Crossing the Cuesta:
A GIS Analysis of Intra-Site Settlement Patterns at the Mt. Albion West Paleoindian Site (AhGw-131)

by

Amelia Kathleen Pilon

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Arts
in
Public Issues Anthropology

Waterloo, Ontario, Canada, 2018

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Excavated by Archaeological Services Inc. (ASI) between 1998 and 2004, the Mt. Albion West (AhGw-131) Early Paleoindian site is one of only a handful of Late Pleistocene sites in Ontario. Situated adjacent to the Red Hill valley on the Niagara Escarpment in Hamilton, Ontario, this site produced four discrete artifact concentration areas. While the tools recovered from this site were thoroughly analyzed, comparatively little attention has been given to its settlement patterns. Settlement pattern analysis is especially important in Ontario Paleoindian research given the material constraints presented by hunter-gatherer mobility and environmental factors not conducive to preservation. In this thesis, the four activity areas from Mt. Albion West are analyzed using Geographic Information Systems (GIS) with an eye toward interpreting the site's function(s) and significance within the broader Early Paleoindian settlement system.

Acknowledgements

First and foremost, thank you to my supervisor, Dr. Chris Watts, who has fostered my interest in Paleoindian lifeways since my undergrad and wrangled me into this unforgettable experience. I'm incredibly grateful for the knowledge and experience you contributed as well as your limitless confidence in and enthusiasm for this project. I hope the results live up to years of wondering what was going on at Mt. Albion West.

To my Committee members – Dr. Chris Watts, Dr. Robert Park, and Dr. Chris Ellis – your taking the time to review this thesis and provide constructive feedback is most sincerely appreciated. Thanks especially to Dr. Ellis for sharing your Paleoindian expertise and valuable insights into Mt. Albion over the summer. I think I speak for the entire Paleo community when I say we'll miss you in your retirement.

Thank you also to Dr. Rob MacDonald and Archaeological Services Inc. for providing the data that made this research possible as well as Markus Wieland and the rest of the staff at the University of Waterloo's Geospatial Centre for helping me make sense of the files and navigate my way through ArcGIS. Your patience with my constant presence this summer is most sincerely appreciated.

My profound gratitude extends to the University of Waterloo's Faculty of Arts and family of Iris Yuzdepski for their financial support throughout this project.

Many thanks as well to the University of Waterloo's entire Department of Anthropology for making my grad school journey one to remember. To Dr. Chris Watts, Dr. Jennifer Liu, and Dr. Secil Dagtas – thank you for challenging me and helping to develop my critical thinking skills. Thanks also to Dr. Rachel ten Bruggencate for being my initial point-person for my many GIS questions. To my friends and colleagues – Stuart Anderson, Yuet Chan, Leah Govia, Matthew Johnson, Jacquie Meijer, Melissa Pynkoski, Alecs Romanisin, and Dana Thacher – congratulations on all your achievements this year. I'm excited to see where your anthropological careers will take you all. A special thank you goes to Jacquie and Dana for taking the time away from your own work to edit and provide feedback for section after section of this thesis.

Thank you to my sisters, Rachael and Bridgette, for reading drafts that I was embarrassed to send to my colleagues and convincing me that they weren't as terrible as I thought, as well as to my partner, Nick, whose patience did not waiver as I talked your ears off with everything archaeology over the last sixteen months. Lastly, thank you to my parents, Brad and Julia, for your support and encouragement as I attempted to figure out what I wanted to do with my life. I dedicate this thesis to you as you embark on your own journey.

Table of Contents

List of Figures

List of Tables

Chapter One

Ecological Embellishment: The Nature-Culture Binary in the Bruce Trail's Conservation Management

1.1 Introduction

"The Niagara Escarpment is one of the world's natural wonders" (Bruce Trail Conservancy 2017). Four hundred and fifty million years ago, geological processes at the bottom of a tropical sea began to form the 725 km long cuesta that transects southern Ontario today. Now, it is home to hundreds of species of flora and fauna and hosts over 400,000 Bruce Trail visitors each year (Bruce Trail Conservancy 2017; Ontario Trails 2016). However, while environmental protection is given tremendous promotion and resources, the trail's cultural features are, by comparison, little acknowledged. This component of my study examines the Bruce Trail Conservancy's policies and procedures for the conservation of its natural resources in contrast to cultural heritage sites, including Hamilton, Ontario's Mt. Albion West Paleoindian site. By using the terms cultural or natural heritage, I am referring to a particularly western ontological stance in which the world is split between a human realm and an ecological substrate. As part of this chapter, I will also examine two Ontario case studies wherein organizations have made efforts to preserve both a landscape's natural and cultural resources and attempted to convey the entangled nature of humanity and the environment while engaging with the public.

1.2 Bridging the Nature-Culture Binary in Archaeology

While the conceptual dichotomy that divides nature and culture is a product of Enlightenment thought (see e.g., Latour 1993), its seed can be traced back to the Old Testament. In this book, there is a call for "humanity to subdue the earth and dominate its creatures" (Kay 1989:214). In the centuries that followed, religious institutions in the west used nature as a distinct, hostile, and tool-like entity to punish or reward. People were taught to fear its wildness and appeal to either religion or the technologies of culture to bring to it some level of predictability.

Scholars have now begun to reconsider the nature-culture binary, questioning the alienation of humans from the worlds in which they live. Kant explored philosophical anthropology and addressed the need for humanity to “respect its own nature” and for our “inclusion into nature in general” (Lotz 2005:44-45). Similarly, some theorists in archaeology have encouraged an examination of the landscape from a phenomenological perspective and questioned traditional ways of thinking about modernity and cultural norms (see e.g., Ingold 1993; Thomas 2001:165-167; Tilley 1994, 2004). Rather than isolating the landscape, they suggest it should be recast as intertwined with culture, shaping human behaviour as it too becomes shaped by human hands. This approach is aligned more closely with Indigenous conceptions of nature and culture; indeed, many local languages do not include a word for ‘environment’ since, according to their cultural traditions, humans are not divorced from the world (Kapyrka 2016).

Ingold (1993:152) argues that the “landscape is an enduring record of – and testimony to – the lives and works of past generations who have dwelt within it, and in doing so, left there something of themselves”. While the artifacts that remain at an archaeological site are often viewed as the only window into the past lives of people, the landscape in which a site is situated is vital to an understanding of why a population selected a particular place to occupy over another. To illustrate this concept, I will discuss how the affordances of one of Ontario’s most prominent landscape features shaped the lifeways of the region’s earliest occupants.

1.3 Effects of the Niagara Escarpment on Human Behaviour

Southern Ontario's physiography is dominated by the Niagara Escarpment, which forms an east-west barrier throughout the region from the Niagara River to the Bruce Peninsula. The escarpment rises gradually from the southwest before abruptly giving way to a steep cliff that faces eastward (Storck 2004:39). If not for a number of valleys formed through glacial erosion, passage to central and northern Ontario would be virtually impossible. As it is, the Escarpment and intermittent corridors that transect it have been critical to shaping the occupation of the province since humans first arrived shortly after 11,000 BP.

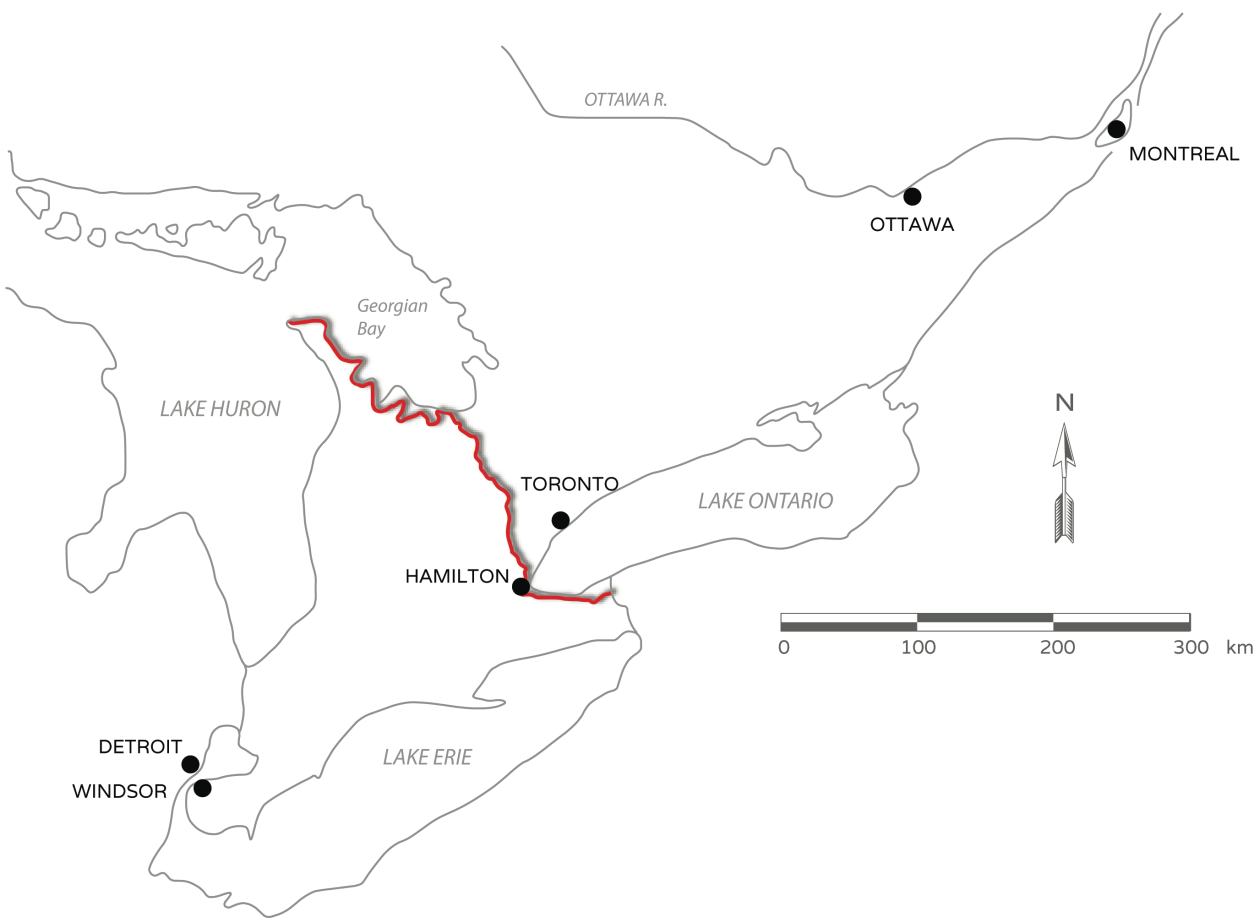


Figure 1: The Niagara Escarpment

When these people moved into the region following the retreat of the Laurentide ice sheet, they had no knowledge of what the landscape had to offer; it was, as far as they knew, an "empty land mass" (Kelly 2003:44). Wisdom passed down from their ancestors was used to guide them as they ventured into an uncharted territory. As hunter-gatherers, they learned the landscape through experience and created cognitive maps that could be transmitted across generations through oral histories. Therefore, landmarks constitute one of the various critical components used to orient oneself and navigate space (Kelly 2003). If a group entered the region through the Niagara Peninsula, the enormous precipice that stretched on as far as the eye could see would have been a natural choice of landmark by which to guide them. In following this topographic feature, these people would have eventually encountered valleys such as Twenty near St. Catharines and Red Hill near Hamilton that allowed passage to the northeast. These same corridors had likely been used by faunal species as migration routes long before human occupation (Storck 2004:39). Once Ontario's earliest occupants realized that the Niagara Escarpment landscape afforded certain subsistence strategies, the knowledge took root in their lifeways and transcended thousands of years.

When Europeans settled in the region, the multiple valleys passing through the Niagara Escarpment continued to be important to mobility. The natural breaks in the landscape that were once used by humans tracking caribou movements on foot now permitted the construction of Ontario's major transportation routes (Storck 2004:39), effectively and perhaps permanently modifying the region. However, the Niagara Escarpment's significance has recently shifted to become almost exclusively environmental.

1.4 The Bruce Trail

In 1960, Raymond Lowes proposed the idea of a public footpath that traced the Escarpment at a Federation of Ontario Naturalists meeting and the Bruce Trail Committee was thus established. The organization canvassed towns and properties along the proposed route to discuss their vision and the need for landowner cooperation in order for it to be realized (Bruce Trail Conservancy 2016d). The length of the trail was divided into nine clubs in 1963, each of which was responsible for maintaining, stewarding, and promoting their respective sections (Bruce Trail Conservancy 2016b). In 1967 – Canada's Centennial Year – the Bruce Trail was officially opened with the unveiling of a cairn at the trail's end in Tobermory (Bruce Trail Conservancy 2016d). To this day, the Bruce Trail is Canada's oldest and longest marked footpath and runs over 890 km from Niagara to the tip of the Bruce Peninsula, with approximately 435 km of side trails. The Niagara Escarpment, meanwhile, has been designated a UNESCO World Biosphere Reserve (Bruce Trail Conservancy 2016a).

The Bruce Trail Conservancy (BTC)'s mission is to establish a "conservation corridor containing a public footpath along the Niagara Escarpment, in order to protect its natural ecosystems and to promote environmentally responsible public access" (Bruce Trail Conservancy 2016f). In order to preserve the vast acreage of the escarpment, the BTC spends $1 to $2 million on land purchases each year and manages these properties through their Land Stewardship program (Bruce Trail Conservancy 2016e). As a charitable organization, the overwhelming majority of this funding is dependent on individual donations, with the remainder coming in descending order from foundations, corporations, land donations, bequests, and the government, as of the 2014 to 2015 fiscal year (Bruce Trail Conservancy 2016c). The BTC also enforces a Users' Code (Bruce Trail Conservancy 2016g) that disallows certain activities in order to prevent damages and protect its valuable ecological resources.

The policies and procedures outlined above make evident that the Bruce Trail Conservancy and greater province of Ontario distinguish their natural from cultural histories while placing significant emphasis on protecting ecological resources. While environmental conservation is certainly critical during the current climate change crisis, attention to the preservation of the Bruce Trail's cultural heritage sites appears to have fallen by the wayside. Throughout the BTC's extensive website, they fail to refer to the Trail's cultural history even once.

This is particularly surprising when one considers that Mt. Albion West, a rare site where Ontario's earliest peoples once camped some 11,000 years ago, sits unnoticed barely 100 m from its path. Indeed, prior to the construction of the Red Hill Parkway in Hamilton, Ontario, the Bruce Trail transected the southeastern-most artifact concentration area of this site before making its way through the Red Hill Valley itself. Without organizations such as the BTC making efforts to promote cultural sites such as Mt. Albion West, the history of ancient human relationships with the Niagara Escarpment is only visible in the archaeological record and in the oral histories of Indigenous people, both of which are not easily accessible to the broader public. In the following section, I discuss two case studies from southern Ontario which may serve as possible methods to preserve archaeological sites along the Bruce Trail, present them to and engage with the public, and bridge the perceived gap between nature and culture.

1.5 Toward the Promotion of a Unified Heritage in Public Archaeology

Although efforts to promote public awareness of the interrelated nature of natural and cultural heritage are few and far between, various organizations make attempts to convey such an idea. The Huron Natural Area (HNA) in Kitchener, Ontario, is a 107 ha site that underwent archaeological assessment by Archaeological Research Associates (ARA) prior to the construction of a nature trail. The project uncovered evidence of a 10-longhouse village inhabited by the ancestors of the Neutral Nation during the Late Woodland period approximately 500 years BP. In order to proceed with the trail construction, the city consulted with ARA and Six Nations and came up with a preservation strategy that was both respectful and involved minimal impact to the site. Ultimately, it was decided that a handmade boardwalk over the site would be the most appropriate solution (City of Kitchener 2010). The site is now protected under the Ontario Heritage Act in addition to a municipal code parks bylaw, both of which enforce significant fines for straying from the trail and for disturbing or removing anything from the protected area. The Huron Natural Area makes a considerable effort to engage with the public and educate them on the long history of Indigenous occupation along the Grand River and within the greater Waterloo region. As visitors make their way through the trails, extensive signage depicts various Neutral Nation activities taking place in the Late Woodland landscape. In order to best represent the lifeways of the Neutral Nation, local artist Emily Damstra conducted extensive research and consulted with ARA archaeologists and members of the Six Nations. These signs also identify significant landscape features, including those that may be the result of human activity.

The Boyd Field School, offered in partnership with the Toronto and Region Conservation Authority (TRCA) and York Region Board of Education, also makes efforts to educate the next generation on the inextricable relationship between humans and nature. The TRCA emphasizes that Toronto's history is "defined by the relationship between its early residents and the lands and waters that constituted the lifeblood of their settlements" and offers "unique opportunities to explore how our ancestors' connection with the natural world shaped their lives and communities" (Toronto and Region Conservation Authority 2016). Over the course of approximately two weeks, high school students participating in the field school partake in an archaeological excavation in addition to logging classroom time led by certified teachers, professionals in the industry, and guest lecturers. The field school earns students one Interdisciplinary Studies credit toward their Ontario high school diploma and has recently begun to award two scholarships to students of First Nations, Metis, or Inuit heritage for the full cost of the program's tuition. As a result of this initiative, the Boyd field school was awarded the Ontario Archaeological Society's Peggi Armstrong Public Archaeology Award in 2005 (Boyd Archaeological Field School at TRCA 2015).

Archaeological preservation in addition to engagement with the public is possible through simple signage to increase awareness of a cultural presence that spanned centuries, by way of field schools that target younger generations, or with a number of other methods. As the Huron Natural Area and TRCA exemplify, simultaneously preserving ecological and cultural resources while presenting them to the public as a collective heritage is feasible and effective. Even the simple act of consulting with an archaeologist or member of an Indigenous community to incorporate cultural heritage into the Bruce Trail Conservancy's website would be a step toward bridging the binary to which they have long subscribed.

1.6 Conclusion

When we conceptualize Ontario's heritage as either natural or cultural, we ignore the inseparable relationship through which they developed and shaped one another. Cultural history varies according to the landscape in which it is situated, which in turn is molded by human interaction. The Huron Natural Area and Toronto and Region Conservation Authority case studies addressed here incorporate this entangled heritage notion into their public outreach efforts. On the other hand, as outlined above, through its policies, procedures, and pubic engagement, the Bruce Trail's management program promotes this divisive conceptualization to, at minimum, its roughly 400,000 annual visitors, and emphasizes the conservation of its natural resources while failing to acknowledge its cultural histories. The preservation of a region's culture must be on equal ground with its ecological resources in order to move toward a comprehensive discernment of its heritage. Provincial parks and conservation reserves such as the Bruce Trail are therefore in a position to use their abundant visitor counts to bridge the long reinforced perceptions of the nature-culture binary and educate the public on their combined heritage.

The goal of the research presented in this thesis is to contribute to the body of archaeological knowledge surrounding Paleoindian occupation in the Great Lakes region. As such, I intend to publish this study in the *Canadian Journal of Archaeology*. Its publishing organization – the Canadian Archaeological Association (CAA) – is the national authority in archaeological research and encourages the dissemination of knowledge in order to promote active discourse and cooperation across the country (Canadian Archaeological Association 2017). It is my hope that, by publishing my results in the *Canadian Journal of Archaeology*, an understanding of Mt. Albion West's settlement patterns will contribute to further investigations of Paleoindian inter-site relationships and make available such findings to various publics, such as students of North American archaeology as well as avocational and professional archaeologists.

Chapter Two

Crossing the Cuesta: A GIS Analysis of Intra-Site Settlement Patterns at the Mt. Albion West Paleoindian Site (AhGw-131)

2.1 Introduction

Over half a century of rigorous archaeological investigations in Ontario and the broader Great Lakes region have revealed a long history of human activity and contributed significantly to our understanding of the region's early inhabitants. However, despite the ever-increasing number of sites documented, evidence of the first people to migrate into Ontario, known as "Paleoindians", continues to be elusive. Indeed, only a handful of large sites comprised of multiple artifact concentration areas have been examined in the province. Previous geomorphological research has shown that the landscape during Paleoindian occupation was markedly different than today, thereby contributing to an interest in how these people made their home in such a hostile environment. This study addresses this very question by investigating the spatial relationships within one of Ontario's few substantial Paleoindian sites: Mt. Albion West (AhGw-131).

Located in Hamilton, Ontario, Mt. Albion West was excavated by Archaeological Services Inc. (ASI) between 1998 and 2004. The tools recovered from this site were thoroughly analyzed in their technical report (Archaeological Services Inc. 2007) and researchers have since conducted investigations surrounding Paleoindian land-use and mobility using geological and paleoecological data from the site (MacDonald et al. 2017). However, comparatively little attention has been given to intra-site settlement patterns among its four artifact concentration areas, which offer a unique window into the activities that were performed within this Paleoindian camp. Therefore, as part of this research, I apply Geographic Information Systems

(GIS) statistical analyses to explore what specific tasks may have taken place in each of the main artifact concentration areas within the Mt. Albion West site and determine if these activity loci were occupied simultaneously or over a span of multiple visits. Using these data, I address such questions regarding the spatial patterning of the site and compare these findings with other existing sites in the region. In this way, and by situating Mt. Albion West within the broader Pleistocene landscape, this research can significantly contribute to our understanding of the earliest occupants of the Great Lakes region.

2.2 Paleoindian Culture History

2.2.1 Origins

The term "Paleoindian" refers to North America's earliest well-documented people whose occupation began at the close of the Pleistocene approximately 11,500 BP (Ellis and Deller 1990:37), although some researchers speculate that humans have inhabited the Americas for significantly longer (see e.g. Adovasio et al. 1978, 1999a, 1999b; Dillehay 1997; Meltzer et al. 1997). Fluted point discoveries in Folsom and Clovis, New Mexico in the 1920s and 1930s were the first indication of this occupation. The projectile point recovered at Folsom was embedded in extinct bison remains (Figgins 1927) while fluted points with slightly different features later discovered at the Dent site in Colorado and Blackwater Draw near Clovis were associated with mammoth bones (Haynes 1964; Wilmsen 1965:183; Wormington 1957). This led archaeologists to conclude that Folsom and Clovis were bison and mammoth-based hunting cultures respectively (Hanson 2010:6; Shott 1990). After similar discoveries continued to occur throughout the American Southwest, F.H. Roberts coined the term "Paleoindian" in 1940 to include all archaeological finds associated with extinct faunal species (Ellis and Deller 1990:37;

Wilmsen 1965:182). While no Folsom points occur in the eastern Great Lakes, forms resembling Clovis appear to evolve throughout the region. For this reason, scholars believe that a Clovis or Clovis-related colonizing movement took place toward the north and east with the recession of the Laurentide ice sheet. This population ultimately reached the Great Lakes region at the end of the Pleistocene shortly after 11,000 BP where a "succession of historically related cultures" (Storck 1990:155) developed.

2.2.2. Paleoenvironment

Environmental conditions during the transition from the Pleistocene to the Holocene varied dramatically. Palynological studies have shown that the paleoenvironment in the Great Lakes region during Early Paleoindian (EPI; ca. 10,900 to 10,300 years BP) occupation would have roughly resembled contemporary sub-arctic conditions (Karrow and Warner 1990; McAndrews 1997) including landscapes comprised of open spruce parklands with grass and sedges that thrive in continuous permafrost soils (McAndrews 1997).

The retreat of the Laurentide ice sheet resulted in the formation of glacial Lake Algonquin in the Huron and Georgian Bay basins, early Lake Erie, and Lake Iroquois in the Ontario basin by approximately 12,000 BP (Karrow and Warner 1990:15; Larson and Schaetzl 2001:531). Throughout EPI occupation in southern Ontario, water levels in the lakes fluctuated considerably. Around 11,000 BP, glacial Lake Algonquin's water levels sat approximately ten feet higher than present (Hanson 2010:15; Larson and Schaetzl 2001:532) while levels in the Lake Ontario basin were significantly lower (Hanson 2010:15), to the point that the western shoreline would have been situated 20 to 25 km east of its current position (Archaeological Services Inc. 2007:13) (Figure 2). Early Lake Erie's levels are subject to more debate (see

Coakley 1992; Jackson et al. 2000; Pengelly and Tinkler 2004:215, 219; Tinkler et al. 1992:232), although the presence of Onondaga cherts at EPI sites indicates that water levels did not rise sufficiently to inundate at least some of these sources, which outrcrop along the northeastern shore of this lake.

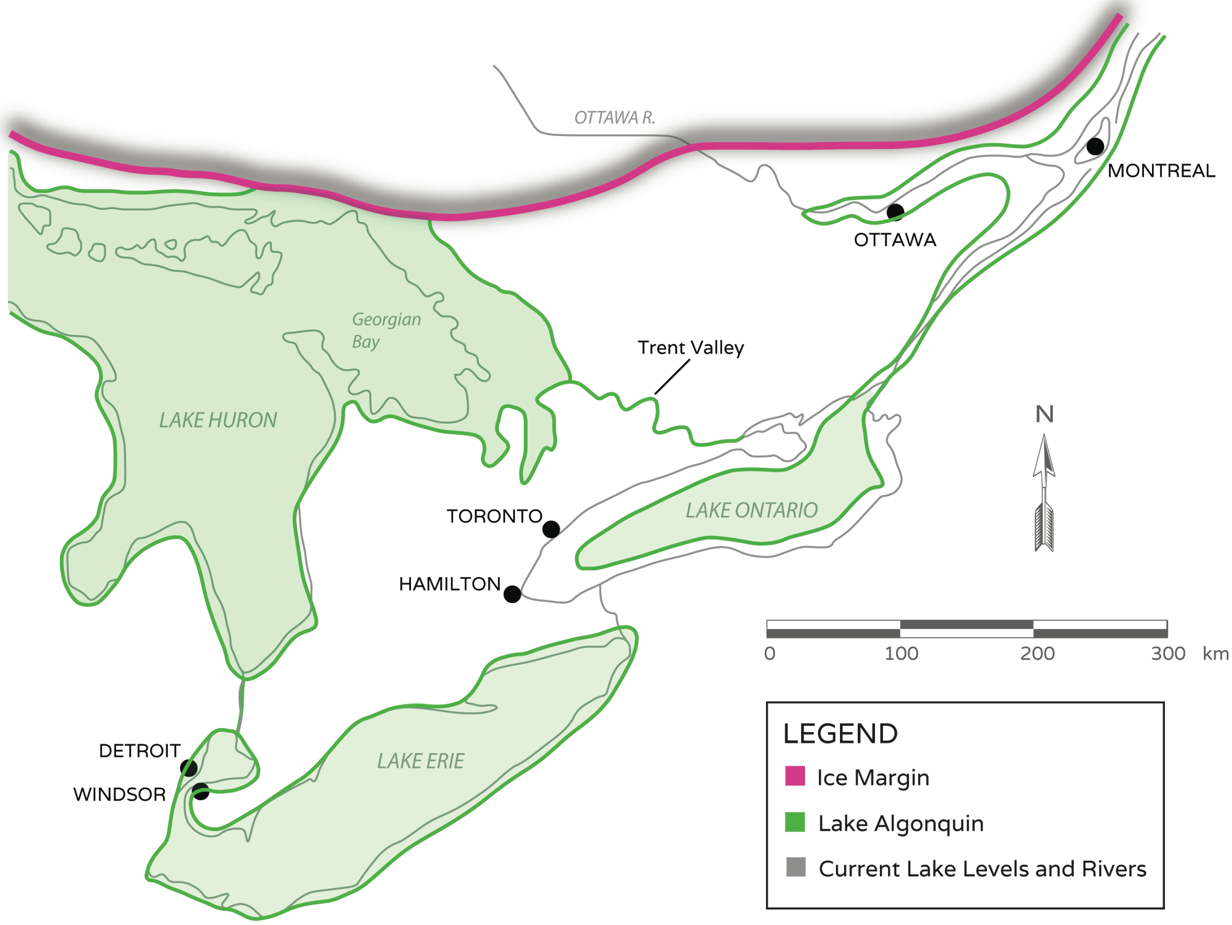


Figure 2: Great Lakes water levels ca. 11,000 – 10,500 BP (after Karrow and Warner 1990:Figure 2.9)

2.2.3 Subsistence

Given the region's sub-arctic conditions, biotic productivity would have been rather low; therefore, the majority of Paleoindian dietary needs were met through hunting and fishing. While numerous archaeological sites across North America, including the Udora site in Ontario (see Storck and Spiess 1994) and Shawnee Minisink in Pennsylvania (see Gingerich 2013), bear evidence of caribou and fish remains respectively directly associated with hearths, the degree of Paleoindian big-game specialization is debated (Gingerich and Kitchel 2015; Grayson and Meltzer 2015; Speth et al. 2013). Various analyses of sites containing megafauna remains have concluded that relatively few sites offer conclusive evidence of human predation on mammoths or mastodons (Grayson and Meltzer 2015). Rather, these and other substantially sized species may have been frequently scavenged after death for tool and food resources. Caribou and deer, on the other hand, were certainly an important constituent in Paleoindian diets. In addition to the presence of their calcined remains on a number of sites outside Ontario, many camps are situated at advantageous locations for intercepting herd migrations. In particular, the Alpena-Amberley Ridge[1] yielded evidence of rock structures along the narrow strip of land – a natural route for caribou migrations – between what would have been two lakes (O'Shea et al. 2013). These structures resemble hunting drives and blinds from arctic regions and are oriented according to the caribou's seasonal movement direction. This demonstrates not only that caribou were hunted, but also that Paleoindians possessed extensive knowledge of the species' behaviour and strategized accordingly.

Although plant resources likely played a small part in Paleoindian subsistence, the species consumed appear to have been selected carefully. Plant species such as tubers and berries recovered from 24 Paleoindian sites in eastern North America, including Shawnee Minisink in Pennsylvania (Gingerich 2013), tend to have relatively low acquisition and processing costs with high caloric returns. This is further supported by the absence from such sites of plant-processing tools and fire-cracked rock, which generally indicates cooking. The availability of these

[1] Now submerged beneath Lake Huron, but exposed during the Late Paleoindian (LPI) from 9900-7500 BP

resources varies seasonally; therefore, in addition to contributing to an understanding of EPI subsistence, their presence can also be useful for interpreting the season of a site's occupation (Gingerich and Kitchel 2015).

2.2.4 Lithic Technology

Paleoindian sites are rare due to lower population densities, mobile hunter-gatherer lifestyles, as well as changes in water levels in the Great Lakes. Those that do exist often have poor organic preservation, which largely limits material remains to lithic artifacts and results in extensive toolkit analysis (Tankersley 1998). Ellis and Deller (1990:45) note that EPI assemblages are often identifiable due to their lance-shaped projectile points with distinctive fluting although other tool forms such as a variety of scrapers, drills, and wedges can also be diagnostic of the period (Ellis and Deller 1988). The fluted points can be divided into three complexes whose characteristics evolved over time: Gainey (10,900 – 10,700 BP), Parkhill (10,700 – 10,500 BP), and Crowfield (10,500 – 10,300 BP) (Ellis and Deller 1990:40). Gainey points, named after the type-site in Michigan, are the largest; they are thick with distinctive parallel sides ending in only slightly flared ears and demonstrate improved Folsom-like fluting, but relatively poor fluting in comparison to the later complexes (Roosa and Deller 1982). Barnes points, whose name is also derived from a type-site in Michigan, are attributed to the Parkhill phase and exhibit intermediate traits when compared to earlier Gainey and later Crowfield forms. Crowfield points constitute the final complex during the EPI and are notably well-made as they are very thin and wide and often possess multiple flutes, (Ellis 1984; Ellis and Deller 1990:45-46).

Paleoindian stone tools are almost exclusively manufactured on high quality, homogenous, raw materials for greater control over flake removal (Ellis 1984:383; Ellis and Deller 1990:43). Within Ontario, Onondaga chert obtained from primary sources on the northern shore of Lake Erie and Collingwood chert from the Fossil Hill formation to the south of Georgian Bay are most frequently recovered from Paleoindian sites (Figure 3). Ontario's

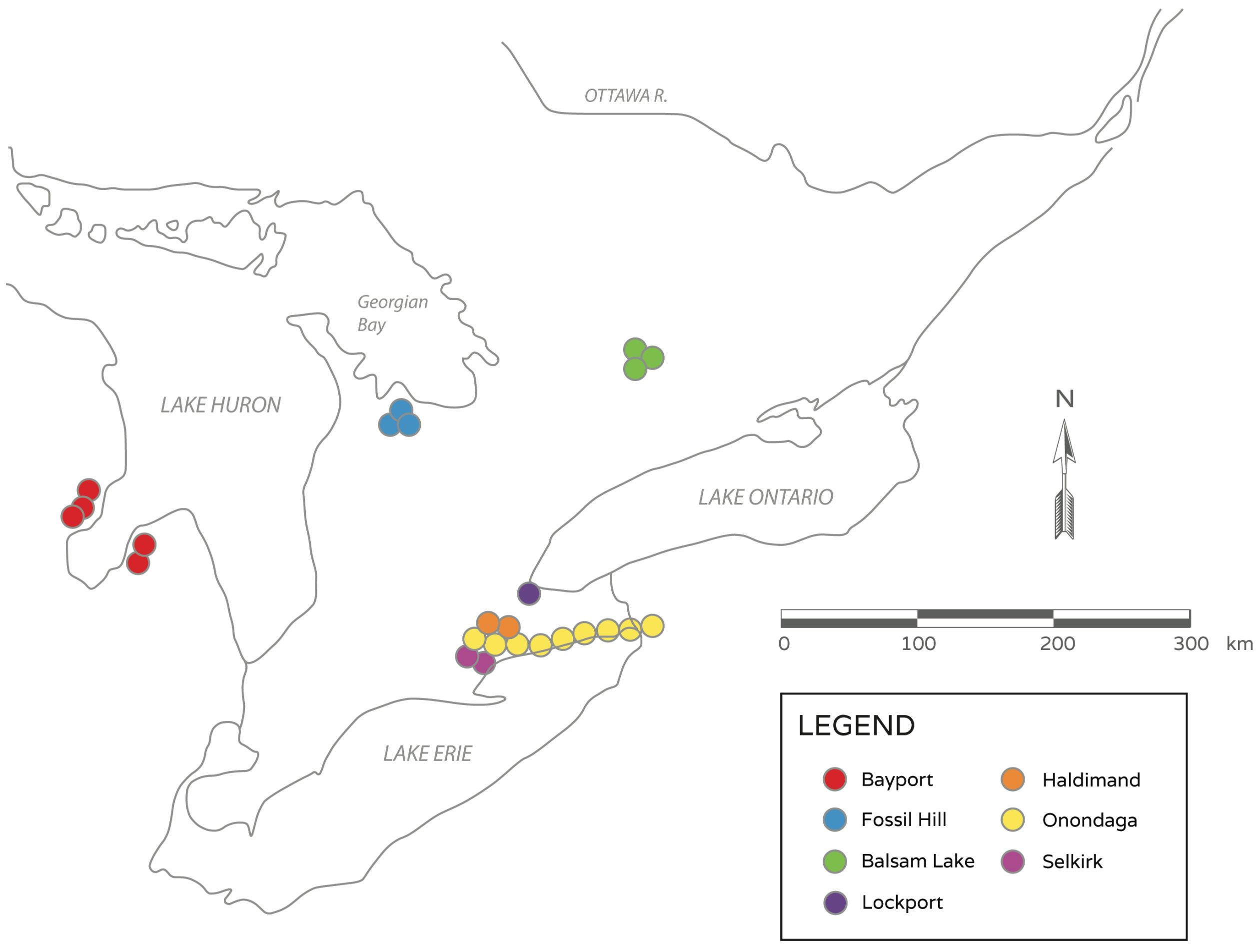


Figure 3: Raw material sources in the Great Lakes region

Haldimand, Selkirk, Ancaster (procured from the Lockport Formation), and Kettle Point toolstones, in addition to Ohio's Upper Mercer and Michigan's Bayport cherts also occur, though in substantially smaller quantities (Ellis and Deller 1990:43). The presence of these materials reflects the immense distance of Paleoindian territorial ranges. At most sites, assemblages are largely comprised of stone procured from sources up to 350 km away. In order to minimize the amount of stone transported, therefore, initial stages of tool manufacture took place at camps at or near a quarry. These sites are identified by the presence of early stage debitage, including cores and large flakes with cortical surfaces, as well as higher frequencies of aborted preforms (Ellis 1984:424-426). Reduction away from quarries, on the other hand, tends to produce later stage debris. Middle stage debitage consists of much smaller thinning flakes while late stage manufacture is evidenced by high quantities of retouch flakes from sharpening working edges (Ellis 1984:423-426; Ellis and Deller 1990:45).

While traditional analyses of Paleoindian toolkits have tended to focus on their morphological characteristics and the tasks that they imply, it has been suggested that stone tools also carry ideological meaning (Ellis 2009; Storck 1990). The Crowfield and Caradoc sites in Ontario, for example, both show evidence of Paleoindians intentionally destroying significant numbers of otherwise usable tools through burning and smashing respectively (Ellis 2009). Miniature points have also been recovered from sites across North America, including the Jones-Miller kill/processing site in Colorado (see Stanford 1978), and offer evidence of their association with ideological meaning. One miniature point from this site was discovered near a post mold resembling historic medicine posts. Based on this analogue to more recent Indigenous hunting practices, its association with a post mold implies that it may have been an offering made as part of a hunting ceremony (Storck 1990). It follows, therefore, that artifact distributions are critical to the interpretation of Paleoindian lifeways.

2.2.5 Settlement Patterns: Inter-Site Patterning

Analysis of settlement patterns is important to archaeological investigations in general as it affords a window into the more intimate dynamics of occupation sites that would not otherwise be available. However, it is especially critical to furthering the understanding of how Paleoindian groups were living in the stark Late Pleistocene/Early Holocene environment of the Great Lakes. In order to interpret settlement patterns, data is collected from a site's size, type, inter-site patterning, and intra-site relationships (Spiess et al. 1998:228). Inter-site connections can explain a site's role in broader settlement systems. Researchers have proposed various settlement pattern models which suggest the importance of proximity to high quality and homogenous raw materials for tool manufacture, both in the form of primary quarries and secondary cobble sources (Custer et al. 1983; Storck 1982). They believe that, during seasonal rounds, Paleoindians exploited raw materials and manufactured tools at a base camp, then sharpened and repurposed them as necessary to extend their use-life. Higher frequencies of raw material sources in a region tend to result in a lower degree of resharpening evident on tools, which likely indicates more constant replenishment, whereas fewer accessible sources would require increased edge modification for a tool to last until the next procurement (Custer et al. 1983).

Furthermore, advantageous hunting locations tend to be an influential factor for some site selection. Paleoindian sites along the Algonquin strandline in particular tend to be elevated with unobstructed views of ideal caribou migration routes, while others occur near valleys that transect topographical barriers into which hunting game could be funneled (Storck 1982). A lacustrine-based settlement pattern is also evident; a number of Parkhill phase sites discovered in close association with the glacial Lake Algonquin strandline led to extensive subsequent research focused on this feature. Gainey sites, meanwhile, are rarely associated with the strandline, although they do tend to overlook interior lake basins (Jackson 1997:133). This distinct variation in settlement patterns between phases may be related to the climate change that occurred, wherein Paleoindians would have been compelled to restructure their settlement strategies in order to accommodate interrelated shifts in caribou behaviours (Jackson 1997).

2.2.6 Settlement Patterns: Intra-Site Patterning

Studies of several Paleoindian sites in southern Ontario and the northeastern United States have yielded distinct spatial patterns in their artifact forms, from which specific activities can be inferred. Although some level of intra-site spatial patterning is often preserved on Paleoindian sites, plow disturbance and erosion can compromise a site's integrity, and therefore results must be approached with caution (Spiess et al. 1998:228). Sites tend to fall within three categories: long-term aggregation sites, short-term camps, and isolated findspots (Jackson 1997). The first type has yet to be discovered in Ontario, although a notable site outside the province includes Bull Brook in Massachusetts (Byers 1955; Robinson et al. 2009). Smaller camps are more common and can be determined to be either residential or logistical in nature based on the degree of tool diversity. Assemblages dominated by a limited range of tool forms and low quantities of debitage indicate that a site likely served as a logistical camp with a focus on game procurement and/or processing. On the other hand, more varied sites with increased evidence of tool manufacture likely acted as residential sites and hosted a diversity of individuals and activities (Jackson 1997:147-150). Isolated findspots often consist of only a few complete points or fore-sections and generally represent hunting loss or kill sites (Deller and Ellis 1992:27; Jackson 1997:138). At such sites, the fore-section of a point breaks off from the haft and becomes embedded in an animal while the base is taken back to camp to be removed and replaced. Deller and Ellis (1992) suggest that kill sites are likely common in close proximity to larger camps, but may go undetected in the absence of faunal remains.

Sites with a single occupation event tend to exhibit artifact concentration areas organized in a distinct pattern such as the circular plan manifested at Bull Brook as well as the linear arrangement exhibited at the Vail and Debert sites, and are often interpreted as aggregation sites where multiple groups gathered for communal caribou drives (Gramly 1982; MacDonald 1968; Robinson et al. 2009; Spiess 1984). Meanwhile, multiple revisits often result in high frequencies of activity loci arranged in a less organized manner (Deller and Ellis 1992:27), although ethnographic studies of arctic cultures indicate a single group may occupy specific spaces recurrently, which may not be reflected in individual artifact concentration areas (Spiess 1984). However, in order to examine contemporaneity between loci, tool fragments can also be examined for potential refits. Dissociated fragments from more than one activity area that can be refit, such as those from the Nobles Pond site in Ohio, suggest that the loci from which they were recovered were occupied concurrently (see e.g., Seeman 1994).

2.3 Mt. Albion West (AhGw-131)

The Mt. Albion West site is located on the Niagara Escarpment, at the southwestern edge of the Red Hill valley overlooking the western shore of Lake Ontario. At the time the site was occupied, this shoreline would have been situated approximately 20 km east of its present location (Archaeological Services Inc. 2007:14). Archaeological Services Inc. (ASI) first detected the presence of a site here when they were contracted to conduct an archaeological assessment of the proposed route of the Red Hill Parkway development in Hamilton, Ontario, in 1996 (Archaeological Services Inc. 2007:10). About two decades prior to ASI's excavations, a pipeline was installed at the top of the Red Hill Valley, impacting the southeastern corner of the Mt. Albion West site and compromising its archaeological integrity (Archaeological Services Inc. 2007:31). However, an early survey just east of the Red Hill valley had yielded an Onondaga chert biface and subsequent Stage 3 testing in 1998 produced a Gainey-type fluted biface. The discovery of these Early Paleoindian artifacts led to a complete excavation from 1998 to 2004, which confirmed a site of significant size and five discrete concentration areas (see Section 2.4 below). Although a radiocarbon assay could not be obtained due to the lack of any surviving organic materials, the presence of tools diagnostic of the Gainey complex and general Early Paleoindian affiliation led to the conclusion that Mt. Albion West's occupation likely fell between 11,000 and 10,500 BP (Archaeological Services Inc. 2007:89). With the completion of the construction project, the Red Hill Parkway now runs directly over Mt. Albion West, effectively destroying it and preventing further excavations. Only three other EPI sites have been reported in the Niagara Peninsula: the small Gainey complex Ward site (AgGu-17; see Ellis 2001) located roughly 30 km southeast of Mt. Albion West, the Barnes phase Glass site (see Deller and Ellis 1992:39) situated approximately 30 km southwest, and the Rogers site about 25 km southeast, which exhibits projectile points with more Clovis-like characteristics than Gainey (see Deller et al. 2017) (Figure 4).

Various scholars have undertaken research on Mt. Albion West since the site was first documented. Recent studies conducted by MacDonald et al. (2008; 2017) have explored EPI land use patterns from both raw material acquisition and subsistence perspectives. The latter of these included a residue analysis of tool samples that detected proboscidea (mammoth or mastodon) antiserum on a graver and canidae (coyote, dog, wolf, or fox) protein on a wedge recovered from Areas A and B respectively. While these results do not confirm that the animals

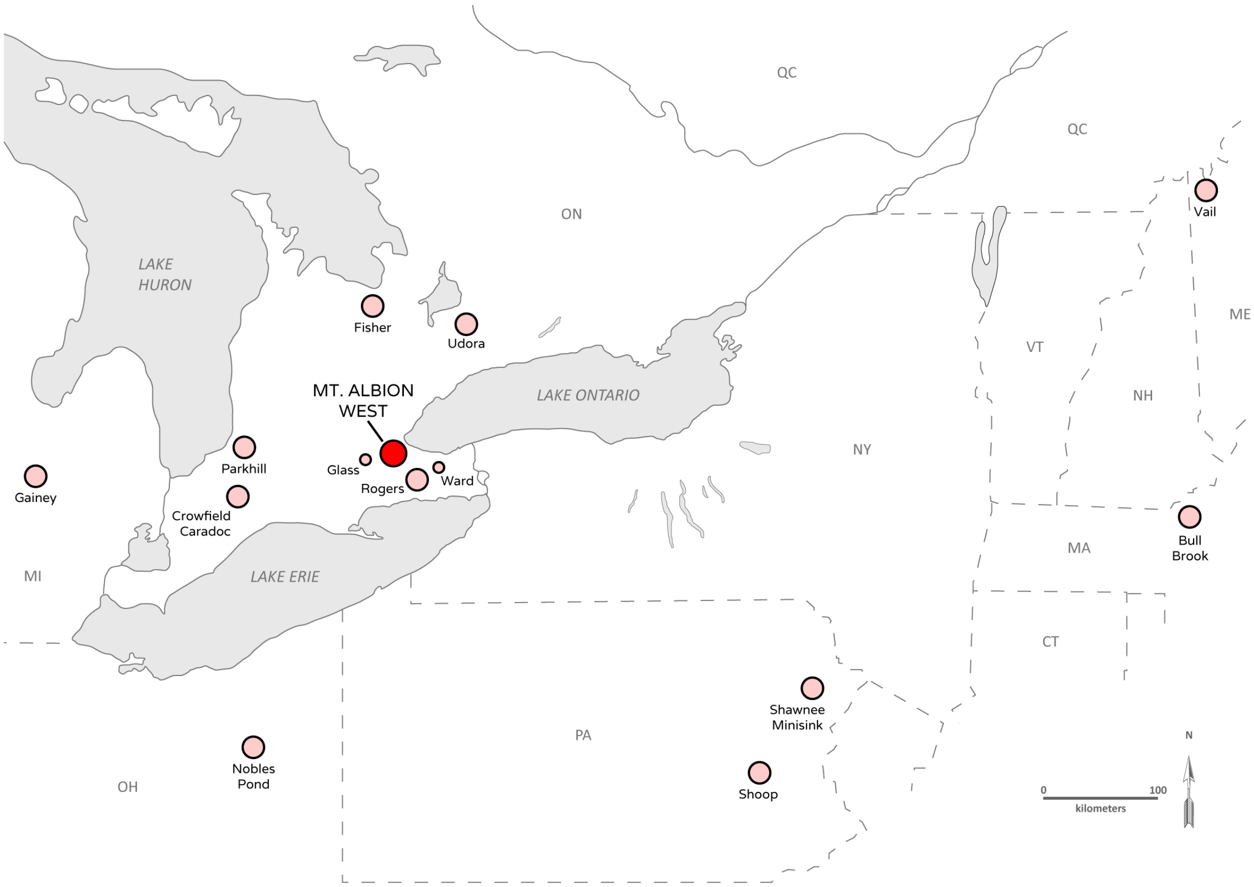


Figure 4: Early Paleoindian (EPI) sites in the Great Lakes / Northeast region

were butchered at Mt. Albion West, nor that they were even killed by humans, the detection of these faunal residues demonstrates that these species were processed and their byproducts utilized by Early Paleoindians in Ontario. The proboscidean residue in particular verifies that human occupation of the region predates the extinction of these megafauna (MacDonald et al. 2017). Additionally, Eckford (2017) performed a detailed analysis on the morphological traits of the fluted points found at Mt. Albion West, comparing them to those that occur at two other EPI sites in southern Ontario in order to observe cultural sequences and explore the relationships between sites. He suggests that the Gainey-like point forms at Mt. Albion West are more in keeping with those recovered from the Udora site and display more variability than those at

Rogers, which suggests the occupation of the site by more than one cultural group, or perhaps over an extended period of time (Scott Eckford, personal communication 2017).

This study addresses the spatial distribution of tool forms and raw materials within Mt. Albion West that have not been explored thus far in order to comment on the functions of each of the site's artifact concentration areas as well as the tasks that took place within them. Additionally, these relationships facilitate interpretations surrounding the occupation frequency and seasonality of the activity loci to contribute to the understanding of how the site fits into Paleoindian movement patterns across the southern Great Lakes region.

2.4 Methodology

Between 1996 and 2004, ASI's surface collections and excavations of Mt. Albion West recovered a total of 318[2] lithic artifacts and 9,930[3] debitage fragments. Of these, 302 artifacts were selected for this study's settlement pattern analysis, which omitted tools that were not considered diagnostic of the Gainey complex or Paleoindian affiliation, as well as those that lacked documented provenience. The analysis proceeded by compiling artifact data provided by Archaeological Services Inc. (2007) into tabular form and sorting the assemblage according to three main variables: tool form, raw material, and artifact concentration area. Although ASI reported five discrete loci, one locus south of Area C (known as Area E) was not separated by sterile units and was amalgamated with Area C for the purposes of this study (Figure 5). This stage of data collection yielded 27 tables (see Appendix A). Quantitative data related to various morphological variables for particular tool classes were also compiled into tabular form but

[2] Modified from Archaeological Services Inc. (ASI)'s (2007) reported 319 lithic artifacts
[3] Modified from ASI's (2007) reported 9,907 debitage fragments

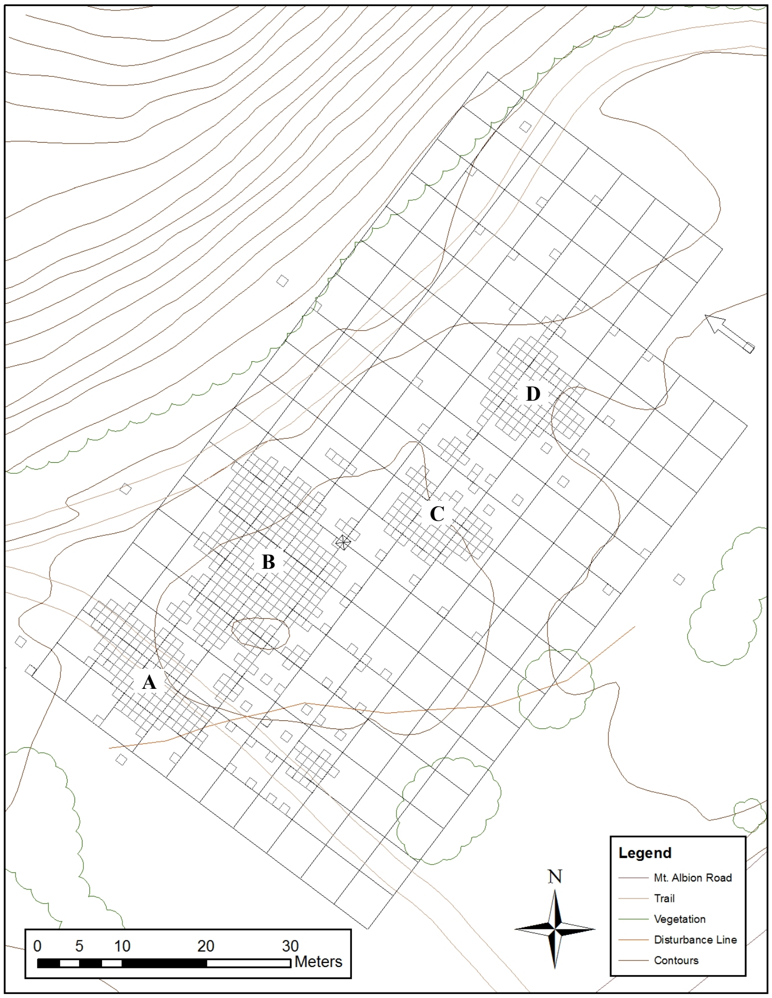


Figure 5: Mt. Albion West artifact concentration areas A through D

proved unhelpful as the study developed; therefore, they will not be discussed further (see Tables A.5 through A.18).

As this study focuses on *intra*-site spatial patterning at Mt. Albion West, the data and GIS analyses were selected accordingly. Spatial analyses were conducted in ArcGIS 10.4.1 as it is the dominant software in archaeological studies (Mills 2009:53). Although some researchers are now using QGIS to make data more readily available to others, ArcGIS alone permits the selection of a specified study area in which to run the Ripley's K Function (Thacher et al. 2017), which is described in detail below. This feature was considered essential to this investigation in order to isolate and analyze the patterns within the distinct artifact concentration areas at Mt. Albion West. The Geospatial Centre at the University of Waterloo assisted with the conversion of CAD drawings provided by ASI into shape files in order to import the data into the GIS software. Subsequently, in order to provide more meaningful data, the converted files that mapped the provenience for the 'scrapers' and 'miscellaneous' tool categories were replaced with newly plotted coordinates for end scrapers, side scrapers, beaked scrapers, and flake gravers using the artifact proveniences catalogued in the technical report (Archaeological Services Inc. 2007). The debitage unit counts were also broken down into early, middle, and late stage flaking debris, in addition to identifying channel flake and preform occurrences, to reveal potential patterns in the spatial organization of the stone tool manufacturing process.

Once these variables were mapped in ArcGIS, the Ripley's K Function was selected to identify and evaluate the statistical significance of artifact clustering and dispersion at various scales. Although more traditionally utilized in ecological research, archaeologists have increasingly applied Ripley's K Function to effectively carry out spatial analyses of cultural remains (see Mills 2009; Sayer and Wienhold 2013; Thacher et al. 2017; Winter-Livneh et al. 2010). Based on the available point data, this method calculates the observed and expected point frequencies within a defined series of incremental radii. Ripley's K Function is calculated as

$$L(r) = \sqrt{\frac{A\Sigma_{i=1\, j=1}^{n}\Sigma_{j\neq 1}^{n} k(i,j)}{\pi n(n-1)}}$$

where r refers to the distance, n is the number of point features, A is the total area of the features, and K_{ij} is the weight which is modified according to the applied edge correction (Winter-Livneh et al. 2010:287-288). Observed values that fall above the expected values suggest clustering while those below indicate dispersion. ArcMap combines this function with the Monte Carlo simulation, which generates random points over the study area to create a confidence envelope (Winter-Livneh et al. 2010). Here, observed values that fall outside the confidence envelope are statistically significant, whereas those falling within are not. For the purposes of this study, 99 permutations were run to translate to a 99 percent confidence level and the Simulate Outer Boundary Values edge correction was used in order to reduce the effects of site and area boundaries. Ripley's K Functions were calculated for the total tools across Mt. Albion West, and then narrowed according to raw material (Onondaga, Fossil Hill, Lockport, and unidentified) and tool type (fluted points, end scrapers, side scrapers, beaked scrapers, and flake gravers) within Areas A through D.

A kernel density estimate (KDE) was subsequently used to illustrate the distribution of artifact densities over the entirety of Mt. Albion West. This analysis is more frequently used by archaeologists and is a useful tool in identifying areas of point aggregation (see Bevan et al. 2013; Blasco et al. 2016; Grove 2011), particularly when employed in conjunction with the Ripley K Function (see Cable 2012; Sayer and Wienhold 2013; Spagnolo et al. 2015; Thacher et al. 2017; Werdelin and Lewis 2013). The KDE analysis places a kernel radius over each point and calculates values that decrease as the distance from the point feature increases (Oron and Goren-Inbar 2014:188; Thacher et al. 2017:23). Unless designated by the researcher, points have a value of 1. In this study's debitage analysis, however, each point associated with an excavation unit was assigned a value indicating the total artifact frequencies collected in addition to breaking the counts down to the total Onondaga and Fossil Hill raw materials recovered from each unit. On the other hand, points representing individual artifacts retained the value of 1. Since the selected kernel radius value can greatly impact the KDE output, the radius used to analyze the formal tool densities at Mt. Albion West was determined using distances that

Ripley's K Function calculated as either clustered or dispersed in a statistically significant manner. In cases where tool categories with K Function results indicated that all distances are statistically significant, a KDE was not necessary since the patterns within the point data are all relevant (Thacher et al. 2017:25). However, in order to visualize the artifact proveniences, a KDE was still conducted under the default search radius. However, when the K Function calculated statistically significant patterns among a tool form at certain distances, the lowest significant distance was selected for the KDE search radius.

In total, these analyses yielded 21 Ripley K Function graphs (see Appendix B), 21 kernel density estimate figures, and seven ArcGIS tool distribution maps (see Appendix C). Together, these studies assist in exploring significant spatial relationships among the tool classes and raw materials present at Mt. Albion West in order to interpret areas for specialized activities and occupation frequency.

2.5 Data and Analysis

2.5.1 Formal Tools

With regard to the formal tool assemblage recovered from Mt. Albion West, end scrapers make up the most frequently occurring identified tools (n=59; 19.0%), followed by utilized flakes (n=35; 11.3%), and bifacially worked preforms (n=28; 9.0%). Compared to end scrapers, which were commonly hafted and used predominantly for hideworking (Ellis and Deller 1990; Loebel 2013; Seeman et al. 2013), side scrapers, which tend to exhibit a greater range of uses, were recovered in significantly smaller quantities at Mt. Albion West, comprising only 2.3 percent (n=7) of the entire tool assemblage and 9.5 percent of the identified scrapers. Fluted points account for 3.9 percent (n=12) of the collection. Flake gravers, used during hide-work for perforating, also occur 12 times across the site. Moreover, while wedges are rare at Ontario Paleoindian sites (Ellis and Deller 1990:47), five are present at Mt. Albion West. These tools are often presumed to have been used for splitting materials including wood and bone (Ellis and Deller 1990; Ellis and Poulton 2014), and the longitudinal splits observed in two of the five wedges here would likely have occurred from the force applied during such use (Archaeological Services Inc. 2007). Also recovered from the site, in Area B, was a single drill, a tool type that tends to be uncommon at other Paleoindian sites as well.

The majority of these tools were excavated within Area B (see Table 1). This same concentration yielded the highest frequencies of each tool form, with the exception of denticulated scraper fragments, flake gravers, and combination tools. The smallest of the four activity loci, Area C, generally accounts for the lowest tool quantities and no end scrapers at all were recovered within its margins. However, two side scrapers are present within Area C: the same frequency as in Area A and only one fewer than Area B. Two combination tools, both of which were identified as cutting and/or scraping tools (one exhibits a pseudo burin tip and the other a single graver spur) were also recovered from the same area, while only one was found in each of the other areas. Predictably, given its large size, Area B yielded the most diverse tool assemblage at eleven classes. However, although significantly smaller in size, Area A follows closely with ten classes. Only six and seven tool classes were recovered from the smaller Areas C and D respectively. Fluted bifaces occur in each activity locus in low quantities, although Area B contains five (41.7%) of the 12 that were present at Mt. Albion West. Within Areas A and B, projectile points account for less than 10 percent of the identified tool forms in each (n=3; 7.7% and n=5; 5.6% respectively) while those in Areas C and D constitute slightly more of the assemblages at 18.2 percent (n=2) and 14.2 percent (n=2) respectively (Table 2). End scrapers

Inter-Area Tool Form Distribution						
Tool	**Area A**	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Bifacially Worked Preforms	5 (18.5%)	15 (55.6%)	2 (7.4%)	1 (3.7%)	4 (14.8%)	**27 (100.0%)**
Projectile Points/Fragments	3 (25.0%)	5 (41.6%)	2 (16.7%)	2 (16.7%)	0 (0.0%)	**12 (100.0%)**
Gainey-Type	0 (0.0%)	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**4 (100.0%)**
Unidentified Fluted PP	3 (37.5%)	1 (12.5%)	2 (25.0%)	2 (25.0%)	0 (0.0%)	**8 (100.0%)**
Drills	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
Wedges	2 (40.0%)	3 (60.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**5 (100.0%)**
Unidentified Bifacially Worked Artifact Fragm	2 (7.7%)	20 (76.9%)	0 (0.0%)	1 (3.8%)	3 (11.4%)	**26 (100.0%)**
End-Scrapers	9 (15.3%)	34 (57.6%)	0 (0.0%)	5 (8.5%)	11 (18.6%)	**59 (100.0%)**
Simple End Scrapers	2 (11.8%)	8 (47.1%)	0 (0.0%)	3 (17.6%)	4 (23.5%)	**17 (100.0%)**
Simple End Scraper w/ Stem-like Haft Element	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
Notched End Scrapers	2 (14.3%)	8 (57.1%)	0 (0.0%)	1 (7.1%)	3 (21.4%)	**14 (100.0%)**
Spurred End Scrapers	2 (20.0%)	6 (60.0%)	0 (0.0%)	0 (0.0%)	2 (20.0%)	**10 (100.0%)**
Micro End Scraper, notched	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	**1 (100.0%)**
Unclassified End Scraper Fragments	2 (12.5%)	12 (75.0%)	0 (0.0%)	1 (6.3%)	1 (6.3%)	**16 (100.0%)**
Side Scrapers	2 (28.6%)	3 (42.8%)	2 (28.6%)	0 (0.0%)	0 (0.0%)	**7 (100.0%)**
Denticulated Scraper Fragment	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	**1 (100.0%)**
Beaked Scrapers	1 (14.3%)	4 (57.1%)	0 (0.0%)	0 (0.0%)	2 (28.6%)	**7 (100.0%)**
Flake Gravers	5 (41.7%)	3 (25.0%)	1 (8.3%)	1 (8.3%)	2 (16.7%)	**12 (100.0%)**
Combination Tools	1 (16.6%)	1 (16.7%)	2 (33.3%)	1 (16.6%)	1 (16.7%)	**6 (100.0%)**
Fragments of Unidentified Scrapers	3 (42.8%)	2 (28.6%)	0 (0.0%)	1 (14.3%)	1 (14.3%)	**7 (100.0%)**
Fragments of Unidentified Unifacially Worked	9 (10.5%)	53 (61.6%)	5 (5.8%)	2 (2.3%)	17 (19.8%)	**86 (100.0%)**
Notched Flakes	4 (36.4%)	4 (36.4%)	0 (0.0%)	2 (18.2%)	1 (9.1%)	**11 (100.0%)**
Utilized Flakes	7 (21.2%)	15 (45.5%)	2 (6.1%)	2 (6.1%)	7 (21.2%)	**33 (100.0%)**
Possible Paleoindian Tools						
Miniature Projectile Point	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
Recycled Projectile Point Fragment w/ Spur	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
TOTAL	**53 (17.5%)**	**165 (54.6%)**	**16 (5.3%)**	**18 (6.0%)**	**50 (16.6%)**	**302 (100.0%)**

Table 1: Inter-area tool form distribution

and fragments thereof were also unearthed from Area B in notably high quantities; 34 (57.6%) of 59 were recovered from that locus while the area with the next highest frequency was in Area A at 9 (15.3%). Of the identified tool form assemblages within Areas B and D, end scrapers constitute 37.8 percent and 37.9 percent (n=34 and n=5) respectively (Table 2). However, tool fragments that ASI was unable to identify constitute a significant percentage of each locus; therefore, the biface and end scraper frequencies may not reflect the total quantities within each concentration area. Area B also includes four of the entire assemblage's seven beaked scrapers.

Intra-Area Identified Tool Form Distribution						
Tool	**Area A**	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Bifacially Worked Preforms	5 (12.8%)	15 (16.7%)	2 (18.2%)	1 (7.1%)	4 (13.8%)	**27 (14.8%)**
Projectile Points/Fragments	3 (7.7%)	5 (5.6%)	2 (18.2%)	2 (14.2%)	0 (0.0%)	**12 (6.6%)**
Drills	0 (0.0%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.5%)**
Wedges	2 (5.1%)	3 (3.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**5 (2.7%)**
End-Scrapers	9 (23.1%)	34 (37.8%)	0 (0.0%)	5 (35.7%)	11 (37.9%)	**59 (32.2%)**
Side Scrapers	2 (5.1%)	3 (3.3%)	2 (18.2%)	0 (0.0%)	0 (0.0%)	**7 (3.8%)**
Denticulated Scraper Fragment	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (3.5%)	**1 (0.5%)**
Beaked Scrapers	1 (2.6%)	4 (4.4%)	0 (0.0%)	0 (0.0%)	2 (6.9%)	**7 (3.8%)**
Flake Gravers	5 (12.8%)	3 (3.3%)	1 (9.0%)	1 (7.1%)	2 (6.9%)	**12 (6.6%)**
Combination Tools	1 (2.6%)	1 (1.1%)	2 (18.2%)	1 (7.1%)	1 (3.5%)	**6 (3.3%)**
Notched Flakes	4 (10.3%)	4 (4.4%)	0 (0.0%)	2 (14.2%)	1 (3.5%)	**11 (6.0%)**
Utilized Flakes	7 (17..9%)	15 (16.7%)	2 (18.2%)	2 (14.2%)	7 (24.1%)	**33 (18.0%)**
Possible Paleoindian Tools						
Miniature Projectile Point	0 (0.0%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.5%)**
Recycled Projectile Point Fragment w/ Spur	0 (0.0%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.5%)**
TOTAL	**39 (100.0%)**	**90 (100.0%)**	**11 (100.0%)**	**14 (100.0%)**	**29 (100.0%)**	**183 (100.0%)**

Table 2: Intra-area identified tool form distribution

The tool assemblage is comprised of three identifiable raw materials (see Table 3): Onondaga, Fossil Hill, and Lockport. Unidentified materials constitute 24.8 percent (n=75) of the collection. Raw material distributions among the formal tools across Areas A, C, and D occur in fairly consistent quantities. There are equal numbers of Onondaga and Fossil Hill chert tools in Area A (n=19; 35.8%) as well as in Area C (n=7; 43.8%), while Area D is composed largely of Fossil Hill chert (n=9; 50.0%). Area B is the only cluster in which Onondaga tools constitute

Formal Tool Distribution by Raw Material					
	Onondaga	**Fossil Hill**	**Lockport**	**Unidentified**	**Total**
Bifacially Worked Preforms	14 (51.9%)	4 (14.8%)	2 (7.4%)	7 (25.9%)	**27 (100.0%)**
Projectile Points/Fragments					
Gainey-Type	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**4 (100.0%)**
Unidentified Fluted PP	5 (62.5%)	3 (37.5%)	0 (0.0%)	0 (0.0%)	**8 (100.0%)**
Drills	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
Wedges	3 (60.0%)	0 (0.0%)	1 (20.0%)	1 (20.0%)	**5 (100.0%)**
Unidentified Bifacially Worked Artifact Fragments	19 (73.1%)	0 (0.0%)	0 (0.0%)	7 (26.9%)	**26 (100.0%)**
End Scrapers					
Simple End Scrapers	13 (76.5%)	2 (11.8%)	0 (0.0%)	2 (11.8%)	**17 (100.0%)**
Simple End Scraper w/ Stem-like Haft Element	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	**1 (100.0%)**
Notched End Scrapers	9 (64.3%)	4 (28.6%)	0 (0.0%)	1 (7.1%)	**14 (100.0%)**
Spurred End Scrapers	6 (60.0%)	2 (20.0%)	0 (0.0%)	2 (20.0%)	**10 (100.0%)**
Micro End Scraper, notched	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	**1 (100.0%)**
Unclassified End Scraper Fragments	9 (56.3%)	3 (18.8%)	1 (6.3%)	3 (18.8%)	**16 (100.0%)**
Side Scrapers	0 (0.0%)	5 (71.4%)	0 (0.0%)	2 (28.6%)	**7 (100.0%)**
Denticulated Scraper Fragment	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	**1 (100.0%)**
Beaked Scrapers	0 (0.0%)	2 (28.6%)	0 (0.0%)	5 (71.4%)	**7 (100.0%)**
Flake Gravers	5 (41.7%)	5 (41.7%)	0 (0.0%)	2 (16.7%)	**12 (100.0%)**
Combination Tools	3 (50.0%)	2 (33.3%)	0 (0.0%)	1 (16.7%)	**6 (100.0%)**
Fragments of Unidentified Scrapers	3 (42.9%)	3 (42.9%)	0 (0.0%)	1 (14.3%)	**7 (100.0%)**
Fragments of Unidentified Unifacially Worked Tools	32 (37.2%)	25 (29.1%)	1 (1.2%)	28 (32.6%)	**86 (100.0%)**
Notched Flakes	1 (9.1%)	6 (54.5%)	0 (0.0%)	4 (36.4%)	**11 (100.0%)**
Utilized Flakes	14 (42.4%)	13 (39.4%)	0 (0.0%)	6 (18.2%)	**33 (100.0%)**
*Miniature Point	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
*Recycled Projectile Point Fragment w/Spur	1 (10.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
TOTAL	**143 (47.4%)**	**79 (26.2%)**	**5 (1.7%)**	**75 (24.8%)**	**302 (100.0%)**
Channel Flakes	27 (64.3%)	13 (31.0%)	0 (0.0%)	2 (4.8%)	**42 (100.0%)**
Distal Bit Fragments	0 (0.0%)	2 (28.6%)	0 (0.0%)	5 (71.4%)	**7 (100.0%)**

Table 3: Formal tool distribution by raw material

over half the assemblage at 55.8 percent (n=92) while Fossil Hill accounts for the next highest frequency at only 39 (23.6%) artifacts. Unidentified materials (n=28; 56.0%) dominate the tools recovered outside the artifact concentration areas. Lockport Formation chert artifacts, despite being made on the closest of the lithic sources, are consistently the least frequent tools by raw material across the site, occurring only in Areas A and B (n=4; 7.5% and n=1; 0.6%).

The Ripley's K Function conducted across the whole of Mt. Albion West yielded statistically significant results over all distances for the entire tool assemblage (Figure B.1), as well as among the total Onondaga (Figure B.2) and Fossil Hill tools (Figure B.3). Within Area A, the K Function analysis shows significant clustering only of Fossil Hill tools (Figure B.6) from approximately 4 to 8 m. Area B yielded clustering in all the tools recovered up to and exceeding 15 m (Figure B.8) as well as in those manufactured on Onondaga chert within the same distance (Figure B.9). The Fossil Hill tools show slight clustering at 1 m, 3.5 to 7 m, and 8 to 14 m (Figure B.10). Of the individual tool types, the analysis shows that Onondaga end scrapers are clustered in a statistically significant manner from 4 to 13.5 m, at which point they disperse significantly (Figure B.12). Within the same area, channel flakes on Onondaga chert display significant clustering at all distances up to 14 m (Figure B.14). The same fluting flakes on Fossil Hill toolstone cluster from 3 to 13.5 m (Figure B.15). Within Area C, the K Function results show that all tools are slightly clustered from 1 to 2 m (Figure B.16). Fossil Hill tools in general in that area are slightly clustered from 1 to 5 m (Figure B.18). In Area D, the total tools cluster significantly from 1 to 8 m then disperse (Figure B.19). Fossil Hill tools in particular are clustered from 3 to 8 m (Figure B.21). There were insufficient points to run Ripley K Function analyses for beaked scrapers and flake gravers.

Kernel density estimates of the entire formal tool assemblage show four large concentrations, with one small additional cluster south of the pipeline disturbance (see Figure 6).

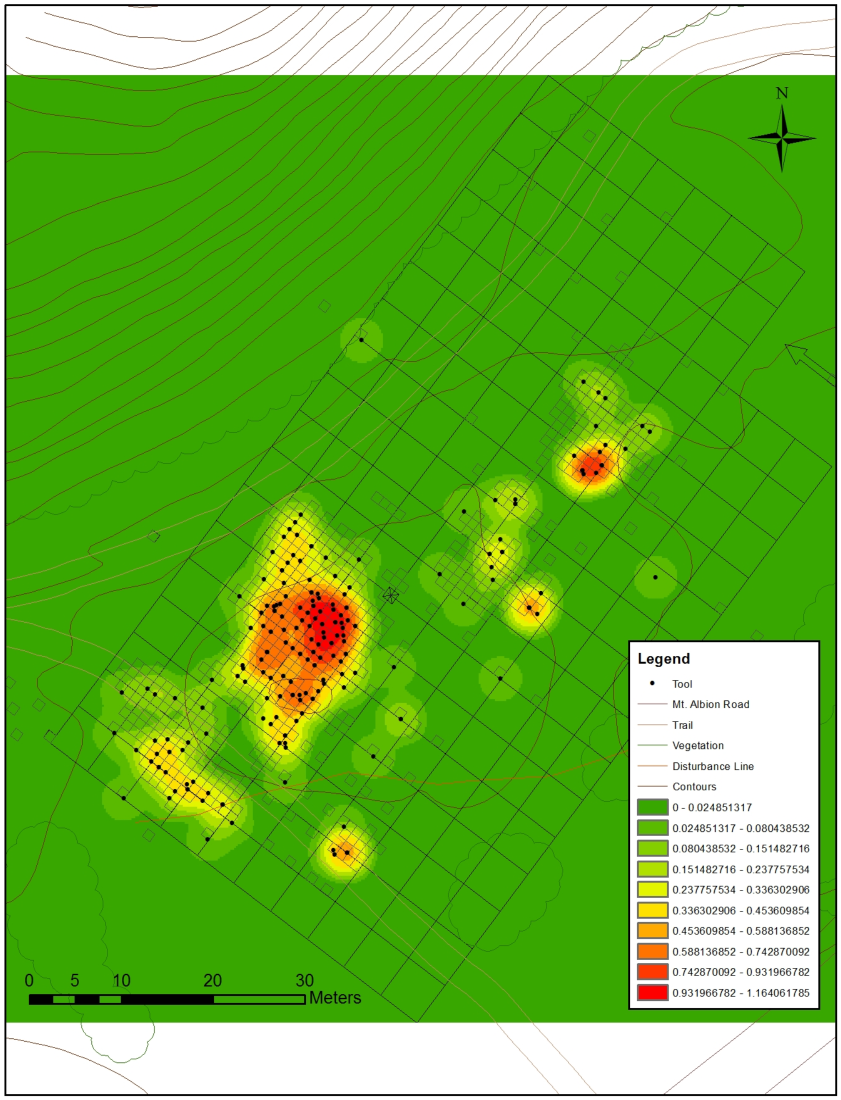


Figure 6: Kernel density estimate showing formal tool distribution

Area B is clearly the largest and densest of the loci. Onondaga tools appear to form smaller, tighter clusters within Areas A and B with a dispersed scatter of tools across Areas C and D. Conversely, tools manufactured on Fossil Hill chert seem to be more widely distributed over Areas A and B and exhibit more clustering in Areas C and D. Onondaga end scrapers in particular occur heavily in the south of Area B, with a particularly dense concentration (n=34; 79.1%) within an elliptical plateau of the highest elevated point (a low knoll) on the valley's edge. Side scrapers (n=3; 7%; Figure C.17), beaked scrapers (n=4; 9.3%; Figures C.18 and C.19), and unidentified scraper fragments (n=2; 4.7%) are also present within Area B in lower quantities.

2.5.2 Debitage

As with formal tool frequencies, the area with the highest debitage frequency was Area B at 4539 (45.8%) fragments. Area A yielded the next highest count at 1790 (18.0%), followed by 1479 (14.9%) from Area D, 1141 (11.5%) from Area C, and 970 (9.8%) outside the main activity areas (see Table 4).

Early stage debitage occurs in each of the four activity areas at Mt. Albion West, although with slightly higher concentrations in areas A and D, and in the northeast of Area B (Figure C.4). Early flakes were generally recovered in very low quantities with the highest area count totaling fewer than 35 flakes and 105 over the entire site. Cores are present only in Areas A (n=5) and B (n=2). Similarly, middle stage flaking debris was recovered fairly evenly from all artifact concentration areas (Figure C.5). Like the early phase, the highest densities in Area B continue to occur in the northeast but are higher throughout the entire northern half of the area. Middle stage flake frequencies are significantly higher, with a total of 891 flakes from all areas and 305 of them occurring in Area B. Late stage debitage was recovered in exponentially increased quantities and totals 1898 flakes over the whole of Mt. Albion West with 1074 located in Area B. The frequencies in Areas A, C, or D, meanwhile, do not surpass 252 flakes. Retouch flakes in particular occur in high quantities, totaling 1081 flakes across the site. Late stage

Inter-Area Debitage Type Distribution							
Type		**Area A**	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Early Stage							
Core	*Random Core*	0 (0.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	**2 (100.0%)**
	Bipolar Core/Nucleaus	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	**2 (100.0%)**
	Unidentifiable Core	2 (28.6%)	4 (57.1%)	0 (0.0%)	0 (0.0%)	1 (14.3%)	**7 (100.0%)**
Bipolar Flake		0 (0.0%)	5 (71.4%)	0 (0.0%)	0 (0.0%)	2 (28.6%)	**7 (100.0%)**
Primary Reduction Flake		5 (50.0%)	2 (20.0%)	0 (0.0%)	2 (20.0%)	1 (10.0%)	**10 (100.0%)**
Primary Thinning Flake		21 (27.3%)	22 (28.6%)	9 (11.7%)	19 (24.7%)	6 (7.8%)	**77 (100.0%)**
	Total	**28 (26.7%)**	**34 (32.4%)**	**9 (8.6%)**	**21 (20.0%)**	**13 (12.4%)**	**105 (100.0%)**
Middle Stage							
Bifacial Thinning Flake		164 (23.1%)	193 (27.2%)	130 (18.3%)	155 (21.9%)	67 (9.4%)	**709 (100.0%)**
Reduction Flake	*Bifacial Reduction Flake*	19 (11.9%)	107 (67.3%)	8 (5.0%)	8 (5.0%)	17 (10.7%)	**159 (100.0%)**
	Bifacial Reduction Flake - Edge Bite	12 (52.2%)	5 (21.7%)	2 (8.7%)	1 (4.3%)	3 (13.0%)	**23 (100.0%)**
	Total	**195 (21.9%)**	**305 (34.2%)**	**140 (15.7%)**	**164 (18.4%)**	**87 (9.8%)**	**891 (100.0%)**
Late Stage							
Retouch Flake	*Bifacial Retouch Flake*	132 (12.2%)	686 (63.5%)	86 (8.0%)	102 (9.4%)	75 (6.9%)	**1081 (100.0%)**
	Bifacial Shaping Flake	23 (14.4%)	46 (28.8%)	34 (21.3%)	30 (18.8%)	27 (16.9%)	**160 (100.0%)**
Bifacial Finishing Flake		96 (15.3%)	319 (51.0%)	55 (8.8%)	95 (15.2%)	61 (9.7%)	**626 (100.0%)**
Channel Flake		0 (0.0%)	41 (97.6%)	0 (0.0%)	1 (0.0%)	0 (0.0%)	**42 (100.0%)**
	Total	**251 (13.2%)**	**1092 (57.2%)**	**175 (9.2%)**	**228 (11.9%)**	**163 (7.0%)**	**1909 (100.0%)**
Unclassified							
Flake Fragment		803 (21.7%)	1311 (35.4%)	491 (13.3%)	659 (17.8%)	438 (11.8%)	**3702 (100.0%)**
Shatter		507 (15.4%)	1795 (54.7%)	318 (9.7%)	401 (12.2%)	262 (8.0%)	**3283 (100.0%)**
Chunk		2 (16.7%)	2 (16.7%)	2 (16.7%)	4 (33.3%)	2 (16.7%)	**12 (100.0%)**
Potlid		3 (10.7%)	18 (64.3%)	4 (14.3%)	3 (10.7%)	0 (0.0%)	**28 (100.0%)**
	Total	**1315 (18.7%)**	**3126 (44.5%)**	**815 (11.6%)**	**1067 (15.2%)**	**702 (10.0%)**	**7025 (100.0%)**
	TOTAL	**1789 (18.0%)**	**4557 (45.9%)**	**1139 (11.5%)**	**1480 (14.9%)**	**965 (9.7%)**	**9930 (100.0%)**

Table 4: Inter-area debitage type distribution

manufacture appears to have been concentrated in the same northeastern corner of Area B in addition to a north-south oriented elliptical cluster situated approximately 5 m southeast of the other (Figure C.6). Channel flakes occur 42 times across the site, 41 of which were recovered from Area B and one from Area D. Of these, 27 (64.3%) are Onondaga chert while 13 (31.0%) are Fossil Hill and two (4.8%) are on an unidentified raw material. Flake fragments and shatter, which account for 6,985 artifacts in the debitage assemblage, as well as 40 chunks and potlids[4] were unable to be assigned to a stage of manufacture and therefore were omitted from the GIS analyses in this study.

Although Onondaga chert occurs more frequently among the formal tools than other raw materials, it positively dominates the debitage collection present at Mt. Albion West, constituting 91.1 percent of the assemblage at 9,048 flakes or flake fragments while Fossil Hill chert makes up the second highest frequency at 748 (7.5%) flakes (see Table 5). The debitage compositions of each artifact concentration area are similar, with Onondaga materials constituting a range from 89.8 percent in Area B to 94.5 percent in Area A. As ASI (2007) has noted, the occupants of Mt. Albion West relied very little on Lockport materials for lithic manufacture, even though the site

Intra-Area Debitage Raw Material Distribution						
Material	**Area A**	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Onondaga	1692 (94.5%)	4077 (89.8%)	1049 (91.9%)	1350 (91.3%)	880 (90.7%)	**9048 (91.1%)**
Fossil Hill	72 (4.0%)	418 (9.2%)	80 (7.0%)	121 (8.2%)	57 (5.9%)	**748 (7.5%)**
Lockport	14 (0.8%)	28 (0.6%)	5 (0.4%)	6 (0.4%)	27 (2.8%)	**80 (0.8%)**
Fossil Hill/Reynales	6 (0.3%)	17 (0.4%)	2 (0.2%)	2 (0.1%)	1 (0.1%)	**28 (0.3%)**
Trent Valley	3 (0.2%)	11 (0.2%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	**15 (0.2%)**
Upper Mercer	0 (0.0%)	2 (0.1%)	2 (0.2%)	0 (0.0%)	0 (0.0%)	**4 (0.0%)**
Kettle Point	1 (0.1%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**2 (0.0%)**
Reynales	0 (0.0%)	1 (0.0%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	**2 (0.0%)**
Selkirk	1 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.0%)**
Unidentified	0 (0.0%)	2 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**2 (0.0%)**
TOTAL	**1790 (100.0%)**	**4539 (100.0%)**	**1141 (100.0%)**	**1479 (100.0%)**	**970 (100.0%)**	**9930 (100.0%)**

Table 5: Intra-area debitage raw material distribution

[4] Flake fragment that 'pops' off a core/flake when heated

is situated directly on the outcrop. However, debitage of this material may be underrepresented since only recognizable flakes or flake fragments were collected as it was difficult to differentiate cultural shatter from the natural materials that littered the site (MacDonald et al. 2017).

2.6 Discussion

2.6.1 Function

Multiple significant patterns are evident within the tabular and GIS data collected from Mt. Albion West. With regard to forming interpretations surrounding the tasks carried out across the site, the tool forms present indicate a degree of functional variability between its activity areas. Areas for specialized activities, as evidenced within the inner clusters at the Bull Brook site (see Robinson et al. 2009), certain areas at Fisher (see Storck 1997), and Parkhill (see Ellis and Deller 1992) manifest in the dominance of one or multiple tool classes associated with a particular task. Ellis and Poulton (2014:96-97) observe that Paleoindian assemblages are often characterized by notably high frequencies (>30%) of either fluted bifaces or end scrapers and this may be critical to interpreting inter-site variability. At Mt. Albion West, two of the loci (Areas B and D) are dominated by end scrapers (n=34; 37.8% and n=5; 37.9%) while Areas A and C exhibit a broader range of tools (Table 6). This pattern suggests that the activity areas at Mt. Albion West may have served different functions.

Loci with broad tool assemblages often represent residential areas in which a wide range of domestic activities would have taken place (Deller and Ellis 1992:27; Ellis and Poulton 2014; Gramly 1982; Robinson et al. 2009). Elliptical concentrations of artifacts roughly 4.5 m by 6 m in extent, which occur at Bull Brook and Vail for example, tend to be typical of house locations containing a small social group or family unit (see Curran 1984; Gramly 1984; Jones 1997;

MacDonald 1968; Robinson et al. 2009; Spiess et al. 1998). Two of the activity loci at Mt. Albion West have larger areas than the typical residential area: Area B is the largest of the four with dimensions of roughly 13 m by 14 m while Area A is intermediate at about 11 m by 7 m. The surface areas of the smallest two clusters (Areas C and D) cover approximately 5 m by 6 m. As such, the latter concentrations suggest single occupation structures containing a small social group, while Areas A and B, with their significantly larger size, may indicate concurrent or sequential use of the site by multiple groups.

However, while the domestic clusters at Bull Brook yielded an average of 70 to 80 tools per area (Curran 1984:40; Robinson et al. 2009:437), the artifact quantities in the activity loci at Mt. Albion West are significantly less. Areas A, C, and D in this study accounted for 53, 16, and 18 artifacts respectively. The tool diversities in Mt. Albion West's two smallest areas are also comparatively low and do not support the range of domestic activities typically associated with a residential camp (Tables 6 and A.4), although their small sample size may have influenced this pattern. While beaked scrapers (also known as flake shavers [Gramly 1992]), drills, and wedges are often recovered from residential loci (Robinson et al. 2009), none are present in the

	Beaked Scraper	Drill	Biface	End Scraper	Wedge	Flake Graver	Side Scraper
Vail Locus H	X	X	X	X	X		X
Bull Brook	X	X	X	X	X	X	X
M.A.W. Area A	X		X	X	X	X	X
M.A.W. Area B	X	X	X	X	X	X	X
M.A.W. Area C			X			X	X
M.A.W. Area D		X	X			X	

Table 6: Residential camp tool form occurrences by artifact concentration area

assemblages collected from Areas C and D while bifaces and gravers are only marginally represented (see Table 1). As well, end scrapers do not occur in Area C and no side scrapers were present in Area D. The paucity of these tool classes suggests that these areas were short-term logistical camps rather than residential areas, likely hosting small hunting groups rather than family units. Contrastingly, all of these tool classes were recovered within Areas A and B, with the exception of drills in the former. These larger areas therefore likely represent occupations in which a wider range of activities was carried out. The frequency of artifacts in Area B, however, was over three times higher than that seen in Area A, indicating that it may have been inhabited for a longer period of time, reoccupied more than once, or hosted a larger group.

Similar lithic manufacturing processes appear to have occurred throughout three of the four activity areas, as evidenced by the stages of flake debris. The three stages of reduction are present across Areas A, C, and D in consistently low quantities, and accord well with debitage patterns generally encountered at short-term logistical camps. Residential occupations, meanwhile, tend to produce significantly higher quantities of flaking debris. Within Area B, there is more than twice the quantity of flakes found in the area with the next highest frequency (Area A). Over 1,000 of these flakes are comprised of retouch flakes whereas only 250 of the same flake type were recovered from Area A. The accompanying artifact count is also substantially higher than what is generally associated with the average habitation of a single group (Gramly 1982; Robinson 2009). Although the high frequency of retouch flakes and end scrapers correlate to specialized use of an area, channel flakes also occur predominantly within Area B. Given the tendency for many Paleoindian activity areas to be dominated by evidence of either biface production or end scraper use (Ellis and Poulton 2014), it therefore seems likely that

Area B represents multiple groups who occupied the area and performed these activities in addition to some domestic tasks largely on separate occasions.

Although the artifact concentration areas at Mt. Albion West exhibit some similarities with regard to function, there are certain exceptions. The first notable pattern is evident in the Onondaga end scrapers present within Area B (Figure 7). The combined K Function analysis and kernel density estimate reflected statistically significant clustering in the south end of the locus. As scholars have hypothesized that Paleoindians used these tools for hide working

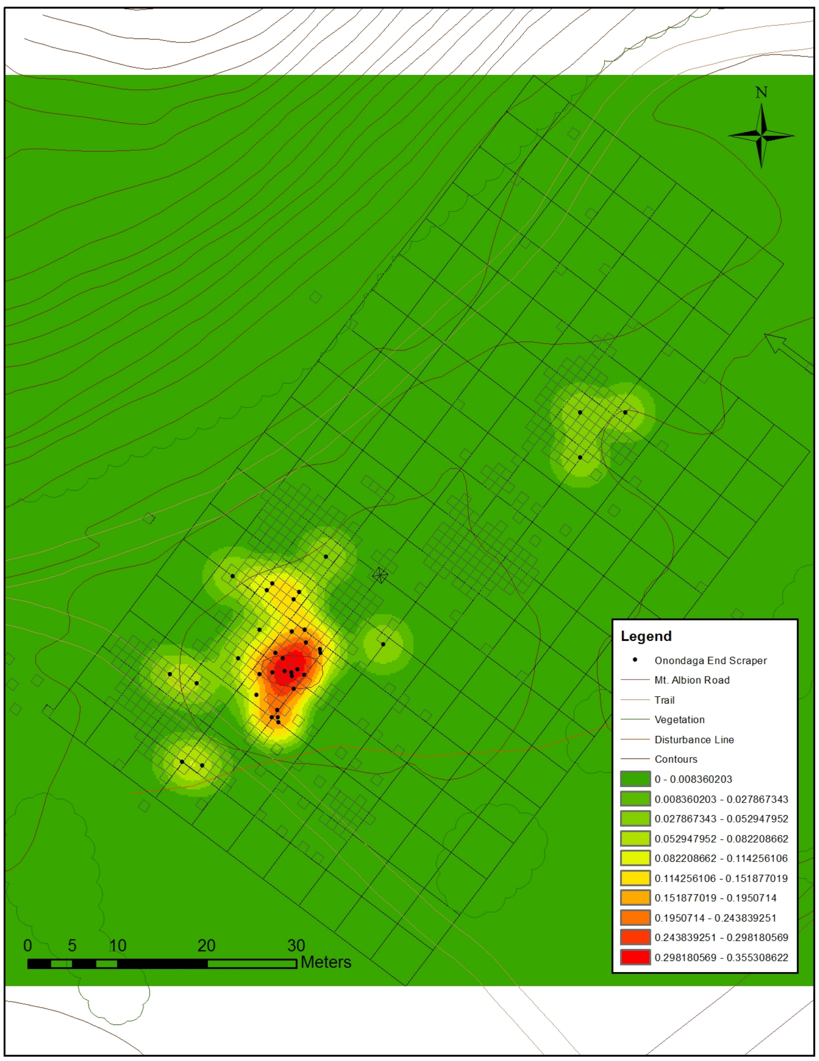


Figure 7: Kernel density estimate showing Onondaga end scraper distribution

(Archaeological Services Inc. 2007:97; Ellis and Deller 1990:48; Loebel 2013; Seeman et al. 2013), such a dense concentration of end scrapers indicates a specific focus on scraping hides in this area. As well, these tools have a long use-life and, being commonly hafted, are highly curated (Ellis and Poulton 2014:97; Simons et al. 1984:270). As such, they tend to be less frequently discarded. This has three implications at Mt. Albion West; first, a significant degree of hide-working must have taken place in this area to produce such a high rate of end scraper discard. The residue analysis by MacDonald et al. (2017) as well as the recovery of proboscidean bone from Lake Iroquois deposits confirms that megafauna were present in the area (Storck 2004:44). Whether megafauna and/or other animals were processed, such activities likely required group collaboration. Further use-wear and residue analyses being conducted on Mt. Albion West's tool assemblage (and on the end scrapers within this concentration in particular; see MacDonald et al. 2017) may prove helpful in identifying which species were processed on site. Secondly, for a group to use these highly curated tools so extensively that they were discarded in such large numbers, a nearby raw material source must have been necessary to replenish them. As the Onondaga outcrops were located only a short distance away (roughly 40 km to the south) and the site was also situated above an outcrop of Lockport formation chert, the acquisition of additional raw materials would not have been particularly challenging. Furthermore, ethnographic studies have shown that women tend to perform hide-working activities in societies that inhabit tundra environments and rely on hunting for their subsistence (Ruth 2013). If this were also the case among Paleoindian groups, it is reasonable to suggest that women may have been the primary users of the clustered end scrapers in the south of Area B and it would support the aforementioned suggestion that the largest area may reflect a residential site for at least one group.

Moreover, the highest debitage density point in the northeast of Area B is isolated from the majority of recovered Onondaga tool forms, especially the cluster of end scrapers. This apparent separation may reflect an effort to keep flaking debris from interfering with workspaces, particularly where attempting to scrape soft tissue on top of a scatter of sharp lithic fragments might ruin a valuable hide.

Within all four activity areas, the propensity toward the recovery of basal fragments (Table A.4) is consistent with hunting camps where its occupants return from a hunt with only the hafted portion of a projectile point (Deller and Ellis 1992). However, as noted by ASI (2007), the 42 channel flakes present at Mt. Albion West occur almost exclusively in Area B within a roughly 5 m by 10 m area (Figure 8), suggesting that this confined space was a focal point for biface manufacturing for one group. Their close proximity to the cluster of end scrapers, however, suggests that this particular area was a desirable workspace for a variety of tasks by different groups. Although the presence of fluted points in each locus supports general hunting activities, the apparent emphasis on biface reduction in Area B may have been, as Storck (2004:45) and MacDonald and others (2017) suggest, in preparation for a hunting expedition into either the Red Hill Valley or Lake Ontario basin.

2.6.2 Occupation Frequency

The artifact concentrations at Mt. Albion West exhibit characteristics of both concurrent site use by multiple groups and re-occupation. ASI (2007) examined the artifacts from Mt. Albion West for refits in order to infer simultaneous occupations. They found that not only did all refits occur within individual activity areas, but that refitted tools were also largely recovered within a few metres of one another. This line of evidence therefore does not support the idea of

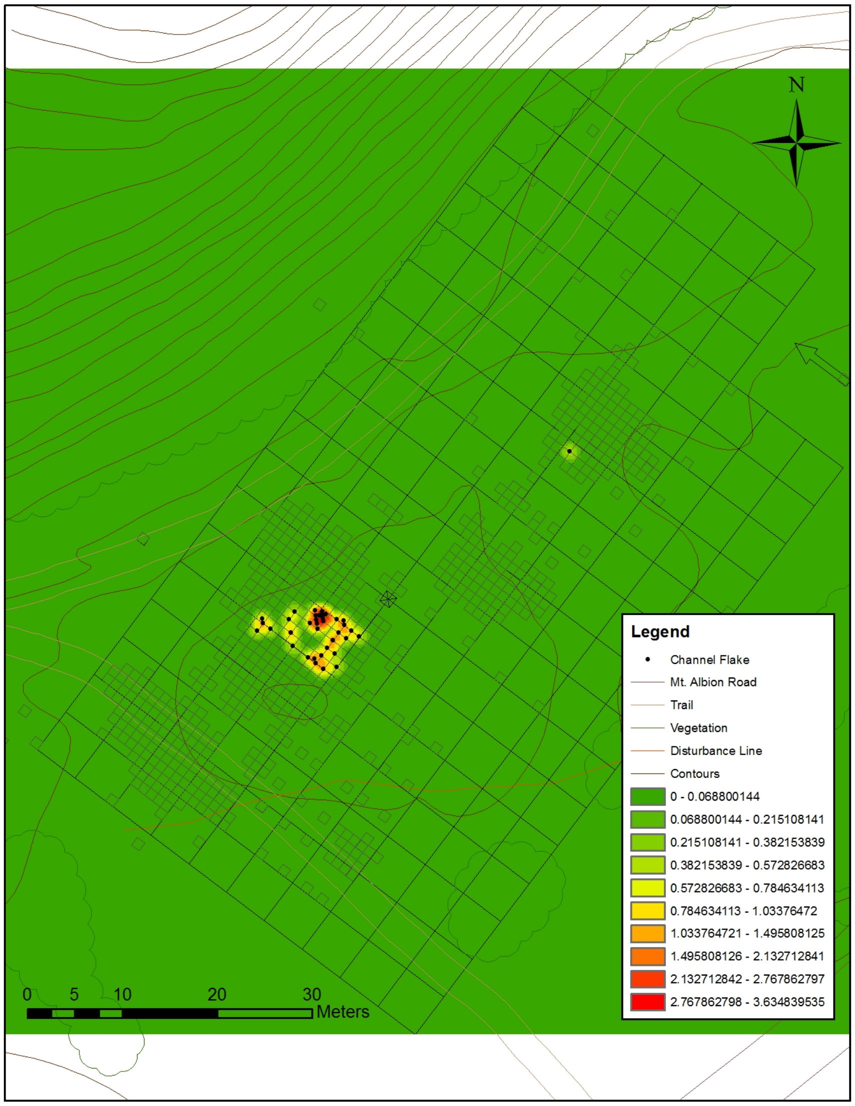


Figure 8: Kernel density estimate showing channel flake distribution

contemporary occupations between loci, however it is not sufficient to confirm that the four areas were occupied on separate occasions.

The artifact concentration areas at Mt. Albion West are situated in a roughly linear fashion no more than 15 m from one another. This small, closely situated concentration with a more defined arrangement is typically indicative of single (or minimal) occupations as evidenced by the roughly 15 m of sterile space separating the Bull Brook clusters (Deller and Ellis 1992:27;

Robinson et al. 2009:432). By contrast, the reoccupied Debert, Fisher, and Parkhill sites lack such large-scale spatial organization and concentrations tend to be situated at least 25 m from one another (Deller and Ellis 1992; MacDonald 1968; Storck 1997). However, the apparent sense of organization between activity loci at Mt. Albion West may have been influenced by landscape features rather than the coordination of aggregated groups. If the occupants used the Red Hill valley as a funnel into which game was driven, their prey likely converged at the point of the valley's V-shape located just west of the site (MacDonald et al. 2017). Its close proximity therefore may have been an important factor in selecting a space to camp. Examining the patterning of loci in comparison to the aforementioned variation in cluster sizes, it is likely that Mt. Albion West was occupied more than once, but by the same or similar groups who were familiar with the Red Hill Valley landscape.

Moreover, the similar raw material composition of the formal tool assemblages across Areas A, C, and D (Figure A.1) further indicates that these loci may have been occupied either contemporaneously or at similar points in seasonal rounds. Because of the Fossil Hill formation's situation in an elevated snowbelt, it was likely only accessible at certain times of the year (Storck 1984:13). As such, Paleoindians presumably occupied camps in the north to procure this material during the warmer months, then travelled south as winter approached. MacDonald et al. (2017) note that while Onondaga chert constitutes the majority of bifacial tools at Mt. Albion West (Table A.2), expediently reworked tools were largely manufactured on Fossil Hill materials (Table A.3; Table 7). This phenomenon suggests that these tools had been transported from northern sources and modified from their original forms to suit the immediate needs of their users. The dominance of Onondaga debitage at the site, however, indicates that its occupants had already visited the outcrop to the south and were working tools fairly heavily (see Figure 9). If

Raw Material Distribution by Formal Tool Type					
	Onondaga	**Fossil Hill**	**Lockport**	**Unidentified**	**Total**
Bifacially Worked Preforms	14 (9.8%)	4 (5.1%)	2 (40.0%)	7 (9.3%)	**27 (8.9%)**
Projectile Points/Fragments					
Gainey-Type	4 (2.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**4 (1.3%)**
Unidentified Fluted PP	5 (3.5%)	3 (3.8%)	0 (0.0%)	0 (0.0%)	**8 (2.6%)**
Drills	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
Wedges	3 (2.1%)	0 (0.0%)	1 (20.0%)	1 (1.3%)	**5 (1.7%)**
Unidentified Bifacially Worked Artifact Fragments	19 (13.3%)	0 (0.0%)	0 (0.0%)	7 (9.3%)	**26 (8.6%)**
End Scrapers					
Simple End Scrapers	13 (9.1%)	2 (2.5%)	0 (0.0%)	2 (2.7%)	**17 (5.6%)**
Simple End Scraper w/ Stem-like Haft Element	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	**1 (0.3%)**
Notched End Scrapers	9 (6.3%)	4 (5.1%)	0 (0.0%)	1 (1.3%)	**14 (4.6%)**
Spurred End Scrapers	6 (4.2%)	2 (2.5%)	0 (0.0%)	2 (2.7%)	**10 (3.3%)**
Micro End Scraper, notched	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	**1 (0.3%)**
Unclassified End Scraper Fragments	9 (6.3%)	3 (3.8%)	1 (20.0%)	3 (4.0%)	**16 (5.3%)**
Side Scrapers	0 (0.0%)	5 (6.3%)	0 (0.0%)	2 (2.7%)	**7 (2.3%)**
Denticulated Scraper Fragment	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	**1 (0.3%)**
Beaked Scrapers	0 (0.0%)	2 (2.5%)	0 (0.0%)	5 (6.7%)	**7 (2.3%)**
Flake Gravers	5 (41.7%)	5 (6.3%)	0 (0.0%)	2 (2.7%)	**12 (4.0%)**
Combination Tools	3 (3.5%)	2 (2.5%)	0 (0.0%)	1 (1.3%)	**6 (2.0%)**
Fragments of Unidentified Scrapers	3 (3.5%)	3 (3.8%)	0 (0.0%)	1 (1.3%)	**7 (2.3%)**
Fragments of Unidentified Unifacially Worked Tools	32 (22.4%)	25 (31.6%)	1 (20.0%)	28 (37.3%)	**86 (28.5%)**
Notched Flakes	1 (0.7%)	6 (7.6%)	0 (0.0%)	4 (5.3%)	**11 (3.6%)**
Utilized Flakes	14 (9.8%)	13 (16.5%)	0 (0.0%)	6 (8.0%)	**33 (10.9%)**
*Miniature Point	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
*Recycled Projectile Point Fragment w/Spur	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
TOTAL	**143 (100.0%)**	**79 (100.0%)**	**5 (100.0%)**	**75 (100.0%)**	**302 (100.0%)**

Table 7: Raw material distribution by formal tool type

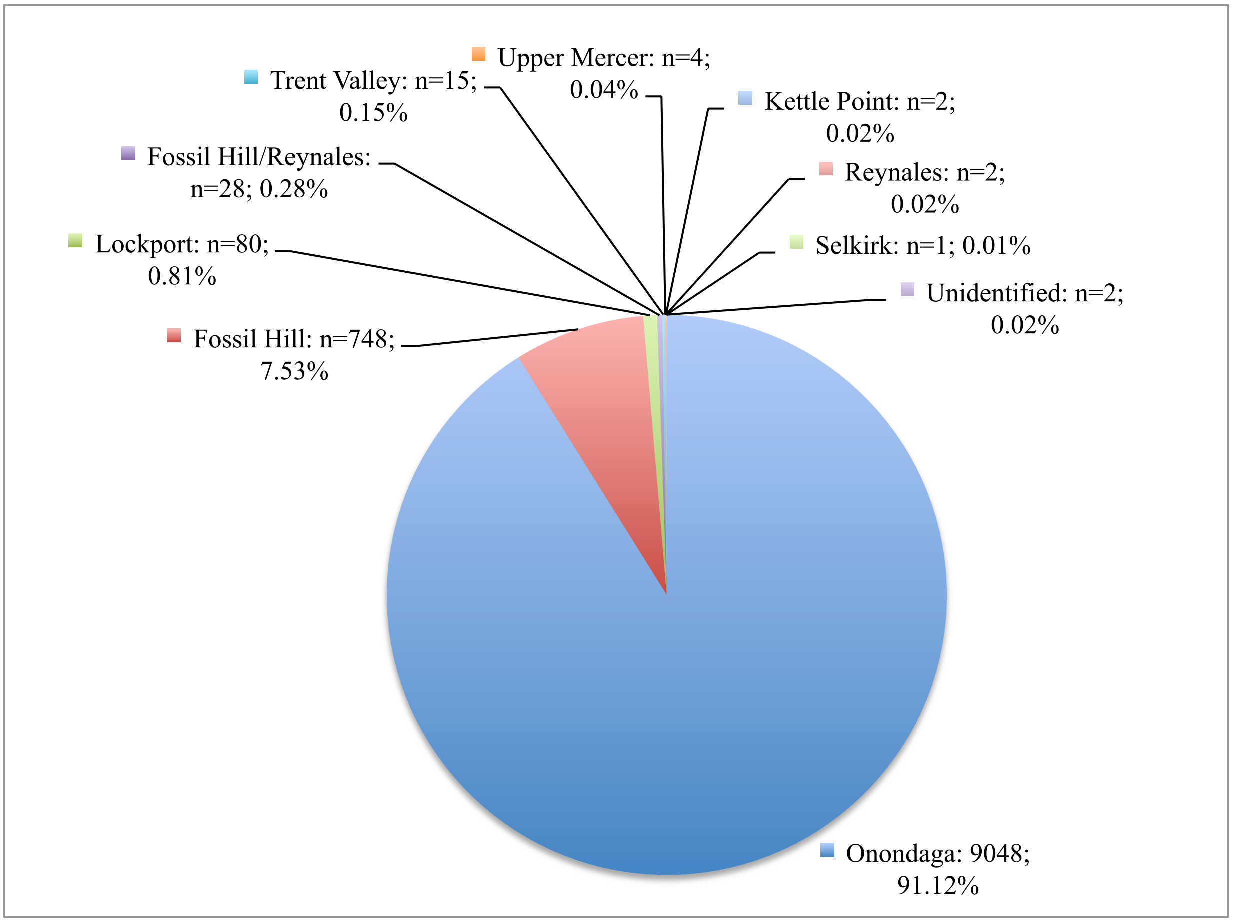


Figure 9: Debitage raw material distribution

the individuals who occupied Mt. Albion West used the neighbouring valley's funnel formation to intercept game during their migrations, the animals were likely moving south for the colder months rather than north toward the open Lake Ontario basin. At this point in the year, caribou would also be meatier after a summer of extensive grazing. It is therefore plausible to suggest that, between the natural movements of game as well as the accessibility of the Fossil Hill outcrops, Mt. Albion West was likely occupied in the fall. Based on their demonstrated knowledge of faunal behaviour, Paleoindians may have travelled south in late summer or early fall to procure sufficient Onondaga materials, then returned to the valley in smaller task groups for the seasonal movement of their prey.

Large concentrations with high artifact quantities may represent longer residency, larger groups, or overlapping reoccupations (Gramly 1982:48; Jackson 1997:139). Area B at Mt. Albion West can be characterized as such, and therefore it follows that the site was likely occupied in one of the aforementioned manners. Gramly (1982:48) maintains, however, that variation in group or dwelling size would demonstrate a randomness that rarely exists in human social behaviour. It is therefore likely that the largest concentration at Mt. Albion West was reoccupied on more than one occasion. Identifying multiple residencies in a single cluster is often challenging; indeed, Gramly professes that they are the bane of an archaeological investigation and nearly impossible to interpret (1982:51-52). Simons and others (1984) encountered a similar cluster size at the Gainey site, where a higher density space in one area supported their suggestion that two deposits overlapped. Within Area B, however, the consistently dense distribution of tools and debris across the entire concentration makes its interpretation more complex. Tools manufactured on Fossil Hill chert are distributed largely in the north while Onondaga artifacts are predominantly present in the south (see Figures 10 and 11). The Fossil Hill artifacts are also generally comprised of more expedient tool forms while curated tools are more frequently fabricated on Onondaga chert (Figures A.2 and A.3). This segregation of raw materials and tool forms suggests two different occupations. Moreover, the evidence at a number of Paleoindian sites such as Parkhill, Debert, and Bull Brook (Deller and Ellis 1992; MacDonald 1968; Robinson et al. 2009) suggests a gendered division of activities in which males were likely responsible for biface manufacture while females performed domestic activities including hide-scraping. At these sites, the different activities tend to take place in clusters separated by up to 15 metres of sterile space. Within Area B, the clusters of end scrapers

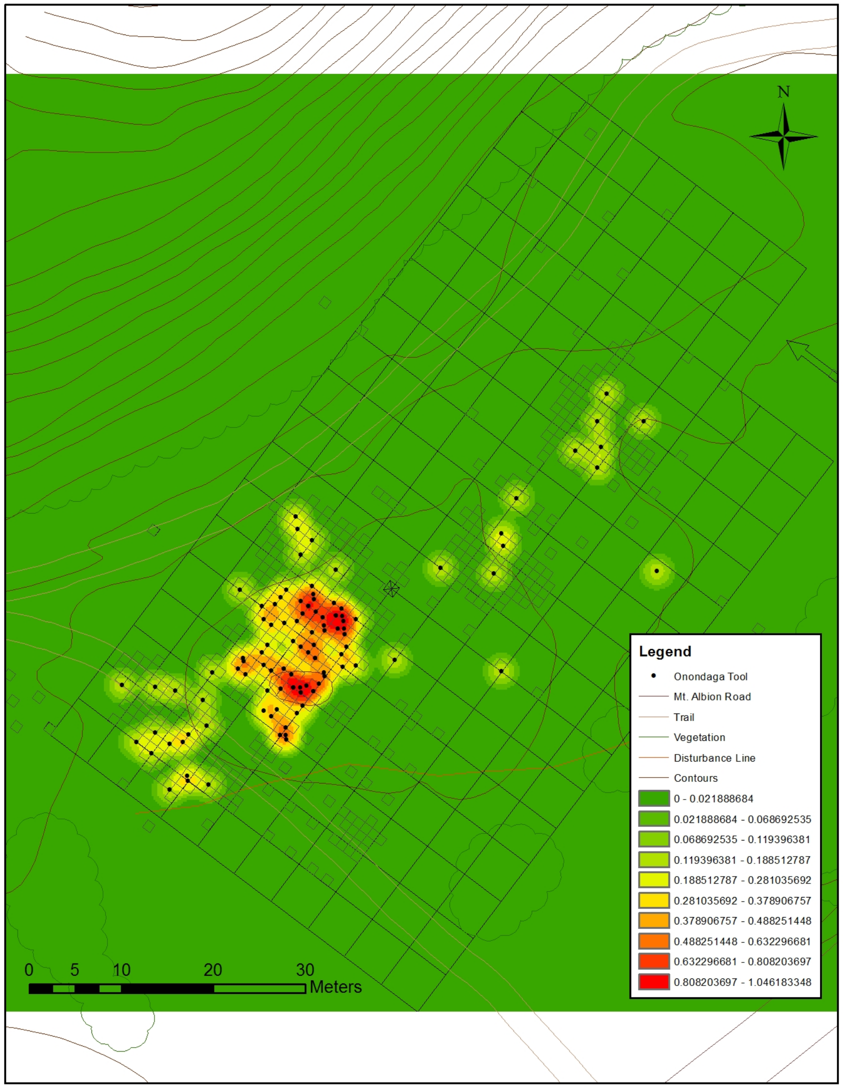


Figure 10: Kernel density estimate showing total Onondaga formal tools

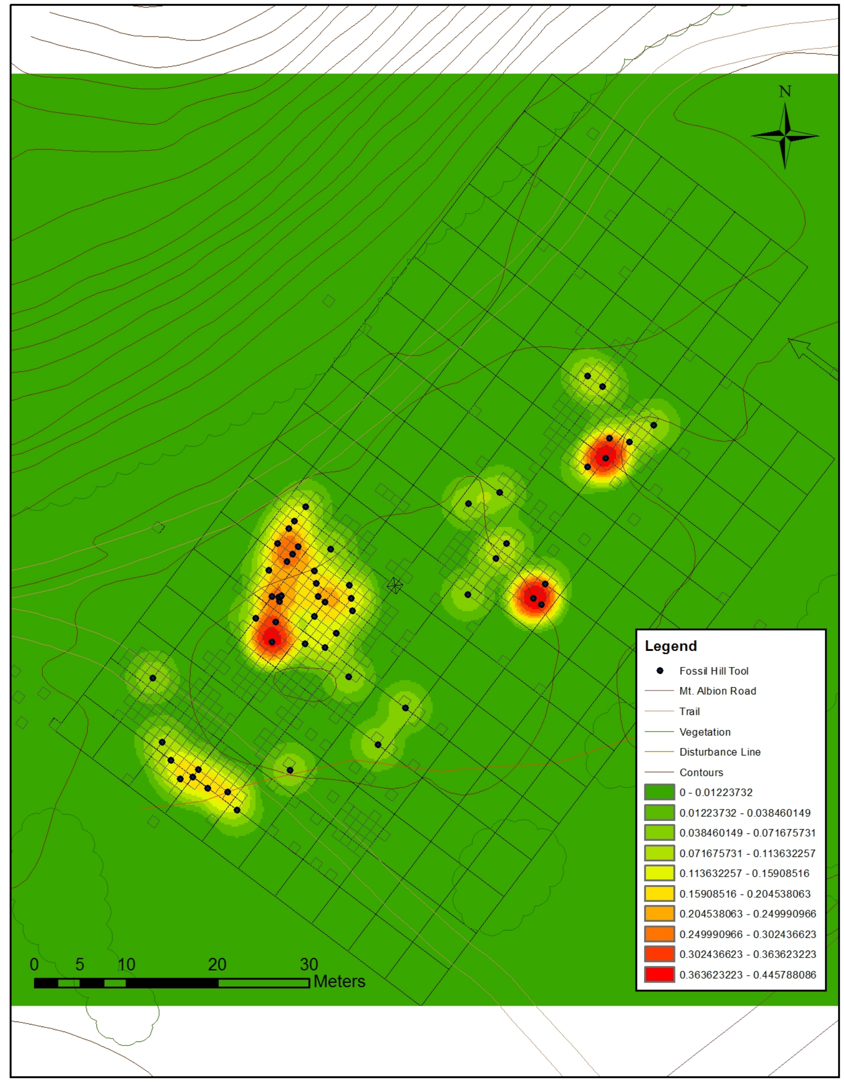


Figure 11: Kernel density estimate showing total Fossil Hill formal tools

and channel flakes both occur in the Onondaga-dominated southern space. Given the proposed pattern of gendered spaces at Paleoindian camps, the comparative lack of separation (less than 5 metres) between these tasks within Area B indicates that the southern half of the cluster was also likely occupied more than once. Further analysis of morphological variation between these spaces in Area B would assist in determining occupation frequency; however, the evidence here indicates that as many as three groups may have resided in the same area on separate occasions.

Furthermore, the conspicuous absence of end scrapers in Area C, as opposed to the five present in Area D, indicates that they were occupied differently. Although the combination tools and side scrapers present in Area C may have served as cutting and scraping instruments, they are less curated forms than end scrapers, which were predominantly hafted. Their presence here may be indicative of an unfavourable hunting excursion or smaller game that required a lesser degree of processing. If this were the case, the occupants may have stayed at the site for a shorter period of time, during which more curated tools such as end scrapers may not have been worked to the point of discard.

The patterns outlined above lend credibility to the suggestion that Paleoindians presumably camped at Mt. Albion West repeatedly over multiple years. The lack of distinctive area specialization is not consistent with a contemporaneously occupied site and tool diversity and quantities across the site suggest short term-use for hunting excursions. However, despite its ideal proximity to a probable caribou migration route through the Niagara Escarpment, it is unclear why Paleoindians appear to have resided at Mt. Albion West only a handful of times. Among other ongoing investigations of the site, this question regarding the apparent end of Paleoindian use of Mt. Albion West merits further exploration.

2.7 Conclusion

The Mt. Albion West site was occupied at a time when the Great Lakes environment was stark and unforgiving. Despite these challenges, Paleoindians learned the landscape and used their extensive knowledge of its features to make it their home. This study shows that the four artifact concentration areas situated adjacent to the Red Hill Valley likely represent several occupations by hunting groups seeking to intercept caribou migrations through the Ontario basin as they moved south for the winter. Quantitative and qualitative analyses of the spatial relationships within and between the activity loci generally indicate reoccupations by smaller task groups who may have, on a few occasions, camped on the Niagara Escarpment for longer periods of time to prepare for their excursions and process their kills. Future fieldwork in the Niagara Peninsula and along the escarpment will hopefully produce more Early Paleoindian sites in order to further the knowledge of how people moved through and inhabited the region so long ago.

References

Adovasio J.M., J.D. Gunn, J. Donahue, and R. Stuckenrath
1978 Meadowcroft Rockshelter, 1977: An Overview. *American Antiquity* 43(4):632-651.

Adovasio, J.M., D. Pedler, J. Donahue, and R. Stuckenrath
1999a Two Decades of Debate on Meadowcroft Rockshelter. *North American Archaeologist* 19(4):317-341.
1999b No Vestige of a Beginning nor Prospect for an End: Two Decades of Debate on Meadowcroft Rockshelter. In *Ice Age Peoples of North America: Environments, Origins, and Adaptations of the First Americans*, edited by R. Bonnichsen and K.L. Turnmire, pp. 416-431. Center for the Study of the First Americans, Oregon State University, Corvallis.

Archaeological Services Inc. (ASI)
2007 The Stage 4 Salvage Excavation of the Mt. Albion West Site (AhGw-131) Cultural Heritage Resource Assessment, Red Hill Creek Expressway (North-South Section) Impact Assessment, City of Hamilton, Ontario. Unpublished Archaeological Report for Licenses 2000-016, 2001-053, P046, P117, MCL CIFs 2000-016-129, 2001-053-015, P046-004, P117-012 on file with the Ontario Ministry of Culture, Heritage Operations Unit and Archaeological Services Inc., Toronto, Ontario.

Bevan, Andrew, Eva Jobbová, Christophe Helmke, and Jaime Awe
2013 Directional layouts in central lowland Maya settlement. *Journal of Archaeological Science* 40:2373-2383.

Blasco, Ruth, Jordi Rosell, Pablo Sañudo, Avi Gopher, and Ran Barkai
2016 What happens around a fire: Faunal processing sequences and spatial distribution at Qesem Cave (300 ka), Israel. *Quaternary International* 398:190-209.

Boyd Archaeological Field School at TRCA
2015 Home. Electronic document, http://www.boydfieldschool.org/#/home, accessed November 26, 2016.

Bruce Trail Conservancy
2016a About Us. Electronic document, http://brucetrail.org/pages/about-us, accessed October 20, 2016.
2016b Bruce Trail Clubs. Electronic document, http://brucetrail.org/pages/trail/bruce-trail-clubs, accessed November 22, 2016.
2016c Bruce Trail & BTC Facts. Electronic document, http://brucetrail.org/pages/about-us/bruce-trail-btc-facts, accessed November 27, 2016.
2016d History of the Trail. Electronic document, http://brucetrail.org/pages/about-us/history-of-the-trail, accessed November 23, 2016.
2016e Land Acquisitions. Electronic document, http://brucetrail.org/pages/land-conservation/recent-land-acquisitions, accessed October 20, 2016.
2016f Mission, Vision and Values. Electronic document, http://brucetrail.org/pages/about-us/mission-vision-values, accessed October 20, 2016.

2016g Using the Trail. Electronic document, http://brucetrail.org/pages/trail/using-the-trail, accessed November 20, 2016.

2017 The Niagara Escarpment. Electronic document, http://brucetrail.org/pages/about-us/the-niagara-escarpment, accessed November 3, 2017.

Byers, Douglas S.

1955 Bull Brook: A Fluted Point Site in Ipswich, Massachusetts. *American Antiquity* 19(4):343-351.

Cable, Charlotte Marie

2012 A Multitude of Monuments: Finding and Defending Access to Resources in Third Millennium BC Oman. PhD dissertation, Department of Anthropology, Michigan State University, Michigan.

Canadian Archaeological Association

2017 CAA Objectives. Electronic document, https://canadianarchaeology.com/caa/about, accessed October 20, 2017.

City of Kitchener

2010 Stories revealed: How a plan for a trail uncovered a cultural treasure trove. *Your Kitchener* (newsletter), November-December 2010. http://www.kitchener.ca/en/livinginkitchener/resources/PAGES6-7hna.pdf, accessed November 21, 2016.

Coakley, John P.

1992 Holocene Transgression and Coastal-Landform Evolution in Northeastern Lake Erie, Canada. In *Quaternary Coast of the United States: Marine and Lacustrine Systems*, edited by Charles H. Fletcher III and John F. Wehiller, pp. 415-426. SEPM Special Publication no.48. Society for Sedimentary Geology, Tulsa, Oklahoma.

Curran, Mary Lou

1984 The Whipple Site and Paleoindian Tool Assemblage Variation: A Comparison of Intrasite Structuring. *Archaeology of Eastern North America* 12:5-40.

Custer, Jay F., John A. Cavallo, and R. Michael Stewart

1983 Lithic Procurement and Paleo-Indian Settlement Patterns on the Middle Atlantic Coastal Plain. *North American Archaeologist* 4(4):263-276.

Deller, D. Brian, Christopher J. Ellis

1992 The Early Paleo-Indian Parkhill Phase in Southwestern Ontario. *Man in the Northeast* 44:15-54.

2011 *The Crowfield Site (AfHj-31): A Unique Paleoindian Fluted Point Site in Southwestern Ontario*. Memoirs Series No. 49, Museum of Anthropology, University of Michigan, Ann Arbor.

Deller, D. Brian, Christopher Ellis, and Merle Franklin
2017 The Rogers Site: An Early Paleoindian Site in the Niagara Peninsula Region of Ontario. Manuscript on file, Department of Anthropology, Western University, London, Ontario.

Dillehay, Tom D.
1997 *Monte Verde: A Late Pleistocene Settlement in Chile, Vol. 2: The Archaeological Context and Interpretation*. Smithsonian Institution Press, Washington, D.C.

Eckford, Scott
2017 What's the Point? An Examination of Three Early Fluted Point Collections from Southern Ontario. Paper presented at the 50th Annual Meeting of the Canadian Archaeological Association, Gatineau, Quebec.

Ellis, Christopher
1984 Paleo-Indian Lithic Technological Structure and Organization in the Lower Great Lakes Area: A First Approximation. PhD dissertation, Department of Archaeology, Simon Fraser University, Burnaby, British Columbia.
2001 Some Sites and Artifacts I Have Known: A Small Paleo-Indian Site in the Niagara Peninsula. *Kewa* 01(1-2):10-19.
2009 The Crowfield and Caradoc Sites, Ontario: Glimpses of Palaeo-Indian Sacred Ritual and World View. In *Painting the Past with a Broad Brush: Papers in Honour of James Valliere Wright*, edited by David L. Keenlyside and Jean-Luc Pilon, pp. 319-352. Mercury Series Archaeology Paper 170. Canadian Museum of Civilization, Gatineau, QC.
2011 Measuring Paleoindian range mobility and land-use in the Great Lakes/Northeast. *Journal of Anthropological Archaeology* 30:385-401.

Ellis, Chris J., and Brian Deller
1988 Some Distinctive Paleoindian Tool Types from the Lower Great Lakes Region. *Midcontinental Journal of Archaeology* 13(2):111-158.
1990 Paleo-Indians. In *The Archaeology of Southern Ontario to A.D. 1650*, edited by Chris J. Ellis and Neal Ferris, pp. 37-63. Occasional Publication of the London Chapter, Ontario Archaeological Society number 5.

Ellis, Christopher and Dana R. Poulton
2014 The Gosling Site (AiHb-189): A Small, Parkhill Phase, Paleo-Indian Site in Guelph, Ontario. *Ontario Archaeology* 94:81-111.

Figgins, Jesse D.
1927 The Antiquity of Man in America. *Natural History* 27:229-239.

Gingerich, Joseph A. M.
2013 Revisiting Shawnee Minisink. In *In the Eastern Fluted Point Tradition*, edited by Joseph A. M. Gingerich, pp. 218-258. University of Utah Press, Salt Lake City.

Gingerich, Joseph A. M., and Nathaniel R. Kitchel
2015 Early Paleoindian Subsistence Strategies in Eastern North America: A Continuation of the Clovis Tradition? Or Evidence of Regional Adaptations? In *Clovis: On the Edge of a New Understanding*, edited by Ashley M. Smallwood and Thomas A. Jennings, pp. 297-318. Texas A&M University Press, College Station.

Gramly, Richard Michael
1982 *The Vail Site: A Palaeo-Indian Encampment in Maine*. Bulletin of the Buffalo Society of Natural Sciences Vol. 30. Buffalo, New York.
1992 *Guide to the Palaeo-Indian Artifacts of North America*. Persimmon Press Monographs in Archaeology, Buffalo, New York.

Grayson, Donald K., and David J. Meltzer
2015 Revisiting Paleoindian Exploitation of Extinct North American Mammals. *Journal of Archaeological Science* 56:177-193.

Grove, M.
2011 A spatio-temporal kernel method for mapping changes in prehistoric land-use patterns. *Archaeometry* 53(5):1012-1030.

Hanson, Caitlin
2010 The Early Paleoindian Occupation of Southern Ontario: Temporal and Spatial Trends. Unpublished Masters thesis, Department of Anthropology, Western University, London, Ontario.

Haynes Jr., C.Vance
1964 Fluted Projectile Points: Their Age and Dispersion. *Science* 145(3639):1408-1413.

Ingold, Tim
1993 The Temporality of the Landscape. *World Archaeology* 25(2):152-174.

Jackson, Lawrence J.
1997 Caribou Range and Early Paleo-Indian Settlement Disposition in Southern Ontario, Canada. In *Caribou and Reindeer Hunters of the Northern Hemisphere*, edited by Lawrence J. Jackson and Paul T. Thacker, pp. 132-164. Avebury Press, Aldershot, UK.

Jackson, Lawrence J., Christopher J. Ellis, Alan V. Morgan, and John H. McAndrews
2000 Glacial Lake Levels and Eastern Great Lakes Palaeo-Indians. *Geoarchaeology* 15:415-440.

Jones, Brian D.
1997 The Late Paleoindian Hidden Creek Site in South-eastern Connecticut. *North American Archaeologist* 25:45-80.

Kapyrka, Julie
2016 The Space Between: Visioning a Decolonized Archaeological Practice. Paper presented at the Ontario Archaeological Society Symposium, Waterloo, Ontario, November 5-6, 2016.

Karrow, P.F., and B.G. Warner
1990 The Geological and Biological Environment for Human Occupation in Southern Ontario. In *The Archaeology of Southern Ontario to A.D. 1650*, edited by Chris J. Ellis and Neal Ferris, pp. 5-35. Occasional Publication of the London Chapter, Ontario Archaeological Society number 5.

Kay, Jeanne
1989 Human Dominion over Nature in the Hebrew Bible. *Annals of the Association of American Geographers* 79(2): 214-232.

Kelly, Robert L.
2003 Colonization of New Land by Hunter-Gatherers. In *Colonization of Unfamiliar Landscapes*, edited by Marcy Rockman and James Steele, pp. 44-58. Routledge, New York.

Larson, Grahame and Randall Schaetzl
2001 Origin and Evolution of the Great Lakes. *Journal of Great Lakes Research* 27(4):518-546.

Latour, Bruno
1993 *We Have Never Been Modern*. Harvard University Press, Cambridge, Massachusetts.

Loebel, Thomas J.
2013 Endscrapers, Use-Wear, and Early Paleoindians in Eastern North America. In *In the Eastern Fluted Point Tradition*, edited by Joseph A. M. Gingerich, pp. 218-258. University of Utah Press, Salt Lake City.

Lotz, Christian
2005 From Nature to Culture? Diogenes and Philosophical Anthropology. *Human Studies* 28(1):41-56.

MacDonald, George F.
1968 Debert: A Paleo-Indian Site in Central Nova Scotia*.* *National Museum of Canada Anthropological Papers* 16. Ottawa.

MacDonald, Robert I., Ronald F. Williamson, and Douglas Todd
2008 Reflections on Early Holocene Chert Use in the Niagara Peninsula. Paper presented at the 75th Annual Meeting of the Eastern States Archaeological Federation, Lockport, NY.

MacDonald, Robert I., Andrew Stewart, Peter Storck, Ronald F. Williamson, Andrea Carnevale, and Peter von Bitter
2017 Gainey/Clovis Land Use as Seen from the Mt. Albion West Site, Southern Ontario. Paper presented at the 50th Annual Meeting of the Canadian Archaeological Association, Gatineau, Quebec.

McAndrews, J. H.
1997 Pollen Analysis of a Sediment Core from a Bog Adjacent to the Fisher Site. In *The Fisher Site: Archaeological, Geological and Paleobotanical Studies at an Early Paleo-Indian Site in Southern Ontario, Canada*, compiled by Peter L. Storck, pp. 295-297. Memoir 30. The Museum of Anthropology, University of Michigan, and The Royal Ontario Museum, Ann Arbor and Toronto.

Meltzer, David J., Donald K. Grayson, Gerardo Ardila, Alex W. Barker, Dena F. Dincauze, C. Vance Haynes, Francisco Mena, Lautaro Núñez, and Dennis J. Stanford
1997 On the Pleistocene Antiquity of Monte Verde, Southern Chile. *American Antiquity* 62(4):659-663

Mills, Tammi
2009 A GIS Based Approach to the Spatial Analysis of the Fincastle Bison Kill Site (DlOx-5). Unpublished Masters thesis, Department of Geography, University of Lethbridge, Lethbridge, Alberta.

Ontario Trails
2016 Bruce Trail. Electronic document, http://www.ontariotrails.on.ca/trails/view/bruce-trail, accessed November 22, 2016.

Oron, Maya and Naama Goren-Inbar
2014 Mousterian intra-site spatial patterning at Quneitra, Golan Heights. *Quaternary International* 331:186-202.

O'Shea, John M., Ashley K. Lemke, and Robert G. Reynolds
2013 Nobody Knows the Way of the Caribou: Rangifer Hunting at 45° North Latitude. *Quaternary International* 297:36-44.

Pengelly, James and Keith Tinkler
2004 Lake Level Changes and Aboriginal Culture Manifestations in Areas Adjacent to and Including the Niagara Peninsula. In *The Late Palaeo-Indian Great Lakes, Geological and Archaeological Investigations of Late Pleistocene and Early Holocene Environments*, edited by Lawrence J. Jackson and Andrew Hinshelwood, pp. 201-224. Canadian Museum of Civilization, Archaeological Survey of Canada, Mercury Series Paper No. 165. Gatineau, Quebec.

Robinson, Brian S., Jennifer C. Ort, William A. Eldridge, Adrian L. Burke, and Bertrand G. Pelletier
2009 Paleoindian Aggregation and Social Context at Bull Brook. *American Antiquity* 73(3):423-447.

Roosa, William B. and D. Brian Deller
1982 The Parkhill Complex and Eastern Great Lakes Paleo Indian. *Ontario Archaeology* 37:3-15.

Ruth, Susan
2013 Women's toolkits: Engendering Paleoindian technological organization. PhD dissertation, Department of Anthropology, the University of New Mexico, Albuquerque, New Mexico. ProQuest (UMI 3601215).

Sayer, Duncan and Michelle Wienhold
2013 A GIS-Investigation of Four Early Anglo-Saxon Cemeteries: Ripley's K-function Analysis of Spatial Groupings Amongst Graves. *Social Science Computer Review* 31(1):71-89.

Seeman, Mark F.
1994 Intercluster Lithic Patterning at Nobles Pond: A Case for "Disembedded" Procurement among Early Paleoindian Societies. *American Antiquity* 59(2):273-288.

Seeman, Mark F., Thomas J. Loebel, Aaron Comstock, and Garry L. Summers
2013 Working with Wilmsen: Paleoindian End Scraper Design and Use at Nobles Pond. *American Antiquity* 78(3):407-432

Shott, Michael J.
1990 Stone Tools and Economics: Great Lakes Paleoindian Examples. In *Early Paleoindian Economies of Eastern North America Research in Economic Anthropology, Supplement 5.* Edited by K.B. Tankersley and B.L. Isaac, pp. 3-34. JAI Press, Greenwich, Connecticut.

Simons, Donald B., Michael J. Shott, and Henry T. Wright
1984 The Gainey Site: Variability in a Great Lakes Paleo-Indian Assemblage. *Archaeology of Eastern North America* 12:266-279.

Spagnolo, Vincenzo, Giulia Marciani, Daniele Aureli, Francesco Berna, Paolo Boscato, Filomena Ranaldo, Annamaria Ronchitelli
2016 Between hearths and volcanic ash: The SU 13 palimpsest of the Oscurusciuto rock shelter (Ginosa – Southern Italy): Analytical and interpretive questions. *Quaternary International* 417:105-121.

Speth, John D., K. Newlander, Andrew A. White, Ashley K. Lemke, and Lars E. Anderson
2013 Early Paleoindian Big-Game Hunting in North America: Provisioning or Politics? *Quaternary International* 285:111-139.

Spiess, Arthur E.
1984 Arctic Garbage and New England Paleo-Indians: The Single Occupation Option. *Archaeology of Eastern North America* 12:280-285.

Spiess, Arthur E., Debra Wilson, and James Bradley
1998 Paleoindian Occupation in the New England-Maritimes Region: Beyond Cultural Ecology. *Archaeology of Eastern North America* 26:201-263.

Stanford, Dennis J.
1978 The Jones-Miller Site: An Example of Hell Gap Bison Procurement Strategy. In *Bison Procurement and Utilization: A Symposium,* edited by L.B. Davis and M. Wilson, pp.90-97. Plains Anthropologist Memoir No. 14.

Storck, Peter L.
1982 Paleo-Indian Settlement Patterns Associated with the Strandine of Glacial Lake Algonquin in Southcentral Ontario. *Canadian Journal of Archaeology* 6:1-31.
1984 Research Into the Paleo-Indian Occupation of Ontario: A Review. *Ontario Archaeology* 41:3-28.
1990 Imperialists without a State: The Cultural Dynamics of Early Paleoindian Colonization As Seen from the Great Lakes Region. In *Clovis: Origins and Adaptations*, edited by R. Bonnichsen and K. Turnmire, pp. 153-162. Peopling of the Americas Publications, Center for the Study of the First Americans, Oregon State University, Corvallis.
1997 *The Fisher Site: Archaeological, Geological and Paleobotanical Studies at an Early Paleo-Indian Site in Southern Ontario.* Memoirs Series No. 30, Museum of Anthropology, University of Michigan, Ann Arbor.
2004 *Journey to the Ice Age: Discovering an Ancient World*. UBC Press, Vancouver.

Storck, Peter L. and Arthur E. Spiess
1994 The Significance of New Faunal Identifications Attributed to an Early Paleoindian (Gainey Complex) Occupation at the Udora Site, Ontario, Canada. *American Antiquity* 59(1):121-142.

Tankersley, Kenneth B.
1998 Variation in the Early Paleoindian Economies of Late Pleistocene Eastern North America. *American Antiquity* 63(1):7-20.

Thacher, Dana, S. Brooke Milne, and Robert Park
2017 Applying GIS and statistical analysis to assess the correlation of human behaviour and ephemeral architectural features among Palaeo-Eskimo sites on Southern Baffin Island, Nunavut. *Journal of Archaeological Science: Reports* 14:21-30.

Thomas, Julian
2001 Archaeologies of Place and Landscape. In *Archaeological Theory Today*, edited by Ian Hodder, pp.165-186. Polity Press, Cambridge, UK.

Tilley, Christopher
1994 *A Phenomenology of Landscape: Places, Paths, and Monuments*. Berg Publishers, Oxford, UK.
2004 *The Materiality of Stone. Vol. 1, Explorations in Landscape Phenomenology*. Berg, Oxford, UK.

Tinkler, Keith J., James W. Pengelly, William Parkins, and Jaan Terasmae
1992 Evidence for High Water Levels in the Erie Basin During the Younger Dryas Chronozone. *Journal of Paleolimnology* 7:215-234.

Toronto and Region Conservation Authority
2016 Historic Sight Seeing. Electronic document, https://trca.ca/activities/historic-sight-seeing/, accessed November 26, 2016.

Werdelin, Lars and Margaret E. Lewis
2013 Temporal Change in Functional Richness and Evenness in the Eastern African Plio-Pleistocene Carnivoran Guild. *PLoS ONE* 8(3):1-11.

Wilmsen, Edwin N.
1965 An Outline of Early Man Studies in the United States. *American Antiquity* 31(2):172-192.

Winter-Livneh, Rona, Tal Svoray, and Isaac Gilead
2010 Settlement patterns, social complexity and agricultural strategies during the Chalcolithic period in the Northern Negev, Israel. *Journal of Archaeological Science* 37(2010):284-294.

Wormington, H.M.
1957 *Ancient Man in North America*. 3rd ed. Denver Museum of Natural History, Denver, Colorado.

Appendices
Appendix A - Tables

Table A.1

Raw Materials by Artifact Concentration Area						
	Area A	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Onondaga	19 (35.8%)	92 (55.8%)	7 (43.8%)	8 (44.4%)	16 (32.0%)	**142 (47.0%)**
Fossil Hill	19 (35.8%)	39 (23.6%)	7 (43.8%)	9 (50.0%)	6 (12.0%)	**80 (26.5%)**
Lockport	4 (7.5%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**5 (1.7%)**
Unidentified	11 (20.8%)	32 (19.4%)	2 (12.5%)	1 (5.6%)	24 (48.0%)	**70 (23.2%)**
Unknown	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	4 (8.0%)	**5 (1.6%)**

Table A.2

Bifacial Tools & End Scrapers (Highly Curated)					
	Area A	**Area B**	**Area C**	**Area D**	**Total**
Onondaga	12 (57.1%)	39 (60.9%)	3 (75.0%)	6 (66.7%)	**60 (61.2%)**
Fossil Hill	2 (9.5%)	10 (15.6%)	1 (25.0%)	3 (33.3%)	**16 (16.3%)**
Lockport	3 (14.3%)	1 (1.6%)	0 (0.0%)	0 (0.0%)	**4 (4.1%)**
Unidentified	4 (19.1%)	14 (21.9%)	0 (0.0%)	0 (0.0%)	**18 (18.4%0**
TOTAL	**21 (100.0%)**	**64 (100.0%)**	**4 (100.0%)**	**9 (100.0%)**	**98 (100.0%)**

Table A.3

Unifacial Tools (w/o End Scrapers) & Expedient Tools					
	Area A	**Area B**	**Area C**	**Area D**	**Total**
Onondaga	6 (19.4%)	37 (51.4%)	4 (33.3%)	2 (22.2%)	**49 (39.5%)**
Fossil Hill	17 (54.8%)	29 (40.3%)	6 (50.0%)	6 (66.6%)	**58 (46.8%)**
Lockport	1 (3.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.8%)**
Unidentified	7 (22.6%)	6 (8.3%)	2 (16.7%)	1 (11.1%)	**16 (12.9%)**
TOTAL	**31 (100.0%)**	**72 (100.0%)**	**12 (100.0%)**	**9 (100.0%)**	**124 (100.0%)**

Table A.4

Total Tool Class Frequency by Area	
Area	**Frequency**
Area A	10
Area B	11
Area C	6
Area D	7

Table A.5

Projectile Points & Fragments	
Section	**Frequency**
Gainey-Type	
Complete	1 (8.3%)
Base (complete)	2 (16.7%)
Base (incomplete)	1 (8.3%)
Unidentified Fluted PP	
Complete	0 (0.0%)
Mid-Section & Base (complete)	2 (16.7%)
Mid-Section & Base (incomplete)	1 (8.3%)
Longitudinally Broken Mid-Section	1 (8.3%)
Base (Medial Fragment)	1 (8.3%)
Ears (with adjoining base frag.)	3 (25.0%)
TOTAL	**12 (100.0%)**

Table A.6

Bifacially Worked Preform Stage of Manufacture by Raw Material					
Stage	**Onondaga**	**Fossil Hill**	**Lockport**	**Unidentified**	**Total**
I	1 (14.3%)	0 (0.0%)	1 (14.3%)	5 (71.4%)	**7 (100.0%)**
I/II	3 (75.0%)	1 (25.0%)	0 (0.0%)	0 (0.0%)	**4 (100.0%)**
II	0 (0.0%)	0 (0.0%)	1 (33.3%)	2 (66.7%)	**3 (100.0%)**
II/III	0 (0.0%)	2 (100.0%)	0 (0.0%)	0 (0.0%)	**2 (100.0%)**
III	5 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**5 (100.0%)**
III/IV	2 (50.0%)	1 (25.0%)	0 (0.0%)	1 (25.0%)	**4 (100.0%)**
IV	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**3 (100.0%)**
TOTAL	**14 (50.0%)**	**4 (14.3%)**	**2 (7.1%)**	**8 (28.6%)**	**28 (100.0%)**

Table A.7

Wedge Fragments	
Trait	**Frequency**
V-Shaped at Both Ends	4 (80.0%)
V-Shaped at One End	1 (20.0%)
TOTAL	**5 (100.0%)**
Longitudinally Split	2 (40.0%)
Intact	3 (60.0%)
TOTAL	**5 (100.0%)**

Table A.8

Unidentified Bifacially Worked Artifact Fragments	
Section	**Frequency**
Proximal/Distal	2 (7.7%)
Mid-Section	4 (15.4%)
Edge	20 (76.9%)
TOTAL	**26 (100.0%)**

Table A.9

End Scrapers Types	
Type	**Frequency**
Simple end scrapers	17 (28.8%)
Simple end-scraper w/ stem-like haft element	1 (1.7%)
Notched end scrapers	14 (23.7%)
Spurred end scrapers	10 (16.9%)
Micro end scraper, notched	1 (1.7%)
Unclassified end scraper fragments	16 (27.1%)
TOTAL	**59 (100.0%)**

Table A.10

Simple End Scrapers Fragments	
Section	**Frequency**
Complete	11 (64.7%)
Mid-Section	1 (5.9%)
Distal	4 (23.5%)
Longitudinal Split	1 (5.9%)
TOTAL	**17 (100%)**

Table A.11

Complete Simple End Scraper Forms	
	Frequency
Ovoid	1 (9.0%)
Rectanguloid	5 (45.5%)
Trianguloid	5 (45.5%)
TOTAL	**11 (100.0%)**

Table A.12

Notched End Scraper Fragments	
Section	**Frequency**
Complete	7 (50.0%)
Proximal	5 (35.7%)
Distal	2 (14.3%)
TOTAL	**14 (100.0%)**

Table A.13

Notched End Scraper - Notch Number	
# of Notches	**Frequency**
Single	12 (85.7%)
Double	2 (14.3%)
TOTAL	**14 (100.0%)**

Table A.14

Spurred End Scraper - Spur/Notch Number	
# of Spurs/Notches	**Frequency**
Single spur	4 (40.0%)
Single spur w/ single notch	2 (20.0%)
Double spur	1 (10.0%)
Number of spurs indeterminate	3 (30.0%)
TOTAL	**10 (100.0%)**

Table A.15

Unclassified End Scraper Fragments	
Section	**Frequency**
Distal	6 (37.5%)
Proximal	2 (12.5%)
Heat spalled	1 (6.3%)
Longitudinally broken	3 (18.7%)
Possible simple end scrapers	2 (12.5%)
Possible single notched end scrapers	2 (12.5%)
TOTAL	**16 (100.0%)**

Table A.16

Side Scrapers	
	Frequency
Complete	3 (42.9%)
Incomplete	4 (57.1%)
Total	**7 (100.0%)**

Table A.17

Distal Bit Fragments	
	Frequency
Rounded Tips	3 (42.9%)
Pointed Tips	3 (42.9%)
Mid-Section	1 (14.2%)
Total	**7 (100.0%)**

Table A.18

Flake Gravers	
# of Spurs	**Frequency**
Complete Tools	
Single spur	2 (16.7%)
Broken Tools	
1(+) spurs	6 (50.0%)
2(+) spurs	2 (16.7%)
3(+) spurs	1 (8.3%)
5(+) spurs	1 (8.3%)
Total	12 (100.0%)

Table A.19

Inter-Area Debitage Raw Material Distribution						
Material	**Area A**	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Onondaga	1692 (18.7%)	4077 (45.1%)	1049 (11.6%)	1350 (14.9%)	880 (9.7%)	**9048 (100.0%)**
Fossil Hill	72 (9.6%)	418 (55.9%)	80 (10.7%)	121 (16.2%)	57 (7.6%)	**748 (100.0%)**
Lockport	14 (17.5%)	28 (35.0%)	5 (6.3%)	6 (7.5%)	27 (33.7%)	**80 (100.0%)**
Fossil Hill/Reynales	6 (21.4%)	17 (60.7%)	2 (7.1%)	2 (7.1%)	1 (3.6%)	**28 (100.0%)**
Trent Valley	3 (20.0%)	11 (73.3%)	0 (0.0%)	1 (6.7%)	0 (0.0%)	**15 (100.0%)**
Upper Mercer	0 (0.0%)	2 (50.0%)	2 (50.0%)	0 (0.0%)	0 (0.0%)	**4 (100.0%)**
Kettle Point	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**2 (100.0%)**
Reynales	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	**2 (100.0%)**
Selkirk	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (100.0%)**
Unidentified	0 (0.0%)	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**2 (100.0%)**
TOTAL	**1790 (18.1%)**	**4539 (45.8%)**	**1141 (11.5%)**	**1479 (14.9%)**	**970 (9.8%)**	**9930 (100.0%)**

Table A.20

Intra-Area Tool Form Distribution						
Tool	**Area A**	**Area B**	**Area C**	**Area D**	**Other**	**Total**
Bifacially Worked Preforms	5 (9.4%)	15 (9.1%)	2 (12.5%)	1 (5.6%)	4 (8.0%)	**27 (8.9%)**
Projectile Points/Fragments	3 (5.7%)	5 (3.0%)	2 (12.5%)	2 (11.1%)	0 (0.0%)	**12 (4.0%)**
Gainey-Type	0 (0.0%)	4 (2.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**4 (1.3%)**
Unidentified Fluted PP	3 (5.7%)	1 (0.6%)	2 (12.5%)	2 (11.1%)	0 (0.0%)	**8 (2.6%)**
Drills	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
Wedges	2 (3.8%)	3 (1.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**5 (1.7%)**
Unidentified Bifacially Worked Artifact Fragm	2 (3.8%)	20 (12.1%)	0 (0.0%)	1 (5.6%)	3 (6.0%)	**26 (8.6%)**
End-Scrapers	9 (17.0%)	34 (20.6%)	0 (0.0%)	5 (27.8%)	11 (22.0%)	**59 (19.5%)**
Simple End Scrapers	2 (3.8%)	8 (4.9%)	0 (0.0%)	3 (16.7%)	4 (8.0%)	**17 (5.6%)**
Simple End Scraper w/ Stem-like Haft Element	1 (1.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
Notched End Scrapers	2 (3.8%)	8 (4.9%)	0 (0.0%)	1 (5.6%)	3 (6.0%)	**14 (4.6%)**
Spurred End Scrapers	2 (3.8%)	6 (3.6%)	0 (0.0%)	0 (0.0%)	2 (4.0%)	**10 (3.3%)**
Micro End Scraper, notched	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.0%)	**1 (0.3%)**
Unclassified End Scraper Fragments	2 (3.8%)	12 (7.3%)	0 (0.0%)	1 (5.6%)	1 (2.0%)	**16 (5.3%)**
Side Scrapers	2 (3.8%)	3 (1.8%)	2 (12.5%)	0 (0.0%)	0 (0.0%)	**7 (2.3%)**
Denticulated Scraper Fragment	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.0%)	**1 (0.3%)**
Beaked Scrapers	1 (1.9%)	4 (2.4%)	0 (0.0%)	0 (0.0%)	2 (4.0%)	**7 (2.3%)**
Flake Gravers	5 (9.4%)	3 (1.8%)	1 (6.3%)	1 (5.6%)	2 (4.0%)	**12 (4.0%)**
Combination Tools	1 (1.9%)	1 (0.6%)	2 (12.5%)	1 (5.6%)	1 (2.0%)	**6 (2.0%)**
Fragments of Unidentified Scrapers	3 (5.7%)	2 (1.2%)	0 (0.0%)	1 (5.6%)	1 (2.0%)	**7 (2.3%)**
Fragments of Unidentified Unifacially Worked	9 (17.0%)	53 (32.1%)	5 (31.2%)	2 (11.1%)	17 (34.0%)	**86 (28.5%)**
Notched Flakes	4 (7.5%)	4 (2.4%)	0 (0.0%)	2 (11.1%)	1 (2.0%)	**11 (3.6%)**
Utilized Flakes	7 (13.2%)	15 (9.1%)	2 (12.5%)	2 (11.1%)	7 (14.0%)	**33 (10.9%)**
Possible Paleoindian Tools						
Miniature Projectile Point	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
Recycled Projectile Point Fragment w/ Spur	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.3%)**
TOTAL	**53 (100.0%)**	**165 (100.0%)**	**16 (100.0%)**	**18 (100.0%)**	**50 (100.0%)**	**302 (100.0%)**

Appendix B – Ripley's K Function Graphs

Figure B.1. Total Tools

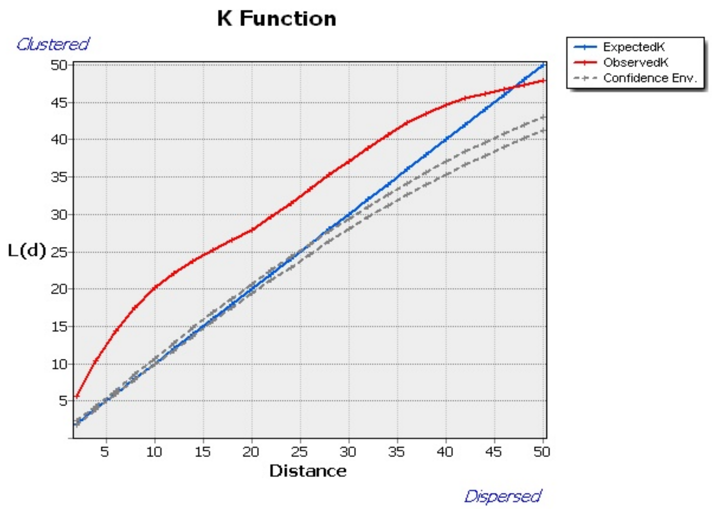


Figure B.2. Total Onondaga Tools

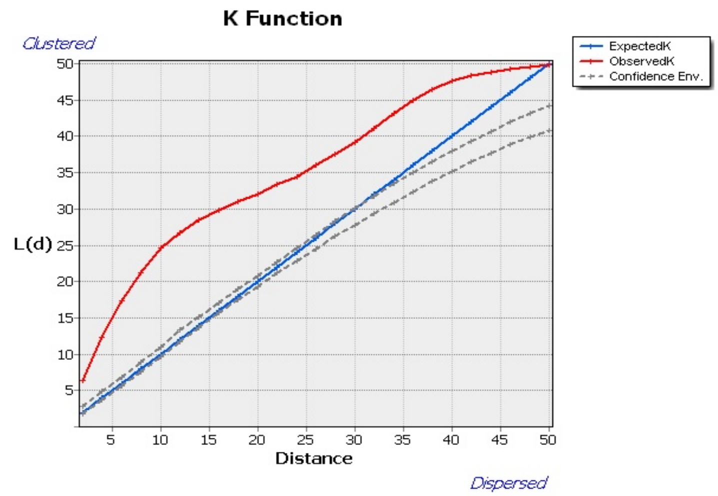


Figure B.3. Total Fossil Hill Tools

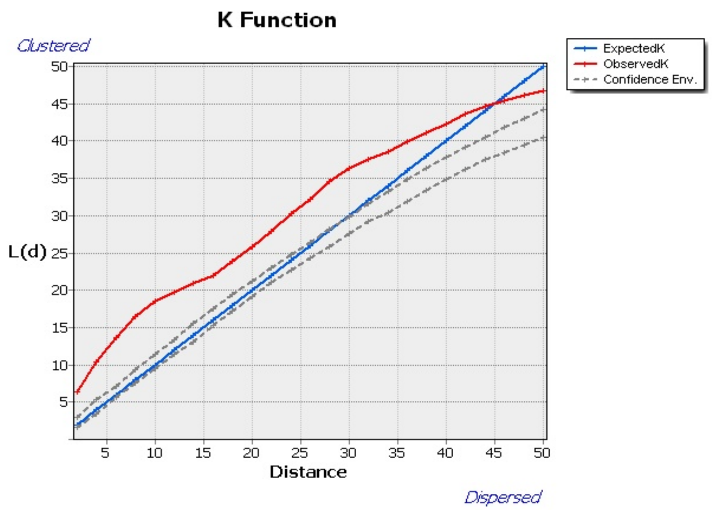


Figure B.4. Total Tools – Area A

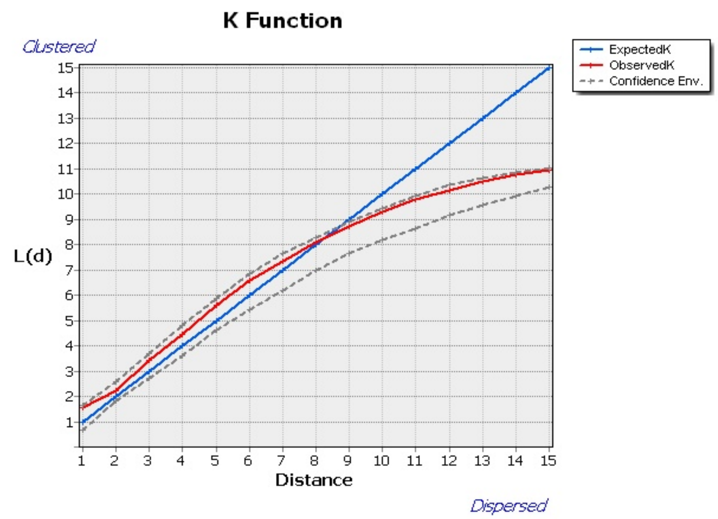


Figure B.5. Total Onondaga Tools – Area A

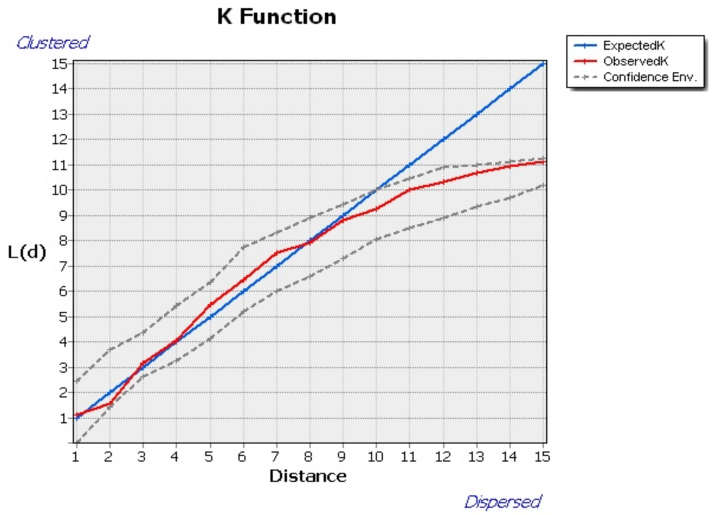


Figure B.6. Total Fossil Hill Tools – Area A

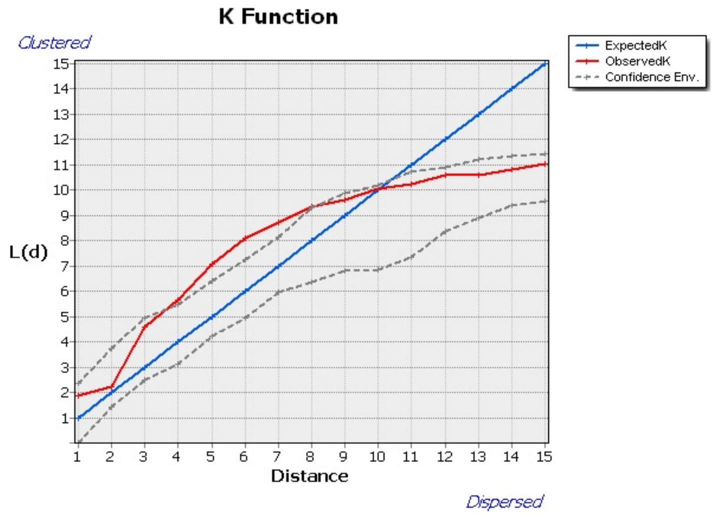


Figure B.7. Onondaga End Scrapers – Area A

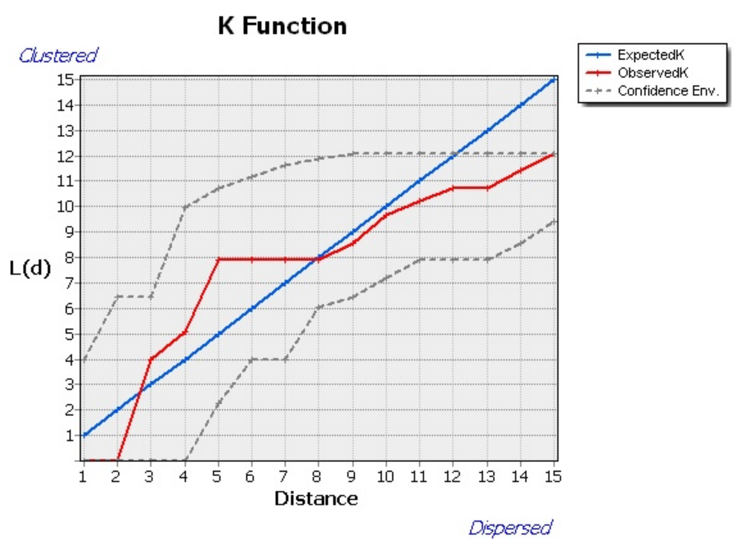


Figure B.8. Total Tools – Area B

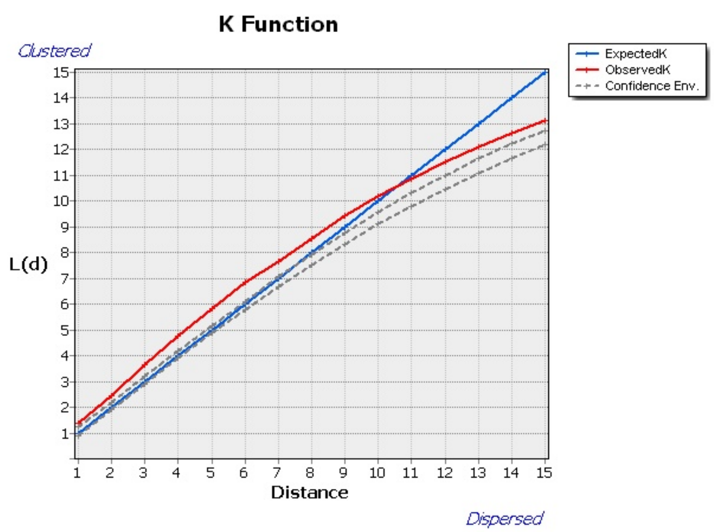


Figure B.9. Total Onondaga Tools – Area B

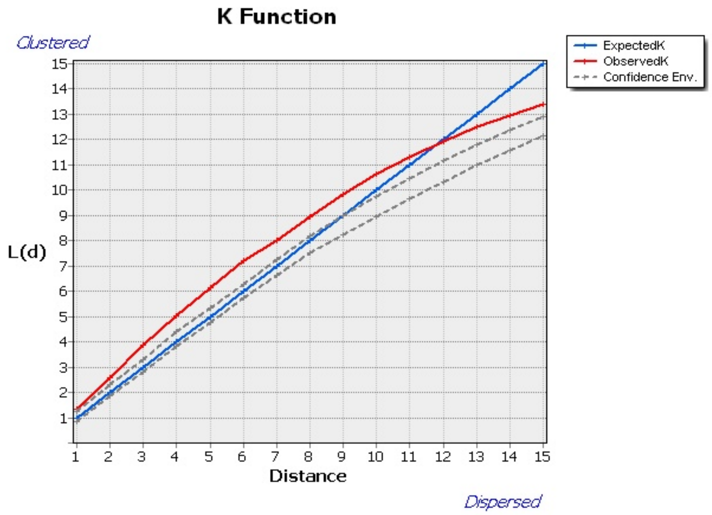


Figure B.10. Total Fossil Hill Tools – Area B

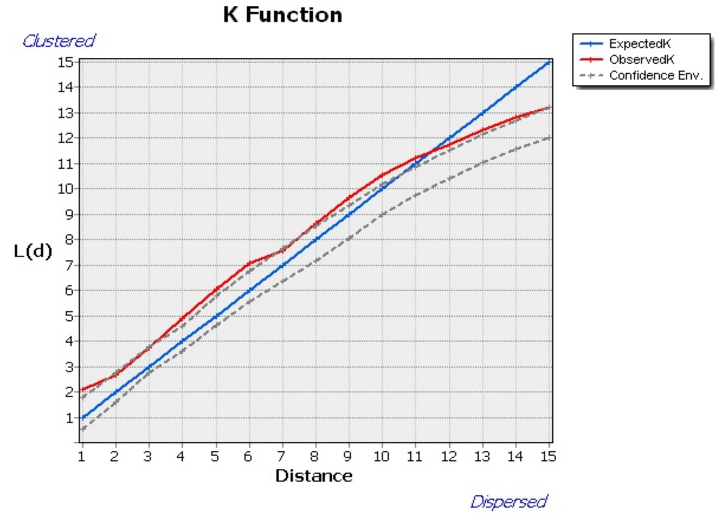


Figure B.11. Onondaga Fluted Points – Area B

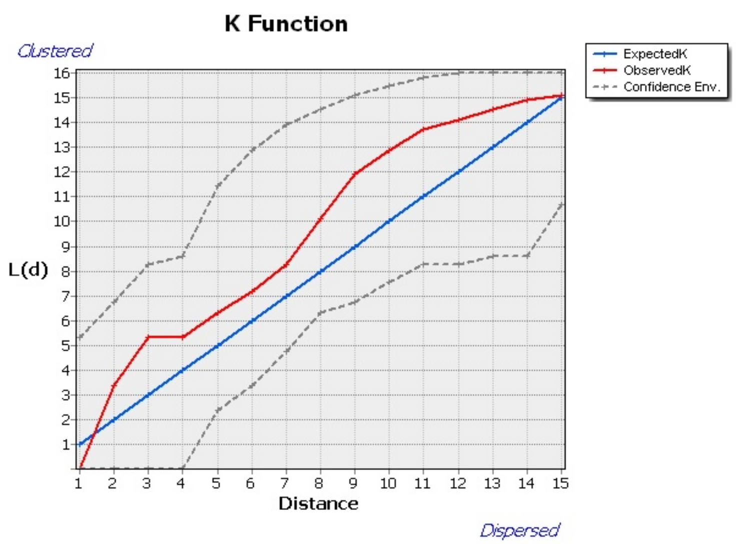


Figure B.12. Onondaga End Scrapers – Area B

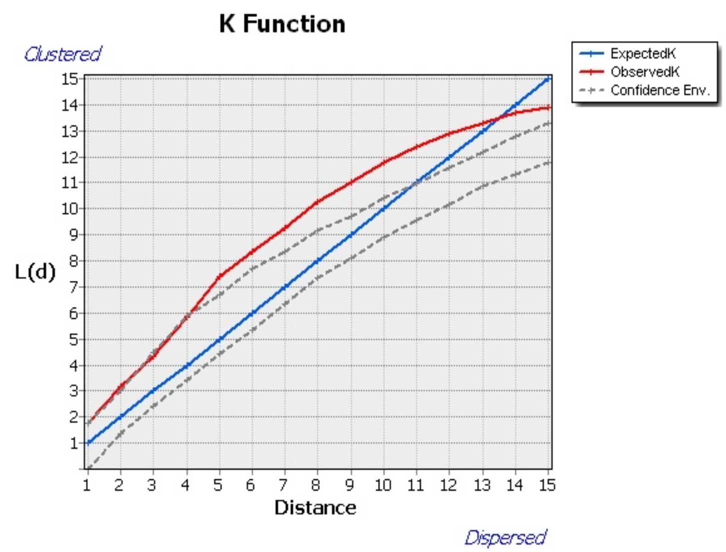


Figure B.13. Fossil Hill End Scrapers – Area B

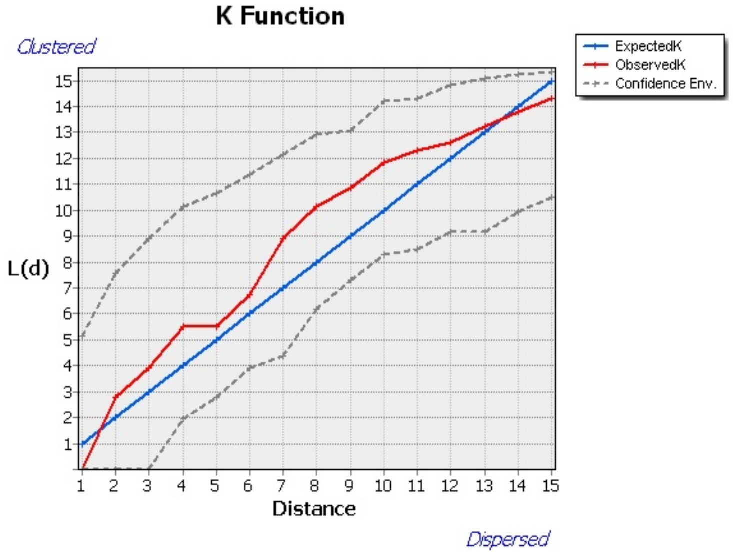


Figure B.14. Onondaga Channel Flakes – Area B

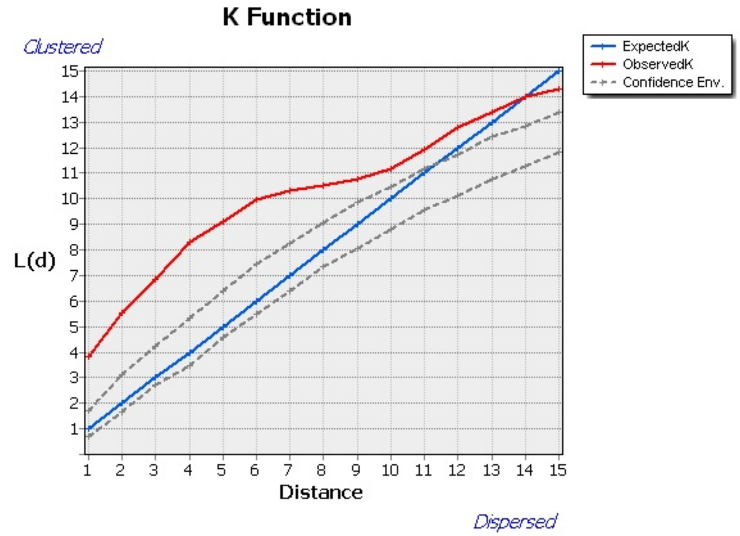


Figure B.15. Fossil Hill Channel Flakes – Area B

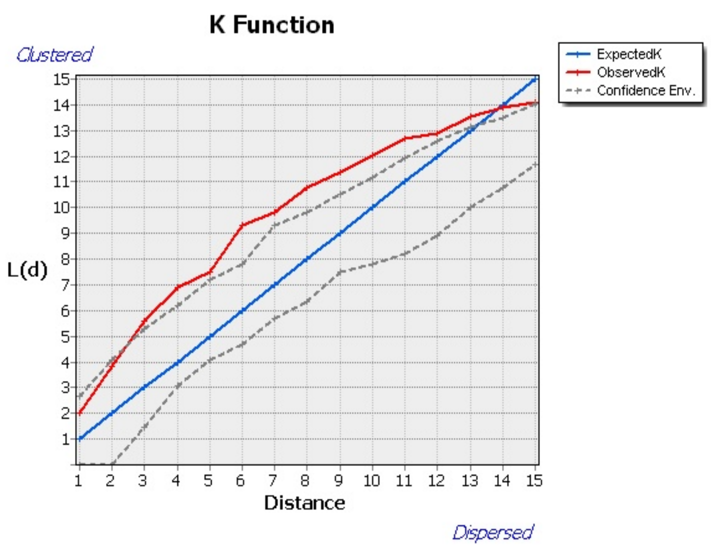


Figure B.16. Total Tools – Area C

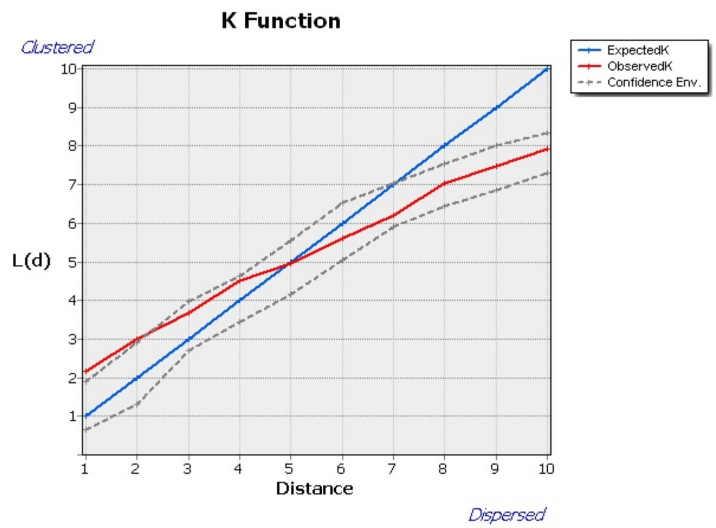


Figure B.17. Total Onondaga Tools – Area C

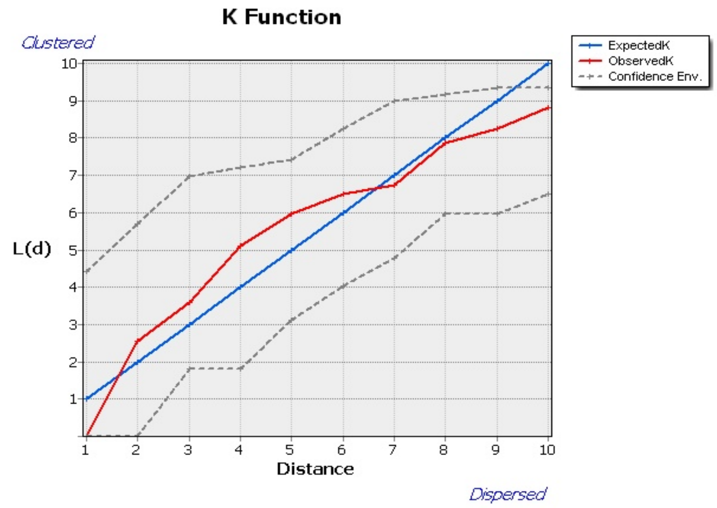


Figure B.18. Total Fossil Hill Tools – Area C

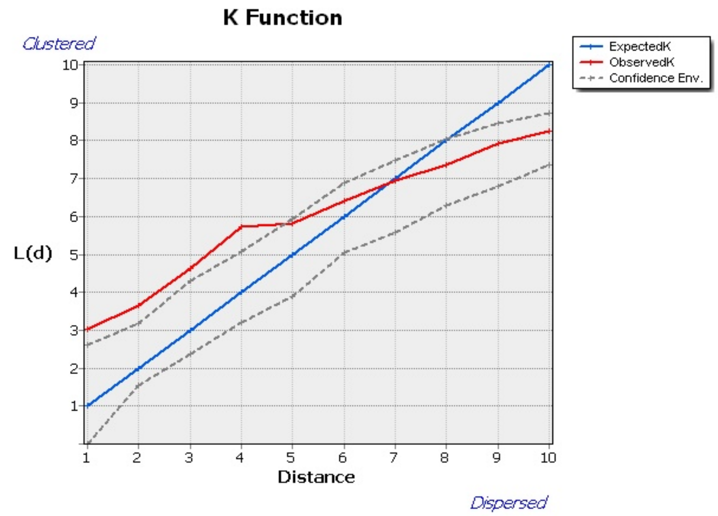


Figure B.19. Total Tools – Area D

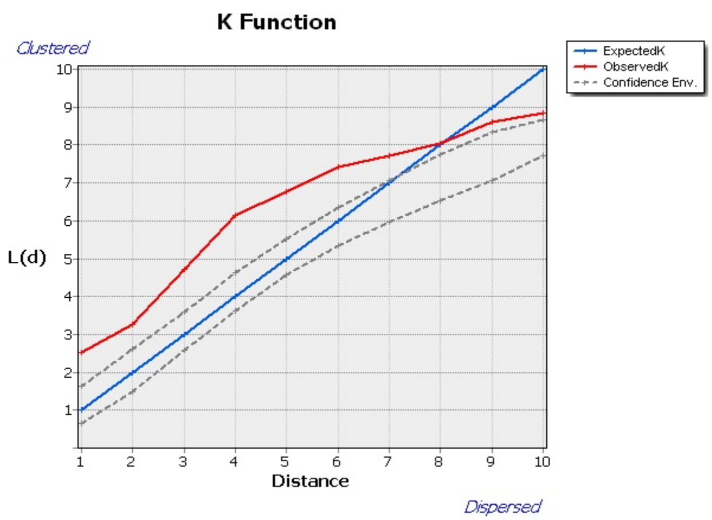


Figure B.20. Total Onondaga Tools – Area D

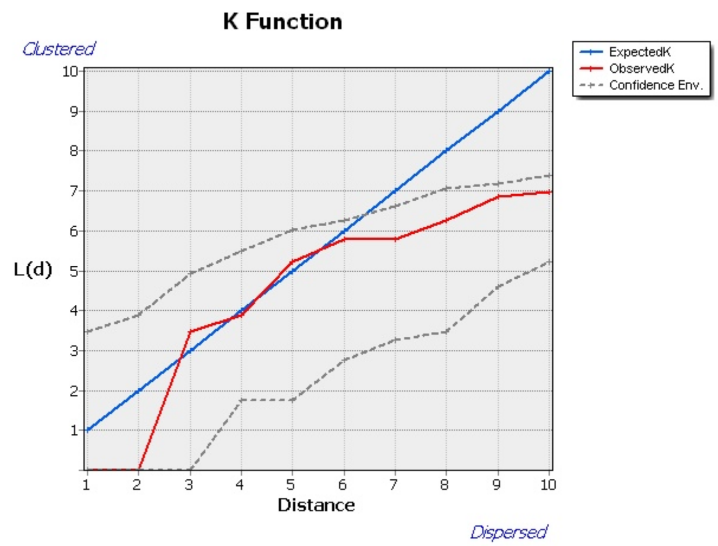
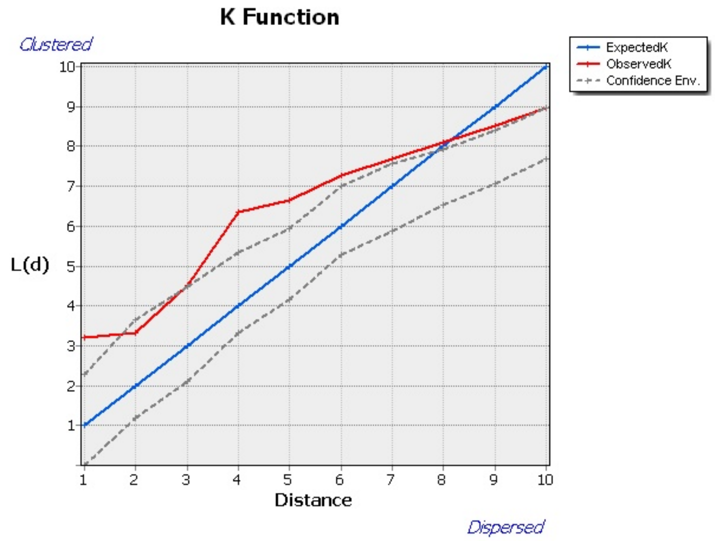


Figure B.21. Total Fossil Hill Tools – Area D



Appendix C – Kernel Density Estimate & ArcGIS Tool Distribution Maps

Figure C.1. Total Unit Counts

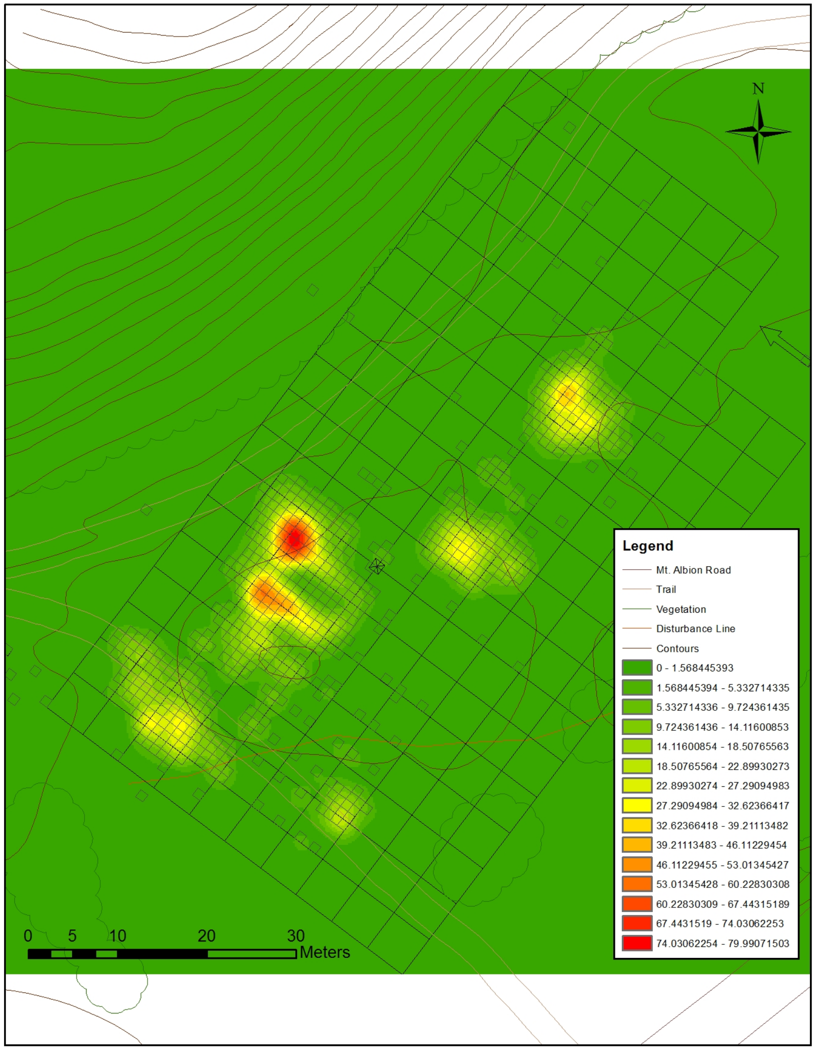


Figure C.2. Total Onondaga Unit Counts

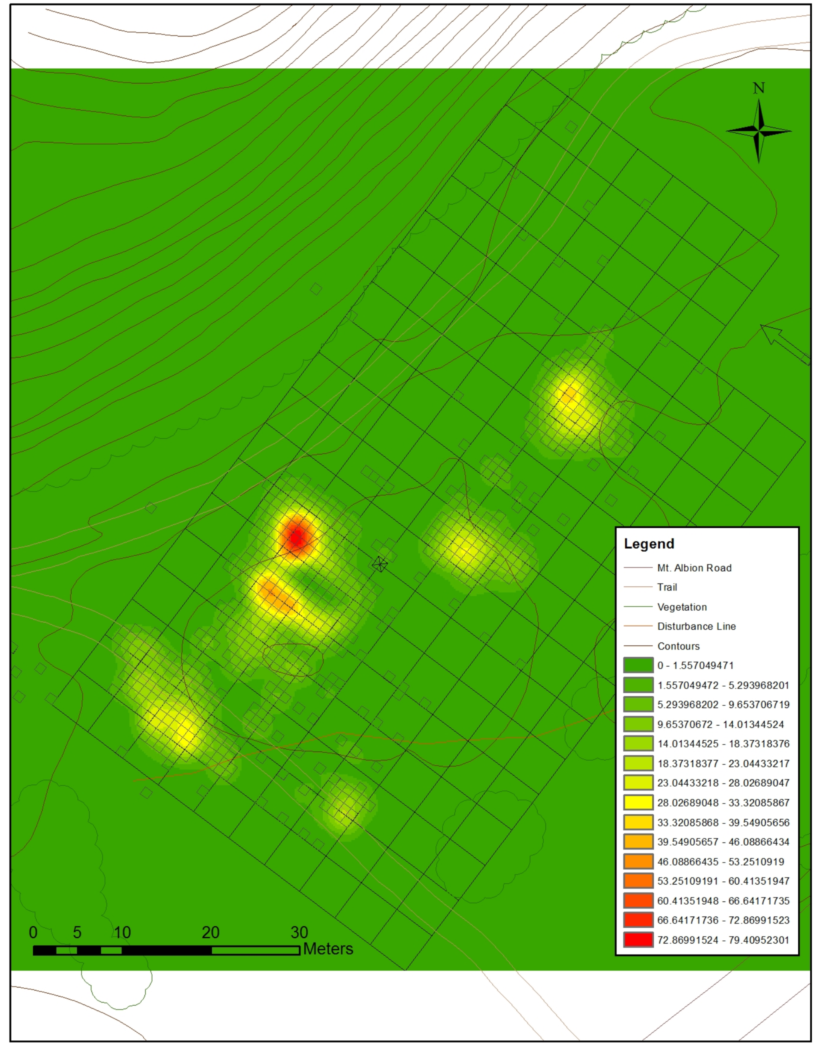


Figure C.3. Total Fossil Hill Unit Count

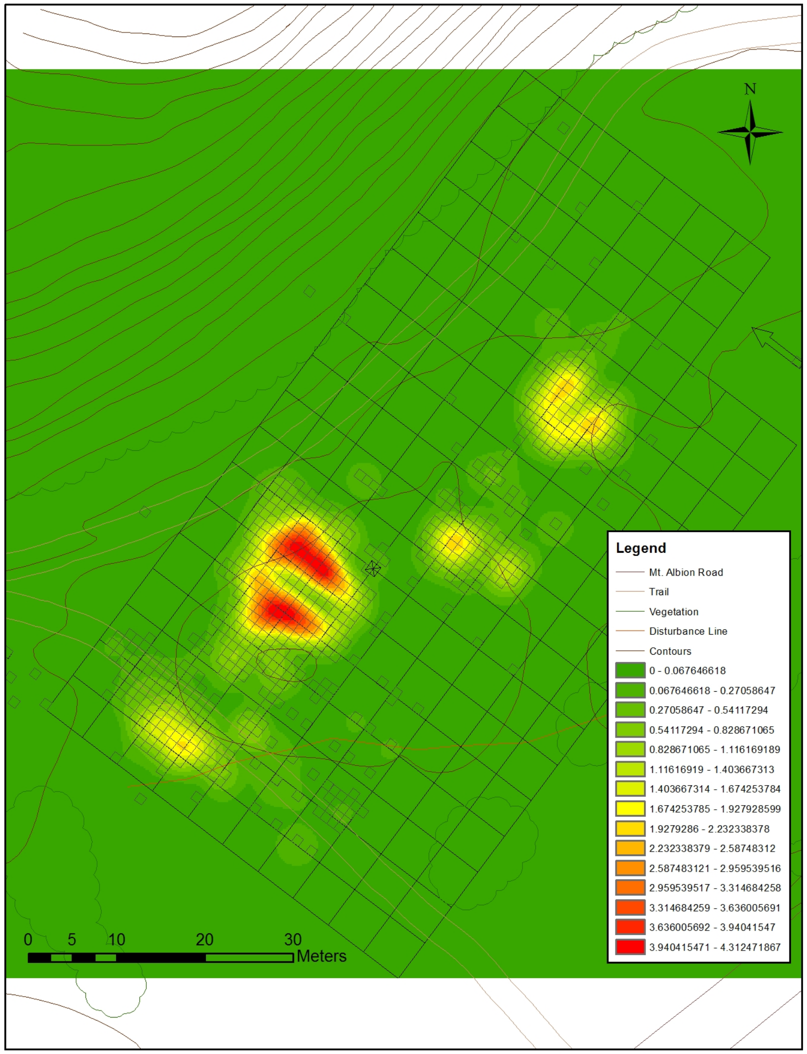


Figure C.4. Early Stage Debitage

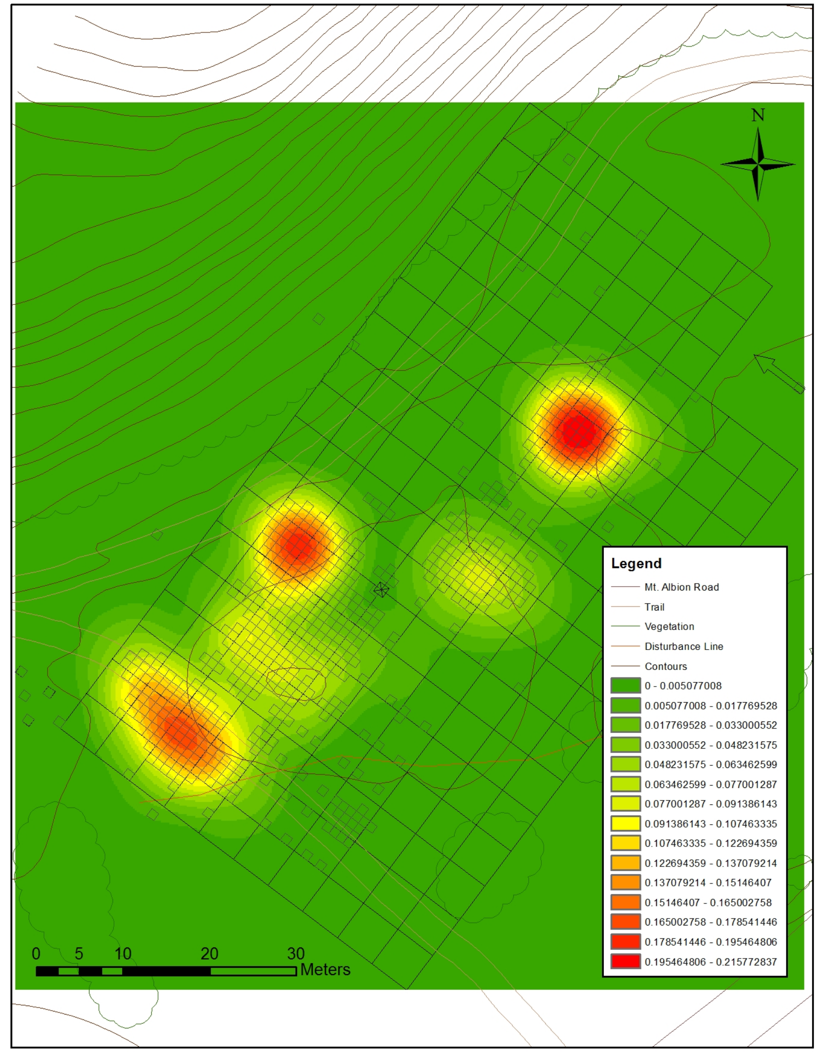


Figure C.5. Middle Stage Debitage

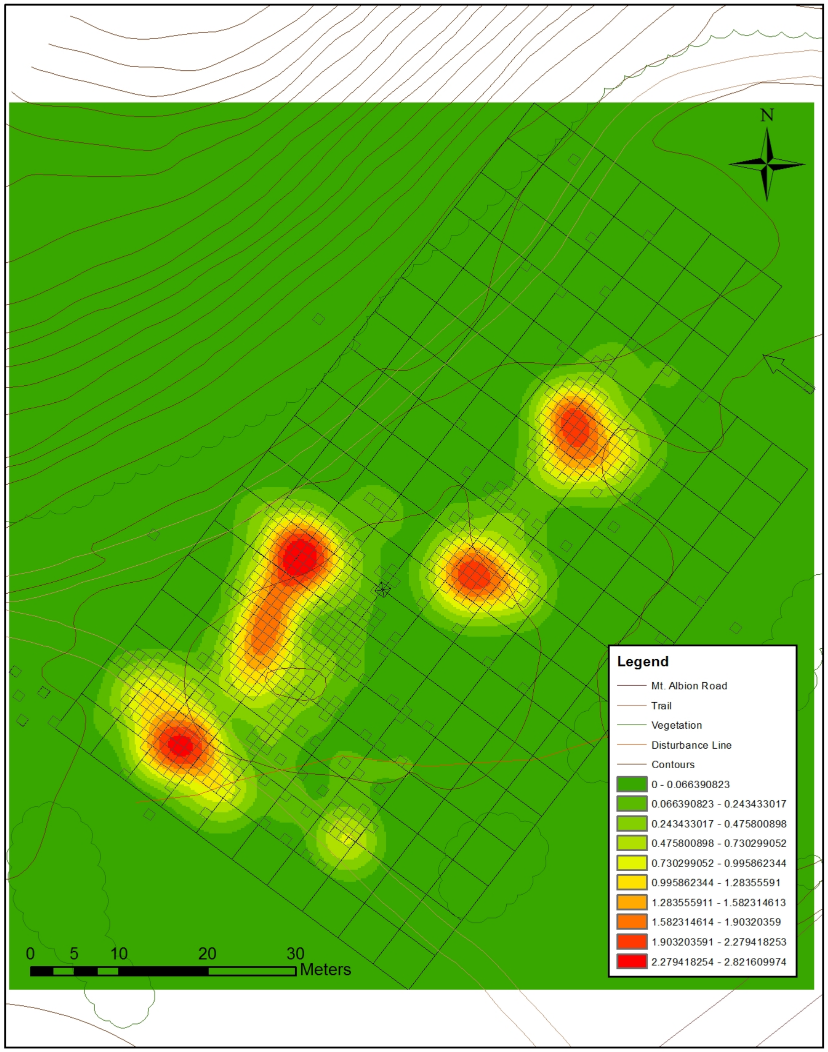


Figure C.6. Late Stage Debitage

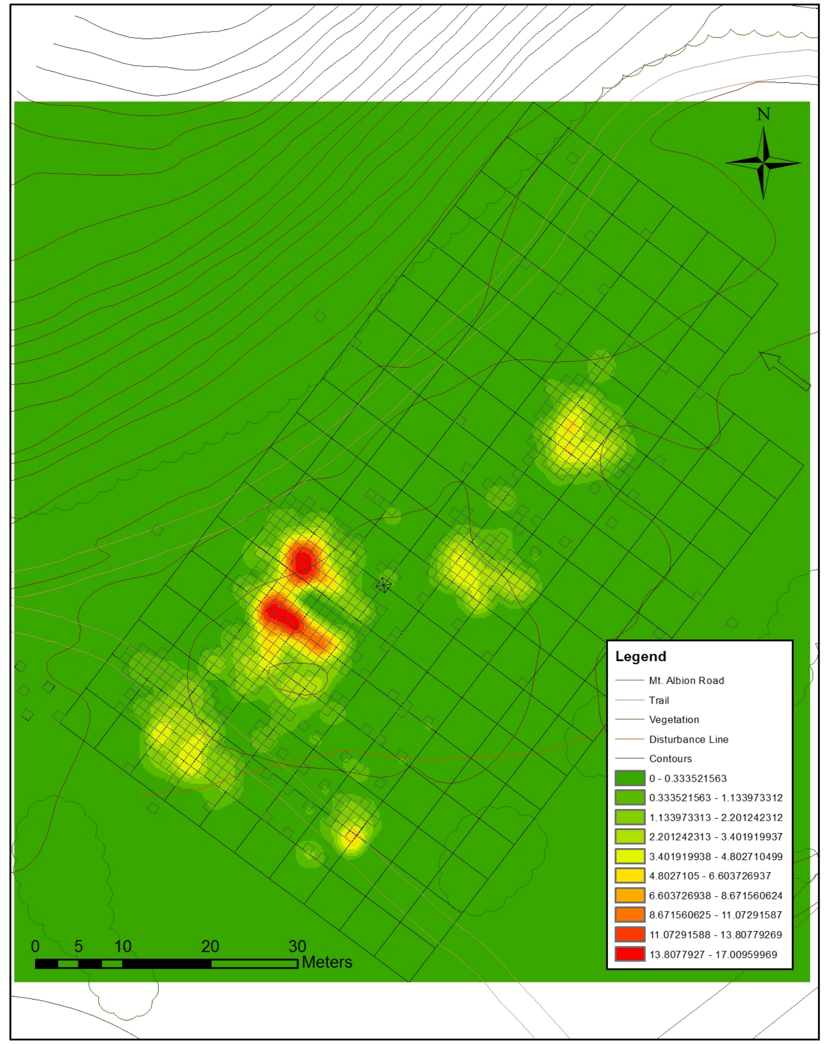


Figure C.7. Onondaga Channel Flakes

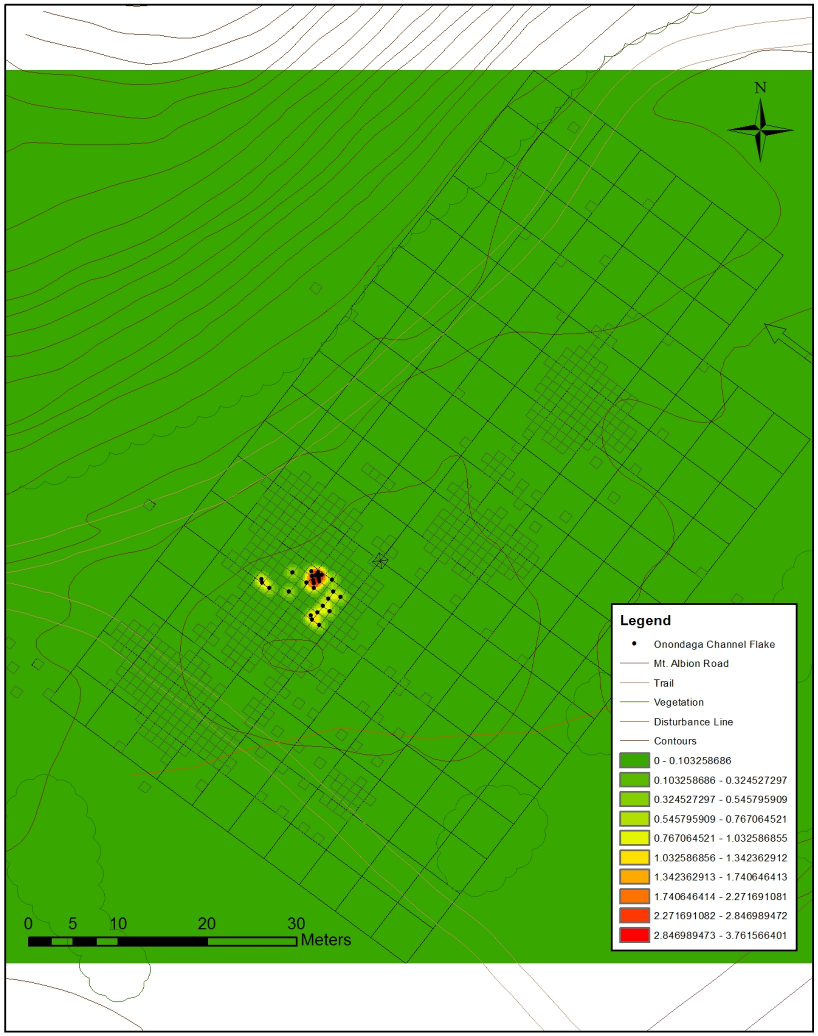


Figure C.8. Fossil Hill Channel Flakes

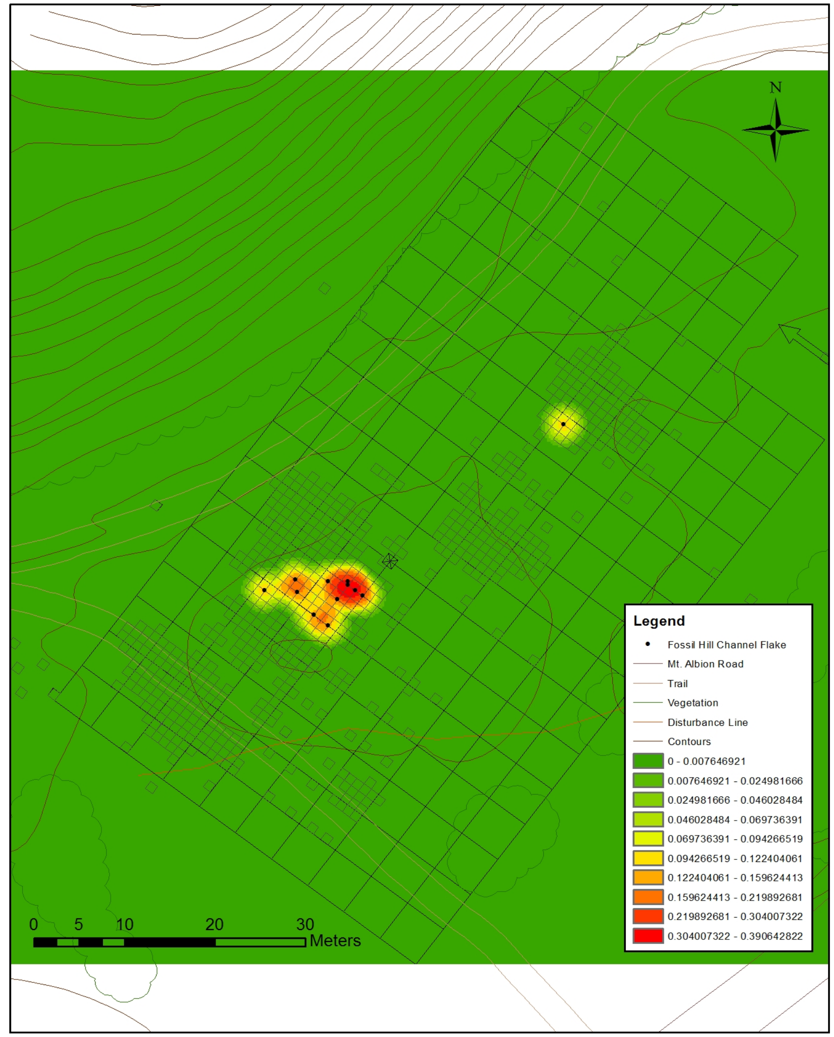


Figure C.9. Category I Preforms

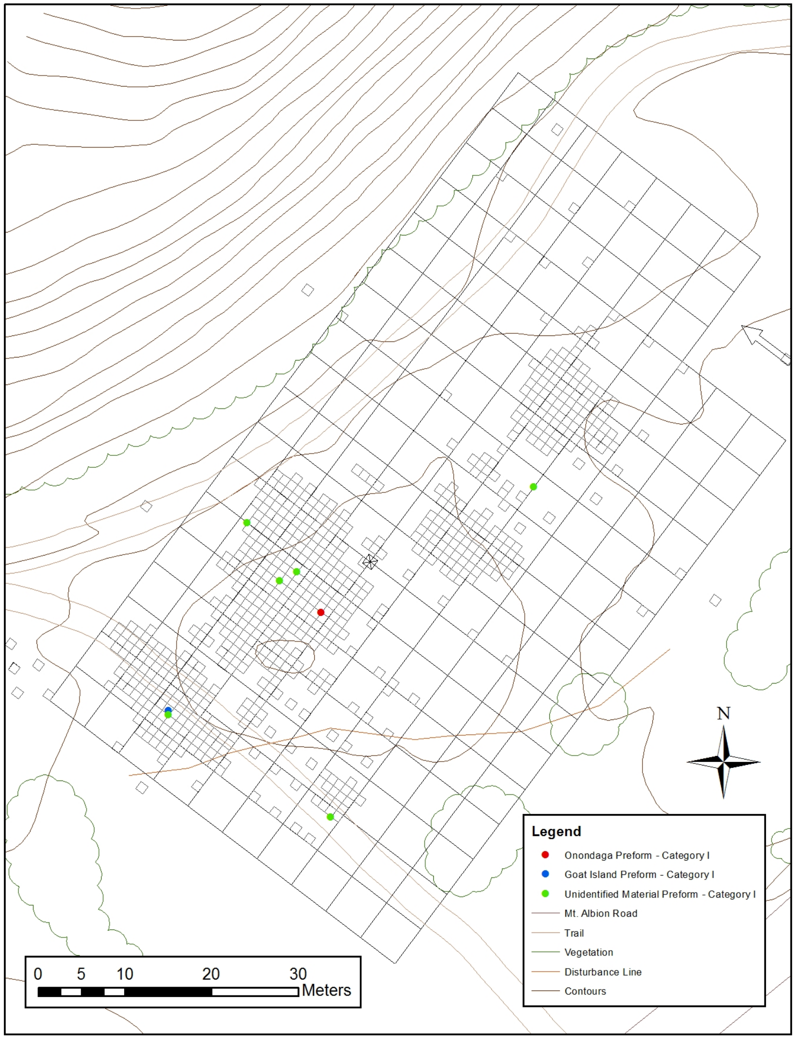


Figure C.10. Category I/II Preforms

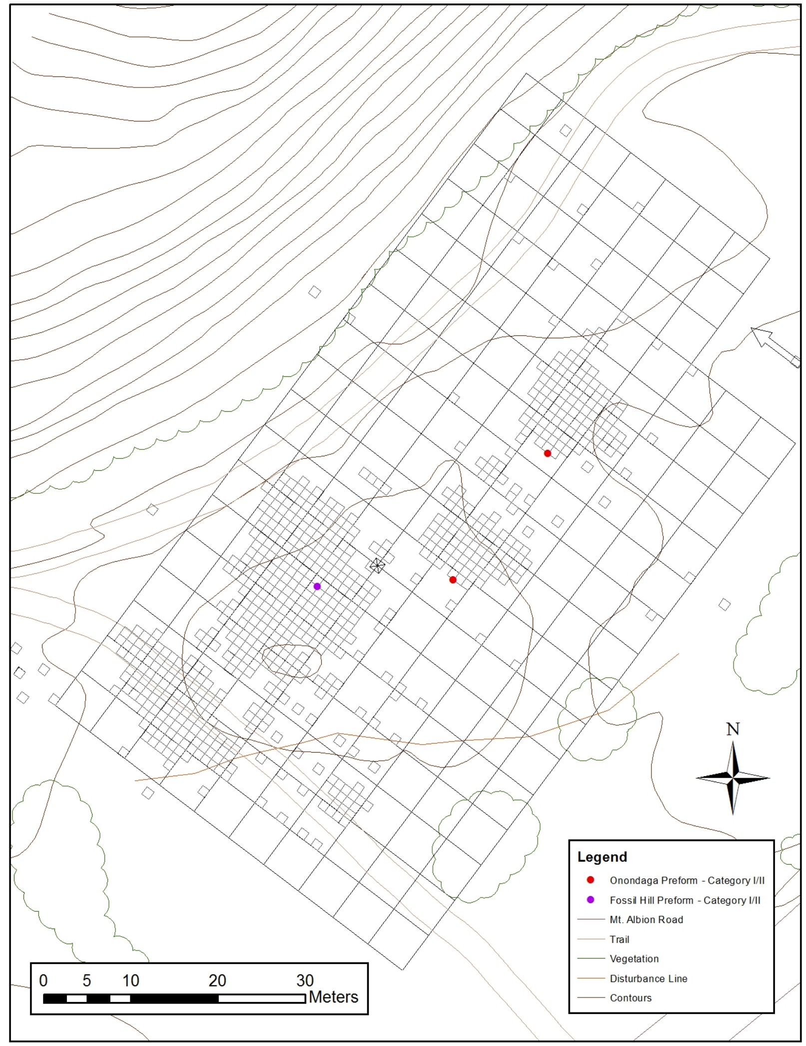


Figure C.11. Category II Preforms

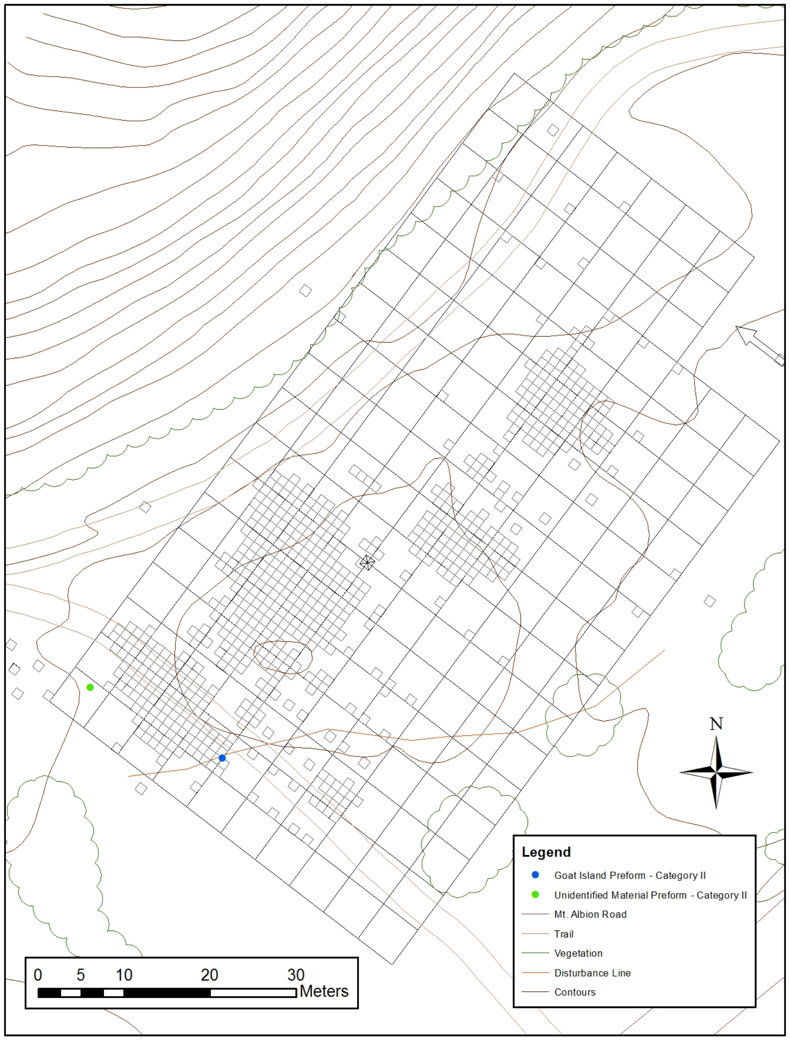


Figure C.12. Category II/III Preforms

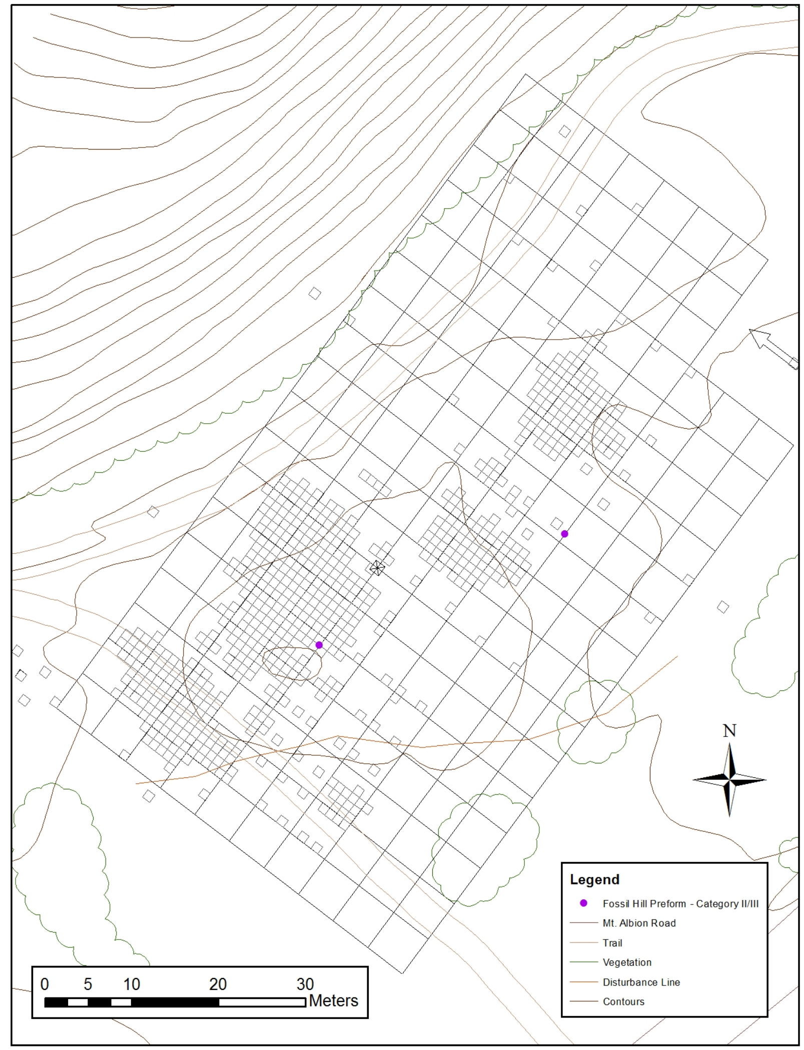


Figure C.13. Category III Preforms

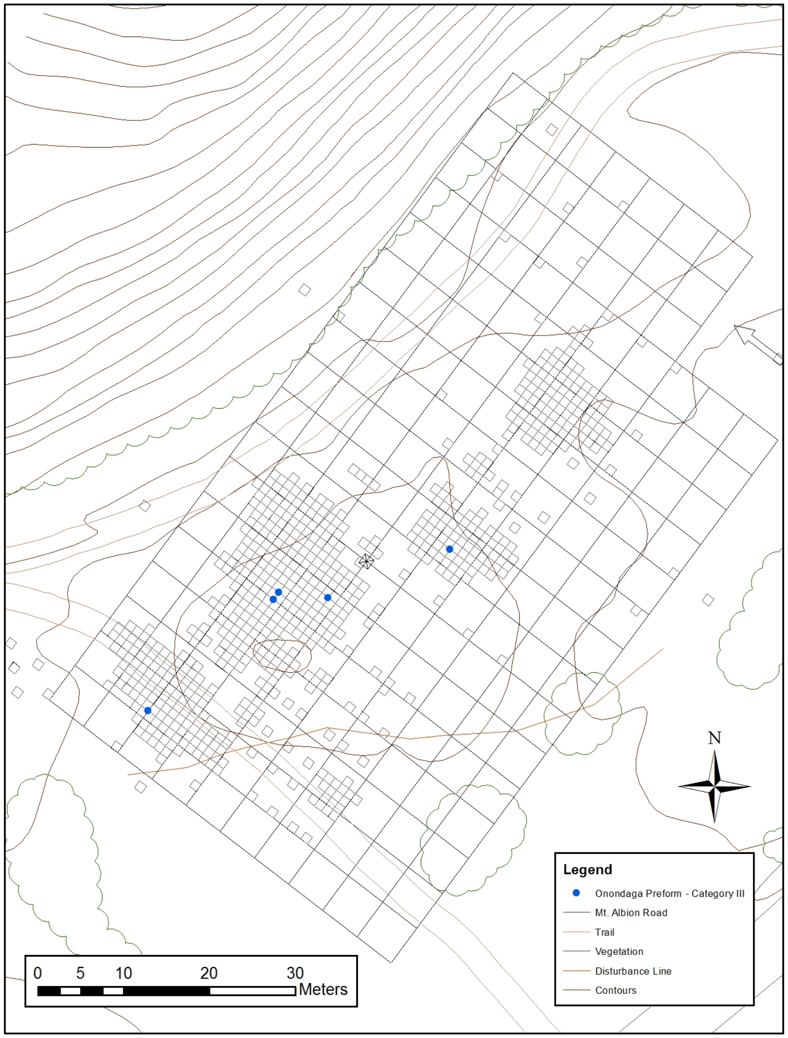


Figure C.14. Category III/IV Preforms

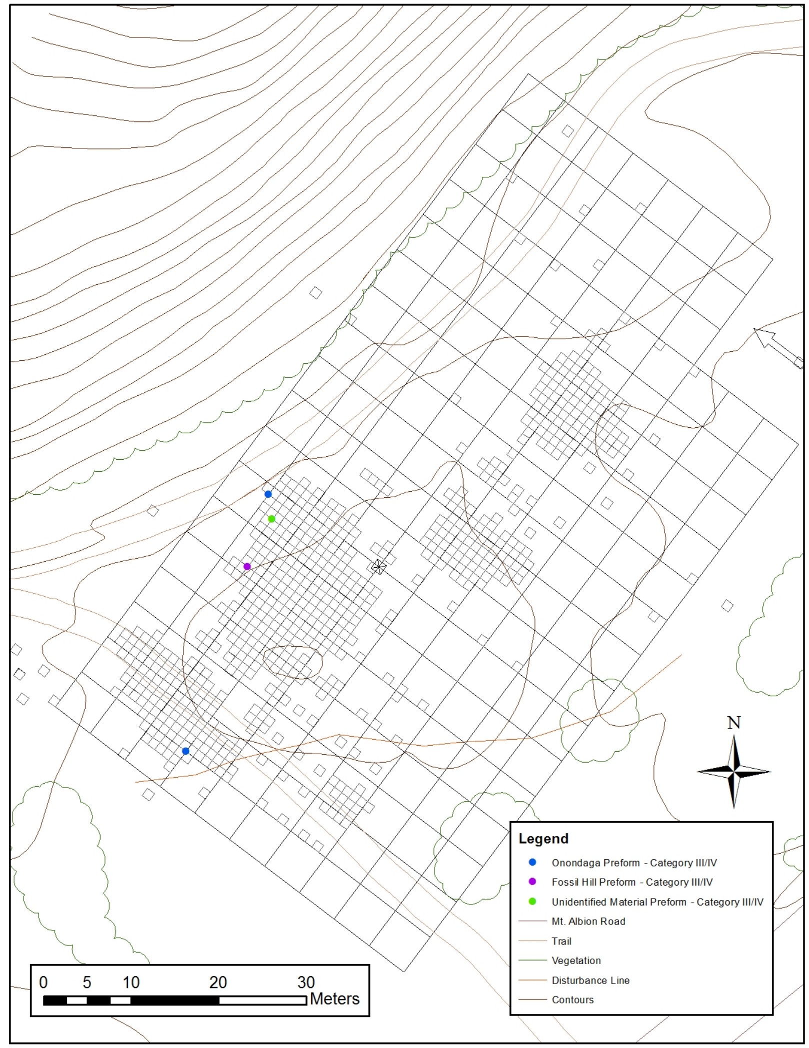


Figure C.15. Category IV Preforms

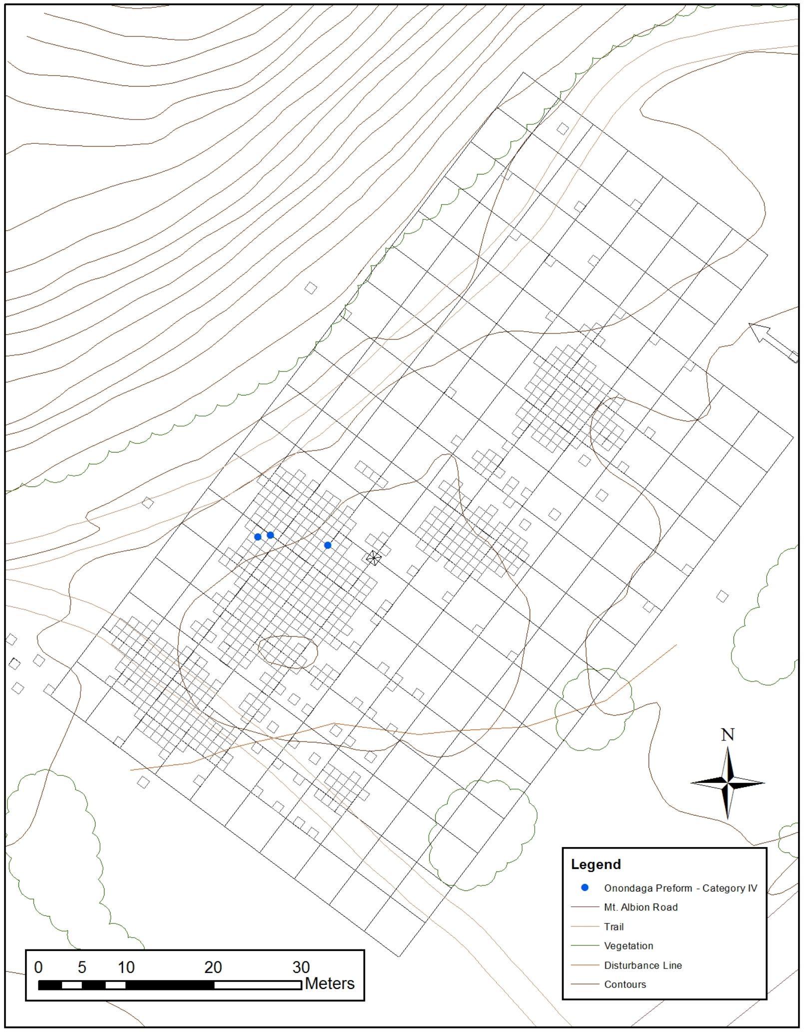


Figure C.16. Onondaga Fluted Points

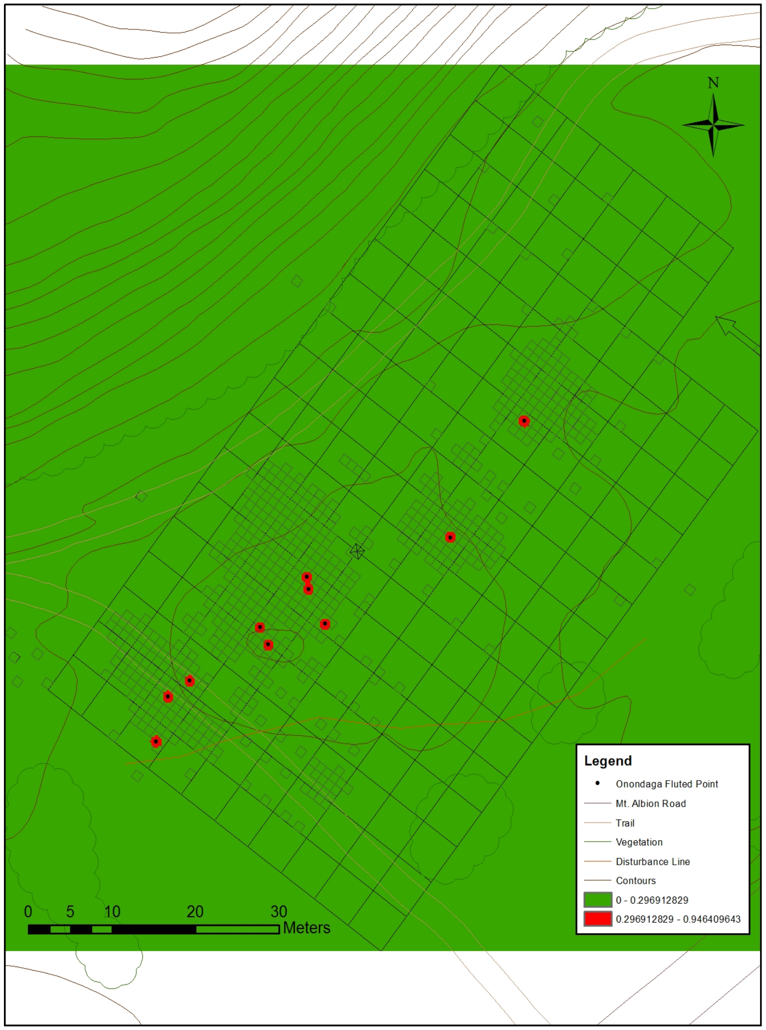


Figure C.17 Fossil Hill Fluted Points

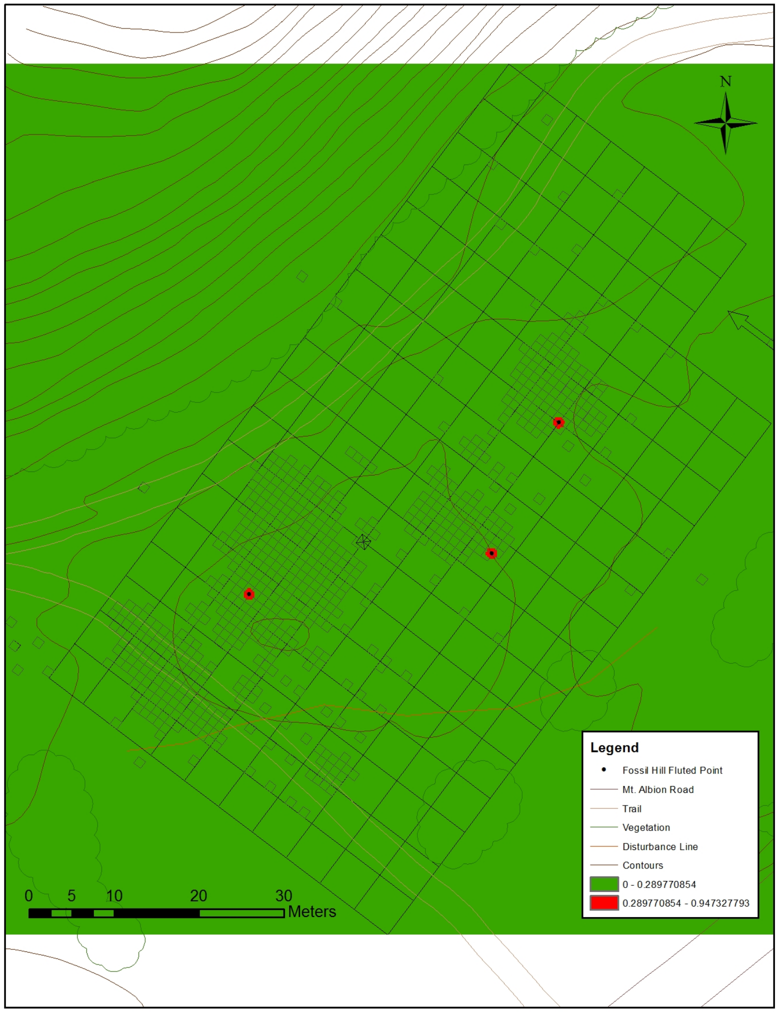


Figure C.18. Fossil Hill End Scrapers

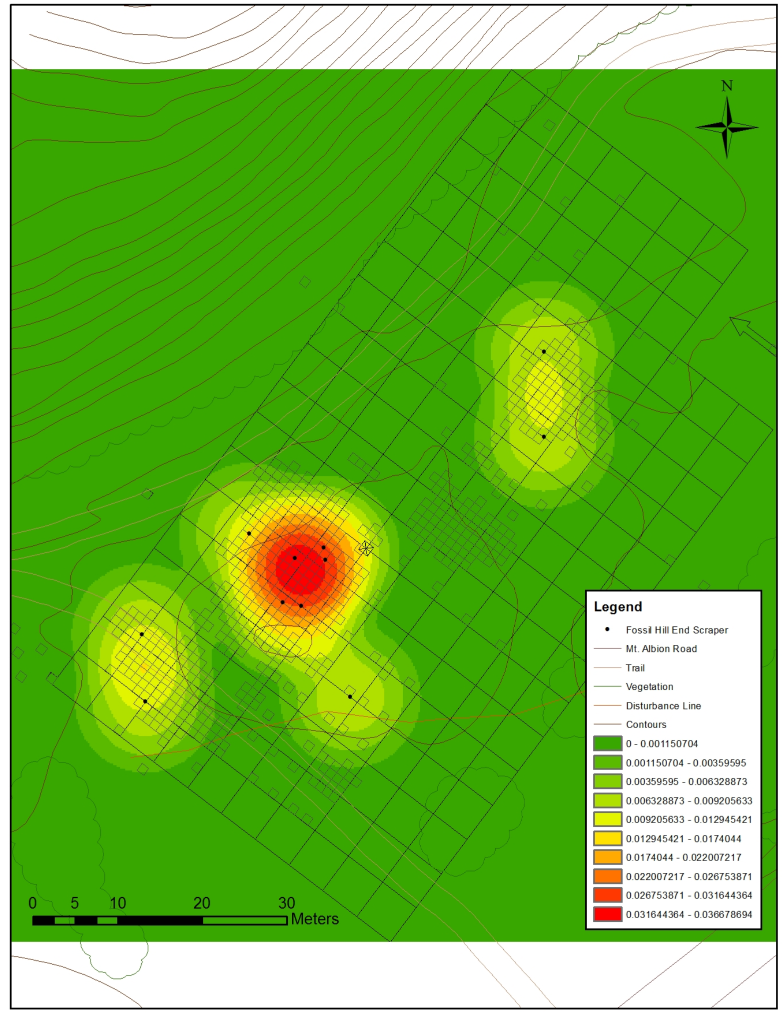


Figure C.19. Fossil Hill Side Scrapers

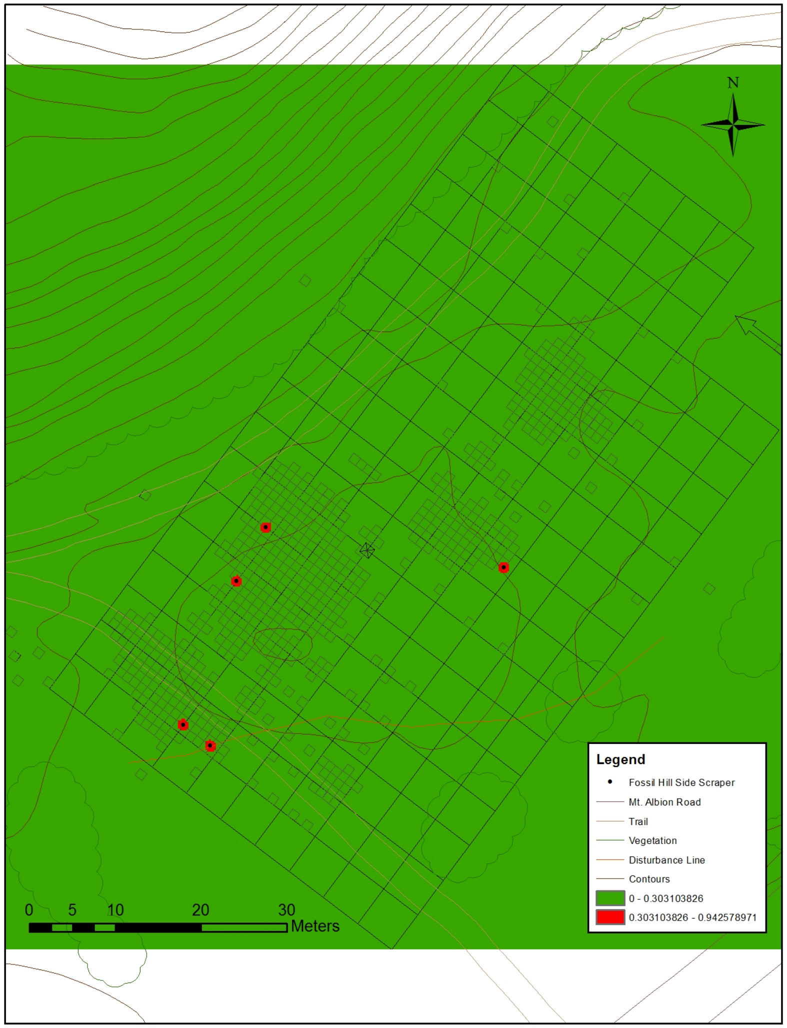


Figure C.20. Fossil Hill Beaked Scrapers

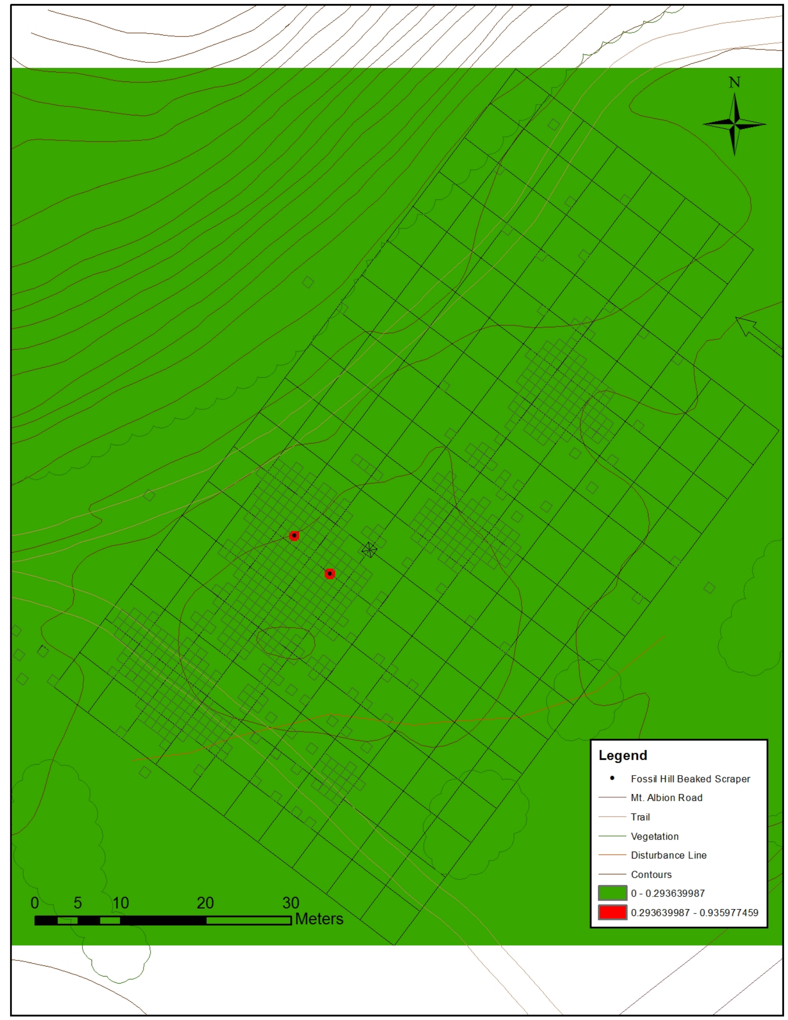


Figure C.21. Unidentified Material Beaked Scrapers

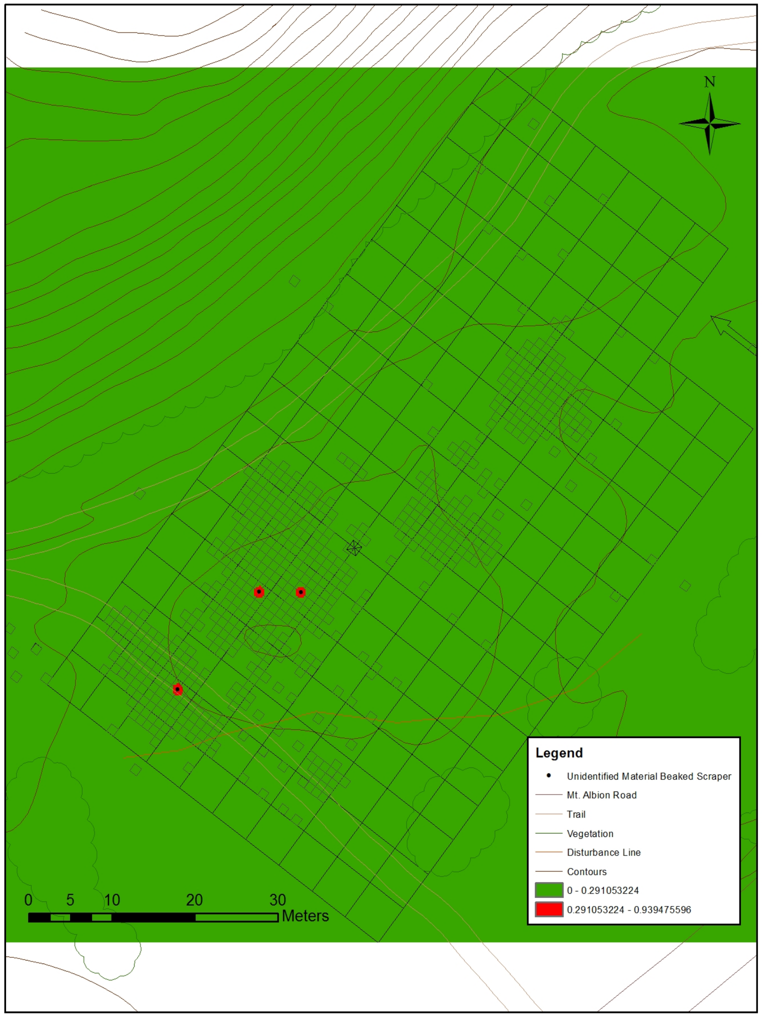


Figure C.22. Onondaga Flake Gravers

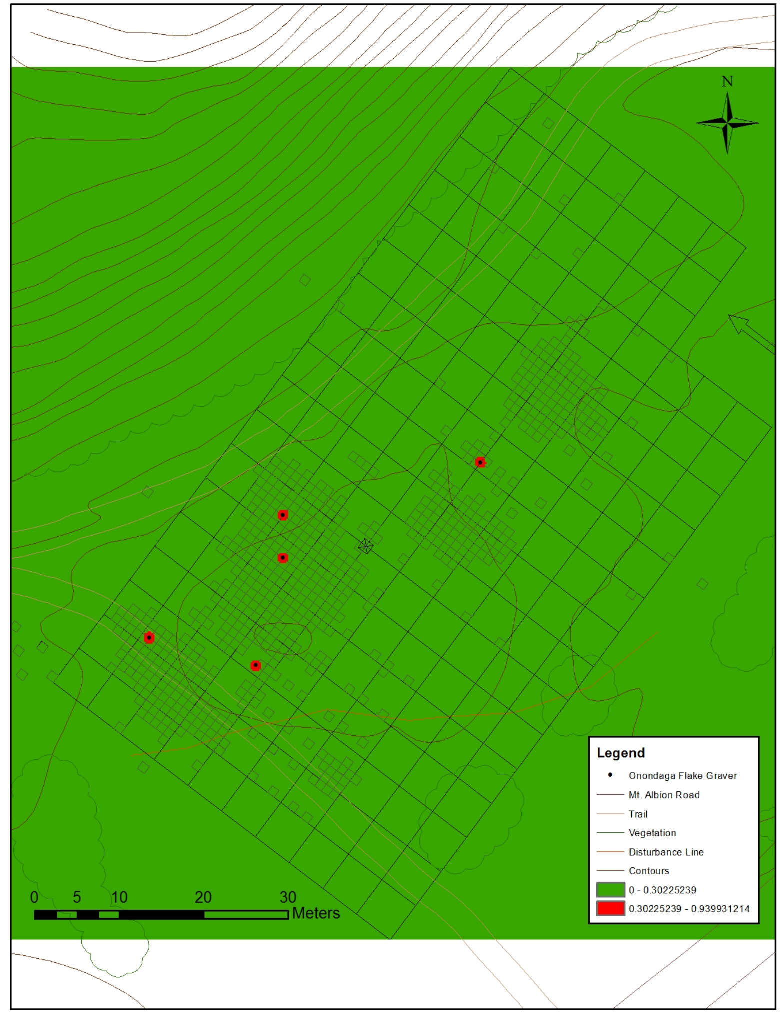


Figure C.23. Fossil Hill Flake Gravers