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Abstract

The abrupt geomorphological changes of the late glacial period in Nova Scotia varied regionally, often drastically changing the subsistence patterns of the ancestors of the Mi’kmaq. This dramatic landscape change has created a unique problem for archaeologists and heritage managers in their efforts to predict Paleo-Indian Period site occurrence in advance of industry- and community-driven land alteration. Policy and practice in Nova Scotia has been slow to recognise the need to identify and consider ancient landscape dynamics and now lags behind policies implemented in New Brunswick. This thesis argues that the current understanding of Paleo-Indian settlement patterns in Nova Scotia can be bridged by building upon existing geological research and freely available LiDAR data. A regionally focused glacial lake inundation model derived from digital elevation model data in Nova Scotia is an effective tool to offer insight into how the ancestors of the Mi’kmaq may have utilized the landscape of Central Nova Scotia over 12,000 years ago.

Keywords: Heritage Resource Management; Glacial lake paleoshores; Nova Scotia; Shubenacadie River Valley; Paleo-Indian settlement patterns; predictive modeling
Dedication

This thesis is dedicated to the loving memory of my guardians Betty and Bill Fisher. Without your love, guidance, and occasional butt kicking, I would not be where I am now.
Acknowledgements

Firstly, I would like to thank my family and friends for their emotional support during this crazy adventure back into the world of academia. To my godmother, Daphne Barr, and my sister Natasha, I am grateful for the encouragement that you both provided to me so that I could hunker down and produce the best work I possibly can. To the countless friends that I roped into proofreading my work in a world of autocorrect, I am indebted to each and everyone of you. Most of all I would like my amazing and beautiful wife Madeline. With your unwavering love and support, you have been my guiding light through this whole process. Date nights will be on the calendar again soon, I promise!

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To the Archaeology Research Division at Kwilmu'kw Maq-klusuaqn Mi'kmaq Rights Initiative (KMKNO-ARD) archaeologists Dr. Heather MacLeod-Leslie and Kaitlin MacLean, thank you for entertaining by endless emails and phone calls that guided me through engagement with the Mi'kmaq and double checking my L'nui'sin. Ralph Stea, your original research into the deglaciation of Central Nova Scotia has given me a sound geological base to build my research upon. I am grateful for your willingness to answer my emails with great speed. To my employer April MacIntyre and my co-workers at Davis MacIntyre and Associates, I am thankful for the time you have given me to concentrate on my schoolwork. I am also grateful for each and everyone of the landowners who allowed me access to their properties and answered my many questions about their dirt.

Finally, I wish to acknowledge that my research was conducted in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaw Nation. I am grateful for the opportunity to conduct my research in your homeland. I look forward to collaborating with KMKNO and Sipekne'katik First Nation in the future subsurface testing of my predictive model.
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Chapter 1.

Introduction

Paleoshoreline data is not consistently used, nor is it required to be used under current policy standards, by archaeological consultants in Nova Scotia when conducting archaeological assessments for the potential of encountering First Nations cultural resources. This has serious implications for the management of cultural resources of Indigenous populations of the region who exploited a dramatic and challenging glacial landscape close to 13,000 years ago during the Younger Dryas Period (Stea 2011; Davis 1991:40). Inconsistency in heritage management practice and protocols means that landscapes are typically assessed in a superficial manner, in their current state, and not as the latest representation of an ancient and ever-evolving cultural landscape (Suttie et al. 2006:1). It is possible, with the elevation data freely available through government departments and the data derived from Ralph Stea’s (Stea and Mott 1998; Stea 2011) ongoing research of glacial lakes and glaciofluvial features formed 12,800-12,000 years ago (11,000 and 10,000 $^{14}$C BP), to recreate these ancient lakes for archaeological predictive modeling. However, these data are seldom used in heritage site identification efforts. Regulatory requirements for archaeological assessments do not mandate attention to past landscapes and ancient shorelines, with the exception being the Debert Lands located approximately 20 kilometers west of the town of Truro. Specific guidelines and protocols have been developed for archaeological assessments within the Debert Lands that acknowledge the uniqueness in predicting Paleo-Indian site occurrence. This has been done with the collaboration of the Assembly of Nova Scotia Mi’kmaq Chiefs and the Department of Tourism, Culture and Heritage (Nova Scotia House of Assembly 2008; Nova Scotia Communities Culture and Heritage 2008; Crook and Munro 2010; Morine Rosenmeier et al. 2012). No further protocols or guidelines have been developed beyond the Debert Lands.

Although the Debert site is the oldest and only known Early Paleo-Indian encampment site in Nova Scotia, it is only one small area of the province (Davis 2011; Keenlysdie 2011). Central Nova Scotia is a large region where multiple glacial lakes were created through the blocking of waterways by the Minas Basin Glacier. Many of
these areas contained ice-free corridors that opened between episodes of glaciation and deglaciation. These corridors may have allowed for the movement of humans into the interior of the province prior to the end of the Younger Dryas Period (Stea and Mott 1998:2). Multiple Mi'kmaw oral traditions and legends have been interpreted by linguists and scholars as a cultural memory of the great flooding caused by glacial lakes, indicating the ancestors of the Mi'kmaq maintained a presence within the region at this time (Sable 2011; Gloade 2009; Shaw et al. 2010).

Strandlines of active and former glacial lakes undergoing vegetative recovery are known to be high potential areas for habitation and resource collection during the Paleo-Indian Period (Dickinson and Jeandron 1999; Boyd 2007; Storck 1984). Resource-rich areas would have been present along the former Glacial Lake Shubenacadie II, which once flooded low-lying areas of the Shubenacadie, Stewiacke and Musquodoboit River Valleys. These former lakeshores are increasingly subject to alteration for community and economic development. However, these areas may not be receiving the consideration similar to that received by the Debert Lands paleoshorelines and glacial landforms. In other words, the site occurrence potential for paleoshorelines and glacial landforms are not being systematically assessed and will not be without regulatory reforms. This means that potential archaeological sites and isolated finds are at risk of being altered or destroyed without prior documentation and investigation in collaboration with the Mi'kmaq. The potential for encountering these resources is being overlooked, and First Nations heritage resources from this temporal period are almost certainly not being managed properly by neglecting to take past geological and hydrological processes into consideration.

In this thesis I will demonstrate that the application of elevation data derived archaeological predictive modeling can be part of an effective and efficient methodology for highlighting areas for closer examination in archaeological consulting practice and management of past landscapes (Legg and Anderton 2010). In particular, I will examine the Younger Dryas- Early Paleo-Indian Period and how catastrophic geological events affected the land use patterns of the ancestors of the Mi'kmaq in Central Nova Scotia. I will argue that the use of predictive modeling, supported by previous geological and archaeological research, and traditional paleoecology, with the guidance of the Mi'kmaq, has the potential to manage these landscapes and deserves to be brought into policy and practice in Nova Scotia.
Chapter 2.

The Shubenacadie River Valley

2.1. The Modern Landscape

The Shubenacadie River Valley was chosen as a localized focus to develop and test an elevation data derived predictive model for the occurrence of unidentified Paleo-Indian Period First Nations heritage resources within Nova Scotia’s interior for archaeological consulting purposes. This valley is situated in the traditional Mi’kmaw district of Sipekne’katik. The Shubenacadie Valley is the location of a well documented glacial lake, Glacial Lake Shubenacadie II, that has been attributed to the Younger Dryas stadial (Stea and Mott 1998:12). The Shubenacadie River in its present state comprises over 72 kilometres of meandering river hemmed by rural farmlands and ever-expanding residential development (Figure 2). The landscape is dotted with knolls, drumlins, eskers, kames, and ancient shorelines carved by glaciers and their meltwaters, cutting across central Nova Scotia following the ancient fault line of Shubenacadie River Valley. It is home to the world’s highest tides with over 40% of the river’s water being affected twice daily by the powerful tidal bore. The river’s headwaters begin at the northeastern end of Shubenacadie Grand Lake. From there, the river travels northeastward on a gradual lowland plain finally draining into the Minas Basin (Davis and Browne 1996:152).

Within the Lowland Plain, the Shubenacadie River meets its major confluence with the Stewiacke River. The Stewiacke River flows from the northeast, beginning at Round Lake, Pictou County, deep into interior Nova Scotia. The Stewiacke Valley is relatively low in elevation with gentle rolling hills (Davis and Browne 1996:101; Preston 1974:30). This region is also highly cultivated but is less subject to new land alterations at this time. Further north towards the mouth of the Shubenacadie River at the Minas Basin, the river is hemmed with sandstone cliffs of to 30 metres in height. Here, the river experiences swift currents and tidal extremes. Many of its tributaries at the river’s most northern extent stretch into marshy floodplains and are bordered by steep wooded slopes (Preston 1974:34-35).
Throughout the precontact and historic periods, this river has been a strategic transportation corridor between Kjipuktuk (Halifax Harbour) and the Minas Basin. The chain of lakes situated northeast of the existing Port of Halifax made it possible to travel near uninterrupted from the Atlantic coast to the Minas Basin. From the earliest evidence of human occupation of the region, some 13,000 years ago, this waterway has been the ancestral home of the Mi’kmaq well into the modern era (McDonald 2016).

The Mi’kmaq continue to have a strong presence in the Shubenacadie River Valley and utilise the region for traditional activities. One of the largest Mi’kmaw communities in Nova Scotia, Sipekne’katik First Nation, is located near the Village of Shubenacadie in central Nova Scotia. The Mi’kmaq and their ancestors have maintained
a continuous occupation in Shubenacadie River Valley since at least the closing of the last Ice Age (McDonald 2016; Dawson 2012:96-99; Julien 2011).

2.2. Geological History

A series of rapid climactic events coinciding with the first known evidence of human occupation in Nova Scotia has greatly shaped the landscape of Central Nova Scotia. Climactic warming during the Allerød interstadial occurred between approximately 16,000 and 12,800 years ago ending the last glaciation period in Nova Scotia. This warming period reduced nearly all the glaciers within Nova Scotia with the exception of those lingering in the Cobequids, Antigonish Highlands and Cape Breton Highlands. Extreme climatic change created a series of muskegs and dense spruce forests, which attracted late Ice Age fauna such as mastodons, giant beavers, and ground sloths, which used this newly ice-free corridor to migrate east along the Minas Basin into Nova Scotia’s interior. As the climate warmed, the landscape experienced a period of isostatic rebound. Sea levels within the Minas Basin fell approximately 30 metres below modern levels (Stea 2011:55).

The climate again cooled sometime after 12,900 $^{14}$C BP, causing several short-lived cycles of glaciation. This rapid cooling event caused the glaciers to re-advance into Nova Scotia. Drops in temperatures decimated the spruce forests, turning the landscape into a shrub filled tundra. Ice-free corridors remained over much of Central Nova Scotia, but ice filled the Minas Basin (Stea 2011:69).

As the glaciers retreated eastward sometime between 12,500 and 11,700 $^{14}$C BP, a clay and ice dam blocked the outlet to the Shubenacadie River, inundating most of the Shubenacadie Valley to the elevation of 30 metres above current sea water levels. Termed Glacial Lake Shubenacadie I, the Shubenacadie River’s outlets flowed southward in the opposite direction, draining into the Atlantic through the Dartmouth chain of lakes and Gibraltar Rock on the Musquodoboit River (Stea 2011:69).

Eventually the northern portion of the Minas Basin became ice-free while glaciers remained on the south side of the basin. The lack of evidence for marine inundation in the deposits left by Glacial Lake Shubenacadie I supports Stea’s theory of this glacial
retreat sequences. The lake rapidly drained sometime after 11,700 $^{14}$C BP as the climate again warmed and the ice dam breeched (Stea 2011:69).

Stea is the leading academic expert of a very small group of geologists that study the deglaciation sequences of Mainland Nova Scotia. He has worked closely with archaeologists and the Confederacy of Mainland Mi'kmaq interpreting the paleoecology of the Debert Lands (Stea 2011). Stea is frequently consulted by archaeologists in Nova Scotia and continues to add to the archaeological understanding of geomorphological processes in the region. Thus, this thesis relies heavily upon his late glacial research.

At about 11,000 $^{14}$C BP, Nova Scotia was almost completely ice free. Due to lower sea levels, aided by deglaciation and isostatic rebound, herds of caribou and other large mammals may have used the lowstand corridors of the Bay of Fundy to migrate into the region. Low shrub and herbaceous vegetation inundate the coast, while trees began to migrate into southern Nova Scotia (Stea 2011:69).

The Younger Dryas stadial abruptly ended this period of warming at approximately 10,800 $^{14}$C BP in the Maritime Provinces. This cooling trend lasted for close to one thousand years, again, drastically altering the landscape. Small glaciers rebuilt, flooding low boggy areas, and trees were decimated due to the drop-in temperatures creating a tundra-like environment (Stea 2011:69). Whether humans followed Late Ice Age fauna into Nova Scotia at the end of the Allerød interstadial or soon afterward during the cooling period of the Younger Dryas, is not fully understood (Stea 2011:58).

The Younger Dryas cooling event resulted in the reformation of the Minas Basin Glacier. The glacier again dammed rivers and low lands surrounding the Minas Basin creating a series of glacial lakes, with the largest two being Glacial Lake Shubenacadie II and Glacial Lake Kluskap in the Annapolis Valley (Figure 3). This reincarnation of Glacial Lake Shubenacadie is believed to have inundated similar levels as Glacial Lake Shubenacadie I, flooding only low-lying areas situated below 30 metres. This is based upon Stea and Mott's extensive testing of late-glacial sediments in the Shubenacadie River Valley. However, the maximum flood extent of the Glacial Lake Shubenacadie II is less certain than those of Glacial Lake Shubenacadie I (Stea and Mott 1998:17).
By the end of the Young Dryas cooling, at approximately 10,000 \(^{14}\text{C}\) BP, the Maritime climate again warmed to pre-Younger Dryas temperatures. The Minas Basin Glacier receded, causing the dramatic breech of the ice dams of the Minas Basin (Mott et al. 2009:637). Stea believes these lakes drained quickly, likening it to the “the pulling of a plug” (personal communication 2018). This perhaps limits the possibility of sustained water levels and shoreline scaring as the lake waters receded. The Shubenacadie River again flowed northward into the Minas Basin and tree species returned during the transitional Holocene, turning tundra to enclosed boreal forests. Low-lying areas of the Shubenacadie Valley emerged as bogs and marshes as the landscape rebounded (Mott et al. 2009:637).

Figure 3. The Shubenacadie River Valley Study area with the maximum estimated flooding extents of Glacial Lake Shubenacadie II during the Younger Dryas cooling event c. 12,900 to c. 11,700 years BP (blue). Approximate ice models (light blue) adapted from Stea and Mott (1998:15) and Stea (2011:70-72).
2.3. Traditional Paleoecology

The Mi'kmaq use the term Wejisqaliati'k, translated as either “sprouted from” or “grew up from the earth”, as oral tradition conceptualizing their continuing existence in Mi'kma'ki (land of the Mi'kmaq) since time immemorial (Confederacy of Mainland Mi'kmaq 2015:193). The first documented use of the phrase Wejisqaliati’k dates to 1749, when several Mi'kmaw Chiefs used this term as the basis of their entitlement to ancestral lands coveted by the British upon the founding of Halifax (Upton 1979:201-202; Confederacy of Mainland Mi'kmaq 2015:16). The settlement of Halifax by the British broke earlier treaties (Confederacy of Mainland Mi'kmaq 2015:16). Wejisqaliati’k also is used to demonstrate the Mi'kmaw worldview that they and all their relations, mits no'kmaq, are part of an endless cycle of thousands of generations living and returning to the earth to once again breed life anew (Confederacy of Mainland Mi'kmaq 2015:193). Nowhere is this connection to the land more apparent than through Mi'kmaq spirituality and oral traditions.

The Mi'kmaq often used oral tradition as imagery and metaphor to describe the geological events that occurred in Mi'kma'ki. In many cases, this would be as how a hunter would envision the evolutionary processes of a given landscape (Hornborg 2016:85). Oral tradition was also used as maps to convey information on how to locate important resources necessary to their survival throughout the precontact and early contact period (Sable 2011:157; Hornborg 2016:85).

The great climactic event that had taken place during Younger Dryas Period is theorised to be represented within Mi'kmaw oral tradition (Sable 2011; Shaw et al. 2010; Gloade 2009). According to Sable, the tradition of Kluskap and his on-going war with Beaver depicts the climactic events that lead to the creation of glacial lakes in Central Nova Scotia (2011:166). Kluskap is a frequent figure in legends recounting the formation of landform features of Mi'kma'ki (Sable 2011:166). Rand, a Christian missionary, described Kluskap as “the most remarkable personage of Micmac [sic] traditions” and a demigod in the oral tradition of the Wabanaki peoples (1850:28). The Mi'kmaq, whose resource areas Beaver’s dam had flooded with a freshwater lake, pleaded with Kluskap to use his strength to breach Beaver’s dam. Breaking through Beaver’s dam at Cape Split, Pleegum “the opening of a beaver dam”, with a hand axe would free both the Shubenacadie and Annapolis Valley. Kluskap’s war with Beaver
would also form several other landform features in the Minas Basin such as Five Islands. These Islands were created when Kluskap threw mud clumps at Beaver for forming the dam across the Basin. As final punishment for altering the landscape, Kluskap shrank Beaver to his present size (Rand 1850:28; Rand 1893:60; Shaw et al. 2010:1090; Sable 2011:166).

Beavers remain a frequent antagonist used in Mi'kmaw oral tradition to describe climactic events relating to the evolution of waterways in the Maritimes and the creation of prominent landform features (Sable 2011:166; Hornborg 2016:86; Beck 1972). This is in part, perhaps a homage to the ability of beavers to sculpt landscapes by changing entire ecosystems when creating their homes (Hornborg 2016:86; Beck 1972). Sable maintains that the giant beaver, *Casteroides ohioenses*, roamed the Maritimes until the end of the last Ice Age, approximately 10,000 years ago, coinciding roughly with the final breaching of the Shubenacadie River ice dam (2011:166). This theory also temporally overlaps with the mean occupation dates provided for the Debert-Belmont Paleo-Indian site at 10,600 ¹⁴C BP. The history of the glacial events of the Minas Basin has not been systematically explored in great detail until Stea and Mott’s (1998) modern research and warrants further study into how these glacial events affected human subsistence patterns in Nova Scotia.

The second Kluskap tradition that can be interpreted as a cultural memory of the extreme climatic change of the Younger Dryas is Kluskap’s battle with the God of Winter. Many years ago, Kluskap had lost his annual battle with Winter, thus a number of summer-less years persisted until he could again defeat winter and end the suffering of the Mi’kmaw (Gloade 2009:12). These traditions add to the Mi’kmaw world view of Wejisqaliati’k and is evidence that the ancestors of the Mi’kmaq remained in the region to bear witness to these catastrophic climatic events.

There is great value in including traditional paleoecology as part of background research for archaeological investigations. The incorporation of a “Two-eyed Seeing” model, a holistic blend of western and traditional Mi’kmaw knowledge, helps archaeologists understand the evolution of the cultural landscape of Mi’kma’ki (Bartlett et al. 2012). It supplements and enhances the current archaeological understanding of First Nations landscape use. Most importantly, it emphasises the cultural value of these landscapes to the Mi’kmaq (Nicholas 2011).
Chapter 3.  Background

3.1. The Paleo-Indian Period in Atlantic Canada

The rapid pace of climactic events that took place during the Late Pleistocene into the Transitional and Early Holocene drastically affected the lifeways and subsistence styles of the ancestors of the Mi'kmaq (Keenlyside 2011). Archaeologists, scholars and the Mi'kmaw community have divided these changes in subsistence into two separate temporal periods. The Saqiwe’k L’nu’k or Paleo-Indian and the Mu Awsami Kejikawe’k L’nu’k or the Early Archaic Period (Table 1). These are based, in part, on lithic technologies, changes in subsistence patterns, and traditions (Lewis 2006; Davis 2011:22). Previous research on the peopling of the Maritimes suggested that there were select windows of opportunity between climatic extremes for human occupation throughout these changes (Keenlyside 2011:145; Tuck 1975). Tuck (1975) refers to this gap in the archaeological record during the transition from the Late Pleistocene into the Early Holocene as “The Great Hiatus”. New theories, however, purposed by Murphy (1998), Keenlyside (2011), and from others in their ongoing field research, challenge Tuck’s theory by suggesting that human existence in the Maritimes was likely experienced as more of a continuum. Gaps in the archaeological record, following similar examples from Maine, are likely due to the lack of formal research on non-coastal sites, as well as the loss of sites due to sea-level rise (Murphy 1998; Keenlyside 2011:153). The earliest known occupation period in Nova Scotia is the Saqiwe’k L’nu’k “the Ancient People” or the Paleo-Indian Period, 11,500 to 8,500 BP (Lewis 2006; Davis 2011:22). Changing ecology and isostatic rebound following deglaciation prior to the Younger Dryas stadial allowed large herds of migratory caribou to seasonally follow glacial edges into Nova Scotia (Keenlyside 2011:147). These herds were closely followed by Clovis culture Early Paleo-Indian groups emerging from the south along the lowstands of the Bay of Fundy (Lothrop et al. 2011:562).

Currently, the Debert and Belmont Sites provide the only significant evidence of Paleo-Indian seasonal settlement in Nova Scotia. However, several isolated finds of Clovis-like Early Paleo-Indian fluted bifaces and sites containing characteristically Paleo tool assemblages have been found throughout Nova Scotia (Keenlyside 2011:147). These finds provide more questions than answers and are challenging our current
understanding of this period. Paleo peoples are commonly believed to be big-game hunters, yet continuing research supports evidence of diverse subsistence patterns, including fishing and small game hunting. These theories are challenging the notions previously accepted by scholars of a subsistence of solely relying on migrating herds and subsequent mass exodus upon climate change, which, in turn, made the environment less hospitable for large herds of caribou. Further research is needed to bridge the gap between how Paleo peoples adapted when the environment again warmed at the transition of the Younger Dryas into the Early Holocene (Tuck 1975; Keenlysise 2011; Murphy 1998).

As the glaciers receded for the final time and the landscape rebounded, ice dammed lakes eventually drained. This created marshy lowlands and rivers. This transition coincides with the beginning of the Mu Awsami Kejikawe’k L’nu’k “the Not so Recent People” or the Archaic Period, dating from approximately 8,500 to 3,000 BP (Lewis 2006; Davis 2011:22). In the Northeast, late Paleo-Indian lithic technologies and subsistence patterns are postulated to overlap into the Early Archaic Period (8,500-5,000 BP) making this change more nuanced in the archaeological record (Keenlyside 2011; Lothrop et al. 2016:193). During this period, humans would have contended with this rapidly changing climate by broadening their substance patterns to a mixture of land and maritime-based resources. This is represented, in part, by the appearance of ground slate points used for spearing fish and marine mammals. Tools such as ground stone axes, gouges and adzes in the archaeological record also appear, suggesting an exploitation of the ever-expanding forest resources. These were used for woodworking and represent a change in transportation and exploration as well as subsistence (Tuck 1975; Dumont 1981).

The lack of transitional technology and assemblages from the Late-Paleo Period to Early Archaic suggests that many of the first populations may have left the region (Tuck 1975). Archaeological evidence from this period may also be absent due to sea level rise and a lack of formal research in inland contexts during this temporal period (Keenlyside 2011:150). Research conducted both by Keenlyside (2011) and Murphy (1998) suggests that the absence of these sites does not necessarily disprove the presence of Late Paleo- Early Archaic peoples in inland contexts, such as the Shubenacadie River Valley.
Table 1. The precontact sequence including generalized terminology and Mi'kmaw terminology now used widely by academic, consulting, governmental agencies and the Nova Scotia Mi’kmaq (Lewis 2006; Davis 2011:22; Confederacy of Mainland Mi’kmaq 2015:11).

<table>
<thead>
<tr>
<th>Mi'kmaw Period</th>
<th>Archaeological Period</th>
<th>Radiocarbon Years</th>
<th>Calendar Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiskuke’k L’nu’k</td>
<td>Contact</td>
<td>450 – 350 BP</td>
<td>500 BP – present</td>
</tr>
<tr>
<td>(Today’s People)</td>
<td>Historic</td>
<td>1600 AD – Present</td>
<td></td>
</tr>
<tr>
<td>Kejikawe’k L’nu’k</td>
<td>Woodland/Ceramic</td>
<td>3,000 – 500 BP</td>
<td>3000 – 500 BP</td>
</tr>
<tr>
<td>(the Recent People)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mu Awsami Kejikawe’k L’nu’k</td>
<td>Archaic</td>
<td>8,500 – 3,000 BP</td>
<td>10,000 – 3,000 BP</td>
</tr>
<tr>
<td>(the Not so Recent People)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saqiwe’k L’nu’k</td>
<td>Paleo-Indian</td>
<td>11,500 – 8,500 BP</td>
<td>13,500 – 10,000 BP</td>
</tr>
<tr>
<td>(the Ancient People)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2. Paleoshores and the Saqiwe’k L’nu’k

Within the Northeast, the Debert-Belmont site is believed to be the one of the oldest and largest Paleo-Indian site complexes located within a periglacial environment (Davis 2011). However, the Debert-Belmont series of sites follow a similar occupation model as several other Early Paleo-Indian occupation sites found within Northeastern Canada and the United States (Dickinson and Jeandron 1999:8). The Debert site is located on a sandy ridge between two feeder streams of the Chiganois drainage on gently sloping plain. With well-drained sands, it provided an excellent location for encampment with a commanding view of the vegetated lowlands below. A glacial meltwater channel, now filled with aeolian sediments, cuts through the northern portion
of the main Debert site. MacDonald postulates this ephemeral stream may have no longer been active during the Debert occupation (1968:3).

Further knowledge obtained from extensive shovel testing programs implemented by archaeological consultants has found the distribution of artifact site locations, summarized by Morine Rosenmeier et al., as “consistently on topographical breaks adjacent to the margins of late glacial landforms and drainage features in varied depositional modes of late glacial cover sands” (2012:119). Morine Rosenmeier et al. has identified four major late glacial topographic and geological contexts within the Debert-Belmont complex:

1) the upper terrace and edges of the Belmont sites; 2) the margins of a distinct and complex late glacial drainage basin and a downcut channel framed by the lower terrace alluvial fan and levee 3) the margins of a meltwater channel framed by the Debert ridge and the opposing stepped gradient of the Debert Site; and 4) the margins of a low-gradient ridge (Morine Rosenmeier et al. 2012:119-120).

Debert is only one small area within a region of several glacial lakes with ice-free corridors that opened between the episodes of glaciation and deglaciation prior to the end of the Younger Dryas stadial (Stea and Mott 1998:2). Surely it is not the only area occupied by Paleo peoples in Nova Scotia. The preference of Paleo peoples to settle paleoshorelines and late-glacial landform features is not a settlement pattern unique to Debert. Research from Maine, New Brunswick, Prince Edward Island, Ontario, and the Canadian Prairies suggests that Paleo-Indian populations actively settled at the edges of glacial lakes and former glacial lakes undergoing vegetative recovery as part of their subsistence patterns (Dickinson and Jeandron 1999; Dawson 1983; Boyd 2007:199; Storck 1984; Nicholas 1990). These strandlines provided open corridors between densely wooded boreal forests and the waters edge for hunting, encampments, and resource collection. Recovering landscapes also proved to be productive resource areas. Vegetative regrowth is sought out as a food source by various species of game and wetlands provided a multitude of resources (Dickinson and Jeandron 1999:7; Boyd 2007; Nicholas 1990). Elevated, well-drained kame terraces and drumlins provide superior views of these strandlines, further increasing the archaeological potential of these paleoshorelines (Dickinson and Jeandron 1999:7-8). Alongside Debert, sites found in association with strandlines and glaciofluvial landforms within the Northeast include the Vale, Munsungun, and Michaud sites in Maine, Marysville site in New Brunswick
(Figure 4), Rimouski in Quebec, and several isolated finds throughout the Northeast continuum including New Brunswick and Prince Edward Island (Dickinson and Jeandron 1999:8; Keenlyside 2011).

Keenlyside (2011) goes one step further in predicting the occurrence of Paleo-Indian sites in relation to glacial lake strandlines and glaciofluvial landforms. The location of isolated projectile points associated with the Paleo-Indian Period correlate closely to the extent of icefields proposed by Stea and Mott (1998). Keenlyside argues that the coincidence of the number of Paleo-Indian point finds near icefields is more than significant (2011:147). To add to his suppositions, these finds are also in close correlation to former glacial lakes created by these icefields (Keenlyside 2011:147; Stea and Mott 1998; see Figure 3).

![Figure 4. The Marysville Site (red ellipse), discovered during highway development in New Brunswick is located along the paleoshorelines of Glacial Lake Acadia (Archaeological Prospectors 2018, Instagram).](image)

The development and collapse of Glacial Lake Shubenacadie II has not been studied as in-depth as substantially larger and longer-lived lakes from the late glacial period in North America (Stea and Mott 1998; Stea 2011; Mott et al. 2009; Breckenridge
Stea's (2011) research has largely focused on mapping deposits, theorising broad development trends of this lake, and testing and dating maximum inundation levels. Therefore, there are still numerous unknowns that would have no doubt affected Saqiwe’k L’nu’k landscape use within the region. However, theories in productivity can be inferred from the research of other glacial lakes from this period.

The increase in water levels of the Shubenacadie drainage system undoubtably disturbed terrestrial animals and affected the biota of the Shubenacadie River (Robinson et al. 2017:324-325). The outlet shift from the Minas Basin to the Atlantic Ocean would have presumably disturbed the seasonal runs of anadromous fish and the fauna that relied upon them. Until these species could adapt, the lake may have not been as productive. A shift in the tidal reaches of the river to the south would likely affect the seasonal settlement patterns of Paleo groups in the region. However, winter ice could have provided a travel corridor for caribou and Paleo groups to more productive areas within the province (Robinson et al. 2017:332).

The draining of Glacial Lake Shubenacadie II is theorized to have happened rapidly (Stea 2018). This suggests that significant paleoshore scars were likely not created while the glacial lake levels receded. It can also be inferred that due to the Shubenacadie Valley being relatively low in elevation, flooding may have also been rapid once the outlet was blocked. Models from longer-lived glacial lakes exhibit a series of paleoshores, such as Lake Agassiz, which once covered much of the Prairies and western Ontario (Fisher 2005; Boyd 2007). These paleoshores represent fluctuating water levels, that occurred for numerous reasons, over Lake Agassiz’s roughly 5,000-year existence. Paleo-Indian settlement and land use patterns in this region reflect these fluctuations (Fisher 2005; Boyd 2007). Current understandings of Glacial Lake Shubenacadie II has its existence spanning a much lesser time period of approximately 1,000 years (Stea 2011; Stea and Mott 1998; Stea 2018).

Predicting water planes of Glacial Lake Shubenacadie II may not be as problematic as Lake Agassiz due to Shubenacadie’s smaller size (Fisher 2005:1481). Stea believes that regional isostatics had very little influence on the water levels (personal communication 2018). Further geological and hydrological research is needed within the bounds of Glacial Shubenacadie II to supplement the study of possible Saqiwe’k L’nu’k land use patterns below Stea’s maximum inundation levels (2011).
3.3. The Shubenacadie Valley During the Historic Period

The occupation of the Shubenacadie Valley after the arrival of the European settlers should not be ignored. When considering the evolution of Mi’kmaw land use and geomorphological changes, the advent of subsistence farming has created its own catalyst for change in the geomorphological history of the Valley. The fertile marshlands located near the confluence of the Shubenacadie and Stewiacke rivers were occupied as early as the late seventeenth century by French descendant Acadian farmers. Skilled in reclaiming marshlands for fertile farmlands using a system of dykes and aboiteaux, the Acadians drastically altered the landscape surrounding the Shubenacadie and Stewiacke rivers (Herbert 2009). After the deportation of the Acadians in the mid-eighteenth century, waves of British and American Loyalist Settlers occupied and improved upon former Acadian lands into the nineteenth century (Nelson 1931). Figure 5 gives an example of the extent of historic agricultural landscape alteration near the confluence of the Shubenacadie and Stewiacke rivers in 1754 and 1903. Extensive sandbars are visible at low tide in Tonge’s 1754 map. A narrower riverbed is also present. This may be due in part to the extensive marshland dyking from the Acadian residents of nearby Ville Pierre Hebert. A separate highland island is depicted in 1903 at high tide (Faribault and Fletcher 1903). This is likely due to less extensive dykes in the area after Ville Pierre Hebert was abandoned prior to the 1755 Acadian deportation of the remaining Acadian villages in the region and tidal variations.

In the early nineteenth century, a large construction enterprise took place fashioning a canal from the Atlantic Ocean to the Minas Basin in the Bay of Fundy. The creation of a series of locks, which enabled ships to sail from Halifax Harbour to the Bay of Fundy, destroyed millennia-old portage routes by physically connecting the Atlantic Ocean to the Minas Basin. The canal was abandoned nearly a decade after its completion in 1860. Rail became the future of transportation across the province making the canal obsolete even before its completion (Dawson 2012:16).
Into the modern era, many of the early Acadian dykes are still in use and are only replaced or built upon when necessary. Modern mechanized farming has further reclaimed marshland and is visible over time using aerial photography. Figure 6 depicts a glare surrounding the highland island in 1931 that was clearly a separate island in the earlier 1903 mapping. This glare is likely caused by poorly drained marshy fields undergoing reclamation at high tide. By 1994, the island is a knoll surrounded by well-
drained dyked farmland. Although much of the study area has remained farmland for the last 300 years of settler occupation, more and more of these lands are subject to development. The increasing urban sprawl of metropolitan Halifax has created new commercial and residential developments that further alter the landscape of the Shubenacadie Valley.

3.4. Previous Archaeological Research

Archaeological research for the Paleo-Indian Period in Nova Scotia has largely been focused on the Debert-Belmont area in North-Central Nova Scotia. This region represents the Early Paleo-Indian period Clovis tradition and is the only known solely Paleo-Indian settlement complex within the province (Davis 2011). The Debert-Belmont site complex is also the oldest known site of human habitation in Eastern Canada with some of its earliest hearths' dates at 13,000 BP (MacDonald 1968; Mott 2011:39; Stea 2011:55). More recent finds at Marysville, New Brunswick have the potential to predate Debert. Intact hearth features were found during a recent highway realignment that predate many of the carbon dates provided for the site occupation at Debert-Belmont, at 12,700 BP. Modern controlled carbon dating techniques were employed (Drost 2017). However, these findings have yet to be officially published and peer reviewed. The archaeological contractor report is still pending.

The Debert site complex is located approximately 10 kilometres north across the Minas Basin from the outlet of the Shubenacadie River. Although the site was first identified in 1948 during military base activities, investigations were limited to the initially disturbed artifacts. Formal excavations did not begin until 1963. Excavation between 1963 and 1967, conducted by George MacDonald of the National Museum of Canada, recovered more than 4,000 artifacts and several undisturbed features. Radiocarbon dates provided from intact hearth features suggest an occupation period of between 11,100 and 10,100 \(^{14}\text{C}\) BP (approximately between 13,000 to 11,000 BP), with an average date of 10,600 \(^{14}\text{C}\) BP (MacDonald 1968; Mott 2011:39; Davis 2011).

In 1989, stump removal activity at a local tree breeding centre approximately 1 kilometre from the original Debert site revealed two additional sites, Belmont I and Belmont II. Stephen Davis, along with a team of students from Saint Mary's University, recovered a further 700 artifacts and an intact living floor (Davis 2011). The Debert and
Belmont sites were collectively designated as a National Historic Site in 1972 (Parks Canada 2018) and has since been designated as a Special Place under Nova Scotia’s Special Places Protection Act (Nova Scotia Communities Culture and Heritage 2008).

In March 2008, a specific set of testing protocols was drafted in conjunction with Chiefs of the Mainland Mi’kmaq and the Province of Nova Scotia for use within the Debert-Belmont Special Place. These sets of protocols were the first of its kind in Nova Scotia and are currently the only set of guidelines pertaining specifically to the uniqueness of First Nations cultural resources and the special considerations that past landscapes require. The strict enforcement of standards for conducting archaeological resource impact assessments (ARIAs) and a review committee have been put in place (Nova Scotia House of Assembly 2008; Nova Scotia Communities Culture and Heritage 2008). Several isolated finds, artifact scatters, and perhaps intact sites, have been uncovered within the Debert-Belmont Special Place by archaeological consultants due to this implementation (Morine Rosenmeier et al. 2012; Crook and Munro 2010; McKillop and MacIntyre 2017:11).

Significant contextual evidence supporting the continuing presence of Paleo peoples within the region from the Late Paleo-Indian into the Early Archaic Period is represented from the Jones site located near the mouth of St. Peters Bay, Prince Edward Island. The period of isostatic rebound following the last glacial retreat within the region created a land bridge that connected Prince Edward Island to the mainland from 10,000 BP till approximately 5,000 BP. Known as Northumbria, this emergent landscape supported a variety of flora and fauna and became part of active Late Paleo-Early Archaic substance patterns (Keenlyside and Kristmanson 2016:61). Initially excavated in 1983 and again in 2000, the Jones site represents a seasonal coastal encampment site with occupational evidence spanning well into the Contact Period. Lithic materials recovered from deeply stratified sand deposits attributed to Late Paleo-Early Archaic Period, have been produced from a specific rhyolite, with its only known source located 170 kilometres away on a direct line to Ingonish Island in Cape Breton, Nova Scotia (Keenlyside and Kristmanson 2016:67-68).

Research of the Paleo-Indian Period within the Shubenacadie River Valley is limited to isolated finds and follow up field investigations conducted by archaeologists working with, or on behalf of, the Nova Scotia Museum. In 1970, Brian Preston, then
Curator of History at the Nova Scotia Museum, conducted an archeological survey of the Shubenacadie River system including much of the Stewiacke River. Preston relocated older archaeological sites reported previously by John Erskine and interviewed landowners who had recovered First Nations artifacts. Preston also conducted limited subsurface testing (1970). His investigations produced two multicomponent sites with chert, possible spurred endscrapers, a lithic typology generally believed to be distinctively from the Paleo-Indian Period. One site was located at the outlet of the Rawdon River at Shubenacadie Grand Lake and was investigated by Erskine in the mid-1960s. This site represented an isolated find near the river bank, likely between what Preston later designated as BfCv-17 and BfCv-18 (Preston 1974:7–8). The other site, BfCv-3 is located approximately 3 kilometres from the Rawdon River outlet on a terrace overlooking the headwaters of the Shubenacadie River. This spurred scrapper was found in the lowest 4 inches of a test pit, just above what he interpreted at the time as culturally sterile subsoil (Preston 1974:16).

Stephen Davis and David Christianson of the Nova Scotia Museum reported and analyzed three Paleo-Indian projectile point isolated finds during the late 1980s from Dartmouth, Amherst Shore, and Yarmouth Nova Scotia (1988). One find of specific interest to my research, was from a ridge overlooking the southern portion of the former Glacial Lake Shubenacadie I and II. This find is in proximity to the outflow of Glacial Lake Shubenacadie at Halifax Harbour near the Tam O'Shanter Ridge subdivision in Dartmouth. Although it was found in redeposited fill, the source was reported to be from fewer than 100 metres away from the find site on nearby Miller Mountain. The single point was fashioned from the same unique brecciated chert used at Debert (Davis and Christianson 1988:194-195). MacDonald postulates that this chert is limited to Paleo-Indian and Early Archaic sites due to Holocene sea level rise inundating the original source (1968:61). However, modern field investigations by Gerald Gloade and Roger Lewis have found a seam of this chert near Bass River, which is located some 20 kilometres away from the Debert site (Mi'kmawey Debert Cultural Centre 2019). The number of trucks removing fill from the Miller Mountain area made it impossible at that time to locate Chambers Point’s original context. Further excavations provided no additional finds (Davis and Christianson 1988:194-195). Yet, this supports the theory that there are additional sites to be encountered from the Paleo-Indian Period along the paleoshorelines of the former Glacial Lake Shubenacadie II. Although limited in formal...
documentation and reporting, these finds provide tangible evidence for human occupation south of Debert during the Paleo-Indian Period.

3.5. **Policy and Protection of Past Landscapes in Nova Scotia**

Issues in heritage resource management and the heritage values assigned to past landscapes have arisen in my archaeological consulting experiences in Nova Scotia. The lack of policy and guidelines regarding the archaeological assessments of past landscapes in Nova Scotia is concerning. It is especially so, when held in comparison to what is required of consultants by New Brunswick regulators. As of August 2019, there have been no amendments to the Nova Scotia Special Places Protection Act or supplementary guidelines supplied by the Department of Communities, Culture and Heritage (CCH) for assessing the archaeological potential for encountering First Nations cultural resources since its adoption in 1989 (Nova Scotia House of Assembly 2011). The Archaeological Resource Impact Assessment (Category C) Guidelines supplied by CCH make no mention of the uniqueness of First Nations cultural values, settlement patterns, or the assessment of past landscapes (Nova Scotia Department of Communities, Culture and Heritage 2014).

In 2005, Mi’kmaw Elders, academics, and experts came together to share their knowledge, identify key issues in heritage stewardship, and strengthen interdisciplinary partnerships in an indigenous lead workshop. The focus of the Debert Workshop was to integrate Eurocentric research and traditional ways of knowing to protect the Debert-Belmont sites well into the future (Julien 2011:2). This workshop was the first-time archaeologists and the Mi’kmaq collaborated on an equal level. Since this time, no further workshops or collaborations have been held in a similarly significant capacity to protect Mi’kmaw heritage resources Nova Scotia.

Following the Debert Research Workshop, the Confederacy of Mainland Mi’kmaq lobbied and conducted treaty negotiations to change provincial legislation within the Debert Lands (Julien 2011:4). This resulted in the enactment of Debert Standards in 2008, which mandated archaeological assessments and specific protocols within the Debert-Belmont Paleo-Indian National Historic Site boundaries. These protocols have been implemented after extensive consultation and collaboration with the Assembly of
Nova Scotia Mi’kmaq Chiefs and CCH to protect over more than 1,000 acres in Western Colchester County (Nova Scotia Department of Communities, Culture and Heritage 2008; Nova Scotia House of Assembly 2008).

The standards used within the Debert Special Place are a starting place for the implementation of future guidelines and protocols beyond this isolated site complex. Currently, excavating to culturally sterile soil is common practice throughout the province. However, this practice has the potential to terminate archaeological testing before glacial deposits, possibly containing late glacial sites, are encountered. The Debert Standards require that either regolith or glacial deposits are to be encountered before testing is considered to be complete (Nova Scotia Department of Communities, Culture and Heritage 2008). This leaves the remainder of the Province’s archaeological landscapes open to biases, personal knowledge of the reviewing consultant and their understanding of an evolving landscape beyond its present state.

Unlike Nova Scotia, New Brunswick has implemented set guidelines through the Archaeological Services Heritage Branch and supplies models for various types of archaeological resource occurrence potentials standardizing assessment protocols for all consultants (Archaeological Services Heritage Branch 2012). The New Brunswick Regulator acknowledges that the testing of an entire large study area using standard testing methodology has the potential to miss archaeological resources and can be unpractical, therefore predictive models are the most effective compromise between efficiency and effectiveness. The current regulated models in New Brunswick have increased precontact finds by 33% over traditional unstandardized assessment models. This increase in finds is based upon the controlled Sevogle River Testing Plot that compared both predictive models and traditional assessments. The increase in artifact recovery is argued as proof that the predictive models are working in practical application by consultants (Suttie et al. 2006; Suttie et al. 2014).
Chapter 4. Methods and Findings from Fieldwork

4.1. First Nations Engagement

The Shubenacadie River Valley lies in the heart of Mi’kmaw ancestral lands, known as Mi’kma’ki. Mi’kma’ki encapsulates all of modern-day Nova Scotia including Cape Breton, as well as Prince Edward Island, central and eastern New Brunswick north of the Saint John River, the Gaspé region of Quebec, the Magdalen Islands, Aroostook County in northern Maine, and southwestern Newfoundland (Confederacy of Mainland Mi’kmaq 2015:15). Figure 7 includes Ktaqmkuk or Newfoundland as one of seven districts of Mi’kma’ki shared with Unama’ki. It is important to recognise that until the early eighteenth century, Newfoundland was not considered to be part of ancestral Mi’kma’ki by many scholars, rather, the ancestral lands of the Beothuk. Permanent habitation by the Mi’kmaq did not occur until after the decimation of the Beothuk population. Others argue that lands of southwestern Newfoundland have been part of Mi’kmaw subsistence patterns well before the arrival of the Europeans. Mi’kmaw title and claim to the lands of modern southwestern Newfoundland continues to be debated (Martijn 2003).

The Shubenacadie River Valley crosses through two of the seven regional districts of Mi’kma’ki. Sipekne’katik, “the wild potato area”, comprises the majority of the proposed study area. The Shubenacadie River, which is the Anglicization of Sipekne’katik, has its headwaters at Tlaqatik “at the encampment” (Shubenacadie Grand Lake). This portion of the study area is located in the district of Eskikewa’kik, “the skin dressers territory” along with the chain of lakes leading to Kjipuktuk (Halifax Harbour) “the great harbour” (See Figure 2; Confederacy of Mainland Mi’kmaq 2015:16).

The Archaeology Research Division at KMKNO was first contacted on 18 April 2018 to communicate my research scope for this project and to inquire as to which First Nations communities I should engage with, as the study area encompasses a large geographical area. Email correspondence and phone conversations with KMKNO Staff Archaeologist Heather MacLeod-Leslie and Kaitlyn MacLean resulted in KMKNO’s expressed interest in my project. If a future shovel testing program is to be developed, KMKNO wishes to be actively involved and they wished to be updated throughout my research process. Finally, a final copy of Heritage Research Permit report A2018NS049
was emailed to KMKNO-ARD on 13 April 2019 asking for any comments or potential concerns. Minor comments were amended before including them in this thesis.

On 20 August 2018, on recommendation by KMKNO, Sipekne'katik First Nation's Chief Michael Sack and Consultation Coordinator Mike Campbell were contacted to discuss research intents and address possible concerns about this research project as well as to seek participation and involvement. Several of my follow up emails and phone calls went unanswered. On 14 May 2019, I delivered a hardcopy of HRP report A2018NS049 along with a cover letter addressed to Chief and Council, to the Chief's administrative assistant. Included within the cover letter was a request for feedback or concerns so that I might include them in this thesis. As of December 2019, no response had been received.

Figure 7. Map of the Mi'kmaw districts and their approximate boundaries in Atlantic Canada (adapted from The Confederacy of Mainland Mi'kmaq 2015:11).
4.2. Maritime Archaeological Resource Inventory

I first accessed the Maritime Archaeological Resource Inventory (MARI) database in May 2018 to illicit information on known sites registered with components attributed to the Paleo-Indian Period in Nova Scotia noted on the MARI forms themselves. The MARI database is a restricted access inventory of registered archaeological sites within the Maritime Provinces. Within the Shubenacadie watershed area, three sites were identified. The first BfCv-03, is located in Grand Lake, near the headwaters of the Shubenacadie River. This site is part of multi-component sites with spurred scrapers identified as distinctly Paleo by Preston (1974). The second is an isolated find 3 kilometres away near the outlet of the Rawdon River located between BfCv-17 and BfCv-18. The third site, BeCv-14, represents an isolated fluted preform made of “Debert brecciated chert” recovered from Dartmouth, above Red Bridge Pond. Within Nova Scotia, in total, 32 sites with Paleo-Indian components are currently registered within the database, 12 of which are south of the Debert-Belmont Site Complex (Figure 8).

Figure 8. A generated map depicting known sites and isolated finds within the MARI database attributed to the Saqiwe’k L’nu’k or the Paleo-Indian Period in Nova Scotia. The location of the Debert-Belmont Complex is circled in yellow. Basemap by Stamen.
4.3. Identifying Paleoshores in a Modern Landscape

The creation of glacial lakes leaves lasting scars that can be still visible on the modern landscape. Depending on the period of consistent water levels, shorelines can appear either faintly or deeply scarred. The use of LiDAR elevation data increases the visibility of these scars and is the most practical identification method for large areas (Ralph Stea, personal communication 2018; Breckinridge 2013; Fisher 2005).

In the field, strandlines are often identified by a break in slope above a lowland plain. This break represents sustained water levels that carve features such as terraces, beaches and wave cut cliffs (Breckenridge 2013:385). The final stage of identifying a paleoshore is soil stratigraphy analysis. Coring of these breaks should exhibit fluvial sediments covering a buried organic layer. In the case of Stea’s coring results of the paleoshores of Glacial Lake Shubenacadie II in Shubenacadie East, fluvial sediments were recorded beginning near the surface to an average depth of 2 metres covering an organic layer. Carbon dates produced from the base of the peat layer resulted in a date of 10.8 ka predating the mean Debert occupation by several hundred years (Stea and Mott 1998; Stea 2018).

4.4. Predictive Model Development

Developing a paleoshoreline predictive model for Shubenacadie River Valley during the Younger Dryas cooling event for archaeological impact assessments is the goal of my research. A working GIS-based predictive model will highlight possible activity areas that are not always visible on the ground during field reconnaissance due to numerous factors. Tree cover, gradual elevation changes, historic land alterations and unknown hydrological histories are just a few examples that can affect how prominent paleoshores appear in the field. A predictive model for Glacial Lake Shubenacadie II is one possible way to ensure the protection of previously unknown heritage resources. A base predictive model can serve as a starting block for future academic research to challenge our current understanding of land use through this little-understood time period. This can be done by combining several readily available data sets and testing the predictive model through field surveys to prove its effectiveness and practicality in the field (Ralph Stea, personal communication 2018; Breckinridge 2013:393; Suttie et al. 2006; Legg and Anderton 2010).
To begin plotting an initial beta shape file to delineate areas for closer examination, Quantum GIS 3.4 (QGIS) in conjunction with Grass 7.6.1 was used with spatial data from the Nova Scotia Topographic Database-Landforms 10K scale topographic vectors. With this base map, I isolated the 30-metre topo line to trace and generate an initial polygon. This polygon represents Stea’s (2011) hypothesis of lowlands inundated by flood waters below 30 metres above modern sea level in the Shubenacadie River Valley and for the entire predicted bounds of Glacial Lake Shubenacadie II.

After I created of the polygon, my initial observations proved promising. The 30-metre polygon in the Musquodoboit, Shubenacadie, Stewiacke rivers and their numerous tributaries created an unbroken perimeter with new outflows into Halifax Harbour and the Musquodoboit Harbour. Subsequently, I used satellite imagery to omit as many unnatural causes for elevation changes as possible, such as roadways and onramps, replacing them with a simple line connecting the nearest observed natural nodes as the original elevation changes are likely disturbed and unknown.

All LiDAR tiles freely available on the GeoNOVA DataLocator Elevation Explorer were downloaded covering approximately 70% of the entire glacial lake bounds with more than 90% coverage of the Shubenacadie Valley (Figure 9). The individual LiDAR tiles cover an average of 8,000 metres by 5,700 metres, with several areas of lesser coverage. These surveys were conducted during 2011-2014 and 2017. Resolution of the rasters is becoming increasingly higher by the year and each of these files includes a 1-metre DEM made available with an unrestricted data licence. In the areas covered by LiDAR, I adjusted the initial 30 metre 10K polygon in areas where obvious discrepancies were easily observed as the DEM is understood to be the most accurate elevation data available.

To formulate the data necessary to create the desktop predictive model for encountering glacial lake strandlines, I consulted the MARI database to identify known precontact sites with Paleo-Indian Period components in the Shubenacadie River Valley region that were located within the 30-metre polygon (Legg and Anderton 2010). This resulted in the identification of three known sites. No sites were identified in the database within either the Stewiacke or Musquodoboit River Valleys. This absence of
known sites is likely due to the lack of previous archaeological research within the region rather than lack of activity as multiple sites have been recorded further south.

When comparing the UTM site locations provided in the MARI database for BfCv-03, located in Grand Lake near the headwaters of the Shubenacadie River, it is apparent that this site is well below 30 metres in elevation at 14 metres (Figure 10). Likewise, the isolated find of a spurred scraper located further south towards the confluence of the Rawdon River and Shubenacadie Grand Lake between BfCv-17 and BfCv-18 is also located well below 30 metres in elevation at approximately 17 metres in elevation using Google Earth Pro and near 15 metres using Provincial topographic lines (Figure 11). Unfortunately, the exact find location is unknown and the streambed where it was found was likely a secondary context. Therefore, the elevation data can be perceived as unreliable for creating a model. No LiDAR tiles are available for this location for me to further assess the presence of shoreline scaring or to provide increased elevation accuracy.

Rather than disproving the application of the 30-metre model, there are several possibilities as to why these sites are at a lower elevation. In comparison, I reviewed all the 16 Paleo sites recorded in the MARI Database for the Debert-Belmont site complex. These sites were recorded above 15 metres, with all but two sites located above 20 metres on ridges above a former glacial lake. Some sites were recorded over 1,000 metres from the nearest present-day navigable watercourse. The elevations recorded from these site locations are more than significant. This suggests that the glacial landforms above a specific elevation were once considered lucrative activity areas during the Early Paleo-Indian Period. Areas below 15 metres, which are closer to current watercourses in the region, would have been less desirable during the time of glacial lake formation and subsequent collapse. This also infers that a similar site elevation comparison to aid in prediction of Paleo activity areas can also be conducted for other regions in Nova Scotia.

In the Shubenacadie Valley, several discrepancies with the existing known sites may prevent the proofing of the 30-metre model against known sites in a similar manner as Debert. These discrepancies include, but are not limited to, the misidentification of artifacts, possible recording errors when coordinates were taken before the implementation of hand-held GPSs, and the lack of identified sites within the region.
Spurred scrapers, the only known diagnostic lithics with possible Paleo origins found within the Shubenacadie Valley, are a typology frequently found in both Paleo and Late Woodland Period contexts (Dickenson 2001). This is problematic for correlating occupation dates with elevation data. Dickson notes that scrapers from both BfCv-03 and between BfCv-17 and BfCv-18 are likely Late Woodland Period (2001) and not Paleo in-origin as Preston originally notes on his MARI forms.

Figure 9. The LiDAR tiles available for the study area. Areas of the Shubenacadie, Stewiacke and Musquodoboit Valleys below 30 m are highlighted by a blue polygon. This polygon represents the maximum flooding extents of Glacial Lake Shubenacadie proposed by Stea (2011). Basemap by Stamen.

The third site BeCv-14, representing an isolated find of a single fluted-preform above Red Bridge Pond in Dartmouth, offers a unique problem for its provenance as it was interpreted to be recovered from a secondary fill deposit. The find site itself is located at approximately 27 metres above sea level via Google Earth Pro, close to Stea’s (2011) maximum flooding extents (Figure 12). The possible source of this fill’s
location is well above 30 metres. LiDAR tiles are not freely available for this area to determine more exact elevations or to determine evidence of stable shoreline scaring. However, in any case, the identification of shorelines may not be possible due to the amount of development in the area. This find offers the most concrete diagnostic information and lithic material suggests that it dates to occupation of the Early Paleo-Indian Period Debert site. Although determining the primary context may never be achievable, this provides evidence of finding intact sites further in distance and elevation from current watercourses. These are areas not generally considered during archaeological consulting to be of elevated archaeological potential for encountering First Nations heritage resources.

Figure 10. The location BfCv-03 (red star) in relation to the 30-metre maximum model (translucent blue). Basemap by Google.
Figure 11. The approximate find location of the spurred scraper (red star) in relation to the 30-metre maximum model (translucent blue). Basemap by Google.

Figure 12. The location of BeCv-14 in relation to the 30-metre inundation model. Basemap by Google.
4.5. Desktop Survey

The next step in my research design was to analyse the 30-metre model to determine its effectiveness in highlighting potential areas for encountering visible paleoshores in the field. For this analysis, only areas within 4 kilometres of the current course of the Shubenacadie River were examined. I identified a small sample of ten areas of high potential for intact paleoshores (Figure 13). For ease of description, these sites were named Putman Road (South Maitland), Saddle Road (Urbania), Lonsdale Farm (Rines Creek), Lightle Hill (Stewiacke), Wildlife Park (Shubenacadie East), Beyeler (Milford), Greenland (South Maitland), Whidden Farm (Riverside), Parker Brook (Rines Creek), and Red Brook (Riverside). For elevation accuracy, only areas with freely available LiDAR tiles were considered. Some reflection was given to areas that may be lucrative for encampment and resource collection during the Paleo-Indian Period; however my main focus was to identify areas of heavy shoreline scaring and to record their elevations to evaluate and use this data to further improve the model (Table 2.

Desktop survey results).

My analysis of all ten high potential areas resulted in an average elevation of 28 metres for the identification of visible shoreline scaring (Figure 14). Of the ten areas, six were identified at 27 metres, making it the most consistent elevation. Difficulties arose in finding distinct points to recover elevation data from in some areas. Stea (personal communications 2018) stated that these shorelines would likely be very subtle, yet he believed that LiDAR would increase the likelihood of identifying scaring. The consistent elevations of these scars suggest these are likely to be the short lived paleoshores of Glacial Lake Shubenacadie II.
Figure 13. Locations of the 10 sites identified through the desktop survey as high potential for encountering visible palaeoshores on the ground. The 30-metre maximum inundation model is in blue. Approximate ice extents adapted from Stea (2011). Basemap by Stamen.
<table>
<thead>
<tr>
<th>Site Name</th>
<th>Community</th>
<th>UTM Coordinates</th>
<th>DEM</th>
<th>Distance to Nearest Navigable Watercourse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Putman Rd.</td>
<td>South Maitland, Hants Co.</td>
<td>20 T 464018 E, 5011001 N</td>
<td>30 m</td>
<td>155 m</td>
</tr>
<tr>
<td>Saddle Rd.</td>
<td>Urbania, Hants Co.</td>
<td>20 T 467947 E, 5004707 N</td>
<td>27 m</td>
<td>502 m</td>
</tr>
<tr>
<td>Lonsdale Farm</td>
<td>Rines Creek, Hants Co.</td>
<td>20 T 469320 E, 4999127 N</td>
<td>27 m</td>
<td>130 m</td>
</tr>
<tr>
<td>Lightle Hill</td>
<td>Stewiacke, Colchester Co.</td>
<td>20 T 472339 E, 4996081 N</td>
<td>27 m</td>
<td>250 m</td>
</tr>
<tr>
<td>Wildlife Park</td>
<td>Shubenacadie East, Colchester Co.</td>
<td>20 T 469554 E, 4992963 N</td>
<td>27 m</td>
<td>483 m</td>
</tr>
<tr>
<td>Beyeler</td>
<td>Milford, Hants Co.</td>
<td>20 T 464951 E, 4989920 N</td>
<td>28 m</td>
<td>1,860 m</td>
</tr>
<tr>
<td>Greenland</td>
<td>South Maitland, Hants Co.</td>
<td>20 T 5009767 E, 464506 N</td>
<td>27 m</td>
<td>115 m</td>
</tr>
<tr>
<td>Whidden Farm</td>
<td>Riverside, Colchester Co.</td>
<td>20 T 470148 N, 5003355 E</td>
<td>27 m</td>
<td>1,060 m</td>
</tr>
<tr>
<td>Parker Brook</td>
<td>Rines Creek, Hants Co.</td>
<td>20 T 466599 N, 5000404 E</td>
<td>28 m</td>
<td>371 m</td>
</tr>
<tr>
<td>Red Brook</td>
<td>Riverside, Colchester Co.</td>
<td>20 T 467961 N, 5006869 E</td>
<td>28 m</td>
<td>360 m</td>
</tr>
</tbody>
</table>
Figure 14. Possible shoreline scaring (arrows indicating faint terraces) in relation to the 30-metre DEM and 30-metre contour shoreline models located near the Wildlife Park site. LiDAR freely sourced from GeoNOVA.
4.6. Field Reconnaissance

Five out of the ten high potential areas highlighted during the desktop survey were selected for a field reconnaissance. These five site locations were carefully chosen based upon landowner permissions, accessibility, safety, and perceived visibility over a large area. Sites were not ranked for their archaeological potential. These sites were Putman Road (South Maitland), Saddle Road (Urbania), Lonsdale Farm (Rines Creek), Lightle Hill (Stewiacke), and Wildlife Park (Shubenacadie East).

All areas were assessed using the 30-metre maximum inundation model to highlight areas for encountering potential intact paleoshores and the elevations were recorded using a single Garmin GPSMAP 64s GPS Unit with GPS GLONASS and WAAS/EGNOS enabled. This resulted in a margin of error of less than 5 metres. All areas were visited between October 2018 and December 2018.

Lightle Hill

The first of the five high potential areas I visited to test the 30-metre model was Lightle Hill, located in Stewiacke near the Saint Andrews River (Figure 15). The study area is a largely open hayfield. Discussions with the landowner indicated that the field has not been recently cultivated. This area has been a hayfield and pasture for more than 50 years, being spared from extensive modern ground disturbing cultivation practices.

The survey began west of the point flagged as high potential for encountering intact paleoshores. An historic road alignment, now used as an ATV trail, was followed along the river eastward on the intervale. This trail has exposed brown medium fine silty sand with cobbles near the river’s edge becoming a brown fine very silty sand with few pebbles moving further west away from the riverbed. This is evidence of past flooding within the interval. However, discussions I had with the landowner suggest that, within recent memory, the river has not overflowed its banks onto the intervale. No visible flood damage was observed on any of the trees within the study area. To the north of the road an abandoned river channel is present and is now a large wetland suggesting that the river is meandering southward away from the ridge.
Continuing west above the intervale, the landscape rises into a terraced ridge (Figure 16). Here, halfway up the ridge, the ATV trail has exposed a course brown nearly pure sand with very little inclusions (Figure 17). The handheld GPS elevation of this deposit is 20 metres above sea level with an accuracy of +/- 5 metres. This sand deposit continues up the ridge to the top, becoming pebblier. The elevation recorded at a visible break in slope on the ridge was recorded at 24 metres als +/- 5 metres.

At the top of the ridge to the east of the road there is a mature spruce stand. This stand conceals a dry laid stone cellar measuring 3 metres by 6 metres and 1 metres deep. A later examination of the 2014 LiDAR available through the GeoNova database suggests that a possible well is located approximately 30 metres west of this cellar.
Figure 16. A view along the ATV trail at Lightle Hill from the intervale, with the ridge and site of potential palaeoshore in the distance (yellow arrow). Looking northwestward.

Beyond the ridge, the pastureland continues, transitioning into a relatively uniform slow-rise to the north. Exposed soils above this point are a red-brown pebbly sandy clay. I followed the road above the 30-metre model buffer and soils continued to be a sandy clay with no significant sand deposits. Moving eastward into the tree line, the landscape remains relatively level and is likely an oldfield. Here, the forest is comprised of mature hardwoods, predominantly maples, on leaf litter substrate. No soils are exposed in this area. Following the ridgeline in this area back towards the west, a deep, well developed brook with large cobble substrate carves a small ravine in the ridge flowing south toward the river.
Figure 17. A nearly pure sand deposit located midway up the ridge at 20 metres asl +/- 5 metres.

Saddle Road

The second area I flagged for reconnaissance is Saddle Road in Urbania (Figure 18). This area is largely overgrown agricultural land and regenerated immature spruce now in possession of the Crown. Several areas show signs of past forestry activity. Saddle Road transitions into a gravel woods road, which was driven halfway to the study area until it became impassible by car. However, walking in provided the opportunity to cross the 30-metre model twice in an area unflagged during the desktop survey.

Here, the survey began along a forestry road to the west of the area flagged as high potential for encountering intact paleoshores using the desktop model. The road is
hemmed with semi-mature spruce with intermittent pockets of immature hardwoods underlain with sages and rhodora. Moving eastward, the first 30-metre buffer we encountered was marked with a noticeable decline towards a culverted brook and pond. Here, possible shoreline scaring was identified at 25 metres+/- 5 metres on the GPS at either side of the brook, however, is very subtle and could be easily be interpreted as a typical ravine with slight terracing. No exposed soils were noted in this area.

As we move further east towards the flagged area, red-brown pebbly silty sands are exposed on the road above the 30-metre buffer. Here the road follows slightly above the buffer above the ridgeline. No significant sands or alluvial deposits were noted. To the north of the road is an old clear-cut block with dense pockets of immature spruce. Visibility of the terrain in this area is difficult due to the amount of forestry disturbance. In the distance, the terrain can be seen rising again forming a distinct hardwood ridge.

Figure 18. The Saddle Road study area with the 30-metre DEM and 30-metre contour model. LiDAR freely sourced from GeoNOVA.
To the south of the road, a predominantly hardwood covered ridgeline drops into a large ravine. Here, a relatively flat, well-drained terrace with a possible paleoshore is recorded at 29 metres asl +/- 5 metres. Just above the drop, red-brown pebbly silty sands with a slightly higher sand content than on the road were observed. No sand or alluvial deposits we observed on the ridge above or below the suspected paleoshore.

**Lonsdale Farm**

The third area I had flagged for reconnaissance was Lonsdale Farm in Rines Creek (Figure 19). This area is located at the base of several moraines, currently occupied by a small family dairy farm overlooking the confluence of the Shubenacadie and Stewiacke rivers. It has been cultivated and subject to crop rotation for at least the last 100 years. The open nature of this study area allowed the terrain to be viewed unobstructed and allowed a large area to be covered.

![Figure 19](image)

Figure 19. The Lonsdale Farm study area with the 30-metre DEM and 30-metre contour model. LiDAR freely sourced from GeoNOVA.
The survey began in the southwest corner of the study area in a well-drained hayfield. Soils exposed in this area are highly disturbed medium brown very silty clay sand with very few inclusions. It is evident that, due to the amount of modern cultivation, observing intact sand or alluvial deposits is not possible. It is also likely that shovel testing would not reveal undisturbed deposits. Although faint and likely modified by cultivation, a distinct ridge line is visible at a recorded elevation of 24 metres asl +/- 5 metres runs northward paralleling the river (Figure 20). This suspected paleoshore is identified by a distinct scar above a relatively flat area. The survey continued along this ridge line with the elevation being recorded at several intervals between 22 and 24 metres asl +/- 5 metres.

![A suspected paleoshore recorded at 24 metres above sea level.](image)

The survey then moved north into a recently cut cornfield. Here, the soils are also highly disturbed with very few inclusions. No significant cultural materials were observed within the area covered by the cornfield. A faint ridge line running northward can be
seen, however with the amount of cultivation disturbance, it is difficult to discern where it starts or ends and if it is a disturbed paleoshore. Because of this uncertainty, elevations were not recorded in this area.

**Wildlife Park**

The fourth area selected for reconnaissance was the Wildlife Park and Picnic Area in Shubenacadie East (See Figure 14). This location is approximately 900 metres southeast of one of the several sites cored by Stea during his research (Stea 2018; Stea and Mott 1998). This area is part of the Shubenacadie Wildlife park, which has operated as an animal refuge since the 1940’s. Several drumlins hem the park and meltwater channels are still visible with LiDAR and are located above the park that once flowed into Glacial Lake Shubenacadie.

The survey began to the west of the area of flagged as high potential for encountering intact paleoshores. Moving east a paved road passes through the Ducks Unlimited Wetland Centre, characterized by several ponds and a large wetland. Several suspected paleoshores are viewed from the road in the distance surrounding this low wetland like an amphitheatre (Figure 21). Unfortunately, the areas with the most visible shoreline scaring are located within wild animal enclosures and are not accessible by the general public. In particular, the Sable Island horse enclosure directly northwest of the road has a deeply scarred terrace. I could not investigate this area up close at this time. However, an elevation measurement of 22m asl +/- 5 metres was recorded outside of the fence line adjacent to the paleoshores.

Our survey then continued to the picnic area to attempt to get as close as possible to the rear of the enclosure above the paleoshore. Above the enclosure, the picnic area is open, rising eastward cresting near the middle of the park. Closer to the enclosure, a terraced ridge line is located directly east of the fence line at the western edge of the picnic area. This terrace is covered largely by mature spruce and pine on sphagnum moss with the occasional hardwood. Immediately within the treeline, a small berm is present, which is likely from leveling the picnic area. Beyond the berm, the terrace appears to be undisturbed, becoming increasingly wet and poorly drained with sages and tamaracks to the north towards the flagged area. No exposed soils were observed within this study area, however Stea proports that moderately sorted, coarse to
medium sand is recorded close to the surface and is underlain by a continuous layer of fibrous, sedge-moss peat recorded no higher than 30 metres asl within the park (2018).

Figure 21. Paleoshores in the distance hemming in the Park.

Putman Road

The final study area flagged for reconnaissance was Putnam Road in South Maitland (Figure 22). Located on the western bank of the Shubenacadie River roughly 7 kilometres from the river’s outlet with the Minas Basin and near the confluence of the Shubenacadie and Five Mile Rivers. In 1901, the Midland Railway constructed a bridge across the Shubenacadie, and a car bridge was constructed in the 1970’s. Both approaches to these bridges altered the flood plain of Five Mile River several hundred metres south. Abandoned river channels have transitioned into several ponds and a large marsh. The terraced highland above Five Mile River has been the site of pasture lands for at least the past 100 years. This terrace is interrupted by a small rock quarry to the east near the bank of the Shubenacadie River.
The survey began in the parking lot of the Fundy Tidal Interpretive Centre. From here, Five Mile River is visible to the south of Route 236. The abandoned channels have transitioned into large ponds with the entirety of the lowlands in the area being marsh. The marsh is hemmed by severe sandstone cliffs on both the southern and northern extents. The survey then continued west and then east along the former rail cut which now is the part of Station Road and the Fundy Tidal Interpretive Centre. From this point I realized that access to the desktop high potential flagged area would require additional land permissions as the cliff was not safely scalable. Several visits and phone calls to the landowner went unanswered. Therefore, the point was not visited during my survey. However, the Fundy Tidal Interpretive Centre Trail and parking lot offered a sufficient view of the flagged area’s landform features above these cliffs.

The sandstone cliffs are steep in this area and are dominated by mature hardwoods on leaf litter. The cliffs appear to be relatively stable. Significantly waterworn
bedrock is visible paralleling the river suggesting significantly higher water levels. A visual inspection of the rockface was not conclusive for signs of mechanical altering that may have occurred during the construction of the railway, suggesting the cliff face is natural. Aerial photography for this area begins in 1939, thirty-eight years after the construction of the rail bed. Above the cliff face, the terrain transitions into a small relatively flat terrace bordering the cliff’s edge. Behind this terrace, a moderate slope continues until it crests on relatively flat old field. Due to the inability to access the terrace, exposed soils were not assessed (Figure 23).

![Figure 23. Waterworn bedrock is visible several metres above the observation platform built upon a support pier from the 1901 railway bridge.](image)
Chapter 5. Results of Analyses

The paleoecological history of the Shubenacadie Valley during the Younger Dryas (c. 12,900 to c. 11,700 BP) reveals that the ice damming of the Minas Basin resulted in the flooding of low-lying areas of the Shubenacadie, Stewiacke, and Musquodoboit Valleys while creating new outlets in both Dartmouth and Musquodoboit Harbour. This glacial lake is referred to as Glacial Lake Shubenacadie II. Extensive coring by geologist Stea suggests that the maximum inundation level was 30-metres above sea level (Stea and Mott 1998; Stea 2011; Stea 2018).

First Nations peoples occupied the interior of Nova Scotia from at least as early as 13,000 BP during the Saqiwe'k L'nu'k or Early Palaeo-Indian Period, which is best represented by the occupation of Debert-Belmont Palaeo-Indian Complex (Macdonald 1968; Davis and Christianson 1988; Morine Rosenmeier et al. 2012; Crook and Munro 2010; McKillop and MacIntyre 2017:11). Several isolated finds have also been recorded to the south of this complex as far as Yarmouth. One find, the Chambers fluted point, is found within close proximity to the paleoshore of Glacial Lake Shubenacadie II (Davis and Christianson 1988). Mi'kmaw oral tradition and legends suggest that the ancestors of the Mi'kmaq were witness to the catastrophic climatic events of the Younger Dryas stadial and had possibly stayed within the region in small groups on a continuum into the early Holocene (Gloade 2009; Rand 1850:28; Sable 2011:166). The Mi'kmaq continue to have a strong presence in the Valley.

The first European descendant settlers in the Shubenacadie Valley were the Acadians during the late seventeenth to early eighteenth centuries. From this time, the region has sustained itself as largely rural farmland that altered the landscape to increase crop production. The fertile marshlands of the Stewiacke and Shubenacadie Rivers have been reclaimed by an intricate system of dykes containing their floodplains. Currently, the urban sprawl of Metro Halifax has resulted in an increased value of these farmlands subjecting them to expanding development.

The results of my desktop survey identified 10 areas of high potential for encountering intact palaeoshores. The shoreline elevations derived from the DEM for these sites resulted in a mean elevation of 28 metres above sea level, with the most common break in slope being recorded at 27 metres above sea level.
Five areas identified as high potential for encountering intact palaeoshores were selected for reconnaissance based upon site accessibility and landowner permissions. All five areas exhibited signs of paleoshores with varying ground visibility. The average break in slope was recorded at 24 metres above sea level (Table 3). In Stewiacke, a dry laid stone historic foundation with an associated well was identified and a MARI form was completed for this site and submitted to CCH. A report summarizing my findings was submitted to CCH in February 2019 under Heritage Research Permit A2018NS049 and was approved in April 2019.

The data derived from my archaeological reconnaissance and desktop survey suggest that due to its sub-metre accuracy and elevation accuracy within 10 cm, the data from the DEM should be taken as the most reliable for improving upon the desktop model. Common handheld GPS is not suitable for this type of data recording due their significant margin of error (+/- 5m). Because of the currently unknown hydrology factors affecting localized water levels such as prevailing winds, localised isostatics, and proximity to inflows and outflows, which all effect localized water levels, the inundation model will stay at 30 metres above sea level. However, where DEM is available, archaeological attention should focus on elevations 27-28 metres above sea level for evidence of paleoshores. Elevations derived from the DEM are currently being used to develop the most accurate model possible for large study areas and will be submitted to CCH and KMKNO once completed in January 2020 (Figure 24).
Table 3. Summary of the desktop survey and field reconnaissance

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Community</th>
<th>UTM Coordinates</th>
<th>Elevation of Shoreline (DEM)</th>
<th>Distance to Nearest Navigable Watercourse (Desktop)</th>
<th>Ground Visibility of Paleoshores</th>
<th>Elevation of Shoreline in the Field (GPS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Putman Rd.</td>
<td>South Maitland, Hants Co.</td>
<td>20 T 464018 E, 5011001 N</td>
<td>30 m</td>
<td>155 m</td>
<td>High</td>
<td>N/A</td>
</tr>
<tr>
<td>Saddle Rd.</td>
<td>Urbania, Hants Co.</td>
<td>20 T 467947 E, 5004707 N</td>
<td>27 m</td>
<td>502 m</td>
<td>High</td>
<td>29 m</td>
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<tr>
<td>Lonsdale Farm</td>
<td>Rines Creek, Hants Co.</td>
<td>20 T 469320 E, 4999127 N</td>
<td>27 m</td>
<td>130 m</td>
<td>Moderate</td>
<td>21 m</td>
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<td>Lightle Hill</td>
<td>Stewiacke, Colchester Co.</td>
<td>20 T 472339 E, 4996081 N</td>
<td>27 m</td>
<td>250 m</td>
<td>High</td>
<td>24 m</td>
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<tr>
<td>Wildlife Park</td>
<td>Shubenacadie East, Colchester Co.</td>
<td>20 T 469554 E, 4992963 N</td>
<td>27 m</td>
<td>483 m</td>
<td>High</td>
<td>22 m</td>
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</tbody>
</table>
Figure 24. The Wildlife Park study area depicting the improved accuracy of the 30m-model using DEM (blue) rather than Provincial topographical contours (red). LiDAR freely sourced from GeoNOVA.
Chapter 6. Discussion and Conclusion

Archaeological predictive modeling derived from elevation data is an effective and efficient tool for highlighting areas for closer examination in archaeological consulting practice and management of past landscapes in Nova Scotia. It is possible to use this model to highlight locations that should have closer consideration for Early Paleo-Indian Period occupation areas. Without using a model, these areas are likely to be overlooked due to the vastly different landscape and distance from existing navigable watercourses. A DEM derived desktop model can be used to focus attention to paleoshores that are not easily observed on ground.

The results of the desktop survey and archaeological reconnaissance suggest that intact paleoshores are to be found at 27-28 metres above sea level within the Shubenacadie Valley. However, due to regional variations and other hydrological considerations that are currently unknown, a predictive model for the Early Paleo-Indian Period site occurrences should remain at 30 metres above sea level, as originally proposed by Stea, until further archaeological/geological research proves otherwise. LiDAR DEM, if available, should focus on 27-28 metres above sea level identifying paleoshores for archeological predictive modeling purposes prior to conducting field surveys. It is recommended that this 30-metre potential model be considered for all future archaeological assessments within the regions inundated by Glacial Lake Shubenacadie II. Simply using the 30 metre 10K topographic lines is not suitable for predictive modeling and will create inefficiencies in practical applications. Field data using high powered GPS/GNSS receivers with sub-metre accuracy should be used and shared in the future for improvements upon the model.

In the future, to improve upon the model, at least one of the five areas identified during the reconnaissance as having intact palaeoshores should be shovel tested in the future using Debert testing standards for presence/absence of fluvial deposits, in collaboration with KMKNO and Sipekne’katik First Nation, to prove or disprove the accuracy of the predictive model. In particular, the Wildlife Park in Shubenacadie East should be considered due to its proximity to meltwater channels, icefields, and known shoreline deposits. The elevations of these deposits should be recorded with a high-powered GPS/GNSS receiver to improve upon the model’s accuracy.
Developing a working paleoshoreline model written into policy will create a standard of practice for consultants and researchers assessing First Nations archaeological potential in the Shubenacadie River Valley and influence localized predictive model research of past landscapes throughout Nova Scotia. I will use the findings from my research to recommend amended policy standards for consultants to follow while conducting assessments for the potential of encountering First Nations cultural resources. Nova Scotia’s Special Places Protection Act is due to be amended within the next few years. These amendments are expected to address uniqueness of First Nations cultural resources based on cultural, traditional, and archaeological standpoints. Adopting standardized archaeological policies and practices in Nova Scotia is long overdue and is out of step with guidelines required by adjoining province of New Brunswick. Implementations of standardized models will no doubt help protect and mitigate previously unknown First Nations heritage resources and aid to our understanding of how the Saqiwe’k L'nu’k adapted to the climactic extremes of the Late Pleistocene into the beginning of the Holocene.

This research has the capacity to influence policy change and how future archaeology will be conducted in Nova Scotia. This model also demonstrates that archaeologists in Nova Scotia must consider landscape change and glacial landscapes, rather than just the modern landscape, when attempting to determine archaeological potential for the Younger Dryas Early Paleo-Indian Period.
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