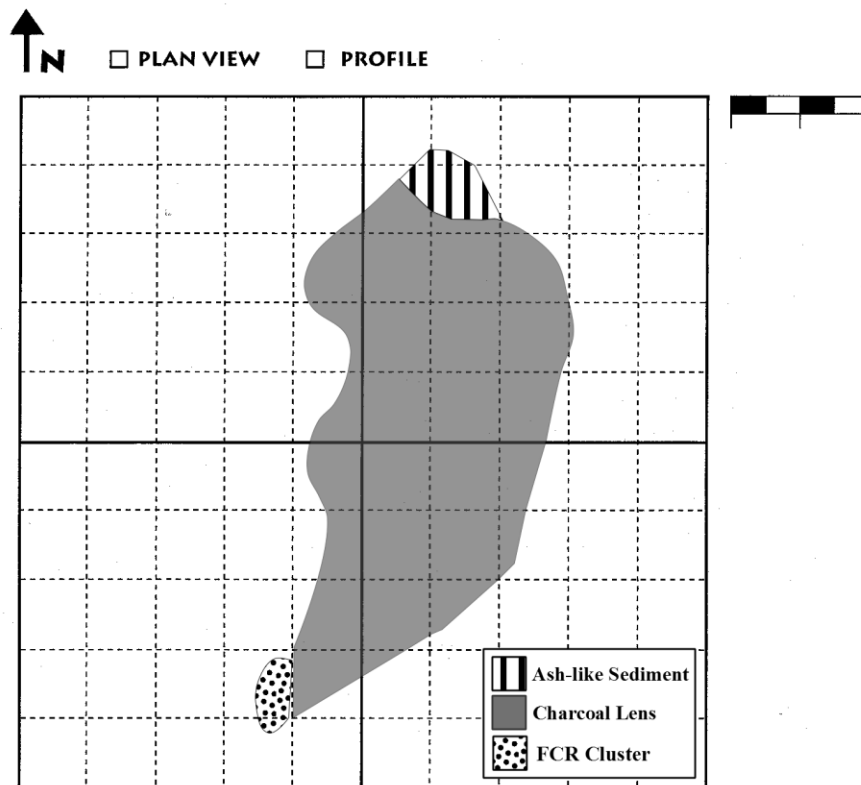


Figure 7.6.17C: Feature in unit 505N/529E, from floor plan of Level 15. See description of this complex unit in Section 7.6.4.

East E

East E is located in the southeast corner of the study area. This cluster provides an interesting case study, as the cluster of cores and core fragments in the south of the study area was not highlighted during initial KDE analysis (see Figure 7.6.9). This limitation emphasizes the inability of the KDE test to identify informative, but low density areas.

A total of twelve tools were recovered within East E, including five complete taconite cores and two taconite core fragments. This represents the highest frequency of core recoveries within the East study area. Other tool recoveries include three bifaces (one Stage 3, and two at Stage 4), one retouched flake, and one drill (Figure 7.6.18 A). With the exception of one siltstone biface base, all tools were manufactured out of taconite.

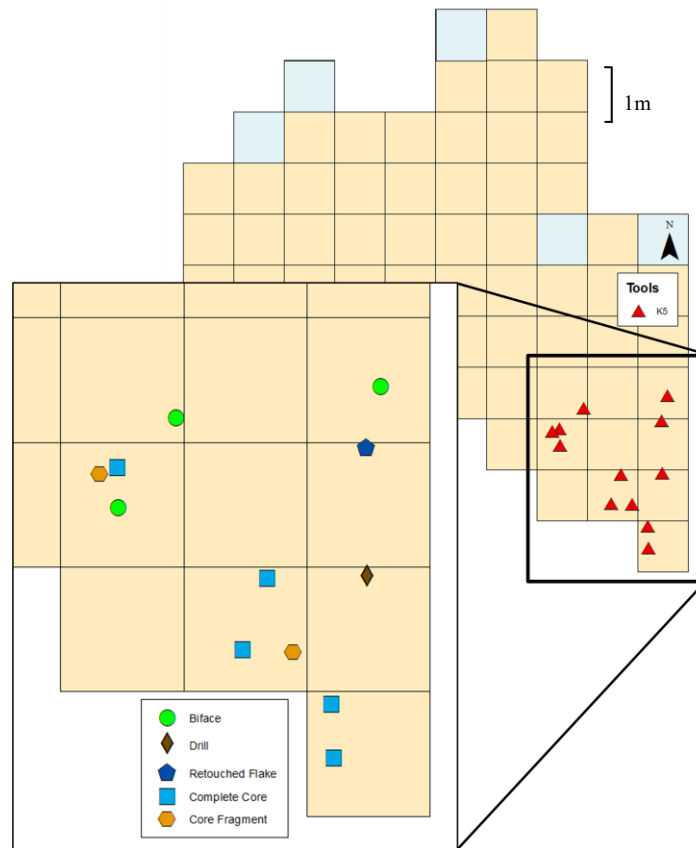


Figure 7.6.18A: Location of Cluster E within the East study area. Inset: Tool distribution within Cluster E.

Debitage distributions are most frequent in the very southeast and northwest areas of Cluster E. Primary debitage was most numerous along the eastern border (Figure 7.6.18 B). Large debitage (25-50+mm) is the highest contributor to the overall debitage frequency, with many of the 50+mm items occurring in the southeast. Of note is the almost complete lack of microdebitage with the exception of a few items in unit 503N/529E. Raw material type for Cluster E is overwhelmingly taconite with the exception of two 50+mm pieces of quartz, and a scattering of gunflint silica. Once again, large stones were associated with numerous FCR fragments and flake clusters in Levels 3 and 4 in the southwest.

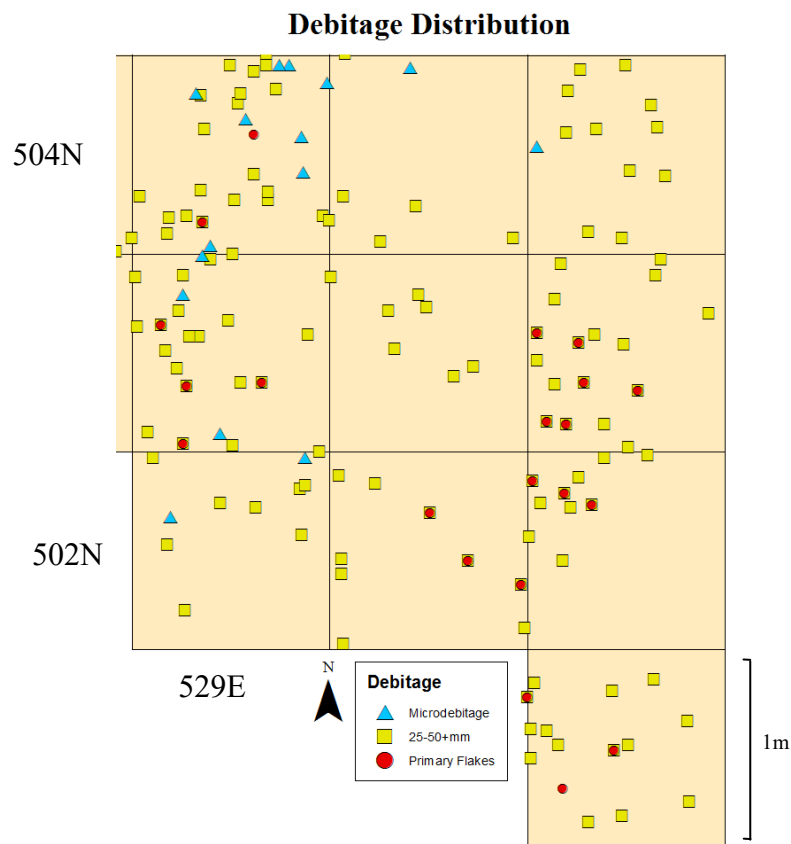


Figure 7.6.18B: Distribution of particular debitage types within cluster East E.

Some soil compaction due to high foot traffic (towards the screens) affected the surface levels of the very southeast corner, although once Levels 3 and 4 were reached the matrix consisted of brown sandy soil with some pebbles. This is consistent with the rest of the Cluster E.

7.7 SOUTH STUDY AREA:

7.7.1 Visual Comparison

Horizontal Distribution

Similar to other study areas, the modern topography for the South is a gently grading surface that slopes upwards to the north between 245.25 and 245.75m asl (Figure 7.7.1). The western extent of Mackenzie I is located only five metres to the west, with a large bedrock outcrop ~19m to the southeast.

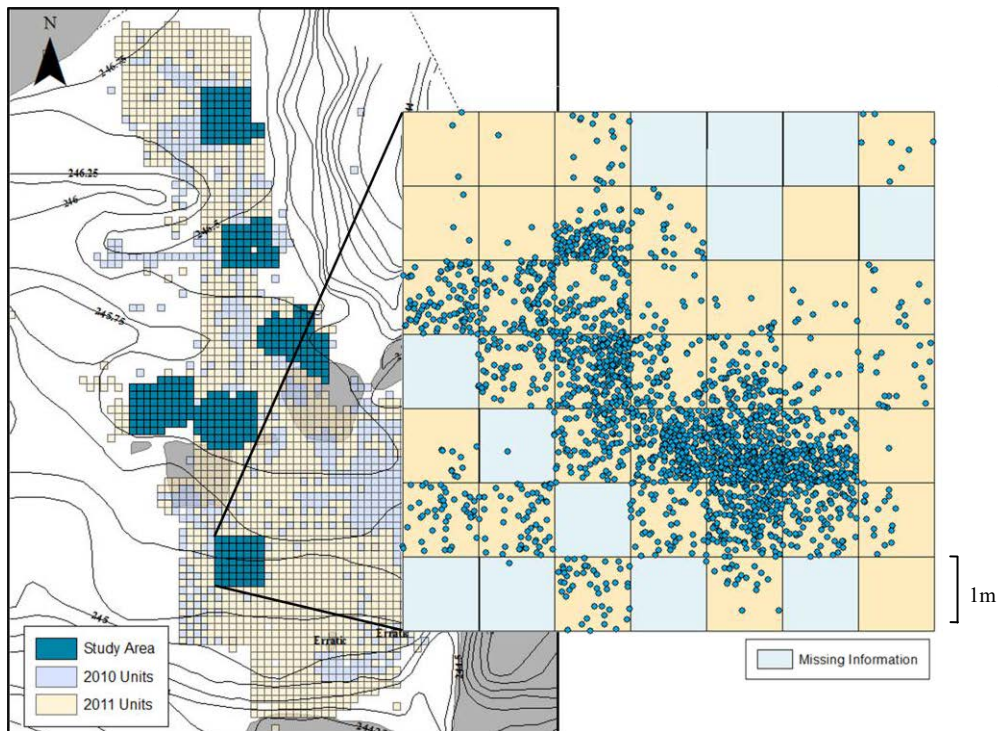


Figure 7.7.1: South study area topography within the Mackenzie I site. Inset: Overall artifact distribution pattern within the South study area.

Although there is no evidence for post-depositional size-sorting of debitage, the observed artifact distribution is incomplete due to a lack of information from twelve units. Only tools are currently reported for units 473N/517E and 475N/517E while no information about the remaining ten units is available. Regardless of this missing data, sufficient information is available to reveal a distinct pattern within the artifact distribution. Finally, unit 478N/518E contained a pit feature analyzed by Shultis (2013) and Gilliland et al. (2012), providing an in-depth review of the matrix composition.

Tool Distribution

A total of 57 tools were recovered from the South study area, including 20 bifaces which represent 35% of the assemblage (Figure 7.7.2). Other tools include one adze, five complete cores, five core fragments, one drill, three knives, one scraper, 12 projectile points, and nine retouched flakes.

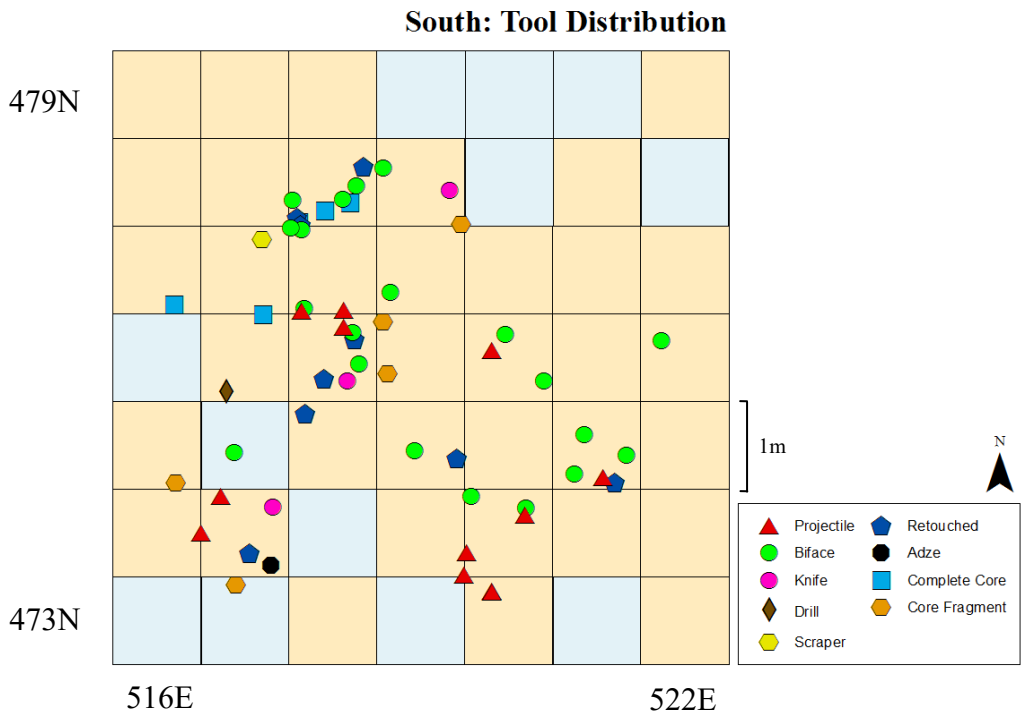


Figure 7.7.2: Tool distribution throughout the South study area. Note: there is an obscured projectile point in unit 473N/520E.

Seven of the 12 projectile points were analyzed by Markham (2013) and are all variations of the constricting category (see Table 4.5.1; Figure 7.7.3). The majority of tools are fragmentary, although two bifaces, one projectile point, one scraper, and two retouched flakes are complete. In addition, a total of nine tools are preforms, including all three knife tips, and five projectile points. A number of tools were manufactured from non-Gunflint Formation material, including three siltstone bifaces, one quartz scraper, one quartz retouched flake, one quartz core, and one chert core (Figure 7.7.4).

Biface Stage and Projectile Point Category

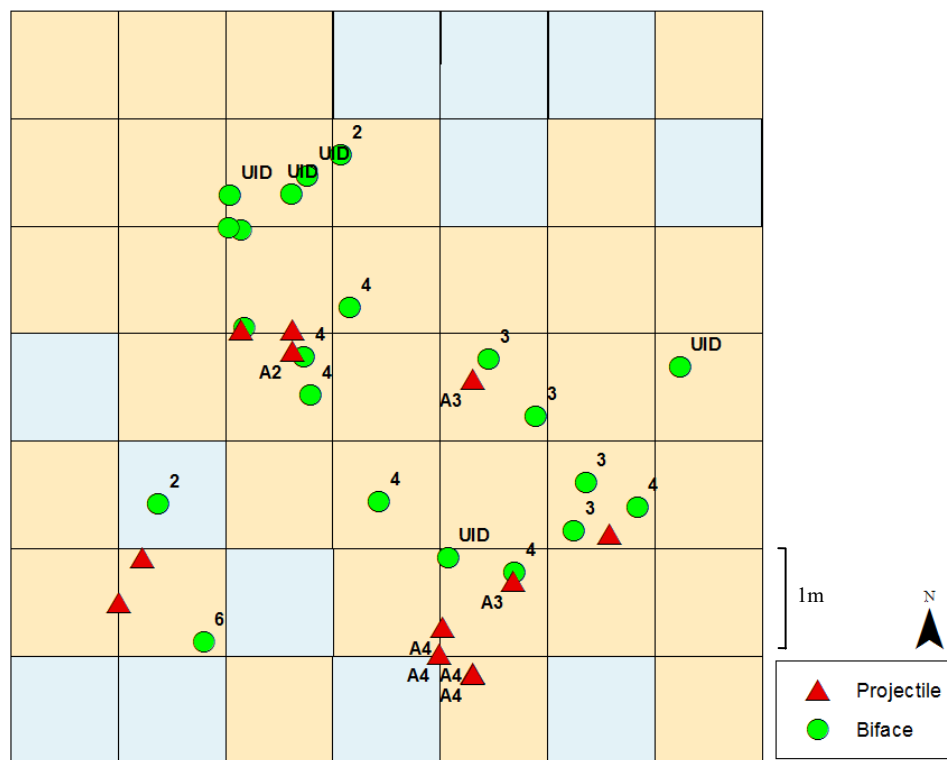


Figure 7.7.3: This map demonstrates the projectile point classification as defined by Markham (2013), and the biface stage as determined by Bennett (2015) for the South study area. Note: A2, Constricting Low; A3, Constricting Straight; and A4, Constricting Convex. See Table 4.5.1 for a guide to the projectile point categories.

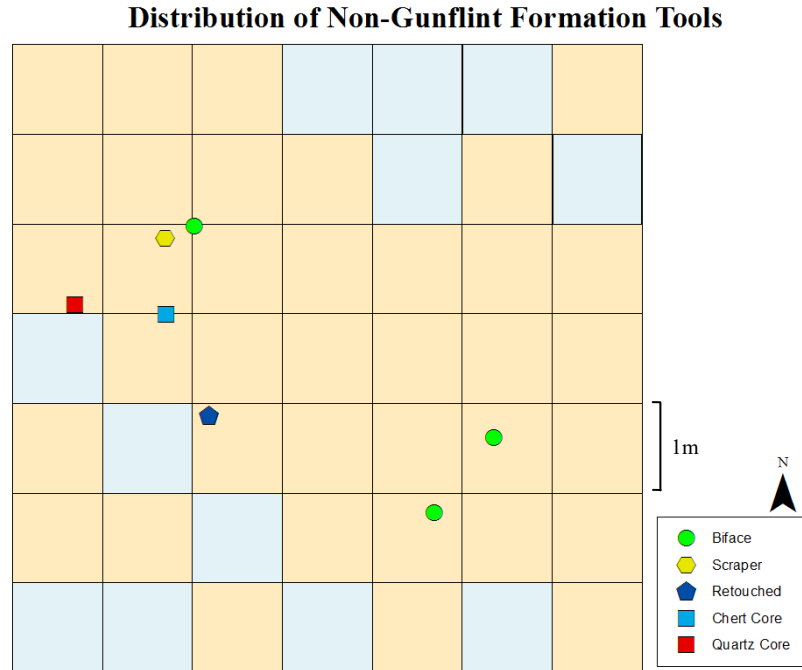


Figure 7.7.4: Distribution of non-Gunflint Formation tools, including three siltstone bifaces, a chert complete core, and three quartz items: a scraper, retouched flake, and complete core.

Debitage Distribution

A distinct pattern is visible, with concentrations occurring around units 476N/518E and 475N/520E (Figure 7.7.5). Many units along the periphery contain few to no artifacts. Two very distinct clusters of primary debitage are evident within or adjacent to high density areas, with the northwest cluster in close horizontal proximity to many of the complete and fragmentary cores. Large debitage (25-50+mm) is numerous, and appears throughout the general artifact distribution. Microdebitage is also dispersed throughout the study area though it is visibly absent within the northern high density unit of 478N/518E. Many of the individual raw material types, such as gunflint silica, are also clustered. Of note is the association between gunflint silica tools and debitage distribution (Figure 7.7.6). Although one chert core was found, there were no associated tools or debitage.

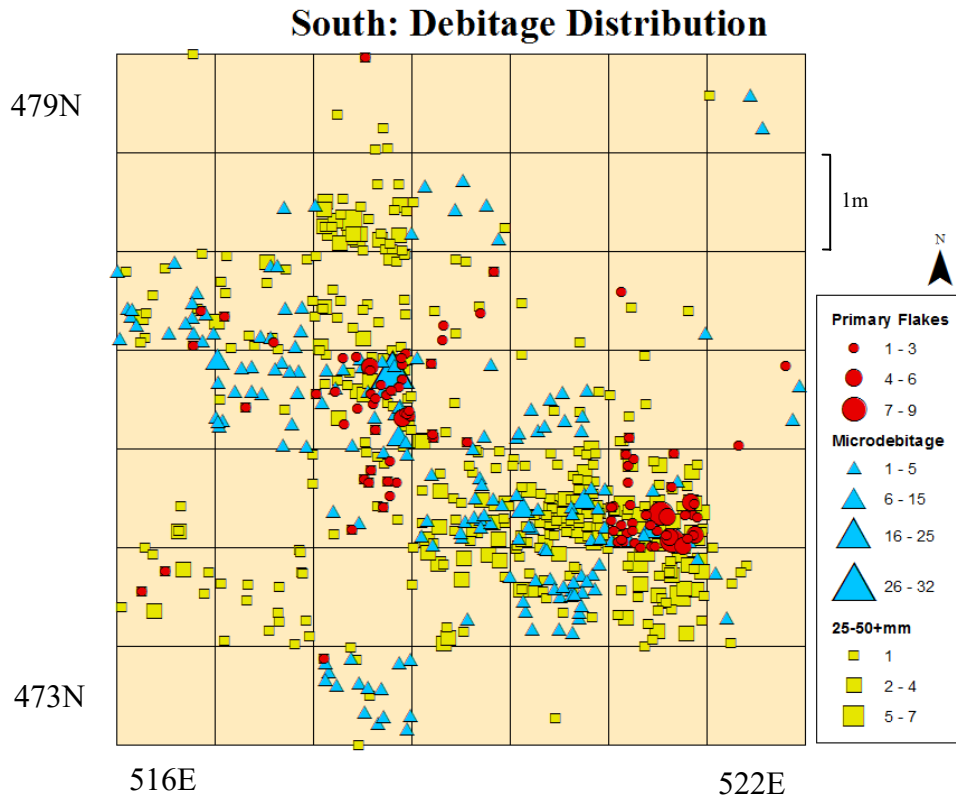


Figure 7.7.5: Distribution of particular debitage types within the South study area. Note: This map excludes secondary debitage (6-25mm) due to its intense frequency.

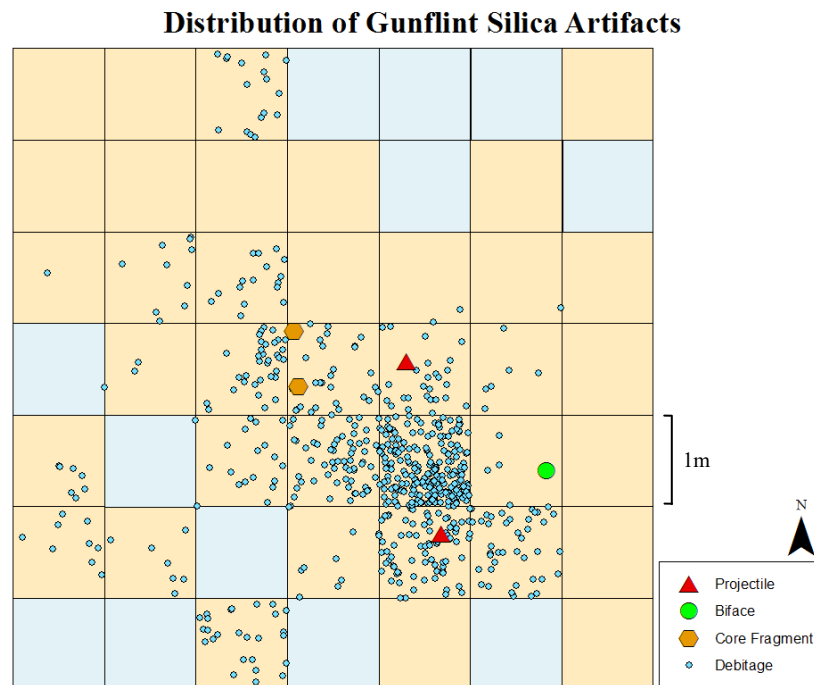


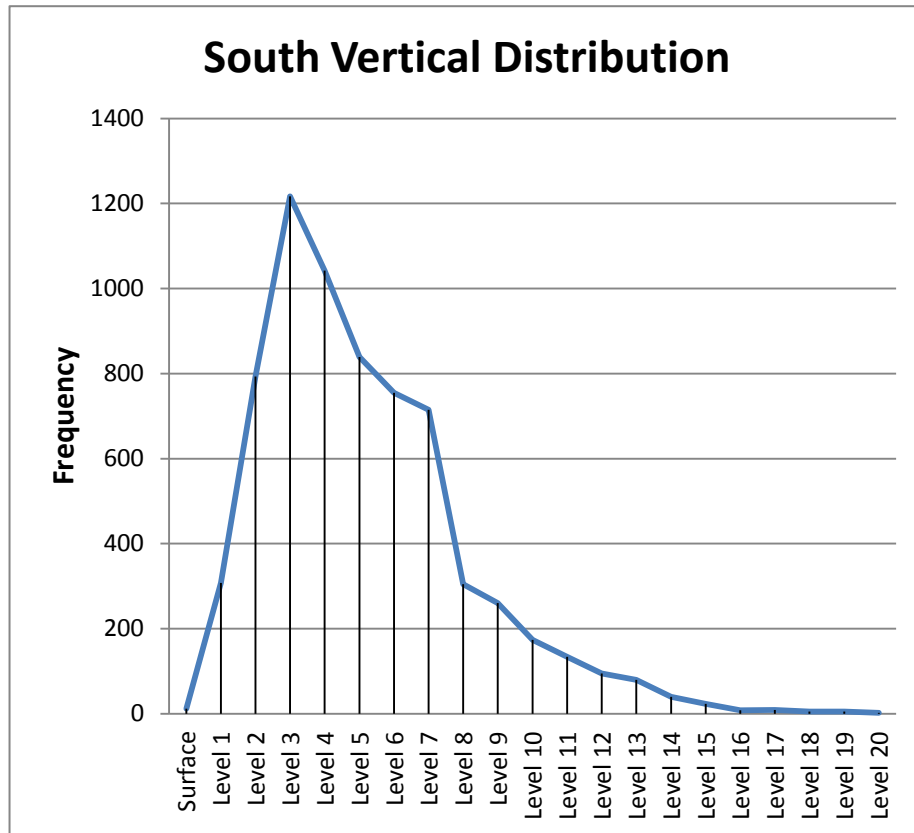
Figure 7.7.6: Distribution of Gunflint Silica debitage with tools.

Vertical Distribution

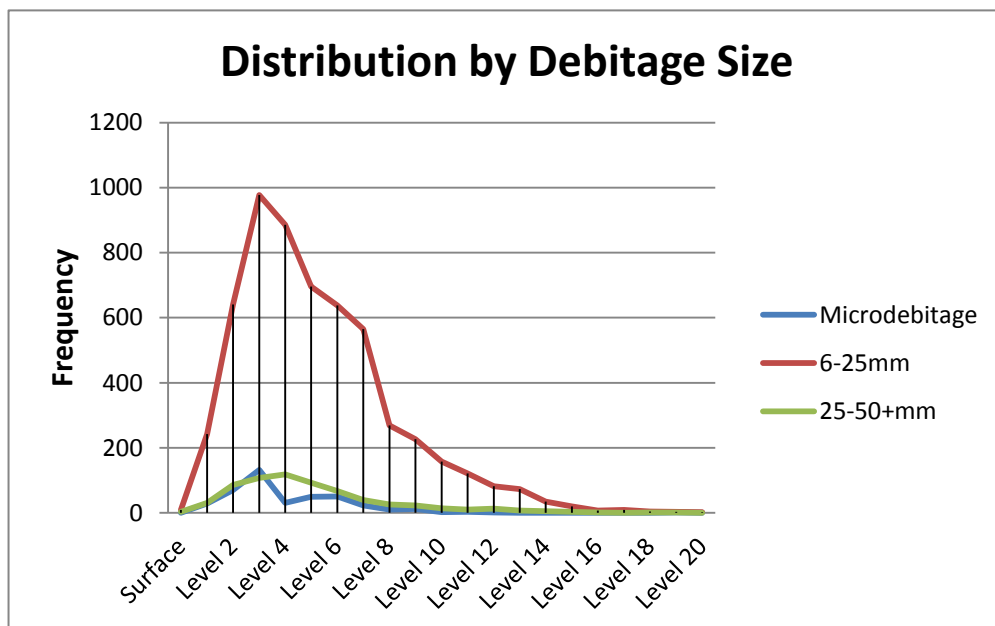
Artifact counts and vertical size sorting indicate that the highest artifact frequencies occur around Level 3 (10-15cm dbs; Figure 7.7.7). However, large debitage (25-50+mm) is most frequent in Level 4 (15-20cm dbs).

7.7.2 Refit Analysis

There were three refits (n=6) within the South study area (Figure 7.7.8). This includes a gunflint silica biface base from Level 9 of unit 475N/521E that refit to another basal fragment from Level 4 of unit 485N/517E, 10m north and 4m west, outside of the study area. A taconite projectile base from Level 3 of unit 474N/520E refit to a midsection from Level 1 of unit 473N/520E, one metre south. Additionally, the lateral edge of a gunflint silica projectile point from Level 5 of 476N/520E refit to a midsection from two units to the north, in Level 2.



(A)



(B)

Figure 7.7.7: A) Vertical distribution for artifacts in the South study area. Artifacts peak at Level 3, with a sharp decrease in frequency between Level 7 and 8 (~35cm dbs). B) Vertical distribution by debitage size.

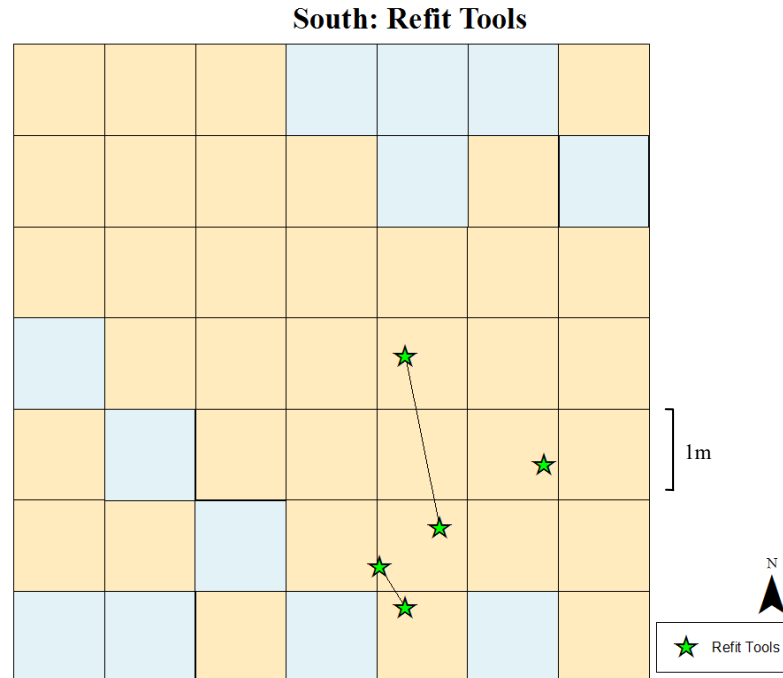


Figure 7.7.8: Refit tools within the South study area, including the biface fragment in the east that refits to an item from 10m north and 4m west.

7.7.3 Spatial Analytical Results

Kernel Density Estimation (KDE)

The KDE smoothed density contour map demonstrates three high frequency areas focused around units 475N/520E, 476N/518E, and 478N/518E. Many of the tools are found within or on the periphery of these high density locales, as exemplified by the tool distribution around unit 475N/520E (Figure 7.7.9).

Nearest Neighbour

The Nearest Neighbour function in ArcGIS was completed three times: for all artifacts (debitage and tools), alldebitage (including shatter), and the tools. Whereas all artifacts anddebitage demonstrate clustering, the tools appear random (Figure 7.7.10).

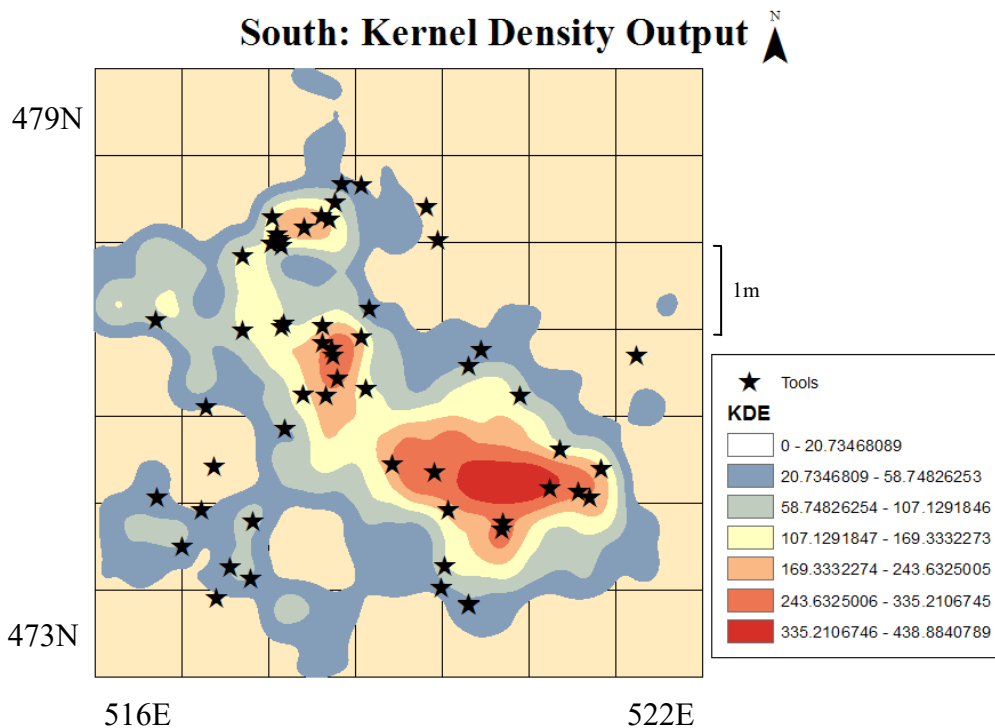
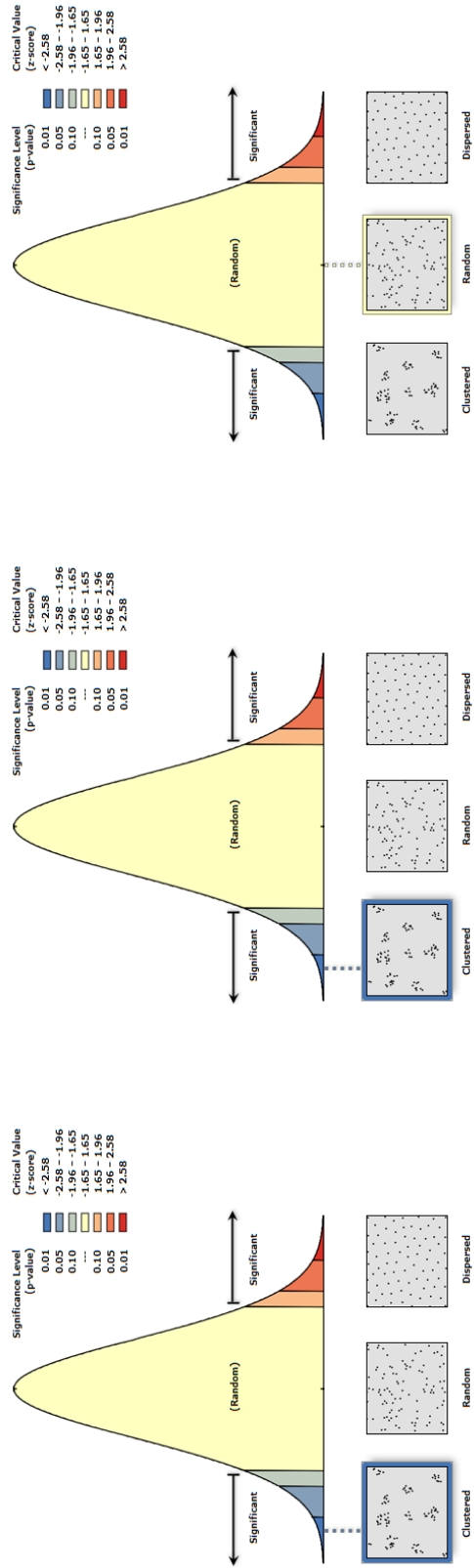


Figure 7.7.9: The smoothed density contour map, which highlights the most dense artifact clusters within the South study area. Tool distribution is within and around the periphery of these locations.

Ripley's K Function

Ripley's K was performed for all artifacts, all debitage, and tools. The artifact and debitage outputs display the presence of clustering, whereas the tools appear clustered only until a certain distance between points is reached (Figure 7.7.11). This means that tools are not clustered if analyzing the study area as a whole.



Given the z-score of -1.60, the pattern does not appear to be significantly different than random.

Given the z-score of -29.22, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Given the z-score of -29.70, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Figure 7.7.10: The Nearest Neighbour outputs for all artifacts, all debitage, and the tools, respectively. The analysis for this South study area suggests that while the debitage appears clustered, the tools themselves appear random.

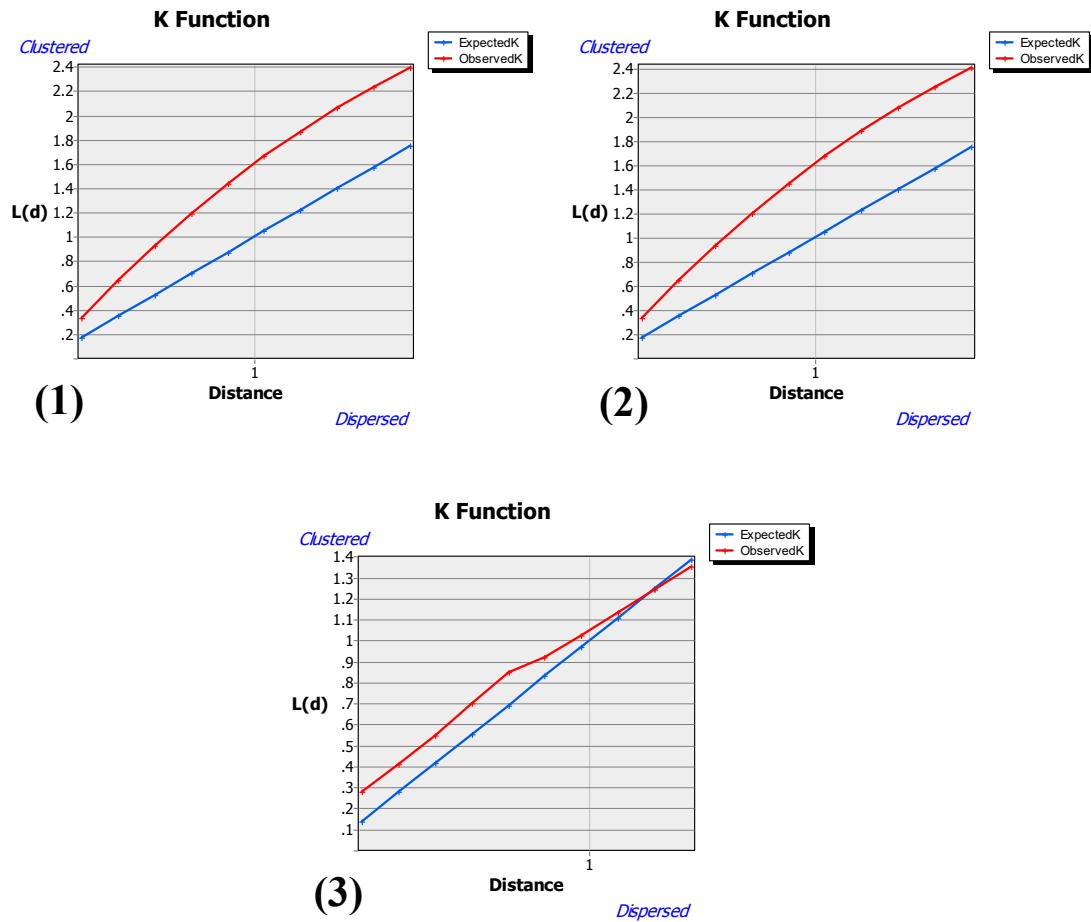


Figure 7.7.11: These three outputs from the Ripley's K analysis demonstrate clustering for South study area artifacts (1), and debitage (2), whereas tools (3) are only clustered to a certain distance.

K-means (Pure Locational Clustering)

K2 to K10 was tested for all debitage and all tools. The $\% \log_{10}$ SSE graph suggests that K3, or three clusters, is the optimal cluster solution for both debitage and tools (Figure 7.7.12), which generally follows the KDE output (Figure 7.7.13). The additional "elbows" in the K-means Tools graph may be the result of missing unit information, and so the results from the K-means tests will only be used as a general guideline. These three clusters are used for further analysis and are referred to as South A to South C.

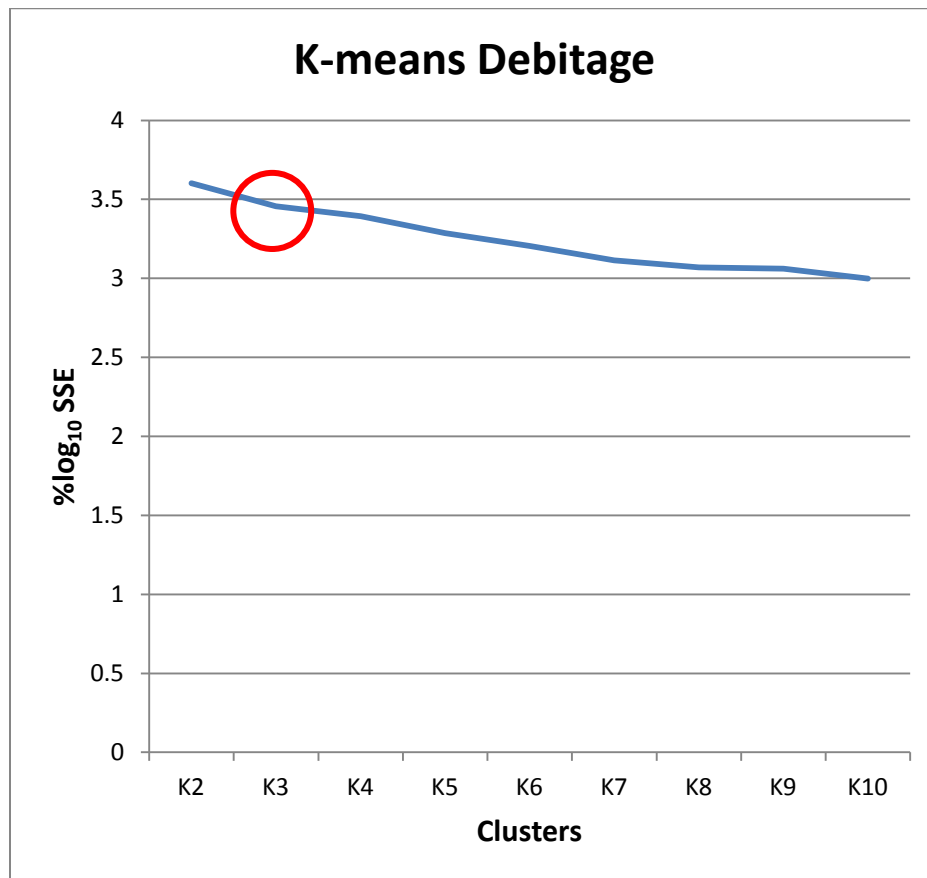
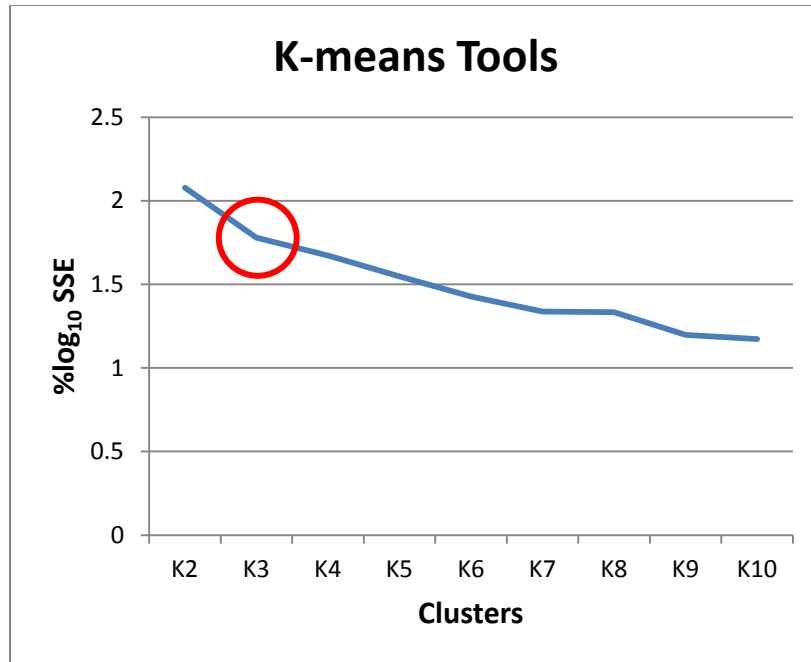
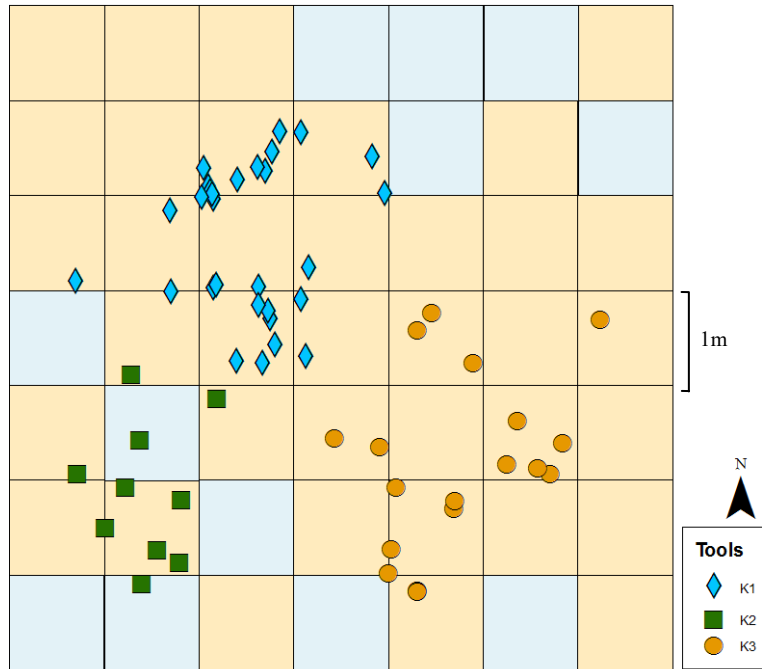


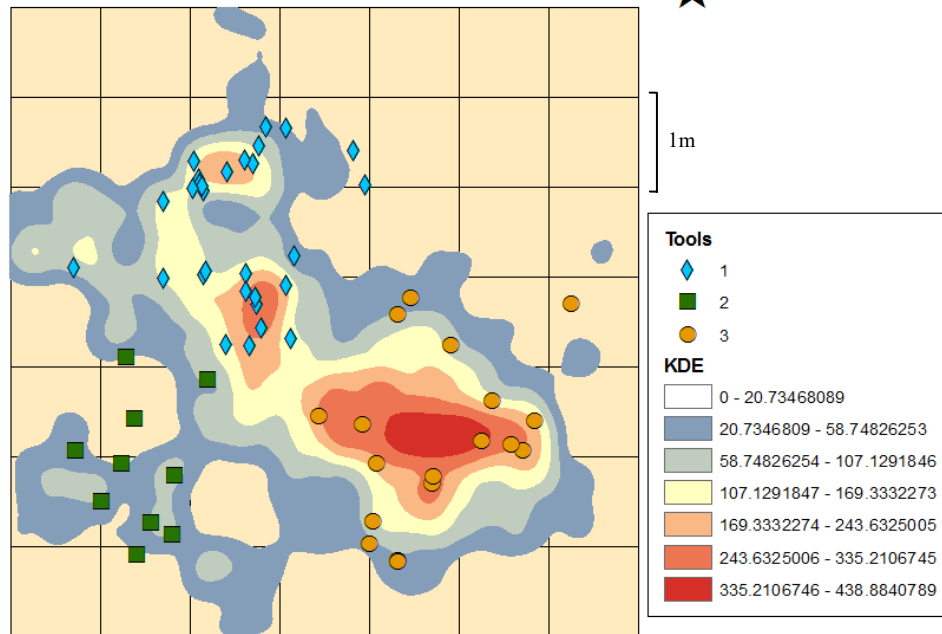
Figure 7.7.12: These graphs represent the %log₁₀ SSE outputs from the SPSS program. A bend, or “elbow” suggests an optimal cluster solution for the South study area. Here, K3 solutions for both debitage and tools were compared in ArcGIS and closely matched.

K-means: 3 Cluster Solution



(1)

K-means with KDE Output



(2)

Figure 7.7.13: The top map (1) demonstrates the three cluster solution for tool recoveries, as determined through the $\% \log_{10}$ SSE tests. The bottom map (2) displays the same three cluster solution superimposed on the KDE smoothed contour map, highlighting the clusters in relation to high density locations. Note: clusters K1 – K3 as shown here coincide with South A to C in section 7.7.4.

7.7.4 Cluster Composition (South A – C)

This section outlines the composition of the three clusters (South A to South C) determined in part, through the exploratory use of the K-means and SSE tests. These tests are used in tandem with KDE and visual comparisons to maximize the interpretation of potential clusters.

South A

South A is the northern cluster within the study area and includes a potential pit feature in unit 478N/518E. A total of 29 tools were excavated from within this cluster including five complete cores, and three core fragments (Figure 7.7.14A).

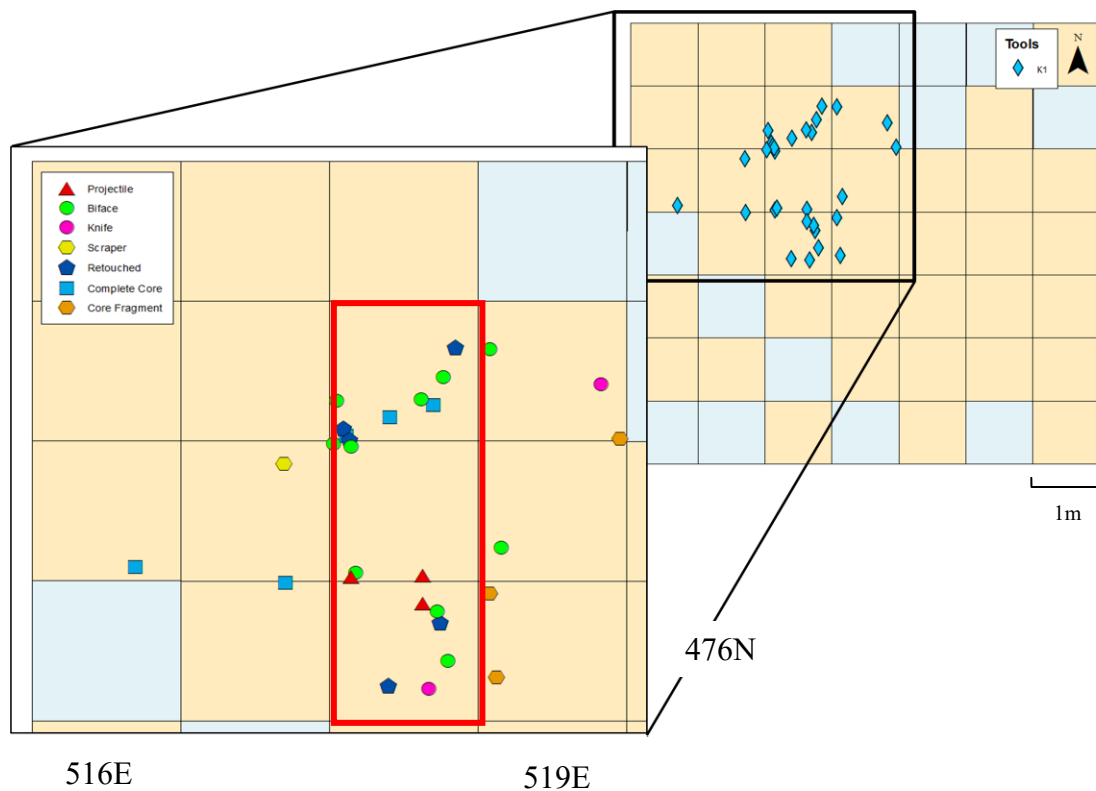


Figure 7.7.14A: Location of Cluster A within the South study area. Inset: Tool distribution within Cluster A. Note: Red square highlights an area discussed in more detail in section 8.2.6 in Chapter 8.

Other recoveries include three projectile points (including one complete preform), ten bifaces (including a complete siltstone item), two preform knife tips, one quartz scraper, and five retouched flakes. One projectile point was classified by Markham (2013) as constricting low. Staged bifaces include three UID, one Stage 2, and three at Stage 4. Three bifaces were not staged in South A.

Debitage frequencies are most dense within the two units of highest tool recovery, including the pit feature in unit 478N/518E and unit 476N/518E (Figure 7.7.14B). Primary flakes are distinctly grouped in one southern unit, with microdebitage concentrated to the southern units of Cluster A. Conversely, large debitage (25-50+mm) was the most frequent recovery in both high density units. Although taconite accounts for most of the debitage, half of the cores collected were of alternate material including chert (n=1), quartz (n=1), and gunflint silica (n=2).

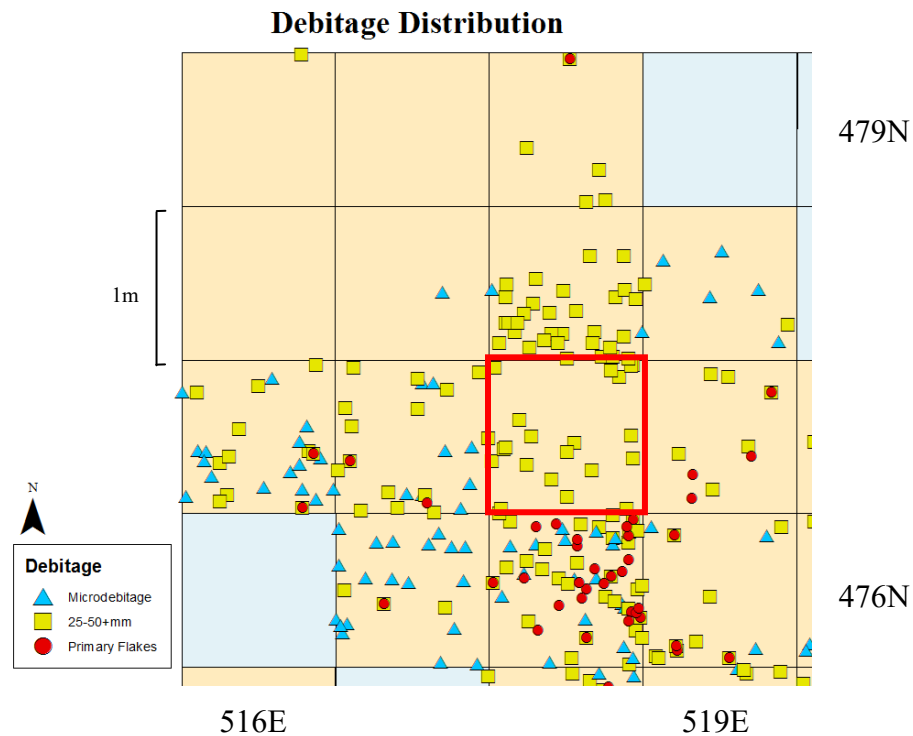


Figure 7.7.14B: Distribution of particular debitage types within cluster South A. Note: Red square highlights an area discussed in more detail in section 8.2.6 in Chapter 8.

Of interest is the pit feature in unit 478N/518E that was addressed by both Shultis (2013) and Gilliland et al. (2012) (Figure 7.7.14 C). Detailed excavation level forms were unavailable for this analysis, making the geoarchaeological and micromorphological work significant for the detail it added during analysis. Most of the assemblage from this unit was recovered in the southern quads from a silty brown sand that was only found in association with the pit features and one linear feature further south (Shultis 2013). This silty, medium-grained sand with pebbles was associated with artifacts and exhibited dramatic differences from other stratigraphic layers, thereby indicating some sort of depositional unconformity (Shultis 2013, 144).



Figure 7.7.14C: South wall profile of pit feature in unit 478N/518E. Modified from Shultis (2013).

Micromorphology within this feature demonstrated a high level of organic material at the bottom of the fill, as well as microscopic traces of taconite (Gilliland et al. 2012). OSL samples were also retrieved from three locations within the feature (see

Section 3.5), however, the nature of the depositional process responsible for this feature is unclear. One possibility is buried ice melt, with clastic dykes as seen in the wall profile (Shultis 2013, 146).

Unit 477N/518E, one metre south of the pit feature, yielded artifacts from the southern quads within a silty brown sand. Similar to the pit feature, no microdebitage was recovered. West of the feature in unit 478N/517E, silty sand in the south contrasted with sterile gravel to the north. Grey and red staining was uncovered from Level 3. However, a stump in the centre of the unit could not be removed until the fourth level and may account for the observed soil discoloration.

South B

Tools within this southwestern cluster focus around unit 474N/517E (Figure 7.7.15A). Of the ten tool recoveries, all were manufactured from taconite and all items were fragmentary. Included in the assemblage is one drill midsection that was discovered on the floor of a previously excavated unit, and one Stage 6 biface that was later interpreted as an adze (Bennett 2015). Other recoveries include two projectile points, one biface (Stage 2), two core fragments, one knife, and two retouched flakes.

Primary flakes were tightly clustered in the north and is likely related to the primary flakes within Cluster A, despite K-means test results splitting this area in two. The distribution of large debitage (25-50+mm) and microdebitage is inconclusive since many surrounding units could not be included in the analysis (Figure 7.7.15B). An observation of raw material suggests that the quartz debitage in the northeast is likely related to quartz items in Cluster A.

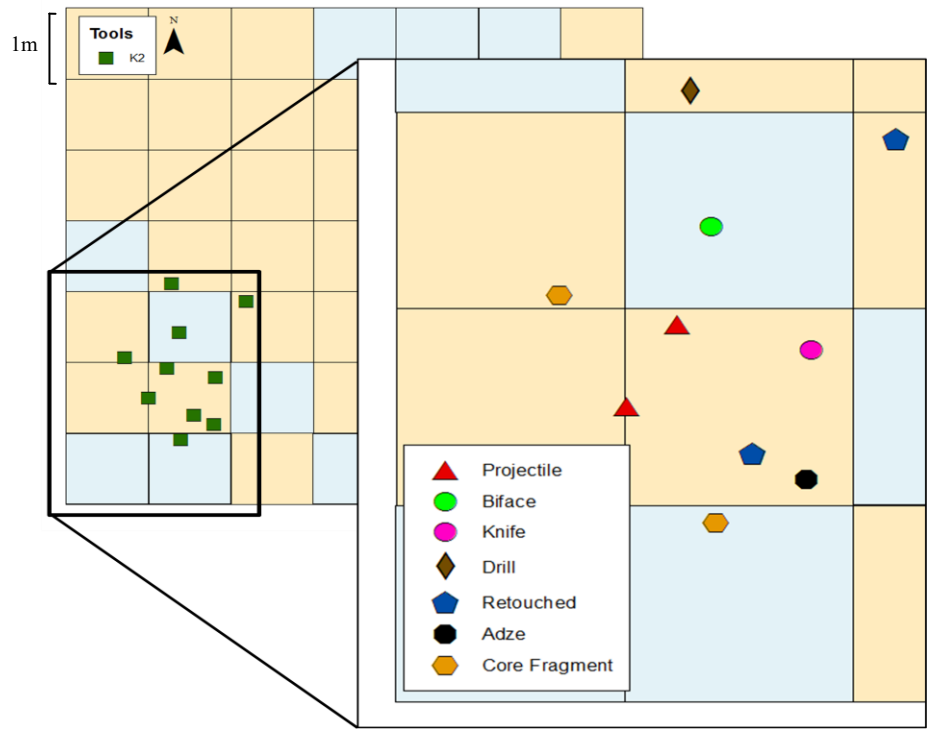


Figure 7.7.15A: Location of Cluster B within the South study area. Inset: Tool distribution within Cluster B.

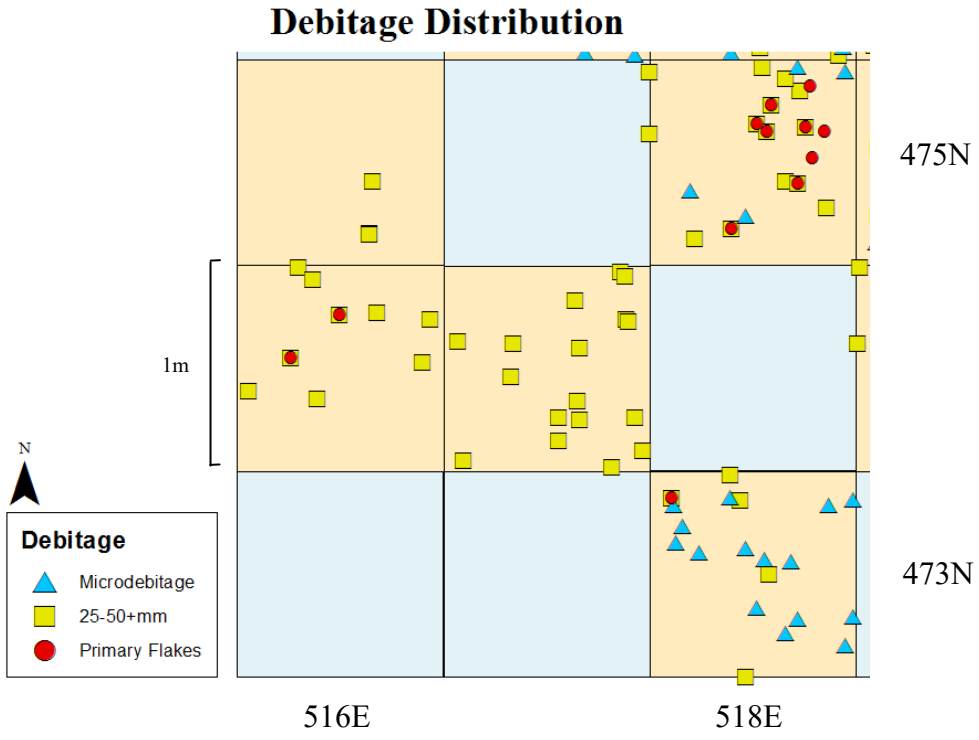


Figure 7.7.15B: Distribution of particular debitage types within cluster South B.

South C

Seven units within this eastern half of the South study area are incomplete, though there is a sharp decrease in artifact frequency outside of the main high density debitage cluster of unit 475N/520E. Stage 2 Assessment test pitting disturbed three units within Cluster C, including most of the southern quads in unit 473N/520E and the NEQ's of both unit 478N/520E and 478N/521E. Many of the Stage 2 test pits ended ~20 to 25cm dbs.

A total of 18 tools, including all three refits within the study area, were excavated within this cluster and consist almost solely of Stage 3 and 4 bifaces, and four projectile point bases (Figure 7.7.16 A). Recoveries include nine bifaces (two UID, four at Stage 3, and three at Stage 4), seven projectile points, and two retouched flakes. Projectile points include one constricting straight item (a refit with n=2), and three constricting convex items (one is a refit with n=2). Both siltstone and gunflint silica were utilized for these tools in addition to taconite. Noteworthy is the lack of tools from within the dense debitage cluster of unit 475N/520E relative to adjacent units.

When considering various debitage categories, there is a clear distribution of primary flakes in unit 475N/521E, although other indicators of primary reduction include the fact that core fragments were not recovered within this area. Large debitage (25-50+mm) was frequent throughout the cluster, while microdebitage was most dense along the western units of South C (Figure 7.7.16B).



Figure 7.7.16A: Location of Cluster C within the South study area. Inset: Tool distribution within Cluster C. Note: Red square highlights an area discussed in more detail in section 8.2.6 in Chapter 8.

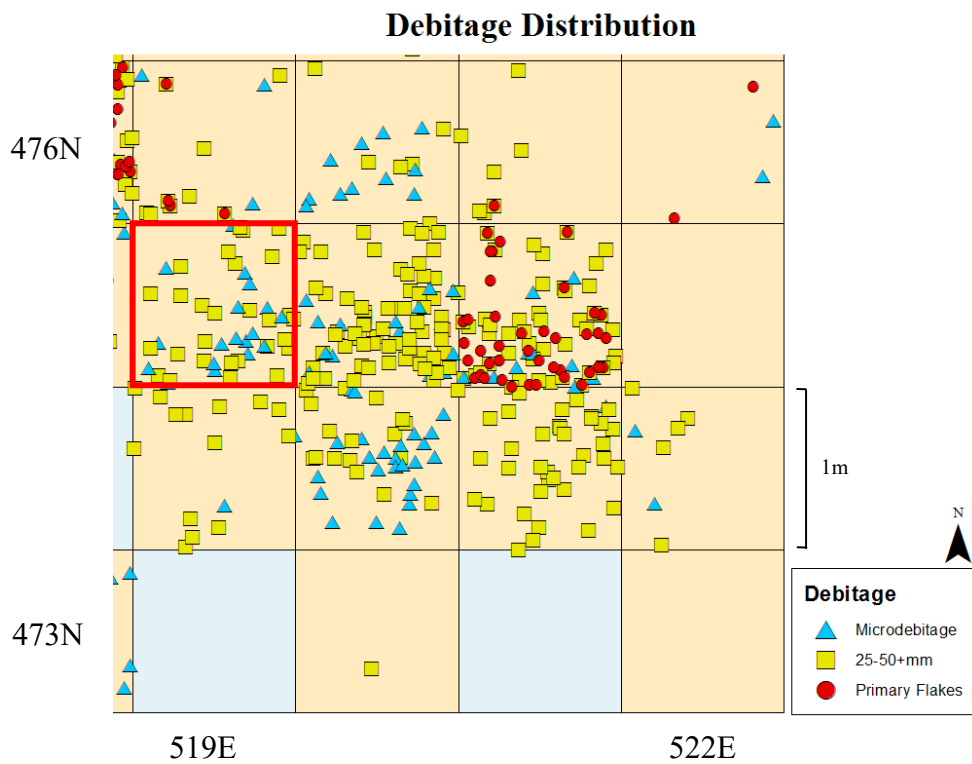


Figure 7.7.16B: Distribution of particular debitage types within cluster South C. Note: Red square highlights an area discussed in more detail in section 8.2.6 in Chapter 8.

Of interest is the high debitage density around unit 475N/520E. Artifacts within this area were found within silty brown sand throughout the unit. Units along the 475N line were excavated to Level 10 or 11 (55cm dbs) with artifacts found throughout. Black and orange staining was present in unit 475N/520E as well as units to the south and west from Levels 4 to 6 and included charcoal and FCR fragments (Figure 7.7.16C).

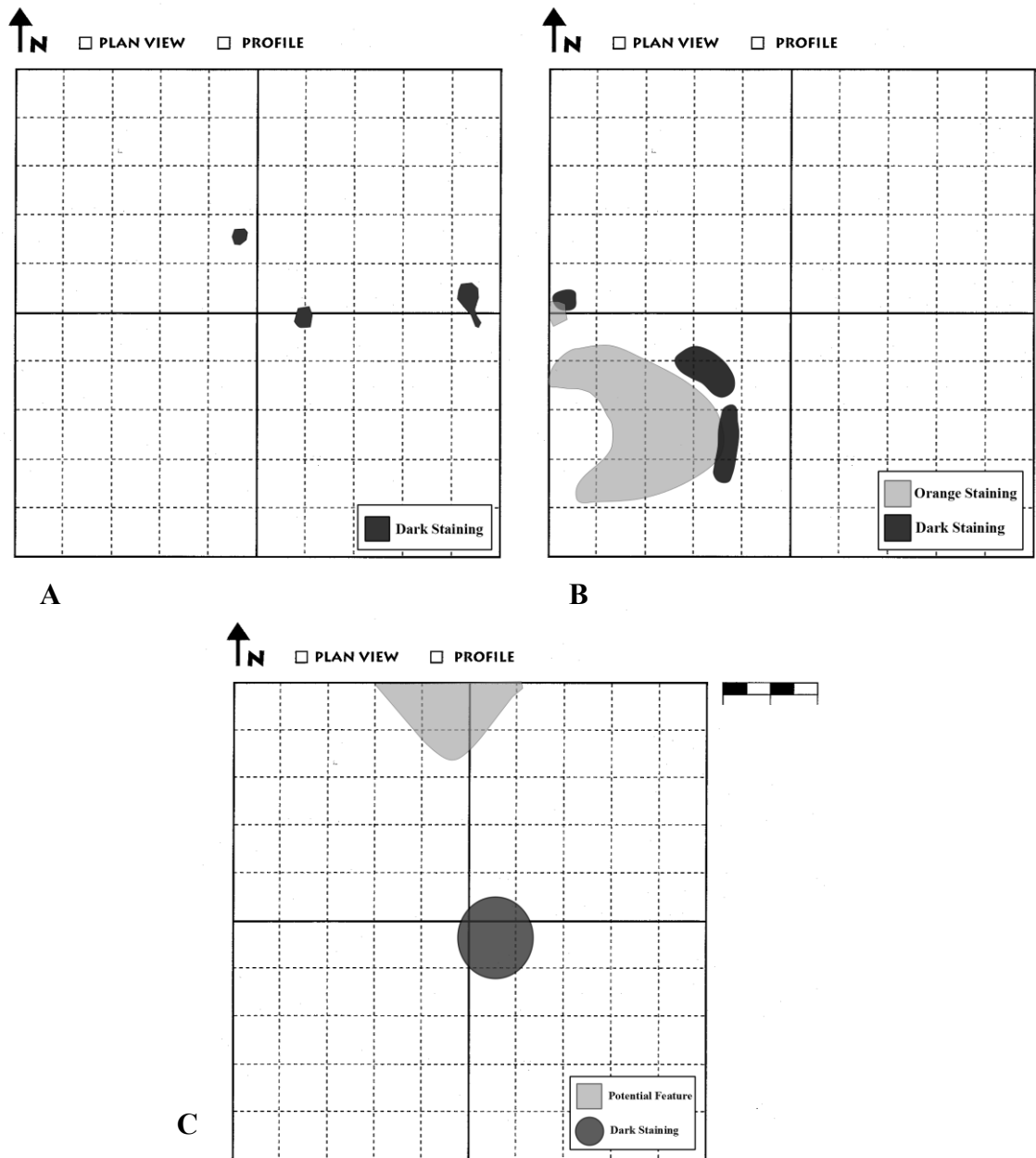


Figure 7.7.16C: Possible feature as mapped in: A) Level 5 of unit 475N/519E; B) Level 6 of unit 475N/520E, and; C) Level 5 of unit 474N/520E. Note: Rotten logs had been present in many of these units.

CHAPTER 8

INTERPRETATIONS FOR THE MACKENZIE I SPATIAL ANALYSIS

8.1 INTRODUCTION

Spatial analysis of the Mackenzie I site facilitates the interpretation of activities and organization of space within the six study areas. Patterns observed within the artifact distribution were interpreted using the ethnoarchaeological and archaeological literature (see Section 4.4). The interpretations within this chapter are reflective of the nature of data available for analysis. While factors such as taphonomical processes, modern disturbances, and excavation bias affect the spatial resolution of the data, the focus on peripheral zones away from the primary site area improve the interpretability of the results presented in Chapter 7.

8.2 STUDY AREA INTERPRETATION

Individual study area clusters are interpreted first, followed by a summary of the overall study area. Overarching themes of the analysis will be discussed in Chapter 9.

8.2.1 North

The locations of each cluster within the North study area, as determined with the K-means results, are provided in Figure 8.2.1.

North A

The presence of two core fragments in North A suggest lithic reduction activities, while the one grinding stone and two late production stage bifaces indicate an advanced

stage in the reduction process reminiscent of Gibson's (2001) stone working (the finishing or reworking of a tool; see Figure 7.2.14A). The Stage 3 and 4 bifaces indicate primary and secondary thinning, while the grinding stone could have been used for platform preparation to enable more direct flaking while formalizing the tool (Bennett 2015; see Table 5.6.5B). Bennett (2015) proposes that at Mackenzie I, bifaces at this phase of the reduction process were likely broken due to material flaws or knapper error.

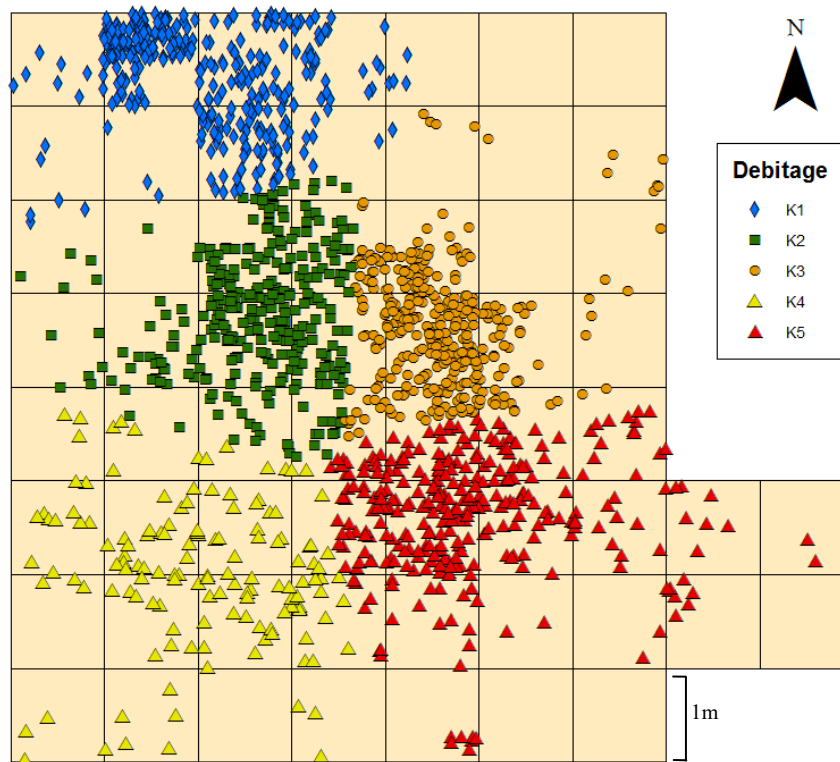


Figure 8.2.1: The location of each cluster within the North study area. Note: K1 through K5 are referred to as North A through North E.

The dense artifact recovery from unit 541N/515E includes numerous large debitage pieces (25-50+mm in size), core fragments, and broken retouched flakes (see Figure 7.2.14A and B). This area may represent a small toss zone to the northwest of the main North artifact distribution (see Figure 7.2.1), or a Type 3 cluster discard where

items were dumped further away from the activity area (Gibson 2001). This cluster may extend to the north outside of the study area.

North B

North B yielded relatively little microdebitage, while larger debitage, primary flakes, and broken tools account for much of the cluster assemblage. Artifacts are sparsely distributed around this cluster (see Figure 7.2.15A). All three recovered bifaces are broken, including the Stage 3 classified as “complete” which was missing a lateral edge fragment from the base. When considered with the rest of the cluster assemblage, it suggests a toss zone or refuse pile. *In-situ* lithic manufacture or stone working (finishing) is unlikely due to the low frequency of microdebitage. While most artifacts were recovered between Levels 3 and 5, a small amount of debitage and two bifaces were recovered from lower levels between Level 7 and 11.

A rock concentration was recorded within the high density unit 538N/516E, with a charcoal concentration below, and FCR fragments in surrounding units (see Figures 7.2.15B and C). This also suggests a refuse pile where people were dumping large, obtrusive items and discarded tools, or items collected during site clean-up and maintenance. Unfortunately, there is not enough information to confirm the presence of a hearth.

North C

Unit 538N/518E had the densest recovery within this cluster, and contained a mix of debitage sizes and a number of fragmentary tools (see Figure 7.2.16A and B). The complete cores indicate primary reduction (lithic manufacture), while the later stage

bifaces are suggestive of stone working. The projectile point base may represent breakage and discard during tool completion, or perhaps a consequence of discard as part of re-hafting.

Three stumps surrounded this high density area and likely affected the post-depositional movement of the artifacts. Apparent root burn was also noted to a depth of 30-35cm (Level 7) in unit 539N/518E. Regardless of this disturbance, the presence of microdebitage within the general debitage distribution, as well as the close association of siltstone artifacts suggests an *in-situ* component (see Figure 7.2.4). Alternatively, this assemblage could have been collected and disposed *en masse* (Binford 1983).

Large stones were associated with dense flake clusters along the boundary between units 538N/518E and 539N/518E (see Figures 7.2.16B and C). While disturbance is evident, the stone slab with supposed red ochre and nearby ochre fragments were encountered below the disturbance zones in Level 9 of unit 539N/518E. Additionally, the hearth feature one metre to the north was discovered between Levels 8 and 10 (Figure 8.2.2; see Figure 7.2.16D). The presence of ochre, in combination with the nearby hearth and stone slab below the level of disturbance, could be indicative of ceremonial activity (Gibson 2001).

North D

Both tool and debitage recoveries from North D are dispersed throughout the cluster, but with no artifacts recovered from lower levels as was observed in clusters North A, B, and C. The lack of microdebitage suggests that the assemblage is not a primary deposition zone, and that little lithic manufacturing or finishing occurred here.

Although FCR was noted in the southwestern corner of the study area, the presence of root burn casts doubt on the cultural nature of these FCR fragments. Gravel was a prominent part of the sedimentary matrix within this cluster as well which was generally associated with infrequent artifact count throughout the site; also suggesting that this is not a primary deposition zone. It is possible that many artifacts from within Cluster D were dispersed or disposed of from the dense area in the central North.

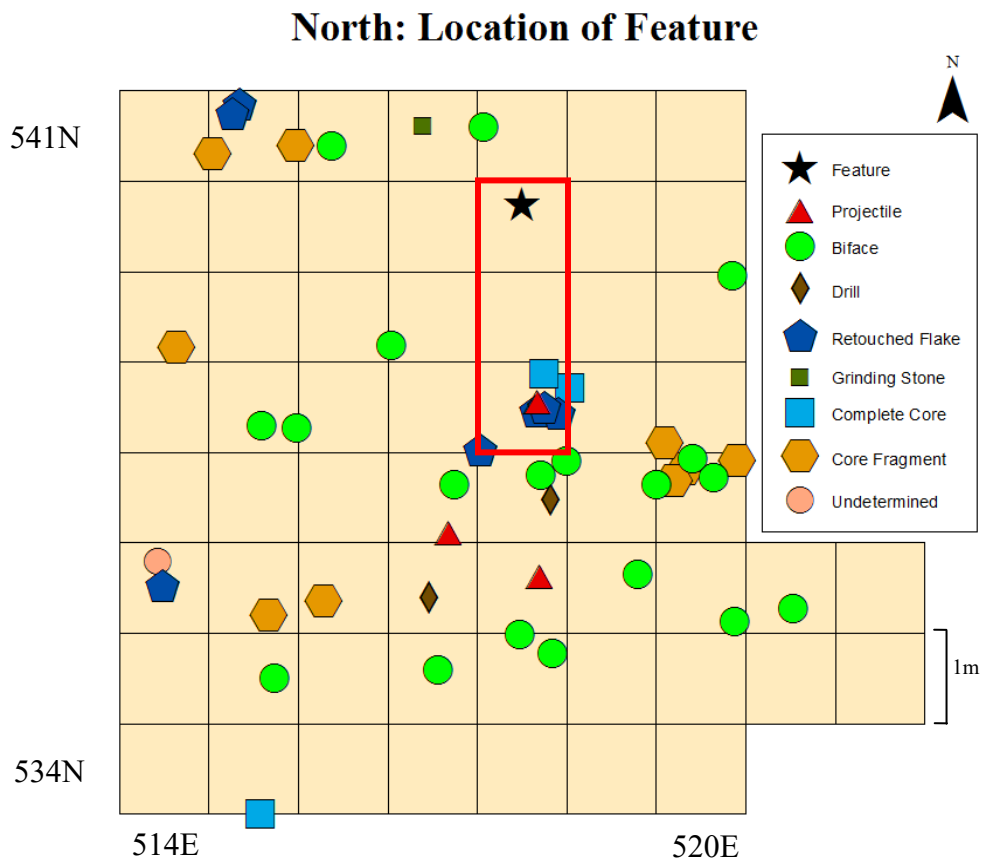


Figure 8.2.2: Distribution of the possible feature in the North study area (unit 540N/518E). The red square indicates the location of the hearth feature, flake clusters, and associated large stones with possible ochre (see Section 'North C').

North E

North E contains the majority of non-taconite artifacts. Though taconite is present, the assemblage is dominated by other material such as siltstone, quartz, and gunflint silica (see Figure 7.2.18C). The distribution of each individual material (for example the association between siltstone tools and debitage) suggests that this is an *in-situ* development, rather than a refuse pile where the assemblage would be more heterogeneous (see Figure 7.2.4). There is no apparent vertical separation between taconite and non-taconite. While artifacts might have moved vertically through various bioturbation and cryoturbation processes, it remains possible that the depositional consistency indicates that these materials were being worked or deposited simultaneously. Though stumps were recorded, disturbance was minimal as demonstrated by the close vertical and horizontal association of this assemblage.

The core fragments and UID bifaces within unit 537N/520E, along with the lack of debitage, is suggestive of a toss zone along the periphery of the *in-situ* assemblage (see Figure 7.2.18A). Activities would have included early lithic reduction (indicated by core fragments and early stage bifaces), and some stone working as indicated by the unfinished siltstone drill and the Stage 6 biface.

If the North E assemblage is *in-situ* there is likely a hearth nearby used for heat and light. Indeed, a large FCR fragment measuring 25cm x 21cm was recovered from under a tree stump in unit 536N/518E; however the natural or cultural character of this item has not been determined. The potlidded taconite drill could indicate heat alteration of raw material; however, only eight tools across all six study areas were potlidded. As the drill was unfinished it could have been tossed into the hearth and discarded after

breakage rather than intentionally heated (Gibson's (2001) Type 2 discard). The hearth could also have been used for re-hafting, as the two projectile points were discarded basal fragments (De Bie et al. 2002c).

Summary of the North Study Area

Artifact displacement would have occurred in the North study area, as indicated by the vertical discrepancy of the refit tool, and recorded bioturbation. Additionally, microdebitage is sporadically distributed throughout the excavation levels. However, overall artifact distribution and debitage size-sorting per level indicate a general pattern of vertical accumulation or deposition of artifacts in Levels 3 to 5 (see Figure 7.2.7). The clustered nature of raw materials also suggests that this study area contains interpretable clusters from which meaningful information can be gathered.

The deeper component in the northern part of the study area does not seem to be the result of significant vertical displacement since it coincides with evidence of potential hearth features (e.g. unit 540N/518E). This component includes the hearth feature, and possible ochre items as well as the small number of tools and debitage within Clusters A, B, and C. While a lower occupation is possible, the detailed stratigraphic records for each unit which could indicate a separate occupation do not exist. Of note, is the possible evidence for ceremonial activity, given the stone slab with supposed ochre, ochre fragments, and nearby potential hearth (Gibson 2001).

The North assemblage suggests that lithic manufacturing and stone working/finishing were the main activities in this study area. The presence of drills suggests that bone, antler, or wood working occurred at Mackenzie I (Carr 1984; Gibson

2001). However, the majority of these items were in the process of being completed suggesting tool production rather than use. Re-hafting or retooling accounts for the projectile point bases and some of the microdebitage recoveries.

The overall artifact distribution is reminiscent of Binford's (1983) outdoor hearth model, with toss zones as seen in Cluster B and E, and either a toss zone or Type 3 discard (Gibson 2001) in Cluster A where items were purposefully dumped further from the activity centre (see Figure 7.2.9). These models are used with caution as the hearth-related distribution differs from Binford's (1983) models which occurred over a shorter time span; Mackenzie I was occupied extensively over a longer period of time, and as a habitation site it contains multiple synchronous and diachronic events. Regardless, slow sediment deposition in the Boreal forest means that successive events could have occurred in relation to preexisting organization of activities (e.g. refuse piles or hearth locations; Bamforth et al. 2005).

Though there is a hearth feature in the north in unit 540N/518E, there were likely other hearths whose remains did not last in the archaeological record, or whose scant remains were overlooked in the field. It is hypothesized that a hearth would have been located just southwest of the *in-situ* assemblage of Cluster C.

8.2.2 Central North

The locations of each cluster within the Central North study area, as determined with the K-means results, are shown in Figure 8.2.3.

Central North A

Many of the tools recovered from this cluster are complete, including two projectile points, one preform, and two Stage 4 bifaces that were found in close horizontal proximity within and around unit 521N/520E (see Figure 7.3.13A). The completeness of tools, coupled with the relatively advanced stage of the bifaces (Bennett 2015) suggests that they might have been part of a cache that was dispersed by post-depositional taphonomic processes. This observation is further supported by the lack of microdebitage in Cluster A indicating that tool finishing occurred elsewhere (see Figure 7.3.13B).

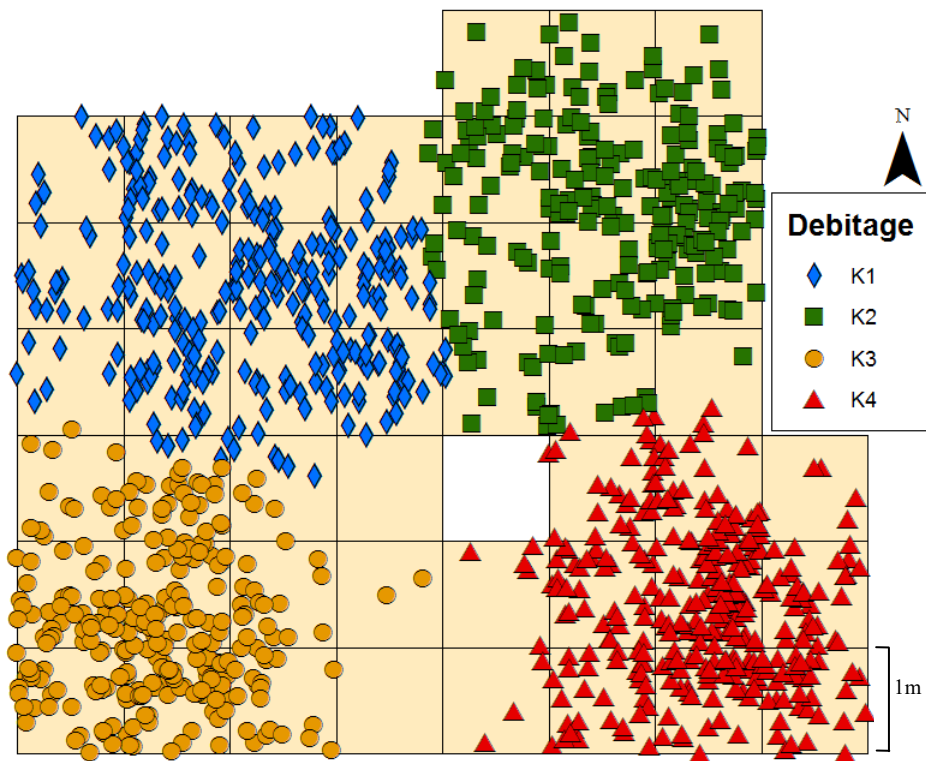


Figure 8.2.3: The location of each cluster within the Central North study area. Note: K1 through K4 are referred to as Central North A through Central North D.

Although many different projectile point morphological shapes were present at Mackenzie I, no spatial patterning by morphological categories, raw material, or flaking style (e.g. parallel oblique flaking) was evident (Markham 2013). This is further emphasized by the close association of both an ‘eared deep’, and ‘constricting straight’ projectile points in Central North A (Figure 8.2.4). This close spatial proximity implies the synchronous deposition of diverse morphological shapes, and that these differences do not reflect temporal change in projectile point characteristics.

Central North B

Cluster B is a hearth-related assemblage along the eastern limits of Mackenzie I (see Figure 7.3.14D). The hearth feature is indicated by FCR, charcoal, and soil discoloration in the northern quadrants of unit 521N/522E, the southern quadrants of unit 522N/522E, and the southwest quadrant of unit 522N/523E (Figure 8.2.4; Figures 7.3.14A-D). This feature is associated with some large stones and a low debitage frequency. Microdebitage and two tool tips (a Stage 4 biface, and burin) are located on the northern periphery of the feature, likely indicating an *in-situ* deposition of the microdebitage, and tools discarded near the hearth.

An area of relatively low artifact density surrounds this feature, with core fragments, primary debitage, and retouched flakes representing a toss zone immediately behind a workspace around the hearth. Gunflint silica artifacts are closely associated and connect the core fragment to the hearth feature (see Figure 7.3.14C).

The limited amount of tools and debitage suggest lithic manufacture was not a central priority within the activity area, although clean-up could have played a role in the

formation of the archaeological assemblage. The presence of the burin, Stage 4 biface, and microdebitage suggest stone working, although these tools could also indicate other activities such as hide, or bone working. These activities generally occur away from large quantities of debitage, and therefore, may be responsible for this cluster assemblage (De Bie et al. 2002c; Gibson 2001). Unfortunately, this observation cannot be confirmed, as organic material associated with hide or bone working did not survive in the Mackenzie I archaeological assemblage.

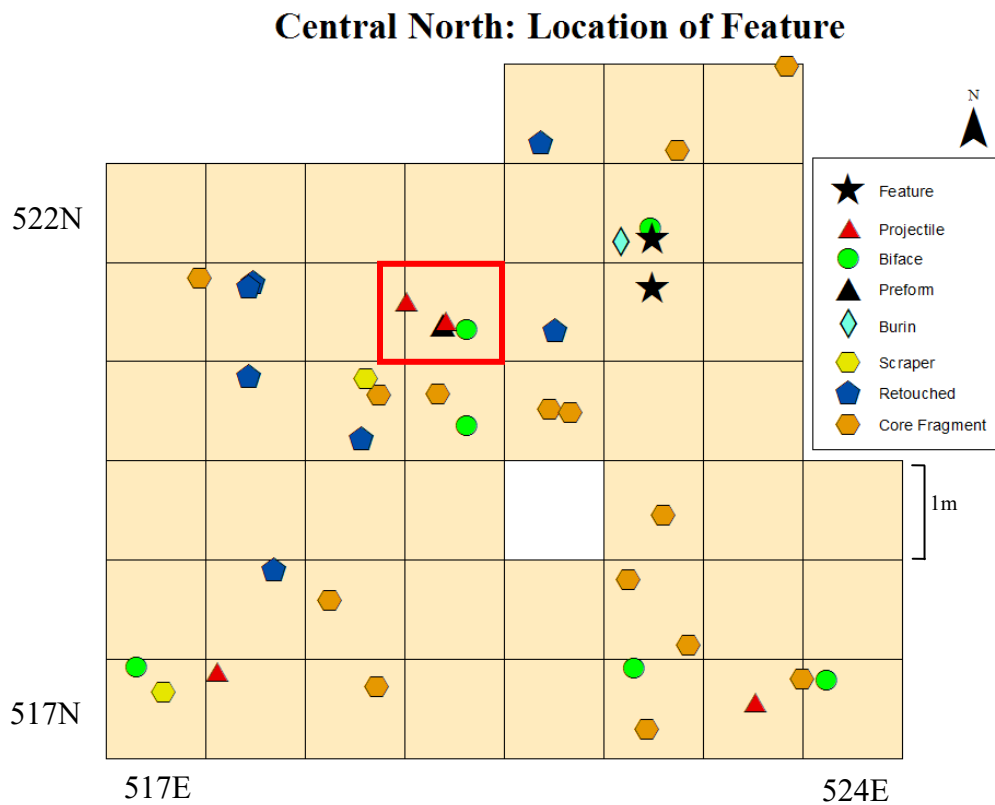


Figure 8.2.4: Distribution of the potential hearth-related assemblage in Central North B. The stars highlight the two main units with evidence for a continual hearth feature (units 521N/522E and 522N/522E). Note: Red square highlights close association of projectile points as discussed in section 8.2.2.

Central North C

The tool assemblage within Cluster C consists of discards, such as the exhausted core and broken tool tips. However, many of the debitage clusters were closely associated with tree stumps and root systems, thus decreasing the interpretability of this area. The sparse recovery of microdebitage suggests that lithic manufacturing or tool finishing did not occur here (Gibson 2001). It is possible that this area may have been a refuse pile where waste was collected and thrown out; however, more information may exist outside of the study area boundaries to the south and west.

Central North D

Central North D was also impacted by stump and root activity, which would have played a role in the post-depositional movement of artifacts. The large debitage, discarded tools, and core fragments are along the periphery of the debitage concentration and suggest a toss zone during lithic manufacturing (see the KDE analysis in Figure 7.3.8); however, the documentation of significant bioturbation inhibits meaningful interpretation of the cluster.

Summary of the Central North Study Area

The Central North encompasses a large area, yet these study area boundaries are subjective. This could result in the exclusion of relevant information if it exists outside of the study area, as may be the case with Cluster C. A larger area also increases the likelihood that multiple events or activity areas are included which can blur potential patterns, and adds complexity to spatial analysis.

Regardless, interesting inferences can be made about the two northern clusters (Central North A, and B). The hearth-related assemblage proposed in Cluster B follows models based in part from ethnoarchaeology and experimental archaeology (Binford 1983; Gibson 2001). Whether the artifact cache and storage of the complete tools is related to this activity area is difficult to ascertain, although both cluster assemblages were recovered from within the same vertical levels. These cluster assemblages likely represent multiple events.

8.2.3 West

The locations of each cluster within the West study area, as determined with the K-means results, are outlined in Figure 8.2.5.

West A

Although information is missing for some units in this cluster, there is a concentration of artifacts around the pit feature in units 497N/506E and 497N/507E (see Figure 7.4.14B). The high number of broken tools (including a high proportion of tips, and later stage bifaces), combined with the small number of complete tools, and extremely high microdebitage frequency suggests that stone working was the dominant activity in this area. A total of 22 projectile points were recovered from Cluster A, half (n=11) of which consisted of tips suggesting that the reworking and discard of tools after breaking was a large contributor to this cluster assemblage.

The presence of drills, the perforator, and the knife indicate the presence of bone, antler, or wood working at Mackenzie I (Carr 1984; Gibson 2001), although these activities likely did not occur here due to the dense lithic frequency of this cluster. No

organic material exists to better infer the location of such activity areas. The number of drill tips, along with other broken tool fragments suggests that many items may have broken during use, or were discarded while attempting to sharpen the tool. Later stage bifaces, or retouched flakes could also be used as multipurpose tools for related activities.

The West A depositional pattern is likely the result of discard into the toss zone, which is defined by more heterogeneous artifact clusters dominated by microdebitage (Gibson 2001). A hearth(s) was likely located nearby. Grey silty sand and charcoal was observed from Levels 10 to 13 in unit 497N/507E (Figure 8.2.6). It is unfortunate that the charcoal samples have not been dated, as they were found in direct association with cultural material, within the pit feature. FCR fragments were recovered from a few units north of the feature, however no other information regarding potential hearth features was recorded.

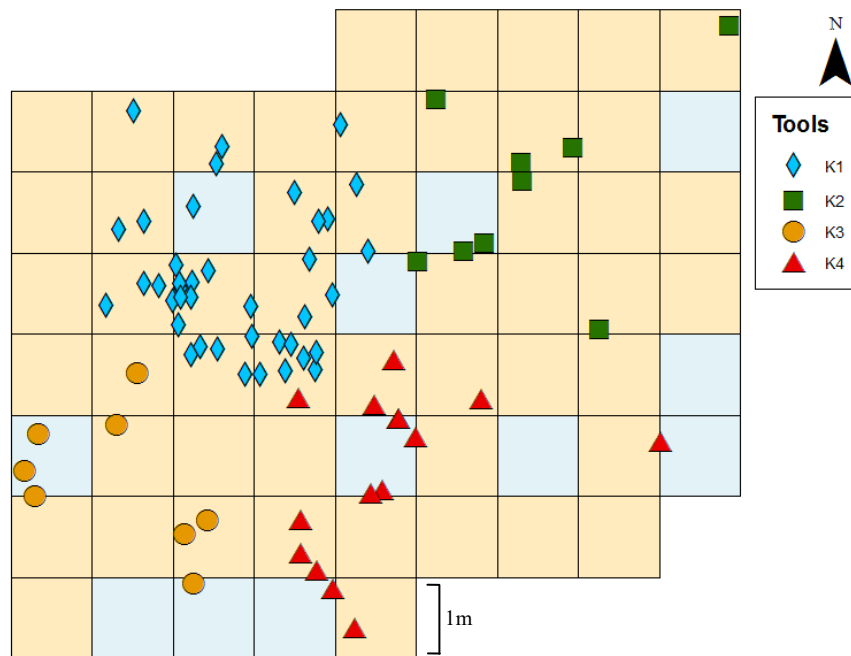


Figure 8.2.5: The location of each cluster within the West study area. Note: K1 through K4 are referred to as West A through West D. Note: The blue squares indicate units with missing information.

West B

This cluster is almost devoid of cultural material, and heavily disturbed. Unit 500N/510E contained the children's dinosaur toy in Level 7, indicating extensive modern disturbance (see Figure 7.4.16A). Two additional units recorded stump and root activity reaching to a depth of ~25cm (Level 5). The debitage found in unit 500N/510E may have originated nearer the main area of artifact deposition in Cluster A (see Figure 7.4.5).

Unit 498N/509E contained a number of large debitage and primary flakes with no microdebitage (see Figure 7.4.16B). This unit, with broken tools nearby, could suggest a toss zone associated with the main activity centre in Cluster A. However, the two adjacent units that might have been informative were not yet available in the catalogue. Regardless of the localized disturbance, a complete lack of cultural material suggests more than post-depositional disturbance. More information would be needed to determine whether clean-up or other cultural factors played a role.

West C

This cluster has been extensively disturbed. Root rot and intrusive roots were present throughout most excavated levels, sometimes reaching a depth of 50cm. The stumps that were dragged from the east during clear-cutting prior to the excavation had a visible impact on the artifact distribution. The debitage is evenly dispersed throughout the cluster, with a low frequency of large debitage, suggesting that they might have been dragged and dispersed with the tree stumps or backdirt (see Figure 7.4.17B). It is possible that the discarded tools within this cluster originated along the southern border of Cluster A, or were dragged in from elsewhere. Units compressed by large stumps along the

southern periphery of the study area, contained mottled and disturbed matrix throughout. Therefore, no meaningful spatial interpretation can be made for West C.

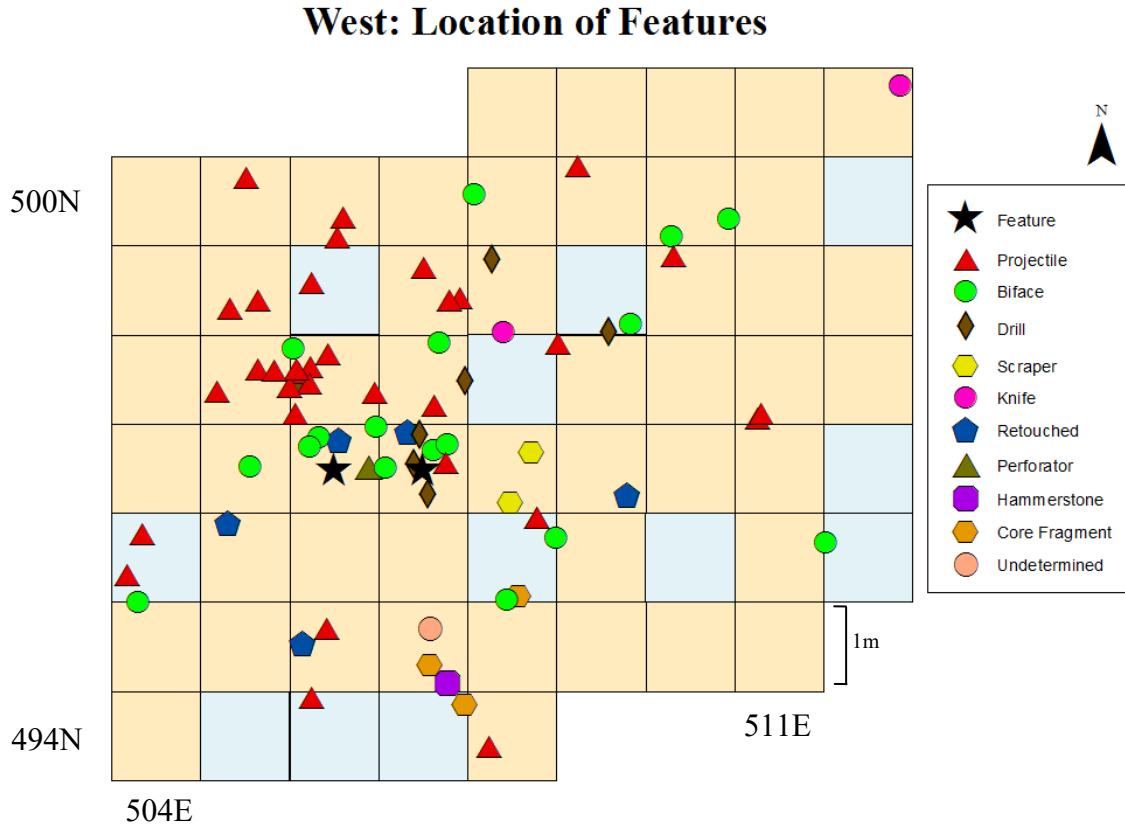


Figure 8.2.6: Location of the feature in the West study area, cluster A. Note: the blue squares indicate units with missing catalogue information.

West D

The close proximity of the hammerstone to the core fragments in the south of the study area suggests the presence of lithic manufacturing (Figure 8.2.6). It is possible that these tools were discarded in a Type 3 cluster discard (Gibson 2001) where items are collected and dumped further from the main activity area. This relationship between West A and D is further suggested by the distribution of quartz artifacts (see Figure 7.4.6). The scrapers in West D also indicate a relationship with West A, as they are found in close

proximity to a number of drills; the close association between drills and scrapers was observed within most of the study areas considered in this analysis and suggest the working of organic material such as bone or hide (Cook 1973; Gibson 2001). Many units surrounding the hammerstone and core fragments were impacted by clear-cutting debris, as noted in West C, which impedes further spatial interpretation.

Summary of the West Study Area

Due to the number and location of missing units within this study area, certain tests were not completed, such as the Nearest Neighbour and Ripley's K tests for the debitage distribution (see Section 7.4.3). Others were used only in an exploratory manner to supplement the visual comparisons and cluster component analysis. Extensive mechanical disturbance due to tree-felling activity prior to the excavation also limits the spatial analysis. Cluster C provides a good example of dispersed artifact distributions resulting from modern activities. Additionally, the very large gap between one refit in Cluster A, and its partner 42m east may be due to modern disturbance. As the refit was recovered outside of the study area, the modern disturbance or Paleoindian behavioural nature of this distance is unknown.

Nevertheless, the analysis of raw material, other refits, and the assemblage of Cluster A do suggest an intact component within the study area. The combination of tool fragments, completed tools, and the high density of microdebitage suggest this area was used for stone working (Gibson 2001; Healan 1995). The unusually high density of projectile points within Cluster A suggest that reworking and discard after breakage is responsible for much of the assemblage. The high tool count for this study area could be

the result of multiple events as it is located along the western periphery of the site; it would be ideal for an activity that creates a lot of waste, and would have been distanced from main habitation centres (Logan and Hill 2000). Activities such as butchering and hide scraping would have also occurred along site peripheries and could account for areas of low lithic frequency.

8.2.4 Central West

The locations of each cluster within the Central West study area, as determined with the K-means results, are demonstrated in Figure 8.2.7.

Central West A

Due to the high frequency of microdebitage and broken tools, stone working was a dominant activity in Cluster A. This activity is also indicated by the presence of smaller hammerstones (Gibson 2001), and finishing flakes within the microdebitage cluster (see Figure 7.5.14A and B). The preforms and later stage bifaces likely broke while finishing, whereas previously completed tools likely broke during use or re-sharpening. Projectile point bases could indicate discard while re-hafting (De Bie et al. 2002c).

Cluster discard (where the material was collected and dumped into a refuse pile) is a possible explanation for some of the clusters as debitage sizes and various raw materials are interspersed, creating a more heterogeneous assemblage (Gibson 2001). The high density and variety of tools is also suggestive of a refuse midden (Keeley 1991). However, the dense cluster of microdebitage is more likely to represent an *in-situ* drop zone. If this does represent the collection and dumping of material, care was taken to gather the microdebitage indicating collection on a mat or hide (Gibson 2001). A number

of large stones were recovered in close association to the dense flake clusters and broken tools. Although the nature of these rocks is unclear, the generally uniform nature of the sediments suggests that they are of cultural derivation.

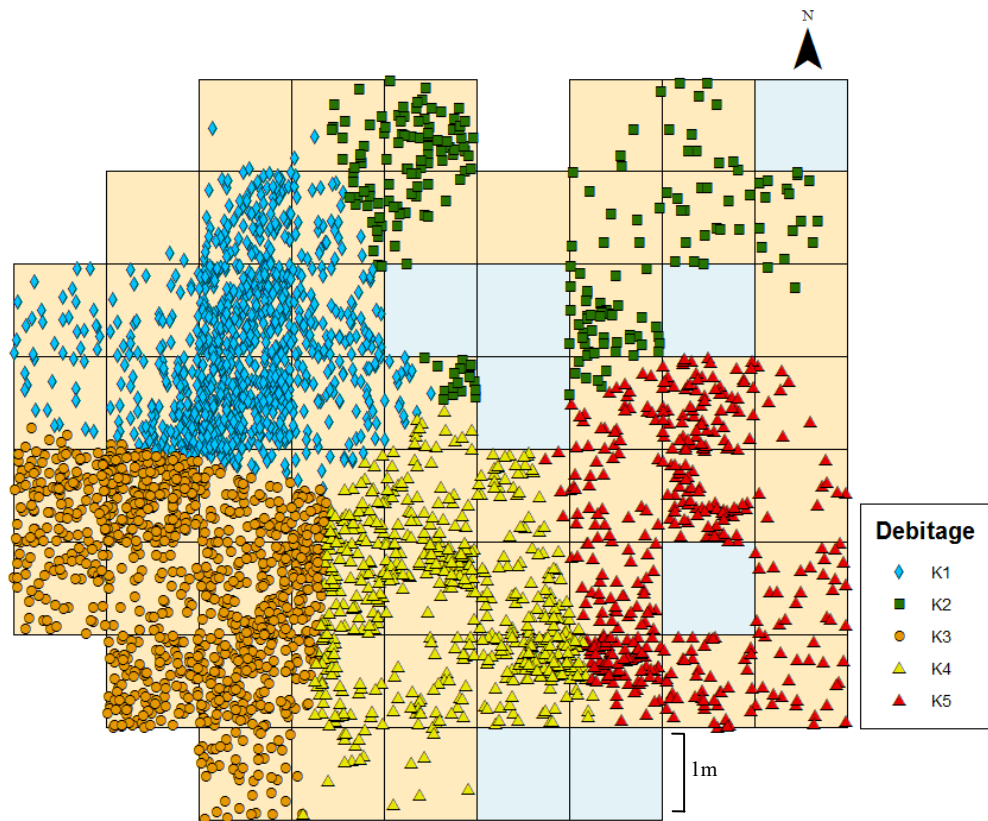


Figure 8.2.7: The location of each cluster within the Central West study area. Note: K1 through K5 are referred to as Central West A through Central West E.

Additionally, the recovery of drills (as in the West study area) indicates that bone, antler, or wood working also occurred at Mackenzie I. Many drills in Cluster A were preforms in the process of being completed. The small cluster of drills and scrapers found in the Central West were located along the same north grid line (497N) as was the cluster of drills and scrapers found in the West study area (~8m apart). As previously stated,

these tool types were closely associated in most of the study areas in this analysis, perhaps demonstrating the purposeful attempt to complete a specific toolkit.

Central West B

Tools within this cluster are limited with no distinct visual pattern, although the overall artifact distribution suggests some dispersal from the main cluster in Central West A (see Figure 7.5.15A and B). What is notable about this cluster are that four out of seven tools are complete; and combined with the lack of microdebitage it is likely not an *in-situ* manufacturing area, or a refuse pile. This cluster distribution likely represents the dispersal of artifacts from Central West A, which is further suggested by the presence of the scraper near the drills and scrapers from Cluster A.

Interestingly, a potential hearth feature was recorded in lower levels of unit 498N/515E (Figure 8.2.8 (A); Figure 7.5.15C). A possible hearth feature was first noted in Level 5 based on the presence of soil staining, FCR fragments, and charcoal fragments. Charcoal recoveries continued from Levels 7 to 11 in association with a silty grey and a silty orange matrix. Five tools between Clusters A and B (within and south/southwest of the feature) were excavated from Levels 7 to 9 and include one scraper, three drills, and one biface. Two of the drill midsections in Level 8 refit, thus this component appears to be *in-situ* and likely related to the hearth feature.

A related drop zone or cluster assemblage may exist to the north, outside of the study area. Within the Central West, the deeper component is contained to those few units (unit 498N/515E, and south). The refit tool in Level 8 and the deeper feature could be suggestive of an earlier occupation.

Central West C

This cluster does not provide enough information to gain significant spatial insight. Rotten wood and roots were found in the south, impacting some units to a depth of 15-25cm below surface. The rest of the cluster had a low artifact frequency, and aside from two complete tools, consisted of artifacts that would have been discarded after breaking. Aside from the bioturbation in the south end of the cluster, little modern disturbance was recorded, suggesting that cultural patterns may have also affected the low artifact count (see Figure 7.5.16B). For example, craft activities such as hide, bone, or wood working generally occurred away from activities that produced a lot of lithic waste (Bamforth et al. 2005; Gibson 2001). Alternatively, increased clean-up or maintenance could have cleared the area of debris if this was a more intensely used area (De Bie et al. 2002c).

Central West D

Tools within Central West D include numerous broken tips, reminiscent of tools from Cluster A. Many projectile points were represented by basal fragments, one of which had failed during finishing. Therefore, these tools were likely discarded during stone working (Gibson 2001). The number of projectile point bases suggest discard during re-hafting (De Bie et al. 2002c). Examination of the area southwest of this cluster might aid interpretation, as the artifact distribution may extend outside of the study area boundary.

Central West: Location of Features

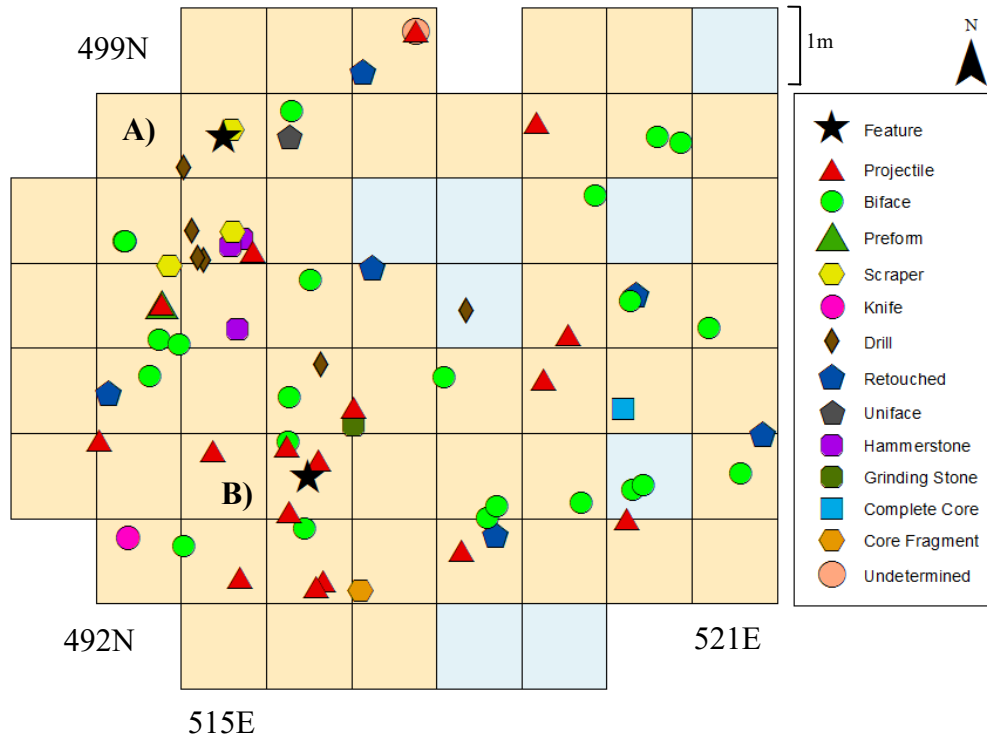


Figure 8.2.8: Distribution of possible features in the Central West study area. A) Potential hearth from unit 498N/515E in Central West B; B) Potential hearth feature as discussed for unit 494N/516E in Central West D.

It is difficult to interpret the debitage patterns, as many quadrants were impacted by Stage 2 test pitting. Furthermore, backdirt deriving from the MTO soil sampling conducted prior to excavation was encountered in the southern units. A large waterlogged stump displaced artifacts in the southwest corner of the study area, and additional bioturbation was noted along the western edge. Regardless, the close association between a gunflint silica biface tip and debitage, as well as the clustered microdebitage, suggest that the area was not completely disturbed (see Figures 7.5.4 and 7.5.17B). This cluster could be an *in-situ* stone working activity area, or the debris from stone working that had been collected and dumped.

High artifact density is associated with a large flat stone in unit 494N/517E, which was found between Levels 3 and 8 (see Figure 7.5.17D). More information regarding this stone is unavailable, which is unfortunate as it may be associated to a potential hearth one metre to the west in unit 494N/516E (Figure 8.2.8 (B)). This feature contained FCR and silty dark sand between Levels 6 and 11, albeit cultural material was limited in these deeper levels and did not contain diagnostic artifacts.

Central West E

The limited frequency of microdebitage, combined with the clustered nature of large flakes (25-50+mm), and the high frequency of broken tools in Cluster E suggests a Type 3 cluster discard where debris has been collected from lithic manufacture and stone working activities, and dumped further from the activity area(s) (Gibson 2001; see Figure 7.5.18B). Evidence of bioturbation was limited, although ideally the data from the missing units would be included.

Mudstone debitage is clustered in unit 493N/518E, and is likely related to the mudstone projectile point in Cluster D (see Figure 7.5.6). A lack of mudstone microdebitage implies that the tools were not manufactured within Cluster E, but that the debris was collected and dumped here afterwards. Refuse piles are usually heterogeneous in nature, and since the small amount of mudstone debris recovered in this study area is clustered, perhaps it represents a discrete knapping event that involved a common general area for waste disposal. Gunflint silica debitage was also found in close proximity to the broken gunflint silica biface (broken due to knapper error), indicative of a separate event or separate knapper (see Figure 7.5.4).

The core and associated cluster of large debitage and primary flakes indicate debris from lithic manufacturing (see Figures 7.5.18A and B). Large stones were associated with this cultural material within and just north of unit 495N/520E. The second cluster of large debitage is centred in the northern quads of unit 493N/519E, with three stone slabs in the SEQ (see Figure 7.5.18C). This area provides another example of the supposed association between large rocks and dense artifact clusters. Although the nature of these stones is uncertain, they could have been used as anvil stones, associated with invisible features, or simply cleared from an area and dumped into the refuse pile.

Summary of the Central West Study Area

Due to the extent of this study area multiple events are likely represented within the Central West assemblage. These multiple, synchronic and/or diachronic events, blur spatial patterns and create a complex dataset. Nonetheless, activities that helped to create the final assemblage can still be inferred. For example, the overall assemblage appears to be the discard from stone working, and some lithic manufacturing activities.

In the west, the dense distribution of microdebitage and broken tools could either represent a drop zone, or cluster discard after collection on a mat (Gibson 2001). Additionally, if this area was used as a refuse midden then it was likely reused for a lengthy period of time. The extensive use of the western portion of the study area may be further supported by the potential lower occupation as seen between Clusters A and B. The amount of refuse in this area suggests that it was located away from more intensely used domestic areas, which would have undergone more rigorous clean-up and maintenance.

Alternately, the low artifact count from the northeast portion of the study area could be due to disturbance, more intensive clean-up, or other activities that required a space with less lithic waste (e.g. hide working). While there is limited evidence for extensive disturbance in this area, it could have simply been unnoted during excavations. More information is required before a natural or cultural cause can be associated with this area.

The southern perimeter of the Central West was impacted by engineer soil sampling conducted prior to the archaeological excavation (see Figure 5.4.1). Notes indicate that backdirt had been collected on some units, though the degree of this disturbance is unknown. It is possible that some units were compressed by this backdirt, affecting the vertical interpretation of those units.

8.2.5 East

The locations of each cluster within the East study area, as determined with the K-means results, are shown in Figure 8.2.9.

East A

Artifact distributions in Cluster A likely represent *in-situ* stone working as indicated by the presence of microdebitage clusters, with some larger flakes, and broken tools throughout the distribution (see Figures 7.6.14A and B). The reworked tool likely broke during the initial reduction process due to its thick cross section and hinge fractures, and was then reworked into a scraper. Lithic reduction was not a dominant activity here as no core or core fragments were recovered, and primary flakes are limited. Furthermore, an *in-situ* component is suggested by the microdebitage and overall artifact

distribution contained within a surrounding area of low artifact density (see Figure 7.6.14B). The clustered nature of siltstone artifacts also implies a lack of post-depositional horizontal disturbance (see Figure 7.6.4).

A potential hearth was uncovered in unit 508N/523E between Levels 3 and 4, with charcoal and a dark grey ash-like matrix (Figure 8.2.10 (A)). High flake concentration in subsequent levels surrounded the potential feature, which likely provided a source of heat and light for people during stone working activities.

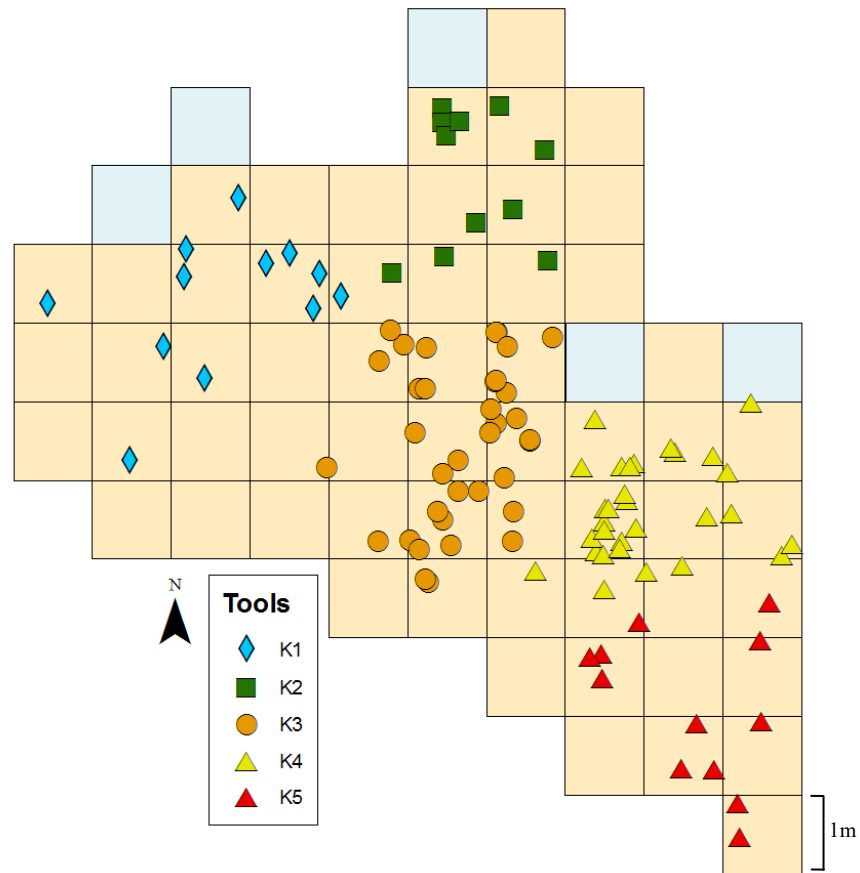


Figure 8.2.9: The location of each cluster within the East study area. Note: K1 through K5 are referred to as East A through East E.

A deeper *in-situ* component was uncovered in relation to the hearth feature in units 508N/525E and 508N/526E (Figure 8.2.10 (B); Figures 7.6.14C and D). This feature was associated with one grinding stone in Level 11, and a projectile point refit in Level 11 and 13. Large stones and FCR fragments were also found at this depth, particularly with the grinding stone in unit 508N/526E. Microdebitage was sparse within these units, and siltstone flakes were associated with the siltstone grinding stone. This feature could represent an earlier cultural event. It is possible that the large stones could have been used as anvils, and when combined with the small grinding stone, may represent bone breaking activities (Gibson 2001). This would account for the low frequency of debitage within the lower levels.

East B

Unlike East A, there are few interpretations that can be made regarding this cluster. A refuse pile or midden is suggested by the lack of tool refits, and the number of broken tools that were discarded after breaking during the reduction process (Bamforth et al. 2005). Projectile point bases and the broken reworked tool imply discard during reworking activities. Though many FCR fragments were noted within East B, they are likely natural as the distribution is spread both vertically and horizontally. Clarification of these interpretations would require more information on the localized stratigraphy and nature of the FCR fragments.

East C

This cluster includes a large section of the East study area, and the dense nature of both debitage and tools suggests that earlier events may be obscured by later activities.

This would result in the blurring of any distinctions between occupations. Dense clusters of debitage, including microdebitage and primary flakes, suggest that site occupants were engaging in both lithic manufacture and stone working activities (see Figure 7.6.16B). This is supported by the recovery of a large number of broken tools, including preforms (Gibson 2001; see Figure 7.6.16A). Many fragments exhibited hinge fractures and other signs of knapper error. Only one core fragment was recorded but it is possible that other cores were tossed or dumped in a midden elsewhere.

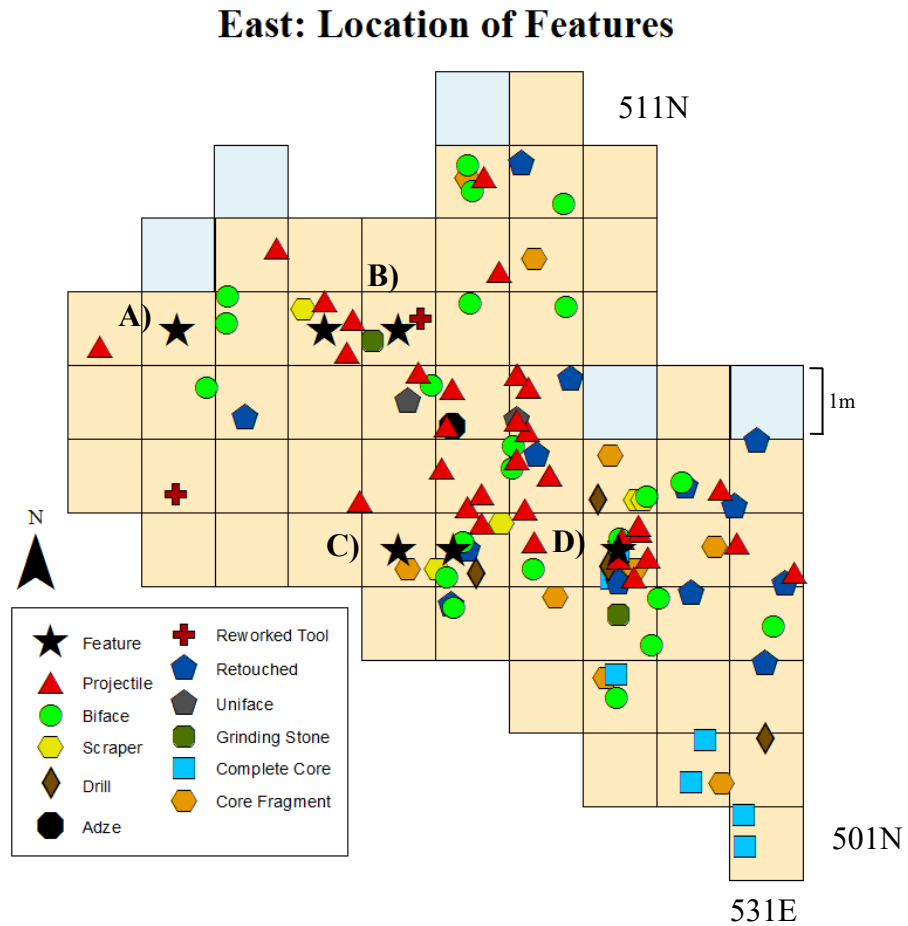


Figure 8.2.10: Distribution of possible features in the East study area. A) Potential hearth in unit 508N/523E; B) Deeper *in-situ* component and hearth from units 508N/525E and 508N/526E; C) Possible feature or refuse pile as discussed for units 505N/526E and 505N/527E; D) Pit feature discussed for unit 505N/529E in East D.

The tool assemblage represents a multitude of activities such as hide working, hunting, wood working, and butchering. However, the nature of this assemblage suggests manufacture rather than use of these tools. The clustered nature of both microdebitage, and multiple raw materials such as chert and siltstone, suggest some *in-situ* occupational debris within Cluster C (see Figure 7.6.6). Many of these raw materials had a low recovery frequency that could mean the tool was brought here to sharpen but not manufactured here initially. Though there are distinctions between the microdebitage and larger debitage (25-50+mm), no clear drop and toss zones were detected.

Six tools were found in deeper levels, although they were scattered throughout Cluster C and therefore could be due to vertical displacement. Conversely, the projectile point preform from Level 9 of unit 507N/526E was recovered just south of the hearth feature discussed in East A (see Figures 7.6.14C and D, and 7.6.16A). FCR and charcoal fragments were recovered beginning in Level 5, associated with a high debitage frequency, and a diffuse layer of dark staining between Levels 7 and 8. Therefore, unit 507N/526E likely represents a continuation of the hearth feature discussed in East A.

A potential feature was recorded further south in units 505N/526E and the western quads of 505N/527E (Figure 8.2.10 (C); Figure 7.6.16A-C). Soil discoloration was not noted, but large FCR fragments were associated with a high debitage frequency. This small assemblage consists of larger flakes and broken tools, while microdebitage is sparse which could indicate a cluster discard with disposal of lithic debris and other refuse.

East D

This cluster contains a large tool count within a small area, and most tools are associated with the pit feature in unit 505N/529E (Figure 8.2.10 (D); Figure 7.6.17A). As with other East clusters, multiple tool kits are represented including hide working, primary lithic reduction, or hunting, though most of these activities did not occur here. Rather, these tools were in the process of being finished or resharpened when they broke and were discarded. Though the artifact assemblage was impacted by bioturbation, causing vertical displacement, general interpretations are made according to the overall content of the assemblage.

Lithic manufacture is represented by the presence of cores, and the large debitage count. Additionally, the high frequency of broken preforms and finished tools is evidence of stone working. Although microdebitage is present in this cluster, it is minimal (see Figure 7.6.17B). Thus, Cluster D could represent a toss zone where lithic remains from lithic reduction and stone working were discarded. A refit between the pit feature and East C indicates a relationship between this toss zone and activities in East C.

Charcoal, in association with FCR fragments and a pattern of orange and ash-like sand was recorded for the pit feature, beginning in Level 15 (see Figure 7.6.17C). However, no confident interpretations can be made because the large stump was not removed until Level 14. Additionally, the stump impeded proper excavation by arbitrary levels which means vertical interpretability is limited. Although the artifact assemblage is indicative of a toss zone from lithic manufacturing, the nature of this deep pit is unclear.

East E

This cluster represents debris from lithic manufacturing, and was likely dumped into a toss zone or collected and disposed of in a midden. A lack of refits, combined with limited microdebitage can suggest a refuse pile or midden (Bamforth et al. 2005; De Bie et al. 2002c). Additional support is provided by the high proportion of cores, large debitage, and primary flakes (see Figures 7.6.18A and B). A connection with other clusters in the East study area is not conclusive as there were no refit tools within Cluster E. Vertical distribution within this zone is similar to the rest of the East study area, however, this refuse pile could be the result of activity to the south, or southwest (outside of the study area boundaries).

Summary of the East Study Area

The overall artifact distribution pattern demonstrates a dense cluster in the centre of the study area, with two interesting artifact densities to the west, and the southeast (Clusters A, C, and D; see Figure 7.6.9). The assemblage likely represents multiple events, however, these three clusters are inter-connected through the presence of refit tools and hearth features. The wide use of this study area and the relationship between such intensively used clusters suggests that the East was ideal for lithic activities and spatially separated from domestic areas. Discrete patterns in both Clusters D and E demonstrate discard into a refuse pile separated from the central activity area. Unfortunately, disturbance such as Stage 2 test pitting and bioturbation inhibit more detailed interpretation. MTO soil sampling was noted south of the study area which potentially impacted some of the most southern units within the East (see Figure 5.4.1).

However, the only recorded disturbance was compaction from a high traffic path leading to the nested screens.

The high tool count in the East study area represents many different activities including wood working, hunting, hide working, and lithic manufacture. The presence of multi-functional tools such as bifaces and retouched flakes indicate that some activities may not be apparent from the tool assemblage. This assemblage represents the manufacture of associated tools rather than their use, and the presence of these other activities. Regardless, this demonstrates the multitude of activities occurring at Mackenzie I. Additionally, many different projectile point morphological shapes are represented within the East assemblage, with no noticeable spatial distinction to suggest temporal differences (see Table 5.6.9C).

8.2.6 South

The locations of each cluster within the South study area, as determined with the K-means results, are outlined in Figure 8.2.11.

South A

There are two discrete artifact clusters within South A, including the pit feature in unit 478N/518E, and unit 476N/518E (Figure 8.2.12 A and B). The two units are separated by one excavation unit whose northern quads are devoid of artifacts (see Figures 7.7.14 A and B). They are also differentiated by their respective biface assemblage which consists of UID biface fragments in the north cluster and Stage 4 bifaces in the south. Although there is no recorded connection between the two discrete clusters, it is possible that the low artifact count between these areas is the result of

modern disturbance such as Stage 2 test pitting. While this could account for the distinct lack of debitage, no such disturbance was recorded in the fieldnotes.

Overall, the presence of complete cores and core fragments, along with the tight cluster of primary flakes, and numerous large debitage (25-50+mm) represents lithic manufacturing and primary reduction (see Figure 7.7.14B). Additionally, the presence of microdebitage, preform tools, and cacheable Stage 4 bifaces represent a stone working component.

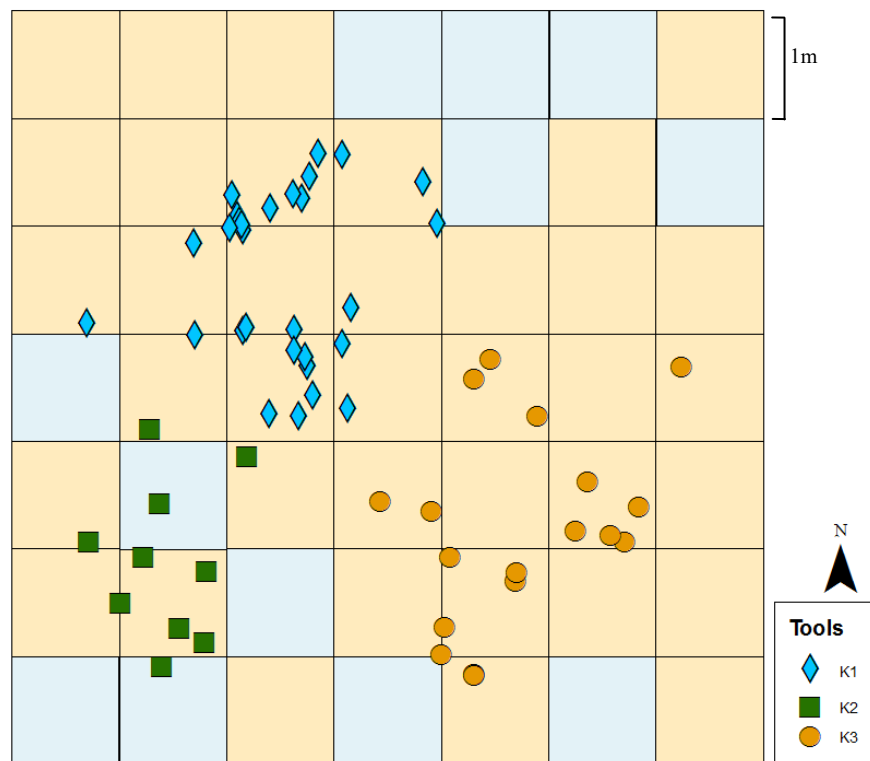


Figure 8.2.11: The location of each cluster within the South study area. Note: K1 through K3 are referred to as South A through South C.

The nature of the pit feature remains unclear. The presence of taconite and organics from the micromorphology analysis clearly indicate the presence of cultural

material within the pit (Gilliland et al. 2012). However, two complete tools were recovered (not including the three complete cores) which are items not generally discarded. An ice wedge is one possible cause for this pit (Shultis 2013), and artifacts could have slowly fallen into the melting ice wedge over time. This could be responsible for the lack of artifacts seen in the northern quads of unit 477N/518E. However, that would not explain the presence of complete tools within the pit assemblage. With the pit feature level forms unavailable for this analysis the nature of this feature cannot be confirmed.

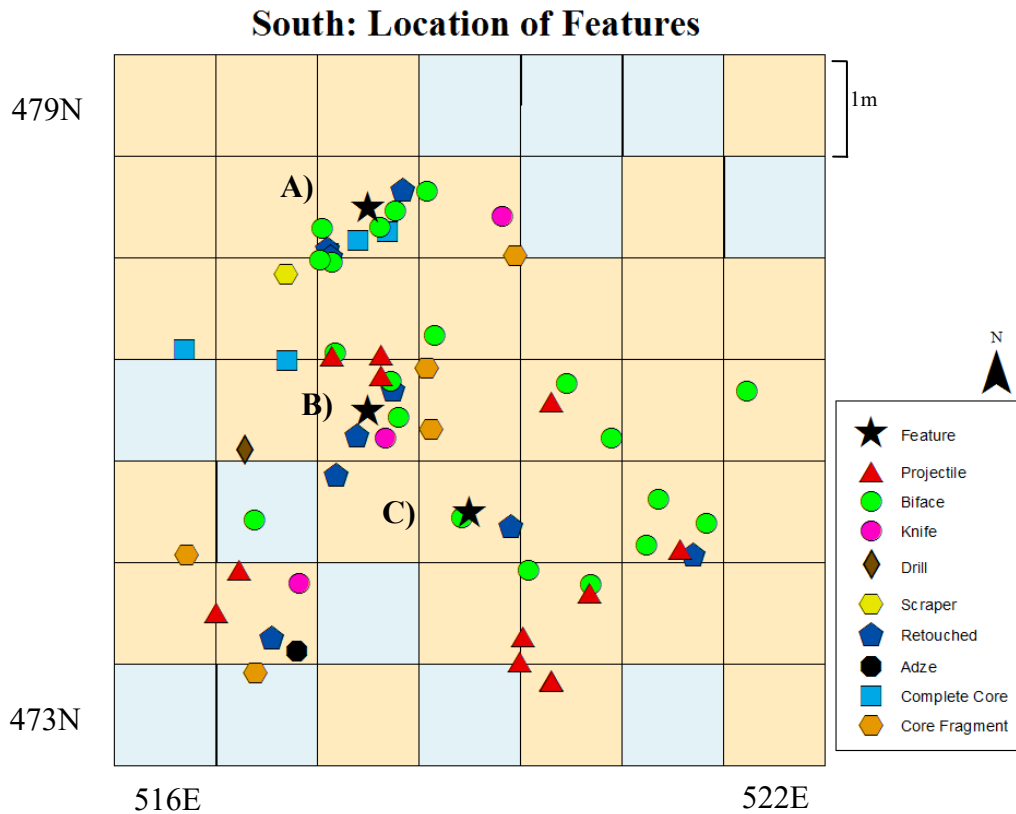


Figure 8.2.12: Distribution of possible features in the South study area. A) Pit feature within unit 478N/518E and; B) The dense artifact cluster within unit 476N/518E; C) Potential hearth feature in unit 475N/519E, beside highly dense flake clusters.

South B

Interpretations for South B are limited, since complete information from four units was not available at the time of analysis (see Figure 7.7.1). Debitage distribution is important for spatial analysis, but unfortunately this data cannot be inferred. The only observation is that the discrete cluster of primary flakes, and quartzdebitage within the northeast corner is likely related to South A (see Figure 7.7.6). Stone working and some lithic manufacturing is suggested from the tool assemblage, including the close association of four preforms (two projectile points, one knife, and one adze; see Figure 7.7.15A).

South C

All three refits within the South study area are located within Cluster C, which may suggest an *in-situ* development rather than a midden (Bamforth et al. 2005; see Figure 7.7.8). Two units of highdebitage density are surrounded by a number of tools, most indicative of stone working (Gibson 2001). Many bifaces are Stage 3 and Stage 4, representing primary and secondary thinning during the reduction process (Bennett 2015). With the exception of one complete biface the tools were fragmentary suggesting they were discarded after breaking.

A potential hearth was recorded within Levels 9 and 10 of unit 475N/519E, with over one thousand pieces ofdebitage recovered from within and around this unit between Levels 7 and 10 (Figure 8.2.12; see also Figures 7.7.16A-C). Additionally, there is a distinction between the tools along the north of this dense cluster (between Levels 6 and 9), and the tools along the south (from Levels 2 and 3). Activities in this area are likely

blurred in part due to multiple events, and could be the result of vertical displacement. If the potential feature does represent a lower occupation, the debitage was discarded in and around the hearth, while the tools were discarded in the drop zone (see Figure 7.7.16A).

This interpretation is speculative given the limited evidence available and the bioturbation that was recorded in the neighbouring unit of 475N/520E. A rotting log was noted on the surface, discoloring soil beneath. Silty sand along the 475N line was associated with artifact distribution though some level form descriptions imply a more mottled appearance indicative of disturbed soil. Mixed orange and black staining, and random charcoal fragments were found in many of the units along the 475N line around Levels 5 and 6. Therefore, although the artifact distribution is discretely clustered the area may be too disturbed for meaningful spatial interpretation.

Summary of the South Study Area

Many of the interpretations made within the South study area are tentative due to the recorded bioturbation in the south and missing catalogue information. Despite this, the tool assemblage demonstrates discard from both lithic manufacturing and stone working activities. The assemblage is contained by a clear boundary of low artifact density which could indicate either taphonomical processes or some level of site clean-up and maintenance (Keeley 1991). Cluster C may be an *in-situ* development with a drop zone and hearth feature. However, the vertical disparity may indicate both blurred cultural events, and bioturbation.

Significant information has been provided on the pit feature in Cluster A, in the form of both micromorphology (Gilliland et al. 2012) and geoarchaeological analysis

(Shultis 2013). Unfortunately, without the excavation level forms and detailed field notes, a well-informed interpretation is not possible. The cultural or natural cause of this pit feature is debated, but the absence of microdebitage indicates that the assemblage is likely not *in-situ*.

8.3 SUMMARY

This thesis was undertaken to analyze the human patterns which can emerge through spatial organization, and to assess patterns through visual and spatial analytical techniques. Certainly, some patterns in the lithic assemblage indicate the presence of *in-situ* activity areas including hearth features, or areas devoted to lithic manufacturing or stone working. The tools themselves represent a wide range of activities that would have occurred within Mackenzie I including wood working, hide preparation or hide working, bone working, butchery, and food preparation.

A noticeable bias exists within these interpretations as organic material did not survive in the archaeological record, resulting in a dataset that was comprised solely of lithic remains. Thus, when areas of artifact density were sought for this thesis, analysis focused on dense lithic clusters resulting in the frequent interpretation of lithic manufacturing or stone working. Additionally, bioturbation was evident throughout the site although its affect on artifact distribution was not always recorded. In some areas, such as Central North D, disturbance and its affect on the assemblage was noticeable. Conversely, areas without mention of bioturbation could be due to oversight, rather than the true absence of disturbance. Therefore, artifact distribution patterns and information

from surrounding units was used to investigate the level of interpretability throughout this analysis.

Nonetheless, discrete patterns were located within many of these study areas and indicated a range of activity. The presence of microdebitage clusters, and distinct raw material clusters may indicate *in-situ* or singular events, therefore, enabling interpretation of the lithic assemblage. The diverse artifact assemblage throughout these six study areas reveals that Mackenzie I was an important area for cultural and community activity over an extensive period of time.

CHAPTER 9

DISCUSSION OF THE MACKENZIE I SPATIAL ANALYSIS

9.1 INTRODUCTION

To date, detailed intra-site spatial analyses of Lakehead Complex sites have been rare (but see Adams 1995; Langford 2015). However, the yield of debitage and tools from the large block excavation at the Mackenzie I site enabled an extensive spatial analysis of several discrete site areas. This facilitated the interpretation of potential activity areas and the organization of space in some of the interpretable portions of the site.

This chapter summarizes the range of cultural activities discerned within the study areas, and the associated implications for human behaviour at the site. The function of the Mackenzie I site during Late Paleoindian occupation, and the site's relationship within the wider Interlakes Composite is also discussed. The benefits of the methodology utilized within this thesis are assessed, with consideration of the limitations and opportunities for future research.

9.2 SUMMARY OF CULTURAL ACTIVITIES

As previously discussed, lithic manufacturing activities (from primary reduction through to the finishing or reworking of a tool) were the primary activities observed within the six study areas (Figure 9.2.1; Table 9.2.1). However, many other activities can be indirectly inferred from the lithic tool assemblage. This section summarizes the substantive information provided in both Chapter 7 and Chapter 8, including both direct

and indirect inferences of activity as well as artifact clusters that may not be as interpretable due to disturbance and the resultant lack of spatial resolution.

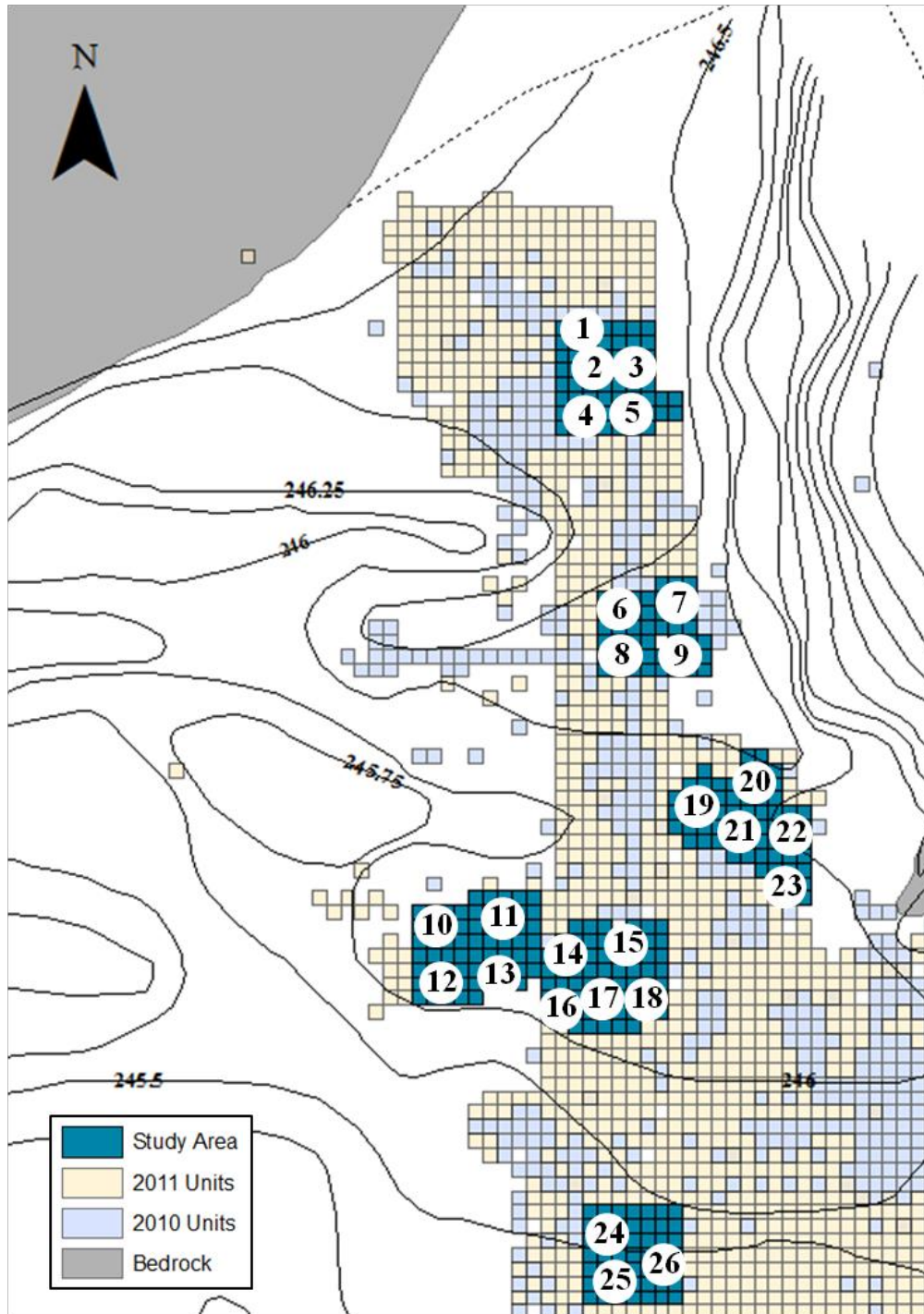


Figure 9.2.1: Summary of various activities within the study areas, as discussed in Chapter 8. See Table 9.2.1 for label descriptions.

Table 9.2.1

Summary of Activity Areas

Number	Study Area	Description
1	North	Toss zone or Type 3 cluster discard
2		Toss zone
3		<i>In-situ</i> lithic manufacturing and stone working; deep feature
4		Possible dispersion from centre of North
5		<i>In-situ</i> lithic manufacturing and stone working with adjacent toss zone
6	Central North	Possible remnants of former tool cache
7		Hearth-related artifact distribution; clean-up of lithic debris or possible evidence for hide or bone working
8		Inconclusive
9		Possible toss zone for lithic manufacturing activities
10	West	Toss zone for stone working activities
11		Inconclusive; missing information
12		Inconclusive; disturbance
13		Type 3 cluster discard from lithic manufacturing activities
14	Central West	Potential Type 3 cluster discard from stone working activities
15		Dispersal from activity in Central West A; deeper <i>in-situ</i> distribution
16		Inconclusive
17		Discard from stone working? Extensive disturbance
18		Type 3 cluster discard from lithic manufacturing and stone working activities
19	East	<i>In-situ</i> stone working; possible deep hearth and tools for possible bone breaking activities
20		Discard from lithic activities
21		Overlapping lithic activities with some <i>in-situ</i> debris; deeper event related to East A
22		Toss zone for lithic manufacturing debris in East C
23		Refuse midden for lithic manufacturing debris
24	South	Discard from lithic activities; inconclusive due to missing information
25		Discard from stone working; inconclusive due to missing information
26		Likely some <i>in-situ</i> lithic events and possible hearth

9.2.1 Direct Inference of Activities

The lithic assemblage throughout all six study areas provided direct evidence for lithic manufacturing and stone working. This includes tools or debitage indicative of the whole reduction process from primary reduction (e.g. primary flakes, cores), to the finishing, re-working, and re-hafting of tools (e.g. microdebitage, later stage bifaces, or other tool preforms). Generally, both lithic manufacturing and stone working co-occurred throughout the 26 clusters discussed in this thesis, although West A, Central West A, Central West D, and East A demonstrated a primary focus on stone working.

The predominance of stone working in these four clusters may be due to the clean-up of more obtrusive items and their disposal into the toss pile or refuse zone, rather than the actual absence of lithic manufacturing and its by-products. Indeed, the West study area provides a good example of this observation. Various assemblage attributes indicate a relationship between the stone working activities of West A and the refuse pile in West D. Therefore, an artificial focus on stone working was created in West A by removing the large waste from lithic manufacture and dumping it in the refuse pile (West D). Thus, while four clusters appear to solely represent stone working, it is likely that this activity was still co-occurring with lithic reduction activities.

In addition to the determination of activity type within these study areas, this analysis was also able to distinguish the depositional nature of many of these activities; whether it was an *in-situ* assemblage, toss zone, or refuse pile. The incorporation of ethnoarchaeological and archaeological literature (see Chapter 5) enabled the comparison of patterns in the literature with those observed within the study area clusters.

9.2.2 Indirect Inference of Activities

Due to the poor organic preservation at Mackenzie I, many indicators of cultural activity (i.e. hide, wood, bone, or antler working, butchery, or food production) are minimal to nonexistent. This results in an apparent over-representation of activities that involve production, use, and refurbishment of lithic objects. Furthermore, since this study focused on six discrete lithic clusters within a much larger site, it is possible that many of the aforementioned activities are not fully represented. In order to indirectly infer a broader range of activities using the lithic assemblage, scrapers, drills, knives, adzes, and other multi-functional tools such as bifaces and retouched flakes were considered. Generally, these items were in the process of being completed suggesting tool production rather than use. However, their use is indicated by the recovery of previously completed tools that were discarded after breaking.

There were four locations within the six study areas that may have indirect evidence of activities that would have generated organic waste (Central North B, West B, Central West C, and East A). Within these clusters, the overall artifact count was low or noticeably absent. This absence could be explained by site clean-up or maintenance during site occupation. Conversely, the low artifact count could be attributed to various forms of post-depositional disturbance (e.g. see the modern disturbance in West B). Disturbance may have also been overlooked and not recorded during the excavation.

Regardless, some of these areas suggest that the low artifact count may be indicative of activities that involved organic materials. Hide scraping, food preparation, and other activities involving organic remains were generally completed away from

activities associated with large accumulations of lithic waste (De Bie et al. 2002c; Gibson 2001). For example, East A contained a potential *in-situ* hearth below the level of disturbance in association with the grinding stone, large stones, and a low artifact frequency (see Figure 8.2.5). The low frequency of lithic waste combined with the large stones and grinding stone could indicate the presence of bone breaking activities (Gibson 2001). The hearth-related assemblage of Central North B also contained a low artifact frequency. The presence of a burin, and a few multi-functional tools could be indicative of hide or bone working (see Figure 8.2.2). These observations can only be indirectly inferred from the assemblage.

9.2.3 Inconclusive Results

Some clusters within this analysis were simply not interpretable. These areas include Central North C, West B, West C, East B, South A, and South B. Several factors contribute to this level of spatial interpretability. In South B for example, missing catalogue data constrained the interpretation of the debitage distribution. Modern disturbance also affected some study areas, as exemplified by the West C assemblage. Recent clear-cutting produced large stumps that were dragged along the ground, consequentially dispersing the assemblage and impacting artifact distribution (see Figure 7.4.17B).

9.3 IMPLICATIONS FOR HUMAN BEHAVIOUR AT THE MACKENZIE I SITE

The Mackenzie I site is spatially extensive and yielded a large and diverse artifact assemblage, suggesting occupation over an extensive period of time. To reiterate, lithic manufacturing and stone working were important activities. However, recovery of tools

such as adzes, scrapers, and drills are suggestive of activities not otherwise apparent given the poor preservation of organic material.

From these observations, inferences about the human behaviour of Mackenzie I inhabitants can be made. The lithic assemblage demonstrates that multiple toolkits were being manufactured, refurbished, and discarded in the same activity area; for example, where hide working tools were being completed alongside projectile points. The interpretation that such activities co-occurred is supported by the close vertical and horizontal association of various tool types in some areas.

In some of the study areas analyzed, there appears to be a stratigraphic distinction between successive occupations that is not reflected by available stratigraphic evidence. While artifacts were generally recovered within Levels 3 to 5, there were small artifact assemblages and features encountered at deeper levels that suggest additional occupation zones. These areas were generally located below the level of recorded modern bioturbation (i.e. in the North, Central West, and East study areas). The hearth-like features and associated artifacts are suggestive of earlier occupations within Mackenzie I that might not be apparent within the existing data. However, the absence of detailed information limits the distinction of separate occupational levels.

Potential hearths may indicate the centre of activity, and potential habitation, within these study areas. Ethnoarchaeological research has demonstrated that many activities, including lithic manufacture and stone working, may have been completed within a structure. A structure would have provided shelter and likely contained a hearth for both heat and light (Gibson 2001). The hearth-related artifact distribution discussed

for Central North B may well be an example of a confined distribution within a structure due to the presence of broken tools discarded near the hearth, and the spatially separated toss zone behind the potential workspace(s). Additionally, Type 3 cluster discard may indicate the dumping of waste after collection (e.g. on a mat) during clean-up within a structure (Gibson 2001). This type of discard was inferred for the North A, West D, and Central West E clusters. The use of tree boughs underneath mats for easy clean-up may also impact the spatial distribution of artifacts within a shelter, as small fragments may fall through and be deposited on the ground beneath rather than accumulate in dump zones with larger material (Ives, pers. comm., 2015). However, reoccupation has likely blurred events and the sample size of known feature locations is too small to confidently determine the presence of possible structures.

The argument for structures within these study areas is tentative, and although Mackenzie I inhabitants likely used some sort of structure for various activities, the existence and location of such items is not definitive. Just as activities with organic material are underrepresented within this study, so too are areas of domestic use and associated activities (e.g. food preparation or cooking, habitation, etc.). And while the intensively used centre of the site was not included in this thesis, peripheral study area interpretations indicate an explicit means of organizing one's actions and activities within the community.

Lastly, although evidence for ceremonial activity is speculative, the presence of both ochre and Hixton Silicified Sandstone may hint at the more intangible behaviour of Mackenzie I inhabitants. The stone slab with supposed ochre, nearby ochre fragments, and *in-situ* hearth below the level of disturbance in North C is enticing. However,

detailed stratigraphic records and use-wear analysis on the stone slab would improve our understanding of this area. Additionally, Hixton Silicified Sandstone artifacts would have been transferred (or traded) a long distance before reaching the Mackenzie I site; and while debitage was recovered, available evidence indicates that Hixton Silicified Sandstone tools were likely not manufactured on site, but had been completed elsewhere. As many of the burned artifacts recovered from the cremation burial at the Renier site were manufactured from this material (Ives pers. comm., 2015; Mason and Irwin 1960), it is possible this exotic raw material held some significance to Late Paleoindian people in the Thunder Bay region.

9.4 IMPLICATIONS FOR INTRA-SITE SPATIAL ANALYSIS

In an intra-site analysis, multiple aspects of the archaeological deposit are studied within a spatial context to detect the presence of patterns that might suggest activity areas used by past populations. A multi-proxy approach was employed to address some of the limitations imposed by the nature of the site, including the paucity of non-lithic materials. Within the limits of available data, multiple lines of evidence were incorporated to maximize the quality and strength of the interpretations. Where possible, this included geoarchaeological, lithic, and absolute dating analyses (Bennett 2015; Gilliland et al. 2012; Markham 2013; Shultis 2013).

Many of the study areas chosen for this analysis were located around the site periphery in an effort to define smaller, discrete clusters of artifacts to improve the spatial resolution. This approach avoided the complex centre of the site, where temporally discrete habitation and work areas likely overlapped, and where spatial interpretability

was particularly challenging. As a result, activities that took place in this intensively used centre are likely underrepresented. Nevertheless, these more interpretable peripheral zones may be useful in extrapolating to other parts of the site.

Previous spatial interpretations of Lakehead Complex sites focused on the visual comparison of artifact distributions (see Chapter 5). While this approach is a useful starting point, it can be difficult to apply to sites such as Mackenzie I with its complex occupational history and challenging taphonomy. Therefore, spatial analytical techniques were used as exploratory tools to define clusters or cultural events that might otherwise be blurred (Mills 2007). These statistical tests also provide a quantitative basis to assess the validity of visual patterns, and a means to study the composition of individual clusters.

While these spatial analytical techniques were beneficial, limitations were observed. As demonstrated in Chapter 7, ‘overall artifact’ distribution demonstrated statistically significant clustering within the study areas, whereas ‘tools only’ indicated that their pattern was random. This appears to be the result of small sample size within the tool assemblage. While the number of tools recovered from the Mackenzie I site was large compared to other regional sites, it proved too small for statistically significant results within each individual study area. As a result, it was important to critically assess the outcome of each test by comparing the results with other quantitative approaches, as well as the more subjective qualitative information from the visual inspection.

Following statistical analysis, the archaeological and ethnoarchaeological literature was reviewed in search of interpretative analogies for the spatial patterns. While

direct comparisons between an ethnoarchaeological study and Late Paleoindian assemblages are not possible, some general interpretations of human behaviour are possible based upon material remains (see Chapter 5). Such interpretations remain constrained by poor organic preservation, taphonomic processes, and the inability to incorporate use-wear, debitage refit, and other time intensive tests within this study.

Determining the presence of patterns resulting from cultural activity, involved sorting through the myriad of information, notes, comments, maps, and data. Although some information was incomplete, the mixed methods approach combined with previous ethnoarchaeological and archaeological research enabled CRM-derived data to more fully contribute to the archaeological discourse. This multi-proxy approach will be useful for future spatial analyses on Mackenzie I, and other complex sites in the Boreal region. At the outset, the spatial interpretability of this intensively used site was uncertain. However, this approach enabled the location of discrete activity and the inference of spatial organization from the site periphery.

9.4.1 Research Limitations

While some excavation and laboratory shortcomings have been discussed (see Section 4.2.1 and 4.5.1), the affects of both excavation and laboratory bias on the final tool assemblage became increasingly apparent during the research. For example, the identification of expedient tools or more ambiguous ones such as grinding stones or hammerstones was variable; hence, these tools are likely underrepresented within the assemblage. Other tools such as later stage bifaces, knives, or retouched flakes were likely multi-functional and the comprehensive understanding of actual tool use must

await use-wear and residue analyses. Furthermore, tools such as scrapers and drills have a variety of morphological shapes that may indicate subtle differences in tool use (e.g. thumbnail scraper, or end scraper). This level of morphological specificity was not included in the base level catalogue entries, limiting detailed interpretations of activity areas until comprehensive analysis of each tool class is completed.

Additionally, the varying reliability of microdebitage recovery impacted the analysis of its spatial distribution. The presence or absence of microdebitage was used to suggest the location of *in-situ* lithic reduction activity areas. However, the frequency and distribution of microdebitage reported in the catalogue represents the final number after the affect of various taphonomical processes on the artifact recovery rate (including excavator bias, screen size, and weather conditions). Though the presence of microdebitage was used as an indicator of *in-situ* activity, the underrepresentation of microdebitage may have distorted some spatial interpretations.

Finally, analysis and interpretation was sometimes limited by variable documentation of disturbance processes, stratigraphic sequences, or possible features. Insufficient photo documentation, wall profiles, and floor maps inhibited the interpretation of clusters. The contribution of an intra-site spatial analysis is directly related to the quality and nature of the data collected. However, the incorporation of multiple analytical procedures enabled the identification and acknowledgement of these factors to determine which areas, if any, were spatially interpretable.

9.5 IMPLICATIONS FOR THE MACKENZIE I SITE OCCUPATION

Many of the Late Paleoindian sites in northwestern Ontario have been found on the high and well-drained remnants of glacial shorelines (Fox 1975, 1980; Ross 1995). The Mackenzie I site conforms to this pattern, while the site expanse and high artifact count suggests a repeatedly occupied Late Paleoindian habitation site.

The study area locations allow for speculation regarding the localized topography and shoreline features. With the exception of the South study area, each study area was located along a relatively flat surface associated with possible berm features (Figure 9.5.1). These features are created when material is deposited by wave action along the backshore, to form a terrace. The visual observation of these discrete study area clusters may be the result of purposeful placement along protected backbeach areas. Conversely, the South study area may have been located nearer the shoreline, after the water level had receded. This observation is speculative, as more stratigraphic data would be needed to assess the validity of such patterns.

The site environment during occupation likely consisted of a spruce-pine transitional Boreal forest (although microclimates would have increased floral variability), providing numerous floral and faunal species for nomadic hunter and gatherers (Boyd et al. 2012; Kingsmill 2011; Kuehn 2007; Newman and Julig 1989). The combination of the Boreal forest environment, the Mackenzie River, and the river-mouth environment with a variety of available resources would have provided an ideal location for habitation. Furthermore, the Mackenzie I site would have provided ample opportunity to watch for migratory game such as caribou, as they avoided traversing the difficult

uplands immediately north of the site and instead traveled along the beaches or crossed the Mackenzie River.

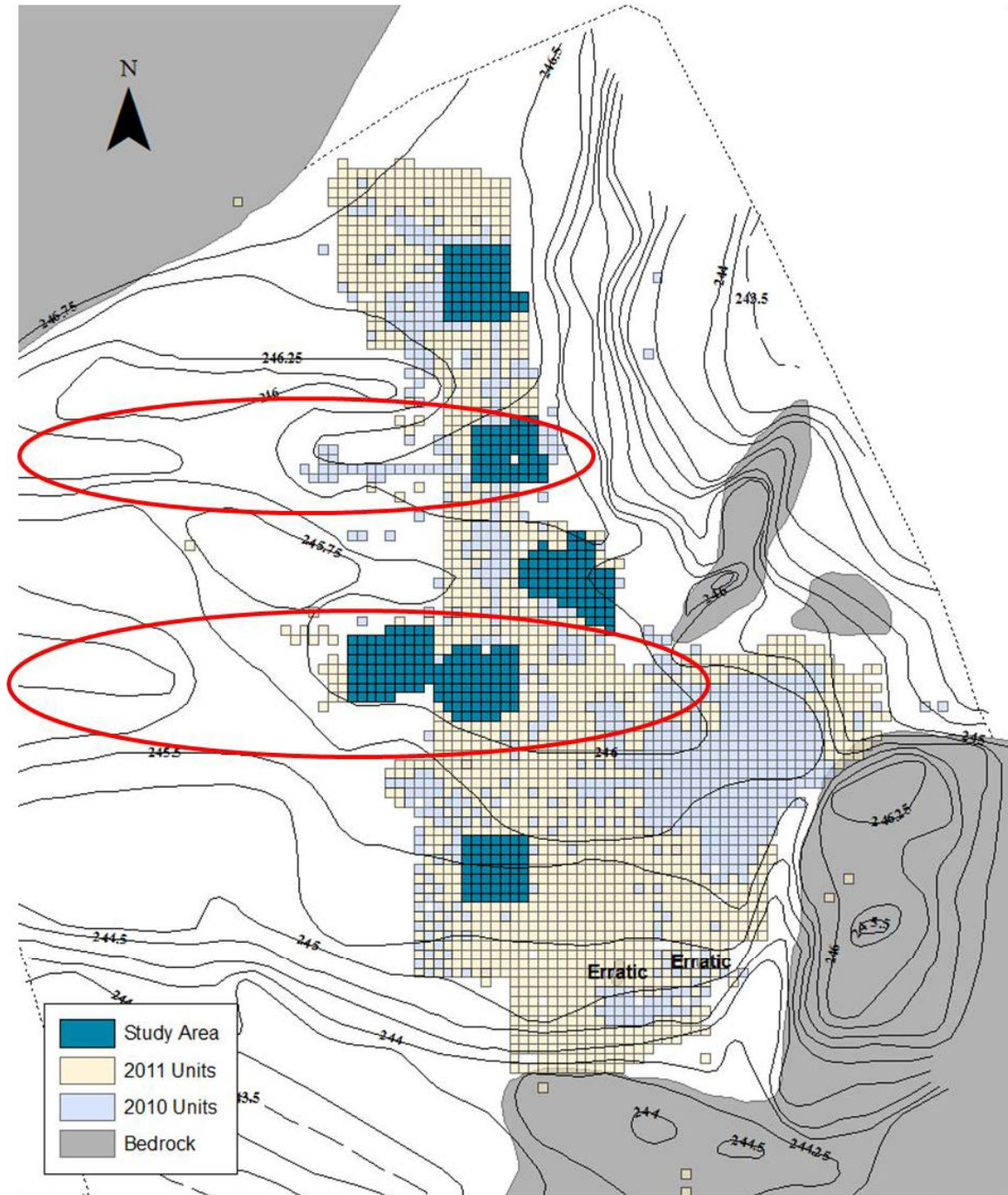


Figure 9.5.1: Topographical map of Mackenzie I which demonstrates study area placement in relation to possible berm and backbeach features (highlighted in red).

The site would have likely been occupied during the warmer months, while the water was flowing and the shoreline environment more productive. Winter occupation might have occurred further inland sheltered from shoreline exposures, however, the search for inland archaeological sites in northwestern Ontario has been limited (see Hamilton 1996). Occupation during the warm season would have been ideal for caribou hunting, as caribou tend to follow shoreline environments (Hinshelwood 1990; Peers 1985). Favoured river crossings may also have been used year after year, offering a predictable food source during the summer and early fall. Therefore, a “concentration of diverse resources” was likely a prominent factor in the extensive use (and re-use) of Mackenzie I (Bamforth et al. 2005, 576).

Extra-regional exchange and cultural interaction have already been demonstrated with the Lakehead Complex and Interlakes Composite (Fox 1975, 1980; Ross 1995). The Mackenzie I assemblage also yields evidence of these patterns. Projectile point morphologies demonstrate a range of influences from both east and west, but are united in the consistent use of parallel oblique flaking during tool production (Markham 2013). Of particular interest is the recovery of a projectile point manufactured from Hixton Silicified Sandstone that exhibits characteristics not found within the rest of the point assemblage (i.e. collateral flaking pattern with a diamond cross section; Markham 2013, 196). Access to this distant raw material, and design traits not associated with the Lakehead Complex, suggests that raw materials, stylistic traits, and perhaps people moved from one region to another.

Thus, while multiple influences are represented in the Mackenzie I assemblage, factors such as the frequent execution of parallel oblique flaking suggests a strong

cultural affiliation among site occupants. It is possible that Mackenzie I represented an ideal gathering place for small nomadic groups during a period of resource abundance, or perhaps an aggregation site related to communal caribou hunting (O'Shea et al. 2013; Robinson et al. 2009). Whether Mackenzie I was repeatedly occupied by a small group of people for many years, or gatherings of multiple culturally-affiliated groups, this site was a significant place for the cultural interaction demonstrated throughout the Interlakes Composite.

9.5.1 Cultural Affiliation

The overwhelming majority of diagnostic tools and other recoveries from the Mackenzie I site are suggestive of Late Paleoindian culture (Fox 1975, 1980; Ross 1995). To date, only one diagnostic tool that does not conform to the Late Paleoindian culture (found outside of the study areas discussed in this thesis) has been recorded from the Mackenzie I site. This potential Meadowood projectile point, which is very uncommon in northwestern Ontario, was manufactured from Onondaga chert and represents an Early Woodland presence (Bennett 2015; Figure 9.5.2).

While Archaic components have been found in association with regional Late Paleoindian sites (Hinshelwood 2004), the use of Paleoindian sites by Woodland populations is not well documented. Perhaps later cultures did not make extensive use of the Mackenzie I site once Glacial Lake Minong water levels receded. The discovery of this shattered projectile point demonstrates the need for future analysis to critically address the question of site reoccupation. Regardless, the final archaeological assemblage, diagnostic tools, raw material, and distinct artifact clusters indicate a predominately Late Paleoindian cultural influence.

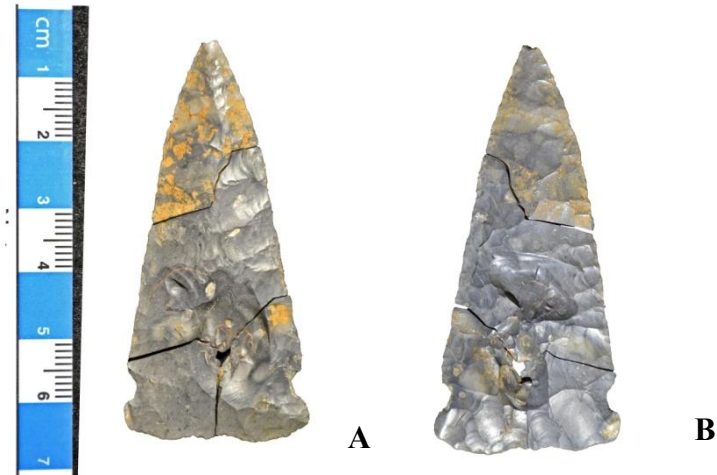


Figure 9.5.2: A possible Meadowood projectile point discovered at the Mackenzie I site, outside the thesis study areas (Bennett, 2015). A) Dorsal view; and B) Ventral view. (Photos by Bennett 2015).

While Archaic components have been found in association with regional Late Paleoindian sites (Hinshelwood 2004), the use of Paleoindian sites by Woodland populations is not well documented. Perhaps later cultures did not make extensive use of the Mackenzie I site once Glacial Lake Minong water levels receded. The discovery of this shattered projectile point demonstrates the need for future analysis to critically address the question of site reoccupation. Regardless, the final archaeological assemblage, diagnostic tools, raw material, and distinct artifact clusters indicate a predominately Late Paleoindian cultural influence.

9.6 CURRENT AND FUTURE RESEARCH IN NORTHWESTERN ONTARIO

Research regarding the series of Paleoindian sites discovered and excavated along Highway 11/17 is ongoing. Forthcoming information will add to the existing archaeological narrative and provide greater detail about the people who inhabited this region. Use-wear and residue analyses are being completed on multiple tool assemblages (Bouchard n.d.; Cook n.d.; Hodgson n.d.), which could have implications for the

functional interpretation of tools at Mackenzie I. Some of this research will provide information on the use of multi-purpose tools which was a limiting factor in this analysis.

The improved resolution provided through use-wear and residue analysis may draw attention to the human activities that are currently underrepresented (i.e. activities that create organic waste). Furthermore, this information would enable a more comprehensive spatial analysis on the Mackenzie I assemblage. In addition to current use-wear and residue analyses, future research to augment the level of detail in the catalogue would be beneficial (e.g. debitage refit analysis or morphological differentiation of specific tools). This would enhance the interpretability of spatial clusters to better infer human activity. The application of techniques recently designed for Boreal sites with compressed stratigraphy may also be useful for future research, and provide more details on temporal distinction between artifacts (Rawluk et al. 2011).

Lastly, the apparent association between large stones and dense artifact clusters should be explored further. Many of these stones were not kept for analysis, however, the examination of items that were kept would be a valuable topic for future study. If a cultural nature for these concentrations is determined, recommendations for future regional excavations could be made regarding the identification of similar activity areas.

In addition to the recently completed and on-going research into Paleoindian use-wear, residue, and lithic analysis, an intra-site spatial analysis was conducted at the RLF site, located west of Mackenzie I. It represents a small-scale lithic scatter along the Minong shoreline at ~243m asl, and represents a single component site primarily used for lithic reduction to produce cache stage bifaces (Langford 2015). This site yields localized

clusters of debitage and offers a dramatic contrast to the more intensively used habitation site of Mackenzie I, with its comparatively large number of diverse tool forms.

9.7 SUMMARY

Mackenzie I offers important insight into the Lakehead Complex, and appears to have functioned as a repeatedly used habitation and gathering site. Many different cultural activities can be either directly or indirectly inferred from the lithic assemblage, although lithic reduction and tool finishing were the dominant activities demonstrated throughout the study areas. The diversity of tools recovered from Mackenzie I is unique within northwestern Ontario, and enabled a systematic approach to the intra-site spatial analysis. Although various limitations were encountered throughout the analysis, the study provided a viable method by which human activity patterns and spatial organization could be inferred.

This research provides an interesting case study for future spatial analyses, especially for complex habitation sites located within a Boreal environment. The outcome and contribution of spatial analyses is dependent on the quality of information available. When the vast majority of sites in northwestern Ontario are excavated under CRM conditions, time constraints may limit the fine-scale resolution that is ideal for spatial analytical techniques. However, the methodology employed within this thesis has allowed for the identification and minimization of many of these factors. Furthermore, the substantial approach taken enabled the determination of lithic clusters and activity areas from which interpretations could be made. Ongoing and future research will greatly

improve our current understanding of the Mackenzie I site and build upon the interpretations presented here.

Although spatial analyses rely on the use of small-scale spatial data, they provide additional context for the understanding of human culture and history within the 'bigger picture'. They allow researchers to delve into the actions and organization of a community on a local level. While not every study area at Mackenzie I yielded information about the spatial organization of its inhabitants, details regarding cultural activities were still visible within the lithic assemblage. Spatial analysis is a tool whereby discrete artifact clusters can become humanized, and the Late Paleoindian culture at Mackenzie I can be better understood.

CHAPTER 10

CONCLUSION

The Mackenzie I site has yielded one of the most abundant Late Paleoindian tool assemblages within Northwestern Ontario. This extraordinary abundance and variety of tools within the site allowed for the application of in-depth spatial analysis techniques that had not yet been applied to Lakehead Complex habitation sites. This thesis was undertaken in order to study the spatial distribution of the Mackenzie I lithic assemblage in order to identify localized clusters of activity areas, and to ultimately infer aspects of the spatial and social organization of its inhabitants. Key objectives included the inference of Paleoindian use of space at the Mackenzie I site, and the exploration of a methodology that could detect spatial organization given the taphonomical processes and poor preservation affecting Boreal forest sites.

One of the most important methodological aspects used was the focus upon artifact clusters that were peripheral to the densest deposition within the site. This sought to avoid the most intensively utilized part of the site that likely possessed little spatial interpretability, in favour of smaller, more discrete clusters of archaeological material. In this way, activity areas were less likely to be affected by multiple activity events or intensive occupation.

Focusing on these periphery locations, six study areas representing discrete artifact clusters were selected. The approach undertaken for this thesis incorporated various forms of quantitative and qualitative analyses such as a tool refit analysis, and Ripley's K and K-means statistical tests to ensure greater interpretability of the study

areas. The presence or absence of subzones (clusters) within each study area was critically assessed using spatial analytical tests such as Nearest Neighbour and Ripley's K. The K-means test was then utilized to determine the optimal number of clusters within each study area, and the associated assemblage within each cluster. Multiple assemblage characteristics – such as tool type, debitage size, and spatial distribution – were then examined, and subsequent patterns were interpreted with reference to ethnoarchaeological and archaeological literature. Overall, this enabled the interpretation of specific activities within each subzone.

During the Mackenzie I analysis, limitations were observed within the application of these spatial analytical techniques (see also Chapter 6). For example, the tool sample size within individual clusters was too small for the Nearest Neighbour test to determine the presence or absence of statistically significant patterning. However, the inclusion of Ripley's K which considers more than just the first nearest neighbour, provided further information to determine the statistical significance of observed patterns. This combination of techniques allowed for maximum interpretability of clusters.

Although a narrow range of activities were noted during the analysis (primarily stone working and lithic manufacturing), indirect evidence based upon inferred function of various tool types suggests the presence of more diverse activities. These may have included hide, wood, antler, and bone working, food preparation, and small-scale butchering. Tools associated with these activities (e.g. scrapers, adzes, etc.) were likely not being used within the study areas, but instead represent the manufacture or refurbishing of such tools, to then be used elsewhere.

Results from this research suggest that many lithic activities were co-occurring within the same activity area. Toolkits were being manufactured, refurbished, and discarded in the same activity area regardless of tool type or the intended purpose of the tool (for example the close association of hide working tools with projectile points). This observation is supported by the close vertical and horizontal association of tool types in some of these clusters. Therefore, these lithic reduction and refurbishing activities do not appear to be spatially segregated.

Conversely, discrete patterns were visible with the distinct spatial organization of midden areas. The consistent utilization of space for a specific purpose (e.g. refuse midden) seems to have played a role in the final Mackenzie I assemblage (Bamforth et al. 2005). For example, discrete clusters of various raw materials in Central West E suggest the consistent reuse of this midden across separate knapping events, and possibly separate occupations (see Section 8.2.4; Figure 7.5.6).

The lack of organic preservation undoubtedly limits archaeological interpretation. Evidence of hearths was minimal due to leaching and bioturbation effects, but were indirectly suggested by the presence of sparse FCR and charcoal fragments, and the patterned distribution of artifacts (see discussion for Central North B, Central West A and B, and East A in Chapter 8). Some activity areas may have also been associated with structures, however, evidence for such remains have not survived in the archaeological record. The low sample size for recorded hearths and other features within these study areas limits interpretations. Future research such as soil susceptibility tests, undertaken with soil samples collected during excavation, could illuminate more invisible

components of the site (e.g. hearths). The determination of further hearth locations would be a welcome addition to future spatial studies.

This study has demonstrated that an intra-site spatial analysis on a complex site can yield a wealth of information. Mackenzie I was utilized extensively, blurring distinctions between multiple occupations or activity areas both synchronically and diachronically. However, the methods in this analysis allowed for maximum interpretability of cultural activity within the study areas.

Furthermore, this study is important for future research on intensely occupied sites, including those that are recovered through CRM mitigations. Intra-site spatial research may not seem like a viable option for sites with a high density of recoveries, poor stratigraphic differentiation, and limited spatial resolution. As demonstrated within this thesis, the use of peripheral clusters enabled the determination of discrete activity areas from which spatial organization could be inferred. This method would be feasible for others seeking to interpret large habitation sites, and represents an important aspect of this thesis.

This also demonstrates an area for improvement regarding impact mitigation procedures for CRM excavations. The methods commonly used to extract information as quickly as possible limit the resolution of site data, and therefore, subsequent research. Put another way, while mitigations similar to Mackenzie I attempt to remove most of the site prior to development, the quality of data renders it difficult to study and contribute to our understanding of how these sites were used. As recent research has demonstrated, more intensive excavation and the three-point provenience of artifacts within peripheral

or moderate density areas allows for a more in-depth analysis (Ives, pers. comm., 2015; see Rawluk et al. 2011). Intensive excavation within more interpretable site areas, rather than overall site recovery, would increase our ability to analyze and understand mitigated sites.

As a significant Late Paleoindian site in the region it is important to study and understand the ‘who, what, when, where, why, and how’ of the Mackenzie I site occupation ~ 9,000 years ago. Previous research conducted on this assemblage has expanded our knowledge of Late Paleoindian occupation in Northwestern Ontario through artifact specific analysis. This thesis expands upon this through the application of an intra-site spatial analysis in order to explore how site inhabitants organized their activities within a Lakehead Complex habitation site. Patterns indicative of cultural activity were highlighted through a multi-proxy approach and the use of peripheral locations within this intensively occupied site. The production of various toolkits within the study areas suggests the multi-functional purpose of activity areas, while the spatial segregation of waste disposal (e.g. toss zones and middens) indicates the purposeful organization of space. Of primary importance, this thesis provides a better understanding of how the Late Paleoindian period populations utilized their lived space, illuminating aspects of the behavioural patterns and spatial organization of Mackenzie I’s past inhabitants.

CHAPTER 11

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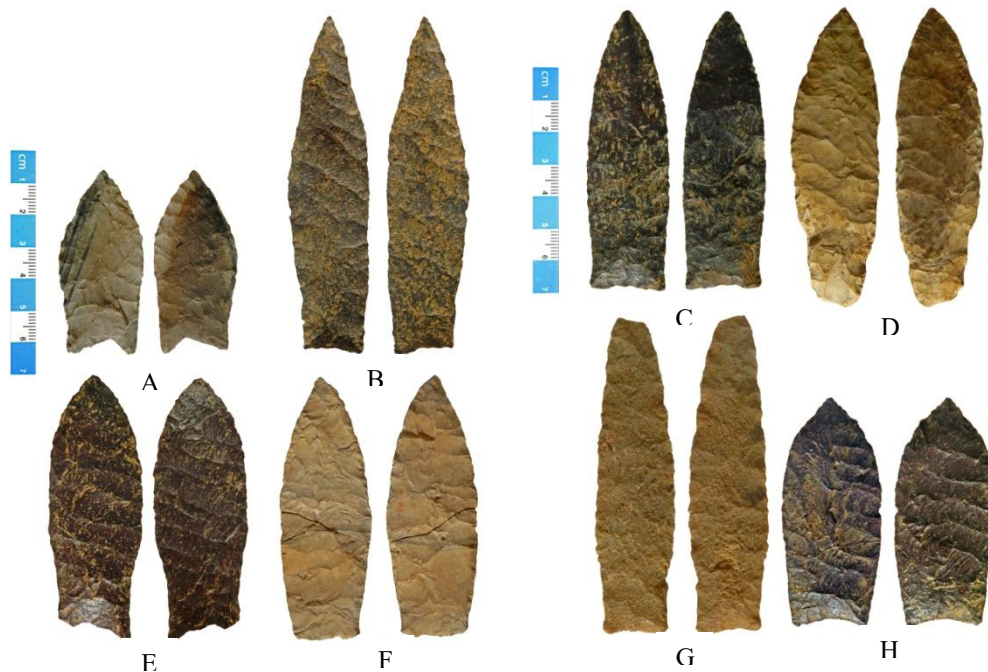
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Appendix

Images of Mackenzie I Artifacts

The following images represent a small sample of the artifacts recovered from the Mackenzie I site. Images 1 through 14 represent different debitage or tool types based on the catalogue definitions. In addition, many of these images illustrate the variety of raw materials recovered during site excavation. The final photographs (Images 15 and 16) are provided to demonstrate site environment during the mitigation process and the nature of excavation. Photos are by the author unless otherwise stated.

LITHIC TOOLS



1) Mackenzie I projectile point variation. Modified from Bennett (2015, 220 and 222). Note: A, D, and F are unidentified siltstone; G) Hixton Silicified Sandstone; while B, C, E, and H are Gunflint Formation taconite.



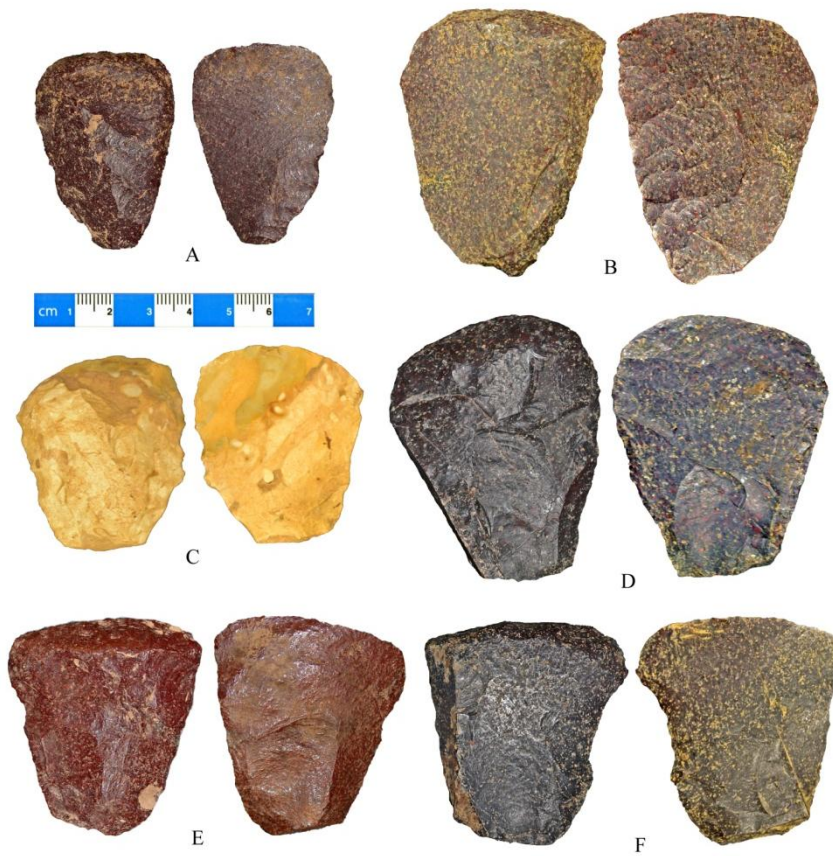
2) Stage 2 mudstone bifaces. Modified from Bennett (2015, 191).



3) Coarse siltstone bifaces. Modified from Bennett (2015, 193).



4) Gunflint Formation taconite knives. Modified from Bennett (2015, 222).



5) Selection of scrapers from Mackenzie I. Modified from Bennett (2015, 226). Note: C is manufactured from Hudson Bay Lowland chert, while the rest are manufactured from Gunflint Formation taconite.



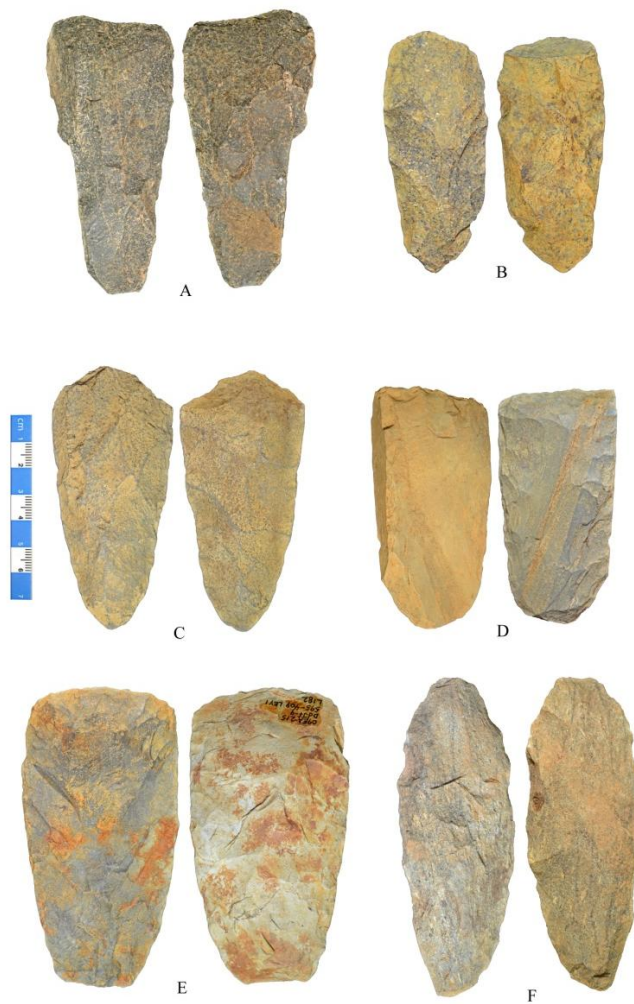
6) Selection of drills from Mackenzie I. Reprinted with permission from Bennett (2015, 224). Note: B is manufactured from siltstone (possibly Knife Lake); E is manufactured from Hudson Bay Lowland chert; F is manufactured from siltstone; while A, C, and D are manufactured from Gunflint Formation taconite.

A

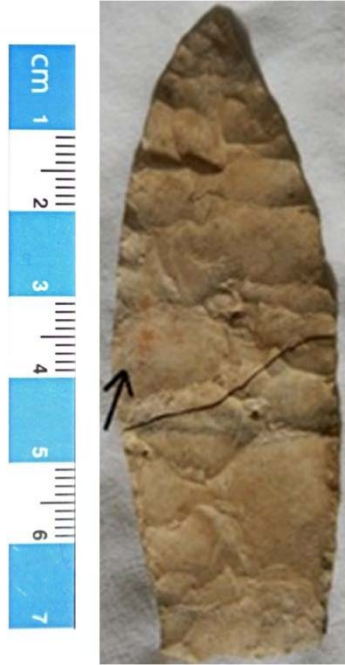
B

7) Gunflint Formation gunflint silica (A), and taconite (B) core fragments.

8) Complete Gunflint Formation taconite core.



9) Variety of adzes. Reprinted with permission from Bennett (2015, 217). Note: A and B are Gunflint Formation taconite; D and E are likely manufactured from Knife Lake siltstone; while C and F are unidentified siltstone.



10) Projectile point with possible ochre indicated by arrow. Modified from Markham (2013, 158).

DEBITAGE

11) Gunflint Formation taconite: microdebitage (0-6mm).



12) Gunflint Formation taconite: secondary debitage (6-25mm).

13) Gunflint Formation taconite: debitage (25-50+mm).



14) Gunflint Formation taconite parallel oblique flakes (A). Reprinted with permission from Bennett (2015, 258). An overshoot Gunflint Formation taconite flake (B).

EXCAVATION PHOTOS



15) Photos demonstrating Stage 4 excavation methods (top); and screening method with a 3mm mesh screen inset within 6mm mesh (bottom).



16) Top: View of bridge construction, looking east from the Mackenzie I site. Reprinted with permission by Markham (pers. comm., 2015). Bottom: Aerial view of the Mackenzie I site. Reprinted with permission by Norris (pers. comm., 2015).