City of Windsor Archaeological Management Plan

2024 Update Appendix A:

Pre-contact Indigenous Archaeological Site Potential

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Table of Contents

PROJECT PERSONNEL **117**

ARCHAEOLOGICAL SERVICES INC. (ASI) 117
FISHER ARCHAEOLOGICAL CONSULTING 117

TABLE OF CONTENTS **118**
LIST OF FIGURES **119**
LIST OF TABLES **119**
1 INTRODUCTION **120**
2 BACKGROUND AND THEORY **120**

2.1 SCALE AND RESOLUTION 123
2.2 MODELING CRITERIA 124

3 HUMAN PALEOECOLOGY **126**

3.1 TERMINOLOGY 126
3.2 GEO-PHYSICAL SETTING 126

3.2.1 Bedrock Geology 126
3.2.2 Surficial Geology 127
3.2.3 Hydrography 131
3.2.4 Soils 132
3.2.5 Climate 135

3.3 BIO-PHYSICAL SETTING 138
3.4 CULTURE HISTORY 146

3.4.1 Late Pleistocene/Early Holocene (ca. 13,000 – 11,000 cal BP) 146
3.4.2 Early/Middle Holocene (ca. 11,000 – 5,000 cal BP) 149
3.4.3 Late Holocene (ca. 5,000 – 400 cal. BP) 151

4 ARCHAEOLOGICAL POTENTIAL MODELLING **156**

4.1 INTRODUCTION 156

4.2 ENVIRONMENTAL LAYERS 157
4.2.1 Hydrography 157
4.2.2 Soils 159
4.3 PRE-CONTACT INDIGENOUS MODELLING CRITERIA 160
4.3.1 Late Pleistocene/Early Holocene (ca. 13,000 – 11,000 cal BP) 162
4.3.2 Middle Holocene (ca. 9,000 – 5,000 cal BP) 162
4.3.3 Late Holocene (ca. 5,000 – 400 cal. BP) 163
4.3.4 Trails 164
4.3.5 Summary of Modeling Criteria 164
5 MODEL EVALUATION 165
6 REFERENCES CITED 167

List of Figures

Figure A1: Bedrock Geology 127
Figure A2: Surficial Geology 128
Figure A3: Watercourses and Strandlines 129
Figure A4: Soil Texture 133
Figure A5: Soil Drainage 134
Figure A6: Soil Capability for Agriculture 135
Figure A7: Pollen Diagrams from Sediment Cores, Central Lake Erie Basin (Lewis et al., 2012 – Electronic Supplementary Material) 140

List of Tables

Table A1: Characteristic Tree Species - Site Relationships in Ecoregion 7E 142

1 Introduction

Pre-contact Indigenous archaeological sites in the City of Windsor represent an important heritage resource for which only limited locational data exist. Access to such distributional information is imperative to anyone managing archaeological heritage; however, the undertaking of a comprehensive archaeological survey of Windsor in order to compile a complete inventory is clearly not feasible. The only alternative is a model that predicts how sites are likely to be distributed throughout the city. The model design may vary, depending on such factors as its desired function, the nature and availability of data used in its development, the geographic scope of the project, and the available budget. Ideally these constraints are balanced in order to produce a model of maximum validity and utility.

In the following sections, a model of pre-contact Indigenous site potential is developed for Windsor. It begins with a brief review of the method and theory associated with site potential modelling. A strategy has been selected which employs a descriptive reconstruction of pre-contact landscapes in Windsor together with a reconstruction of pre-contact land-use patterns informed by both known site locations as well as archaeological and ethnographic analogues. This information is brought together in the definition of a list of criteria which are used to define a zone of archaeological potential on GIS-based mapping of the City.

This document makes only general reference to the very rich and varied Indigenous culture history of Windsor, which is thoroughly detailed elsewhere in Indigenous oral and written histories, historical records, academic histories and ethnographies, and archaeological reports and published literature.

2 Background and Theory

Archaeological site potential modelling can trace its origins to a variety of sources, including human geography, settlement archaeology, ecological archaeology, and paleoecology. The basic assumption is that human land use was influenced and constrained by ecological and socio-cultural parameters. If these parameters can be discovered, through archaeology and paleoecology, land-use patterns of the past can be understood.

Two basic approaches to predictive modelling can be described. The first is an empirical or inductive approach, sometimes referred to as correlative (Sebastian & Judge, 1988) or empiric correlative modelling (Kohler & Parker, 1986). This method employs known site locations, derived from either extant inventories or through sample surveys, as a guide for predicting additional site locations. The second is a theoretical or deductive approach which predicts site locations on the basis of expected behavioural patterns as identified from suitable ethnographic, historical, geographical, ecological, and archaeological analogues. While data requirements or availability tend to influence the particular orientation of the study, every modelling exercise will incorporate both inductive and deductive elements. Foremost is the need to employ all available data effectively and expeditiously.

It is important to note that, while those managing archaeological heritage generally prefer to work with specific inventories of resource locations, predictive models do not provide this degree of resolution. Instead, they classify the environment into zones of archaeological potential. Three major factors limit the resolution of our images of the past and hence our ability to predict pre-contact site locations with precision.

First, our knowledge of the structure of the socio-political environment in the past is limited by both the inadequacies of the existing archaeological database and the inherent difficulties in interpreting extinct socio-political systems. With respect to the database, the coverage of archaeological survey in Ontario remains spotty at best. Comprehensive survey, using officially sanctioned methods, has only recently been implemented for three decades in the context of various pre-development approval processes and archaeological management plans. Areas that have been the object of such comprehensive surveys are relatively few. Although coverage in some other areas may be adequate, through the cumulative efforts of both professional and avocational archaeologists over time, there is currently no quantification of this work that would permit analysis of the province-wide quality of coverage. It is known, however, that vast tracts, including most of Windsor, have never been systematically surveyed.

Second, our knowledge of the pre-contact natural environment is limited by both the inadequacies of the existing paleoenvironmental database and the inherent difficulties in interpreting extinct ecosystems. Just as reconstruction of past social environments minimally requires a basic understanding of the structure of pre-contact social networks, so does reconstruction of past natural environments require some minimal direct evidence of the structure of extinct biotic communities. Although evidence from early historic land surveys, pollen cores, floral and faunal remains, and other sources is slowly accumulating, it remains difficult to carry paleoenvironmental reconstruction beyond a relatively general level. As it does in archaeology, stochasticity, or randomness, imposes interpretive limits on the data since the dynamic character of biotic systems makes them increasingly difficult to reconstruct at larger scales. More importantly, it is clear that the distribution of natural resources on the landscape merely constrained rather than strictly determined pre-contact land use.

Third, from a modern perspective it is probably not reasonable to assume that decisions made in pre-contact cultural contexts necessarily followed the same lines of economic logic that we might employ today. People in the past possessed a world view that was both structurally and substantively different than our own. Therefore, our own concepts of rational behaviour may not completely apply to the pre-contact case. Moreover, there are certain classes of sites, for example rock art sites or burial grounds, that were situated primarily for ideological or aesthetic reasons and are therefore impossible to assess using economically based methods of spatial analysis.

In spite of these limitations, predictive modelling efforts to date have proven successful to the extent that they can permit site potential assessments at a level of probability that is useful in the context of heritage resource assessment and planning.

2.1 Scale and Resolution

The portrayal of land use patterns, in either a modern or pre-contact context, must also address the limitations imposed by mapping scales. Specifically, one must consider the requirements of accuracy and resolution of the intended analysis. In southern Ontario, archaeological sites typically range between about 10 and 500 metres in diameter, although most are probably around 25 metres. It is therefore possible to place known sites on existing 1:50,000 topographic base maps, and in fact the Ontario Archaeological Sites Database (OASD) employed this format for many years. In recent years site locations have been increasingly determined through global positioning system (GPS) technology and the OASD is now maintained on a digital geographic information system (GIS) platform.

Whether working with analogue or digital maps for purposes of mapping archaeological sites, one must consider both the accuracy of the base map and the accuracy with which additional features can be added to it. For example, the accuracy ratings of Class A Standard 1:50,000 N.T.S. maps are as follows: horizontal—90% ± 25 metres; vertical—90% ± 0.5 metres of contour interval (Geomatics Canada, 1996, 2003; Surveys and Mapping Branch, 1974, 1976). In other words, a feature mapped at this scale has a 90% chance of being within 25 metres (0.5 mm on the map) of its actual location on the ground. Displacement of archaeological sites, due to inaccuracies of the base map alone, could therefore range from 250% of the site diameter for the smallest sites to 5% for the largest. Additional displacement, stemming from difficulties in accurately relating the site to existing features on the map, can be expected to be equally, if not more, severe. Such distortion may be entirely acceptable in the context of evaluating broad categories of archaeological site potential. In contrast, it would clearly be unacceptable as the basis for locating the majority of sites in the field.

In addition to accuracy, one must consider the implications of generalization that pertain to various scales. Since maps are abstractions of reality, and given the constraints of accuracy noted above, maps at different scales exhibit different degrees of resolution. In other words, a feature visible on a 1:2,000 scale map may be too small to represent at 1:50,000. Resolution standards are arbitrary and subject to cartographic licence, however published guidelines are available. For example, N.T.S. 1:50,000 series maps employ the following minimum dimensions for topographic features: islands—15 metres (width); eskers—500 metres (length); lakes—60 metres (width); marshes—150 metres (width)(Surveys and Mapping Branch, 1974). The ramifications of generalization apply primarily to the utility of various mapping scales as sources of physiographic data. For instance, at a scale of 1:50,000 one might have difficulty relating known sites to all parts of a drainage system since springs and smallest water courses might not be represented.

For purposes of this study, base mapping was developed from a LiDAR-based Digital Elevation Model (DEM) with an error range of ± 0.5 m obtained from Land Information Ontario. This provided very high resolution of all topographic features. Scaling of the soils data to the 1:2,000 base will have resulted in some distortion, since the original soils mapping was compiled at a scale of 1:63,360. Any such distortion was deemed to be acceptable for purposes of this study, given that the original soils mapping depicts relatively gross generalizations.

2.2 Modeling Criteria

A useful analogy can be drawn between the criteria used to construct predictive models and the optical filters used in photography: each is used to clarify an image by screening out nonessential information. In predictive modelling, we seek to improve our image of past land-use patterns by focusing on places with a positive attractive value to humans and filtering out places with a neutral or negative value. Some filters are designed to admit a very narrow spectrum while others are less discriminating. Since the efficacy of each filter is in part determined by what is being viewed, none are truly all-purpose. The best image is often achieved by selectively combining several filters. Proper use, therefore, requires knowledge of both the characteristics of the filters and the proposed context of application.

In Ontario, most criteria for predicting pre-contact site potential modelling can be considered narrow-spectrum filters. The best broad-spectrum filter to date, and by far the most methodologically developed, is the one implemented in the “Ontario Hydro Distance to Water Model,” also known as simply “The Hydro Model” (MacDonald & Pihl, 1994; Peters, 1986, 1994; Pihl, 1986). The success of this model can be attributed to its focus on a criterion that is arguably the most fundamental human resource: water. Regardless of a group's subsistence economy, whether based on hunting herds of caribou or growing corn, it will require access to water. The universality of the need for this resource makes its consideration a logical point-of-departure for most predictive modelling exercises. Having considered proximity to water there are a variety of narrow-spectrum filters that can be considered. Selection of additional criteria will depend on consideration of the context of use as well as a cost-benefit analysis of their application. While the concatenation of various criteria will improve the filtering effect, there will always be residual sites that cannot be isolated by modelling. The objective, therefore, is to implement a logical series of criteria until one reaches a threshold of diminishing returns that is determined by the needs of the particular study.

3 Human Paleoecology

Since the end of the last ice age, the Windsor area has been the stage upon which a series of peoples have acted out the events of human history. For over 13,000 years, Indigenous peoples occupied and exploited the changing landscape of what is now southern Ontario and eastern Michigan adapting to changes in the environment and climate, to the movement of peoples and ideas, and to the introduction of new technologies and new cultures. These adaptations will be tracked from Late Pleistocene hunters through to the Indigenous farmers encountered by European explorers in the seventeenth century.

3.1 Terminology

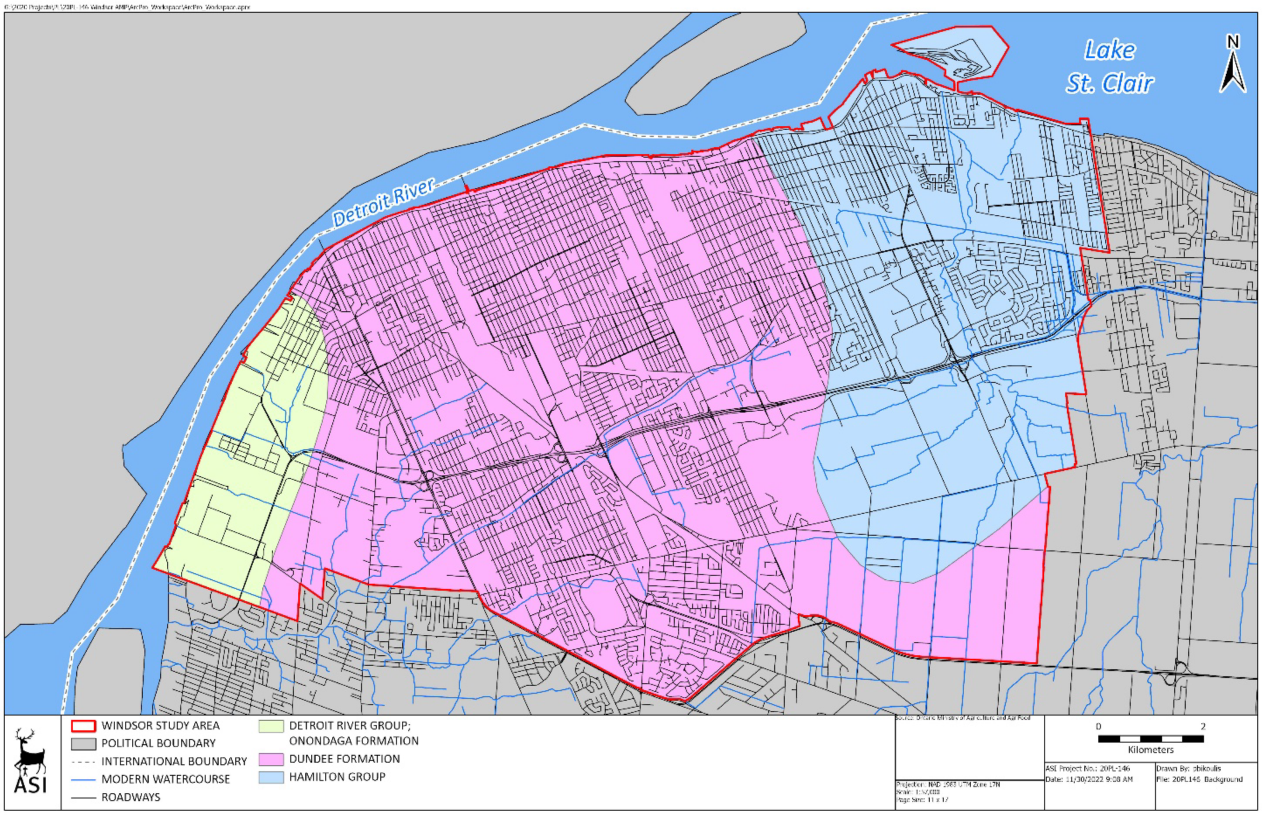
Indigenous peoples have been living in southwestern Ontario since time immemorial, something that is generally not acknowledged or reflected in the archaeological practice of subdividing the past. Discussions in the Ontario archaeological community have started to recognise the sharp divide between Indigenous and archaeological understandings of the past, and to acknowledge the negative effect that certain archaeological terminology has on the ongoing process of reconciliation (Hazell, 2019; Hinshelwood, 2019; Sherratt, 2019; Taylor-Hollings, 2019). In light of this, we will discuss the Indigenous history of southwestern Ontario without reference to the periodization terminology traditionally employed by archaeologists (e.g., Paleo, Archaic, Woodland).

3.2 Geo-physical Setting

3.2.1 Bedrock Geology

Windsor is underlain by sedimentary bedrock which dips gently southward (Figure A1). These Paleozoic rocks are of Devonian age (ca. 359-416 million years). All comprise limestone, dolostone, and shale, and are classified as facies of the Onondaga Formation/Detroit River Group, Dundee Formation, and Hamilton Group. The bedrock surface, which slopes gently to the northeast and exhibits very modest topographical relief, is buried by Quaternary deposits ranging from 30 to 60 metres in depth

Figure A1: Bedrock Geology



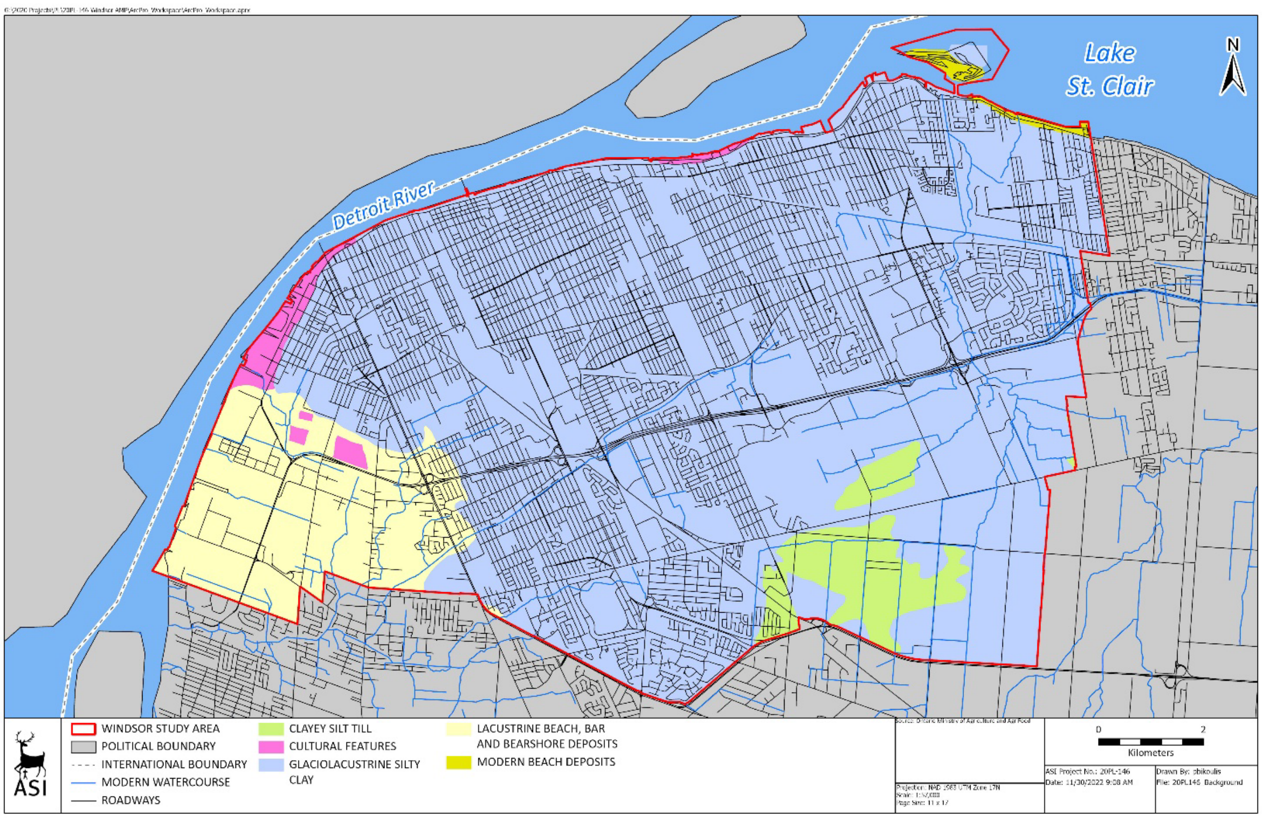
throughout Windsor (Morris 1994).

3.2.2 Surficial Geology

The surficial deposits of Windsor (Figure A2) are Late Pleistocene sediments of Late Wisconsinan age or later. Although underlain by earlier sediments, fine-grained Tavistock till is the oldest outcropping stratum. Morris (1994:26-30) has identified a series of modest recessional moraines in Essex County, two of which extend into

Windsor. The Bryndale moraine is a glacial recessional ridge that trends along a

Figure A2: Surficial Geology

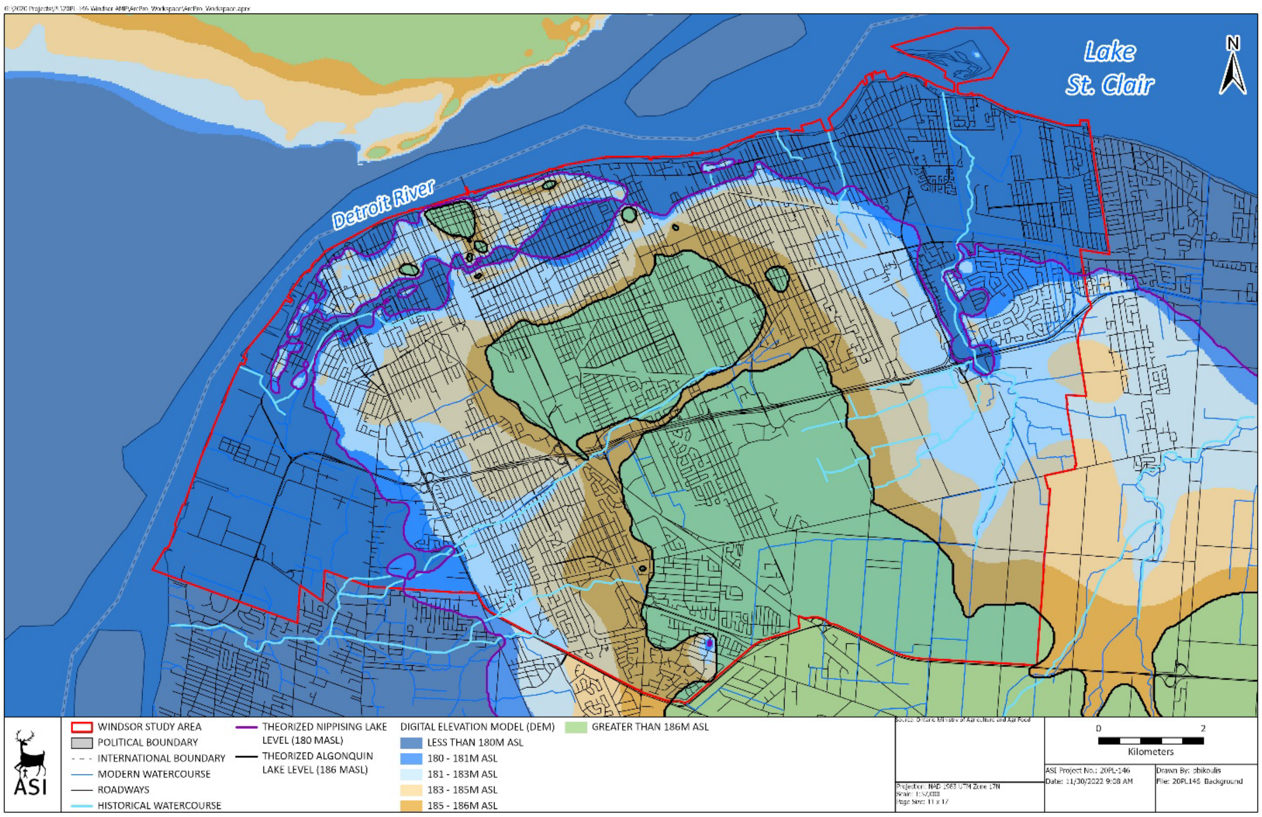


northwest/southeast alignment extending into Windsor east of the airport. Composed of till with a half-metre cap of sand, this feature rises a mere 2.8 metres above the surrounding clay plain. The Elmstead moraine is a similar recessional moraine that extends southward from the airport.

As the Laurentide Ice Sheet withdrew from the Windsor area, it was fronted to the south by glacial Lake Warren and its recessional successors (glacial lakes Wayne, Grassmere, and Lundy) (Calkin and Feenstra 1985; Chapman and Putnam 1984). These pro-glacial lakes capped the Tavistock till with widespread deposits of thinly laminated glaciolacustrine clay and silt.

The inception of non-glacial waters, which marks the beginning of early Lake Erie, occurred around 14,500 cal. BP (Calkin & Feenstra, 1985, p. 163). The evolution of the lake since then is characterized by a complex sequence of fluctuating levels controlled largely by variations of inflow from the Huron basin via Port Huron, and by changes in the controlling outlet sills of the Niagara River attributable to the countervailing effects of erosion and isostatic rebound. Meteorological conditions have also contributed to fluctuations in lake level. Annual fluctuations historically range about a metre on average, although extreme rises of up to 2.4 metres have been recorded. From deglaciation until around 13,000 cal. BP a sill at Fort Erie/Buffalo was in control. Control then switched to the Lyell/Johnson sill located downstream near Niagara Falls, as isostatic rebound raised it to, and eventually about three metres above, the Fort Erie/Buffalo sill. During this time, the main highstand of glacial Lake Algonquin in the Huron-Michigan basin may have contributed waters to the Erie basin raising the water plane to earlier levels and flooding the Windsor area (Figure A3) up to an estimated elevation of 186 metres asl (above sea level) (Lewis et al., 2012; Tinkler et al., 1992). This highstand lasted until about 12,500 cal. BP, when a new outlet at North Bay was established in the Huron-Michigan basin thereby diverting drainage from the upper Great Lakes down the Ottawa River and cutting off flow into the Erie basin. During the resulting lowstand, the Erie basin was a closed system with no outlet and a water plane up to twenty metres lower than today. The overland distance to Lake Erie from Windsor would have increased from roughly twenty to about thirty kilometres, as waters in the western basin shrank in extent and were isolated from the waters in the central and eastern Erie basins. This lowstand lasted until ca. 6,000 cal. BP when climate change, closure of the North Bay outlet, and return of drainage from the upper Great Lakes raised water levels once again through a phase called the Nipissing highstand (Herdendorf, 2013; Lewis et al., 2012; Lewis, 2016; Pengelly et al., 1997).

Figure A3: Watercourses and Strandlines



With the elevation of the Erie water plane controlled by the Lyell-Johnson sill, a highstand in the Erie basin returned, essentially turning the lower Detroit River into a large embayment meeting an expanded river at Windsor (Figure A3). The water plane in the Erie basin is estimated to have been about 180 metres asl (Lewis et al., 2012; Pengelly et al., 1997) while levels in the Huron basin have been calculated at 183.3 metres asl at the Port Huron/Sarnia outlet (Morrison, 2017; Thompson et al., 2011), so Lake St. Clair would also have risen to a level between these elevations during the Nipissing phase. An abandoned channel, situated within 2 kilometres of the Detroit River and likely dating to the Main Algonquin highstand, may have been partially or fully reactivated during the Nipissing highstand. Deposits of lacustrine sand, minor gravel, and sandy silt in beach, bar, and nearshore deposits that occur in southwest Windsor at the terminus of these abandoned channels (Morris, 1994) may have been laid down where this channel discharged into the freshwater estuary (Herdendorf, 2013; Lewis et al., 2012).

This final Lake Erie basin highstand lasted until ca. 3,770 cal. BP when the Lyell-Johnson sill was breached by headward erosion of Niagara Falls. Throughout the last three millennia, water levels in the Erie basin appear to have been largely within the modern range due to the relative stability of inflow and the controlling sill, although isostatic rebound continues to gradually lift the north shore. Meteorologically produced lake-level fluctuations also occur, and significant rises have been suggested for the periods around 2170, 1350, 820 and 430 B.P. again (Herdendorf, 2013; Lewis et al., 2012; Lewis, 2016; Pengelly et al., 1997).

3.2.3 Hydrography

Windsor is drained by three primary and several smaller subwatersheds of the Detroit River (Figure A3). The Little River rises south of the airport and flows northerly to its mouth on the Detroit River at the outlet of Lake St. Clair. It drains an area of about 6,490 hectares, most of which lies within the City of Windsor with the remainder in Tecumseh. Turkey Creek rises along a drainage divide with the Little River, generally west of the airport, and flows westerly to its mouth at Lasalle across from the north end of Fighting Island. This subwatershed of about 6,112 hectares lies mostly within Windsor but also extends into Tecumseh and Lasalle. The 8,993-hectare Pike Creek subwatershed, which straddles the townships of Tecumseh and Lakeshore, drains a tiny portion of eastern Windsor. The remainder is drained by minor watercourses rising along the drainage divides with Turkey Creek and Little River and flowing northerly or westerly into the Detroit River. Also noteworthy is the Canard River, the largest subwatershed in Essex County, which lies immediately south of Windsor and drains an area of 34,776 hectares westerly into the Detroit River at north Amherstburg.

Studies of the St. Clair River delta (Thomas et al., 2006) reveal a developmental history consistent with water level changes in the Huron and Erie basins described above. Flow into Lake St. Clair began depositing deltaic sediments during the Nipissing highstand prior to which this was no flow into the St. Clair River from roughly 12,500 cal. BP to 6,000 cal. BP. The St. Clair delta exhibits two surfaces, an upper one laid down on a much older surface of lacustrine clay dating to about 6,000 cal. BP and a lower, modern surface dating to around 3,770 cal. BP. Contemporary flow through the Detroit River would have been similar.

During the Great Lakes lowstands there would have been lower base levels and flow through the entire Lake St. Clair/Detroit River/Lake Erie system and the Windsor subwatersheds described above. Given that the Holocene lowstands of the Great Lakes were a phenomenon primarily driven by a drier climate, it is expected that all hydrographic features in and around Windsor, including wetlands, shrank or disappeared completely from the early to middle Holocene but were reactivated thereafter.

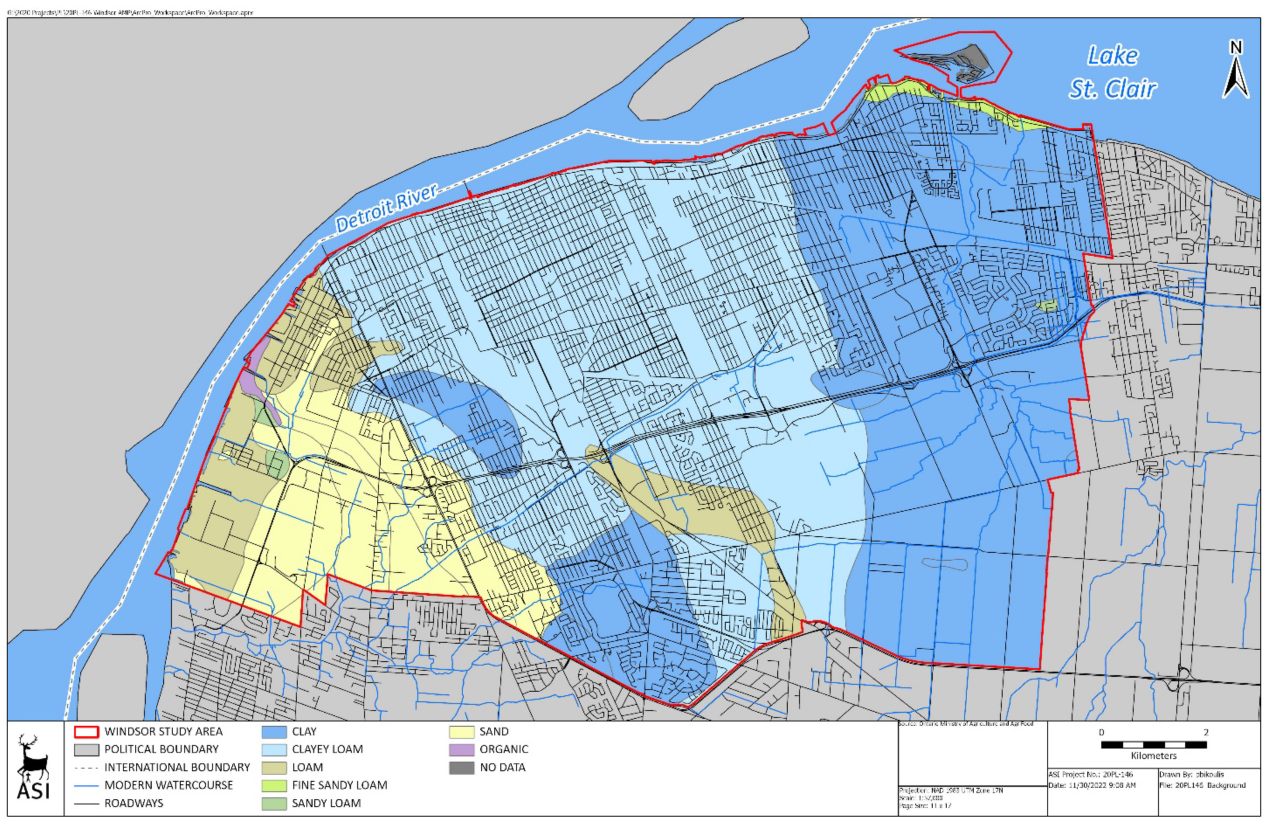
Prior to European land clearance and drainage, it is estimated that wetlands comprised 9,854 ha (82.0%) of Windsor, which is similar to the percent estimate for Essex County (83.4%). As of 2002, it has been estimated that this area had been reduced to 107 ha (0.9%), a loss of roughly 99% from the original coverage. This is above the provincial average for southern Ontario, which is estimated to be on the order of 72% (Ducks Unlimited Canada, 2010).

3.2.4 Soils

Several different soils have developed on the surficial deposits of Windsor (Figures A4-A6). These have been mapped according to 12 soil series together with marsh, bottom land, and unmapped (urban) lands (Richards et al., 1949).

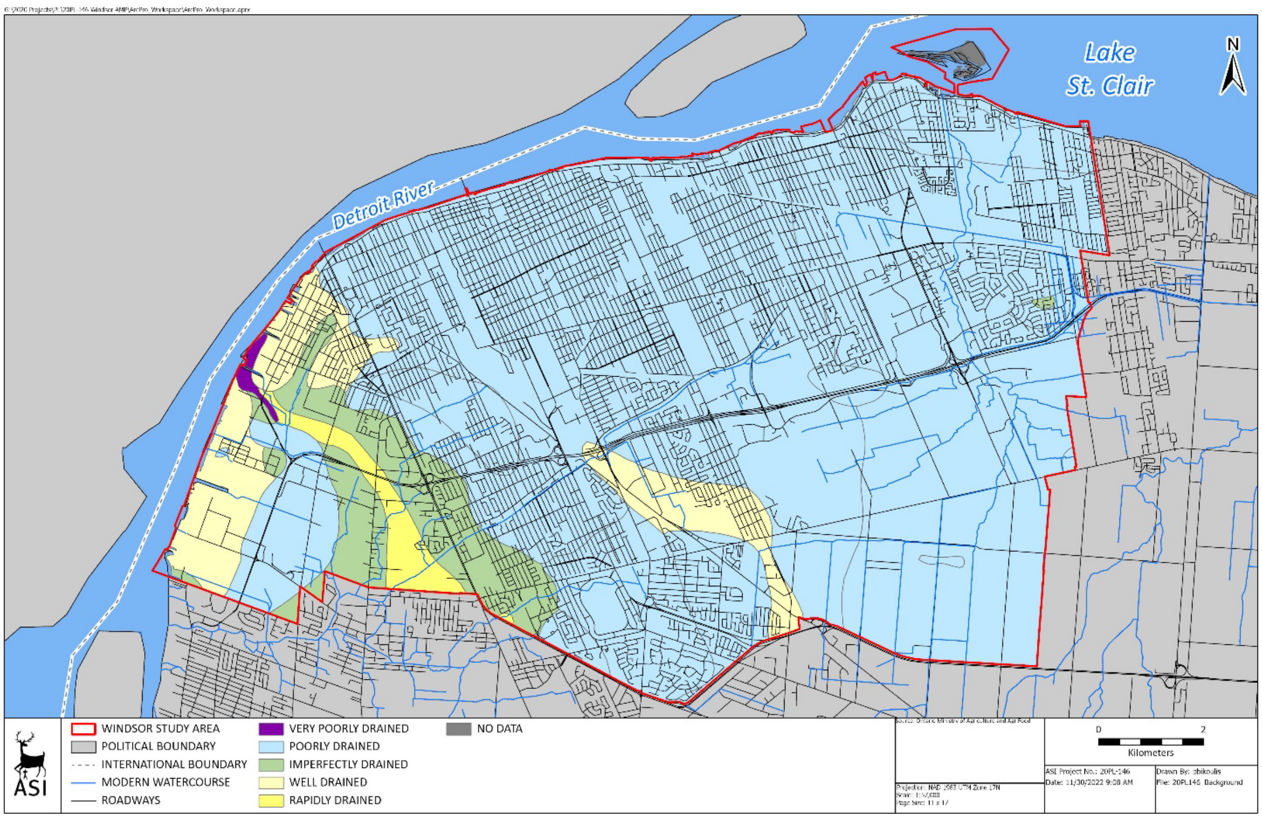
With respect to soil texture, the distribution (Figure A4) is strongly correlated with the geological origins of the parent materials (Figure A2). Fine-grained materials were primarily derived from glacio-lacustrine silts and clays and Tavistock till. Coarser materials were derived from sandy to gravelly lacustrine beach, bar, and nearshore deposits. Heavier soils composed of clays and clay loams are most common, representing about 82% of Windsor, while coarser sands, sandy loams, and gravels only comprise about 17% of mapped soils. The coarser soils mostly occur on the west side of Windsor within the former Lake Erie highstand embayment discussed above. There is also some sand capping the Bryndale and Elmstead moraines. Heavier texture clays and clay loams occur throughout most of central and eastern Windsor.

Figure A4: Soil Texture



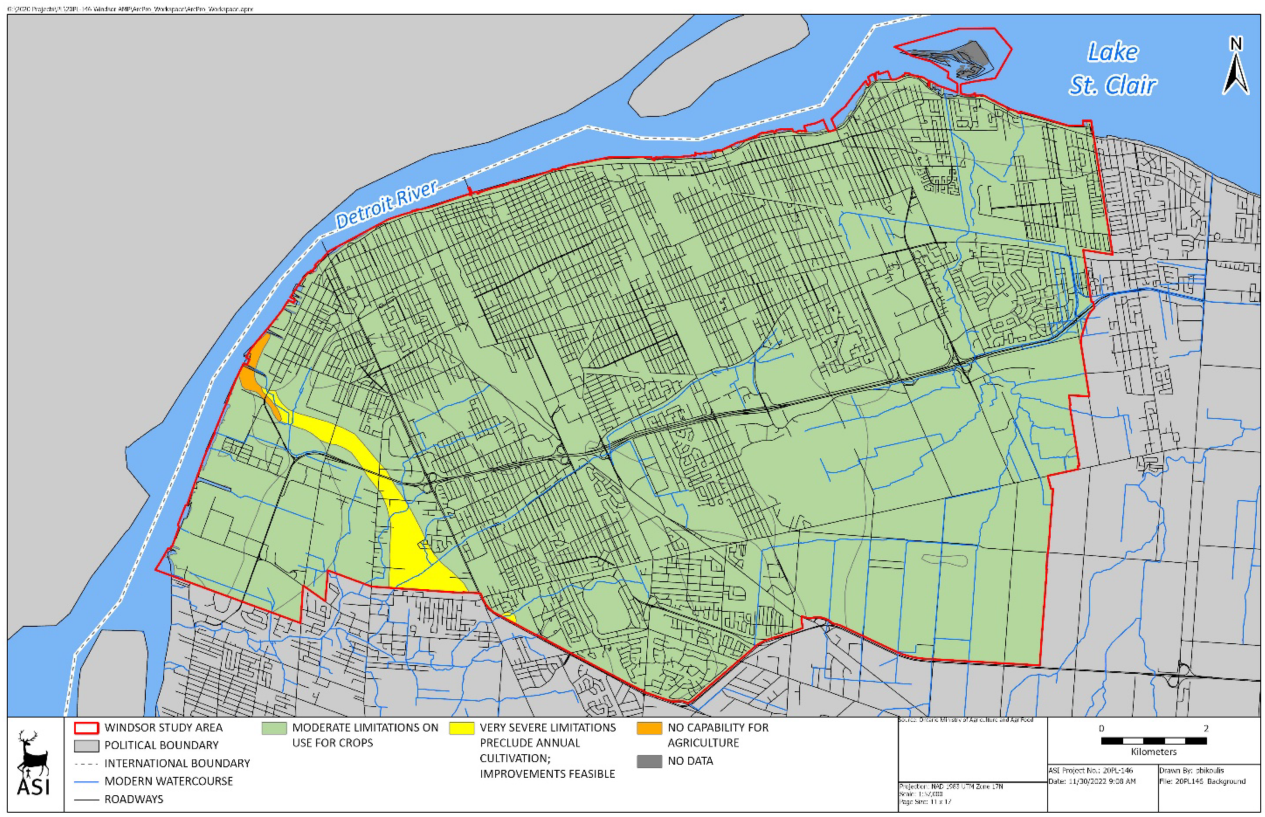
The generally low relief and high density of the surficial deposits has produced soils in Windsor that are predominantly imperfectly to poorly drained (83%). By drainage class they break down as follows: rapidly drained (0.3%), well drained (1.2%), imperfectly drained (14%), poorly drained (82.6%), very poorly drained (0.03%), variably drained bottom land (0.1%) and a mix of lands without soil classifications, (1.3%) (Figure A5). The well and imperfectly drained soils are mostly situated on the coarse lacustrine sediments and moraines. The remaining soils are mapped as poorly drained.

Figure A5: Soil Drainage



The Canada Land Inventory (Canada Land Inventory, 1965) rates 98% of Windsor as arable farmland (Figure A6). Most of this mapped as Class 2 with moderate limitations to agriculture arising from low fertility (14%) or excess moisture (84%). Only 1.5% is rated Class 7 with severe limitations due to excess moisture.

Figure A6: Soil Capability for Agriculture



3.2.5 Climate

The climate of southern Ontario is described as having warm summers, mild winters, and a long growing season with usually reliable rainfall. Precipitation is fairly evenly distributed throughout the year. Regional climatic variations are due primarily to elevation and topography, prevailing winds, and proximity to the Great Lakes. Year to year variability is attributable to the nature and frequency of weather systems which cross the area (Brown et al., 1980, pp. 1–2).

The fossil pollen record provides an outline of the regional paleoclimate (Byun et al., 2021). After adjustments are made for the differential dispersion of pollen by various plant species, a reconstruction of the prevailing climatic conditions through time can be undertaken on the basis of the preferred habitats of those species, especially trees.

During the period of initial deglaciation (ca. 14,000 cal. BP), a harsh climate characterized by cool and extremely dry conditions prevailed throughout southern Ontario. Mean annual temperatures were probably less than -3° Celsius (McAndrews, 1981). Some have attributed these low temperatures throughout the Great Lakes-St. Lawrence region to the inflow of large volumes of glacial meltwater or proglacial lake water (Lewis et al., 2008; Lewis & Anderson, 1989). However, more recent research suggests that the residual Laurentide Ice Sheet north of the Great Lakes continued to affect the climate by favouring the flow of cold dry Pacific and Arctic air masses across the basin thereby blocking the northward flow of moist subtropical air masses leading to a much cooler and drier climate through the early to middle Holocene (Lewis, 2016). This resulted in a protracted lowstand throughout the Great Lakes watershed between roughly 12,300 and 8,300 cal. BP (Lewis, 2016; Lewis et al., 2012).

After about 8,300 cal. BP, the regional climate became more moderate, experiencing warmer mean annual temperatures and greater precipitation (Lewis, 2016). At their maximum, during this Holocene Climatic Optimum (also known as the Altithermal or Hypsithermal), temperatures probably exceeded present levels by 1° to 2° Celsius. It is unlikely, however, that this climatic amelioration was sufficient to affect the zonal vegetation (McAndrews, 1981). Essentially modern mean annual temperatures and precipitation levels were reached by around 7,000 cal. BP.

Climatic trends and fluctuations play a significant role in determining the character of the natural environment to which human populations must adapt. As the shift in climatic conditions which occurred following deglaciation was very gradual, the concomitant changes which were necessary to the subsistence modes of Indigenous populations were also gradual. While long-term climatic trends did not directly influence the subsistence practices of a population in the short term, there are many short-term climatic factors that had significant implications for local settlement-subsistence practices, the most critical of which were temperature, precipitation, potential evapotranspiration, frost-free days, snowfall, and wind-speed and direction. Short-term climatic irregularities may have been most keenly felt during the last millennium before European contact, as Indigenous groups became increasingly reliant upon agriculture to supplement their dietary requirements.

The number of frost-free days, which represents the effective length of the growing season for agriculture, would have been of importance to Indigenous horticulturalists. The mean length of the frost-free period is about 165 days in the Essex and Kent counties area (Brown et al., 1980, p. 60), which is more than adequate for traditional Indigenous agriculture. Moreover, Windsor lies within the 3300-3500 range for corn heat units (CHU), a measure of capacity for corn maturation based on maximum and minimum daily temperatures. Grain corn is typically grown in areas exhibiting >2500 CHU, while corn can be grown for sileage in areas of only 2100 CHU (Brown et al., 1980, pp. 37–38).

The mean annual precipitation in the Windsor area is about 76 centimetres, with monthly means fairly evenly distributed at about 65 millimetres. The Essex and Kent counties area has the shortest period of snow cover in southern Ontario, with a median of 42 days and a typical maximum cover of 36 cm. Factors influencing precipitation at the mesoclimatic scale in southern Ontario are slope, elevation, proximity to the large lakes, and the prevailing winds (Brown et al., 1980, p. 39). The last two variables exert considerable influence on local precipitation patterns. For Indigenous horticulture, the amount of precipitation during the growing season would have been sufficient in Windsor, ranging around 35 centimetres.

The relatively flat topography of Windsor and its proximity to large bodies of water would have moderated climatic variability across the City on an annual basis, however climatic conditions have been far from constant over the last millennium. Of particular importance is a climatic period characterized by cooling and referred to as the "Little Ice Age" (Bryson & Murray, 1977; Grove, 2004). This episode, which is conventionally dated to between A.D. 1550 and 1880, may have reduced average daily temperatures in southern Ontario by about one-half degree Celsius. In addition, early fall temperatures may have been reduced by about 1.5 degrees Celsius (Bryson & Murray, 1977).

3.3 Bio-physical Setting

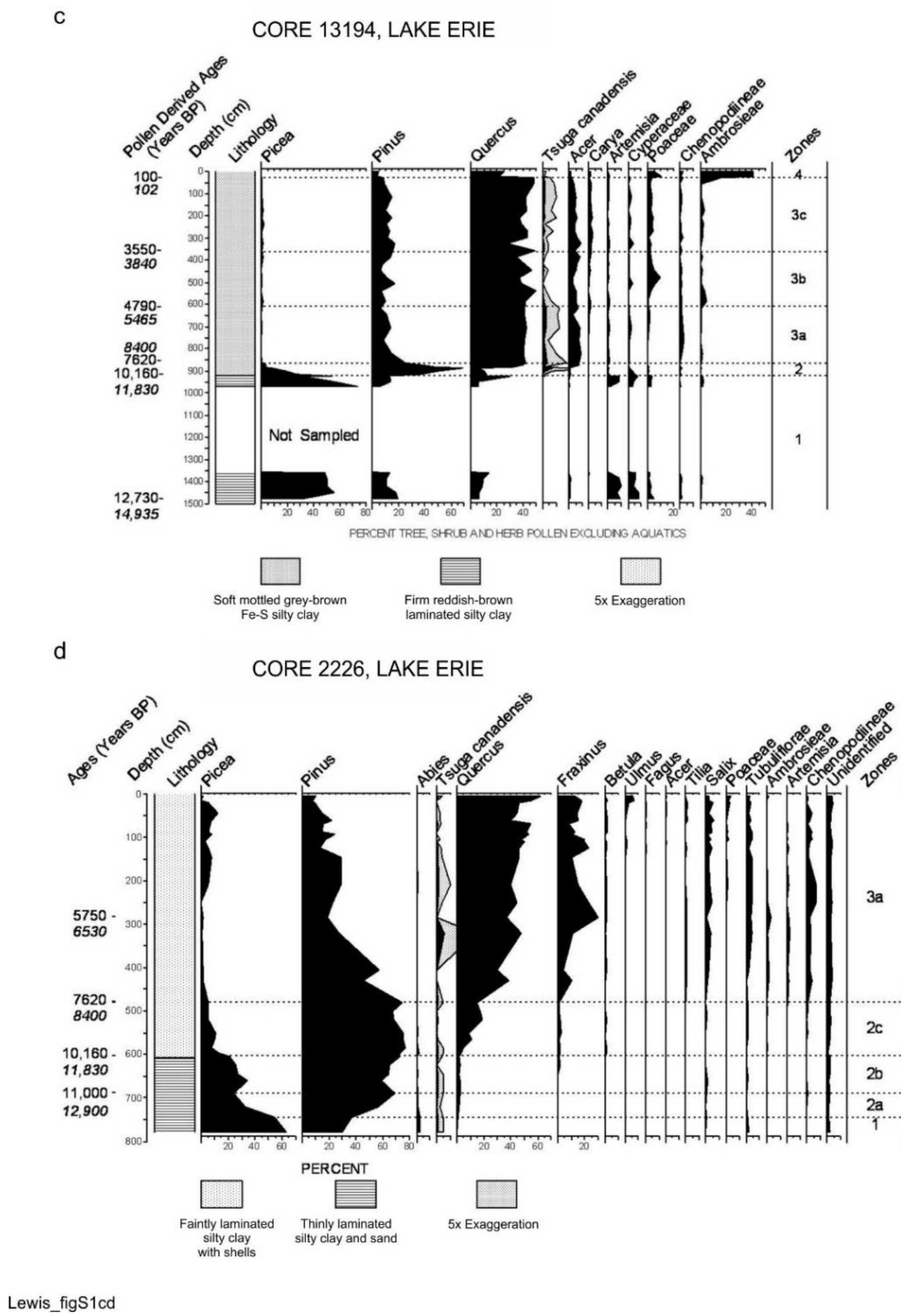
While a comprehensive discussion of the pre-contact vegetation of Windsor is beyond the scope of this study, it is possible to draw some general conclusions regarding the development of plant communities within the City since the Pleistocene. In addition, as the nature of understorey and forest floor vegetation is often dependent on the same factors which determine forest cover, and on the forest cover itself, an understanding of these factors may be useful in the recognition of particular floral resources within the environment which may have been actively sought out by past populations. The identification of these potential resources, and the determination of their general spatial and temporal variation within the study area, will further assist in reconstructing the subsistence strategies of Windsor's pre-contact Indigenous occupants and the changes these practices may have undergone over time.

Since the geographical distribution of forest communities is significantly influence by factors such as soil texture and drainage, terrain, and climate, it is important to remember that these attributes of Windsor have changed significantly over time. During the first millennium of human occupation, water levels in the Great Lakes were high. The situation was much different over the next six millennia, as levels in the Erie basin dropped during a cool, dry climatic regime (see Byun et al. 2021). These lower base levels would have promoted downcutting of tributary watercourses, thereby locally lowering the water table and likely shifting the location of wetlands and forest communities adapted to moist conditions onto the former Erie and St. Clair lakebeds. This was reversed again during the roughly two millennium Nipissing highstand in the Huron and Erie basins. Essentially modern conditions developed over the final four millennia.

Pollen spectra from central Lake Erie (Figure A7) (Lewis et al., 2012) indicate that spruce (Picea sp.) and pine (likely Jack pine (Pinus banksiana) dominated the regional forest in the period following deglaciation until around 11,000 cal. BP. Pine (likely white pine (Pinus strobus)) assumed dominance at that time and was joined by oak (Quercus sp.), likely the more dry-adapted species of oak given the climate at the time. After about 8,300 cal. BP, as the climate became more moist, additional northern hardwood taxa became established, including maple (Acer sp.), hemlock (Tsuga canadensis), ash (Fraxinus sp.), birch (Betula sp.), alder (Alnus sp.), and willow (Salix sp.).

Although this northern mixed hardwood forest prevailed throughout southern Ontario until the land clearances of the nineteenth century, there would have been fluctuations in forest composition due to climatic change and regional processes of forest succession. These processes would have included centuries of Indigenous farming up to the middle of the seventeenth century that would have been a local

Figure A7: Pollen Diagrams from Sediment Cores, Central Lake Erie Basin (Lewis et al., 2012 – Electronic Supplementary Material)



agent of land clearance triggering forest succession. This succession would still have been in progress when Euro-Canadian settlement began roughly two centuries later.

Since the late eighteenth century, the natural vegetation communities of Windsor have been severely reduced with only isolated remnants still extant. A number of sources are available to permit the reconstruction of local vegetation immediately prior to colonial settlement. These include historical descriptions, early land surveyors' notes and maps, phytosociological reconstruction based on soils, and extrapolation from extant forest stands in, and adjacent to, the study area.

Under the widely used ecological land classification system developed for Ontario by Hills (Hills, 1958), revised by Burger (Burger, 1993), and others (Crins et al., 2009; Wester et al., 2018), Windsor lies within Ecoregion 7E Lake Erie. Characteristic tree species for various soil moisture and ecoclimatic regimes within these site regions are presented in Table A1.

Ontario's ecoregions have been further classified into ecodistricts (Wester et al., 2018). Windsor lies within Ecodistrict 7E-1 (Essex Ecodistrict), which extends easterly beyond the boundary of Essex County. Ecosystems in this area often exhibit a high degree of biodiversity. Tree species typical of the Essex Ecodistrict include sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), northern red oak (Quercus rubra), American basswood (*Tilia americana*), white ash (*Fraxinus americana*), eastern hop-hornbeam (*Ostrya virginiana*), black cherry (*Prunus serotina*), bitternut hickory (*Carya cordiformis*), trembling aspen (*Populus tremuloides*), large-toothed aspen (*Populus grandidentata*), butternut (*Juglans cinerea*), yellow birch (*Betula alleghaniensis*), and balsam poplar (*Populus balsamifera*). On moist sites common tree species include bur oak (*Quercus macrocarpa*), silver maple (*Acer saccharinum*), black ash (*Fraxinus nigra*), American elm (*Ulmus americana*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and Manitoba maple (*Acer negundo*) are typical.

Table A1: Characteristic Tree Species - Site Relationships in Ecoregion 7E

ECOCLIMATE (TEMPERATURE)								
Hotter			Normal			Colder		
SOIL MOISTURE								
Drier	**Fresh**	**Wetter**	**Drier**	**Fresh**	**Wetter**	**Drier**	**Fresh**	**Wetter**
Site Region 7E Lake Erie								
r, b, ch Oak	w,r Oak	*r, si Maple*	**w Pine**	**h Maple**	**sw, pi Oak**	*e Hemlock*	**w Elm**	*ba Fir*
sb Hickory Butternut	w Ash	*w, r Ash*	**r w Oak**	**Beech**	**r, b Ash**	*w Pine*	**b Ash**	*w Spruce*
	h maple	*w Elm*	**sb, p Hickory**	**Basswood**	**w Elm**	*h Maple*	**r Maple**	*r Maple*
	b Walnut	*Sycamore*	**w, ro Elm**	**r, w Oak**	**bn Hickory**		**e Hemlock**	*y,w Birch*
	Tulip	*Tulip*		**sb, bn Hickory**				*ew Cedar*
t,l Aspen	p Hickory	*e Cottonwood*		**e Cottonwood**				
	Butternut	*b Gum*		**b Cherry**				

Bold = High proportion of site region, Normal = Moderate Proportion of site region, *Italics* = Low Proportion of site region

For each site region, upper row taxa are climax species and lower row are pioneer species.

Abbreviations: b=black, ba=balsam, bn=bitternut, ch=chinquapin, e=eastern, ew=eastern white, h=hard, l=largetooth, p=pignut, pi=pin, r=red, ro=rock, sb=shagbark, si=silver, sw=swamp, t=trembling, w=white, y=yellow (Burger, 1993)

Subordinate species, many with southern affinities, include black maple (*Acer nigrum*), black walnut (*Juglans nigra*), blue-beech (*Carpinus caroliniana*), shagbark hickory (*Carya ovata*), sycamore (Platanus occidentalis), black willow (*Salix nigra*), rock elm

(*Ulmus thomasii*), common hoptree (*Ptelea trifoliata*), American chestnut (*Castanea dentata*), eastern cottonwood (*Populus deltoides*), common hackberry (*Celtis occidentalis*), and slippery elm (*Ulmus rubra*). Several Carolinian species reach the northern limit of their range in the Essex Ecodistrict including tulip tree (*Liriodendron tulipifera*), sassafras (*Sassafras albidum*), Kentucky coffee-tree (*Gymnocladus dioicus*), black gum (*Nyssa sylvatica*), blue ash (*Fraxinus quadrangulate*), chinquapin oak (*Quercus muehlenbergii*), black oak (*Quercus velutina*), honey-locust (*Gleditsia triacanthos*), swamp white oak (*Quercus bicolor*), shellbark hickory (*Carya laciniosa*), and pawpaw (*Asimina triloba*) (Wester et al., 2018).

The use of historical survey data involves the reconstruction of vegetation based on the observations of early land surveyors. These surveyors routinely recorded information about trees located along their survey lines. These data are found in the surveyor's notebooks, diaries, and maps, compiled when the original land surveys were carried out in the early nineteenth century. The quantity and quality of information regarding vegetation in these notebooks, however, is quite variable (Gentilcore & Donkin, 1973; Karrow & Suffling, 2016). The procedure for transcribing vegetational data from the notebooks to topographic maps has been outlined by Heidenreich (1973), and carried out for parts of Essex County (Finlay, 1978). While the necessary survey records are incomplete or missing for most of Windsor, this evidence can be augmented by commentaries from early observers. Together, some understanding of pre-settlement vegetation communities and associations of these with physiographic and edaphic conditions can be elucidated and extrapolated.

On 11 August 1679, Recollet missionary Father Louis Hennepin sailed up the Detroit River on the sailing ship “Griffon” with French explorer Rene-Robert Cavelier Sieur de Lasalle and Lasalle’s crew. Hennepin described the scene as follows (Thwaites 1903: 108-109):

> This straight is finer than that of Niagara, being thirty Leagues long, and every-where one League broad, except in the middle, which is wider, forming the Lake

> we have call'd St. Claire. The navigation is easie (sic) on both sides, the Coast being low and even. It runs directly from North to South.
>
> The Country between those two Lakes is very well situated, and the Soil very fertile. The Banks of the Streight (sic) are vast Meadows, and the Prospect is terminated with some Hills covered with Vineyards, Trees bearing good Fruit, Groves, and Forests, so well dispos'd, that one would think Nature alone could not have made, without the Help of Art, so charming a Prospect. That Country is stock'd with Stags, Wild-Goats, and Bears, which are good for Food, and not fierce as in other Countries; some think they are better than our Pork. Turkey-Cocks and Swans are there also very common; and our Men brought several other Beasts and Birds, whose names are unknown to us, but they are extraordinary relishing.
>
> The Forests are chiefly made up of Walnut-trees, Chestnut-trees, Plum-trees, and Pear-trees, loaded with their own Fruit and Vines. There is also abundance of Timber fit for building; so that those whose who shall be so happy as to inhabit that Noble Country, cannot but remember with Gratitude those who have discover'd the way, by venturing to sail upon an unknown Lake for above one hundred Leagues.

Seventy years later, in 1749, French military engineer Joseph Gaspard Chaussegros de Lery provided additional detail along with a map of the area (Lajeunesse 1960):

> The lands on the east side of the river are bordered by prairies in such a way that the inhabitants have no wood to cut in order to clear their fields and sow their grain. It is only necessary to plough the land and cut down some shrubs.

A "sandy barren plain" extending along the Detroit River waterfront from a point roughly opposite the western end of Belle Isle westerly and southerly to the Canard River marshes is also noted by land surveyor Patrick McNiff in 1792. It is estimated that these plains encompassed an area of 45 square kilometres (Bakowsky and Riley

1992: 9). Today the Ojibway Prairie Remnants Area of Natural and Scientific Interest (ANSI) together with the Ontario Prairie Provincial Nature Reserve protect about 349 hectares of these plains, which include tallgrass prairie, black oak savanna, and other rare communities (https://www.ojibway.ca/complex.htm).

When Father Hennepin commented on the appealing landscape of the straight connecting Lake Erie with Lake Huron that “one would think Nature alone could not have made, without the Help of Art, so charming a Prospect” he may not have been wrong. Szeicz and MacDonald (1991) have investigated the postglacial history of oak savanna in southern Ontario in order to test the hypothesis that purposeful burning by Indigenous hunter-gatherers contributed to the development of these rare communities by delaying forest succession (see also Munoz and Gajewski 2010). While they concluded that, for the areas they studied, other factors—particularly the dry climate regime that created the early through middle Holocene lowstands in the Great Lakes combined with dry and well-drained substrates—were more compelling with respect to the initial establishment of these communities, it seems reasonable to consider the possible manipulation of the environment with fire by Indigenous people. Such activity has been well documented throughout the northeast (Blarquez et al. 2018; Munoz and Gajewski 2010) and may have contributed to the maintenance of oak savanna. This may be particularly true in areas like Windsor where prairie and/or savanna extended into areas with poorly drained substrates (Munoz and Gajewski 2010).

In its climax state on mesic substrates, the closed canopy hardwood forest exhibits a heavily shaded understorey of limited biotic diversity and productivity, hence it is relatively impoverished as habitat for game animals or plant resources. This may be mitigated locally by the relative complexity of the vegetation as determined by the terrain and to historical contingencies, such as windthrow, which created gaps in the forest canopy. For example, being more exposed, the fringe of the Detroit River valley and shores of Lake St. Clair may have been more prone to windthrow. A glimpse of the pre-settlement forests of the interior can be gleaned from timber records made by the early land surveyors (Finlay, 1978). Unfortunately, the available mapping of this information for Essex County is limited to the area south of County Road 42, south of the airport. Nevertheless, this sample suggests a mosaic of forest communities likely reflecting variable local factors as noted above, including potential Indigenous manipulation of the landscape by fire. The mapped forest communities include mesic to moist forests dominated by maple and beech with subordinates that include basswood, elm, and oak, oak dominated communities with subordinates of maple, beech, and basswood, and black ash swamp with elm, basswood, willow, and hickory (Finlay, 1978).

3.4 Culture History

3.4.1 Late Pleistocene/Early Holocene (ca. 13,000 – 11,000 cal BP)

The First Peoples began to move into what is now southwestern Ontario as the continental ice sheet retreated at the end of the last ice age. As populations increased in southeastern North America around 13,000 years ago, small groups of people gradually moved north into a newly revealed land (Chaput et al., 2015; Lothrop et al., 2016). The landscape that greeted them would have been open and cold, sparsely vegetated with tundra plants such as lichens and sedges, with spruce and tamarack trees growing up over time (McCarthy et al., 2015; Stewart, 2013; Yu, 2003). The spruce parkland was home to mammoth, mastodon, stag-moose, giant beaver, caribou, arctic fox and snowshoe hare, California condors, and many other boreal species which no longer call the area home (Ellis, 2013; Stewart, 2013; Storck & Speiss, 1994). The first peoples would have moved across this landscape in small groups, following herds of migrating animals and searching for food in a post-glacial landscape that was constantly changing. As they moved across the landscape, they often followed the shoreline of glacial Lake Algonquin or one of the waterways that shifted across the clay plains, camping close to the water's edge. They gathered nearby stones to support a portable shelter, cooked meals prepared from animals hunted, trapped, or fished, and resharpened large, fluted spear points or remade them into smaller tools for other uses (C.A.R.F., 1992; Ellis, 2013; Julig & Beaton, 2015).

Archaeological sites left behind by these First Peoples are usually small and ephemeral, the results of short-lived camps located close to ancient shorelines or at strategic inland locations (Jackson, 1997, 1998). Artifacts at these sites tend to consist of a few large spear points coupled with waste stone from the production of these tools, as organic materials such as wood, bone, and furs do not preserve on these exposed strandlines over the millennia. In combination with Indigenous oral histories, the archaeological record of these sites has the potential to illuminate the lives of the original residents of Windsor.

Sites dating to this earliest period are sparse in Ontario, and none have been identified within the bounds of the City of Windsor. There is, however, an unconfirmed report of contemporary artifacts having been recovered during an archaeological survey of the Turkey Creek valley conducted in 1968 and 1969 by Father Jack Lee (Baumann, 1978). Unfortunately, the sites from where these artifacts were recovered were not registered and their exact nature and location are unclear. Sites which have been identified elsewhere in the province are located primarily on relict strandlines of glacial Lake Algonquin and its correlate in the Erie basin, and many have been discovered through targeted survey of these geologic features (Storck, 1984, 2004). If any of the earliest sites exist in Windsor, they would likely be situated near or above the estimated level of glacial Lake Algonquin (186 metres asl), although sites dating to later phases of this period may occur on recessional strandlines below this elevation.

The closest sites to Windsor dating to the latter phase of this period are the Holcombe Beach group of sites located about 15 kilometres north of Detroit. The Holcombe Beach sites were interpreted as temporary camp sites used to process barren ground caribou and make and repair stone tools and were located on a sand ridge overlooking a shallow glacial lake (Fitting et al., 1966). Chert types and the workmanship identified on projectile points link Holcombe to sites in Ohio, the Delaware Valley of the eastern

US, and to quarrying areas around Saginaw Bay in Michigan and on the northeastern shore of Lake Erie (Ellis & Deller, 1990, p. 41; Fitting et al., 1966, pp. 90–92); groups moving between these areas would have passed through Windsor. Isolated Holcombe and Hi-Lo projectile points have been located within Windsor including within Sandwich West along the drainage of Turkey Creek, and on the grounds of the Windsor Airport along the drainage of the Little River (Ellis & Deller, 1990, p. 55; Garrad, 1971; Stantec, 2014), and it is possible that undiscovered sites also exist. Desirable site locations would have shifted as animal habitats and migratory routes changed with the retreat of glacial Lake Algonquin and early Lake Erie and the resulting alterations of local watersheds and drainages but raised sand ridges and glacial strandlines possess significant potential for sites from this period.

As time passed and Indigenous communities became more familiar with the seasonal changes and the habits of local animals, they began to establish regular camps to return to on a seasonal basis. Resources may have been initially quite limited, as the forest evolved from a conifer-dominated community to a more mixed community with nut-producers like oak. Although the ability of interior habitats to sustain hunter-gatherer bands through the warm season improved over time, reduced cold season carrying capacity would require bands to spread out their population over the winter. During the cold seasons, these bands likely dispersed themselves by smaller kinship groups into interior hunting territories. Such hunting territories would likely have been organized on a sub-watershed basis, with individual families occupying adjacent stream catchment areas. Riparian wetlands and swamps would have provided fuel, building materials, roots and tubers, and small game. Archaeological evidence of such sites may be difficult to distinguish from warm season hunting camps, although the sustained occupation of a site over several months would likely leave a more substantial artifact assemblage. The few sites of this period in Windsor are situated in the middle and upper reaches of headwater streams and may reflect seasonal forays from coastal base camps later eradicated by the Nipissing highstand.

Throughout the lower Great Lakes there is evidence of seasonal camps being situated at toolstone (e.g., chert) sources, at wetlands where waterfowl gathered annually to lay eggs and raise young, or at river crossings where migrating herds of caribou were forced to slow down and bunch up (Ellis, 2013; Roosa & Deller, 1982). The most evocative example of large, seasonally visited sites is the evidence, now submerged beneath the waters of Lake Huron, of caribou hunting structures on the Alpena-Amberley Ridge (AAR). The network of hunting blinds, drive lines, cairns, caches, stone rings, and shelters are all that remains of a landscape in which, between 10,000 and 7,000 years ago, many of those living in the Great Lakes area would gather to take advantage of a constricted area on the annual caribou migration route (Julig & Beaton, 2015; Lemke & O'Shea, 2015; O'Shea & Meadows, 2009). While this is a good distance to the north of what is now Windsor, there are few landscapes like the AAR which can be examined on a large scale archaeologically, but the identification of sites of a similar age near Windsor is difficult due to their probable scarcity and small size. It is also possible that the Windsor area was less desirable during the lowstands in the Huron-Michigan and Erie basins, when flow into the St. Clair River and through Lake St. Clair and the Detroit River to Lake Erie was minimal or suspended.

3.4.2 Early/Middle Holocene (ca. 11,000 – 5,000 cal BP)

As the climate continued to warm after 11,000 years ago, the land in southern Ontario became more hospitable and food resources more abundant. Isostatic rebound altered drainages and caused water levels in the Great Lakes basins to begin rising again, but Lake Stanley (in the Huron basin) still drained northward via the North Bay outlet and not through the Detroit River and Lake St Clair. Some groups began to establish claims over specific areas of land and to follow the seasonal round within a more restricted territory, often within a particular watershed (Ellis 2013). One side effect was that access to the highest quality tool stone—none of which outcrops in the Windsor area—was no longer available to all groups (Fox 2013). Poorer quality local chert sources were sufficient for making everyday tools, but as a result the spear points and other lithic objects were never as finely made as those carried by earlier hunters (Ellis 2013; Fox 2013). Groundstone axes and adzes were added to the toolkit as coniferous forests established themselves in southern Ontario and the people made wooden dugout canoes and cooking troughs; other new groundstone tools were used to process a diversifying array of plant resources, or as weights for fishing nets (CARF 1992; Ellis 2013; Kapches 2013).

Ways of life changed over the next few millennia, as deciduous woodlands replaced the coniferous forests, and the post-glacial tundra became a distant cultural memory. Adaptive patterns would have completed the shift from the initial ecological framework outlined above in response to the establishment of the hardwood forest, with many nut-producing trees, abundant wetlands, and the wider range of available plant and animal resources. Warm season macroband camps would have still been situated at coastal river mouths to intercept spawning fish while interior stands of mast-producing trees (e.g., oak, hickory, beech) would have attracted both Indigenous foragers and game animals (e.g., deer, raccoons, squirrels, passenger pigeons) in the fall.

Warmer waters in the Great Lakes, and stable stream and river beds provided new habitats for many of the fish species still found in the region today. These were caught using fish hooks made of bone or antler, or copper transported by canoe from the western end of Lake Superior (Ellis 2013; Fox 2013). Increasingly, large groups of people gathered together during spring and autumn fish spawning runs to catch fish in nets and to cooperate in the cleaning and processing of large catches (Needs-Howarth, 2013). In parts of Ontario, fish weirs built at river narrows during this period were subsequently used for thousands of years; even when no longer used to harvest fish, the weirs still served as important gathering places for ceremonies and trading (Needs-Howarth, 2013). More changes to food gathering came with the introduction of the bow and arrow, which allowed hunters to target smaller game with something other than traps and snares (Needs-Howarth, 2013). A surplus of food, hides, or fur could be exchanged in trade or as gifts for exotic materials, allowing copper from Lake Superior, marine shells from the Atlantic coast and the Gulf of Mexico, and finely made

Onondaga chert bifaces from the Niagara Peninsula to find their way into the hands of people living in diverse parts of eastern North America (Ellis, 2013; Fox, 2013). By about 3,500 years ago, favoured resource sites on the seasonal round were being re-inhabited year after year, with some groups beginning to establish cemeteries for their dead, marking ritually and territorially important places on the landscape (Ellis, 2013; Spence, 2013; Stewart, 2013).

3.4.3 Late Holocene (ca. 5,000 – 400 cal. BP)

After the Nipissing highstand, water levels in the Huron-Michigan and Erie basins gradually fell to modern levels (Morrison, 2017) and by about 4,000 cal. BP the physical and biotic landscape of Windsor was essentially similar to that which existed immediately prior to the colonial period. While the environment continued to fluctuate and evolve as a result of natural processes such as forest fire and windthrow, re-modelling of waterways, organic in-filling of wetlands, animal population cycles, and others, these generally cannot be resolved with currently available paleoenvironmental data. Nor is it necessary to do so given the scope and analytical scale of this study. The lifestyle of Late Holocene hunter-gatherers seems to have been relatively unchanged from that practiced by their ancestors.

Around 3,000 years ago, people in southern Ontario began to make low-fired ceramics, a change in technology which would eventually have a profound impact on ways of life. The earliest pots broke or wore out quickly, and so were made and used in the same camp and disposed of before moving on to a new location (Kapches, 2013). They did not at first replace the string bags, birch bark containers, and skin sacks which were already being used as storage vessels but were instead used to cook foods at a simmer, allowing the integration of more plant foods into the diet (Kapches, 2013; Williamson, 2013).

Changes that had begun on a small scale in earlier times were now more entrenched, especially regarding treatment of the dead. The ancestors were buried in knolls, sandbanks, and other visible natural features, often close to a favoured camp re-inhabited on an annual basis (Spence, 2013; Williamson, 2013). The remains of those who died close to the cemetery were buried soon after death, some with finely made stone objects, or with red ochre, or with exotic traded materials like marine shells or galena (natural form of lead sulphite) obtained through exchange networks built up over the preceding millennia (C.A.R.F., 1992; Spence, 2013; Williamson, 2013). The remains of those who died at a distance from the cemetery were temporarily laid to rest on platforms or cremated, until they could be reunited with their community in the cemetery, often bundled together with other ancestors (C.A.R.F., 1992; Spence, 2013). The gatherings around this reinterment may have coincided with the spring resource harvest and included feasting and the presentation of gifts to the ancestors in the form of caches of stone tools, gorgets, and food such as turkey, deer, fish, and dog which were buried within the bounds of the cemetery but not necessarily with any particular individual (Spence, 2013).

Over the next several centuries, the daily life and sense of identity of those living in the Windsor area began to diverge from that of people living farther east. Some of this was a result of the widespread influence of mound-building peoples in the Ohio and Mississippi river valleys, whose extensive trade networks introduced new materials such as Flint Ridge chalcedony, and new ceremonies involving the construction of earthworks and burial mounds (C.A.R.F., 1992; Fox, 2013; Watts, 2016; Williamson, 2013). These earthworks usually consisted of a circular or semicircular embankment with associated ditches and mounds, enclosing an open area “from around 100 square metres to more than a hectare”; their use likely varied depending on time and context, providing defensive capabilities, an open space for trading, or for ceremonies (Watts, 2016, p. 1).

Life continued to follow a seasonal round; people congregated in larger groups for the warm season, usually in a succession of camps near the Detroit River, and dispersed to smaller, single-family camps in the interior during the cold season, with visits to numerous other small satellite camps throughout the year to take advantage of specific resources as they became available (Spence, 2013). Harvesting fish formed a major dietary focus, with different water and environmental conditions requiring the use of a wide variety of tools: harpoons, spears, leisters, and fishhooks to catch single fish; and seine nets to take advantage of spawning runs of fish such as walleye in spring, and freshwater drum in summer (Foreman, 2011; Needs-Howarth, 2013). Ceramic construction improved during this time: grit temper was added to clay to strengthen the fabric, and coil-built pots were fired at higher temperatures than they had been previously (C.A.R.F., 1992; Kapches, 2013). Regional differences in ceramic decoration and stone tool knapping across southern Ontario indicated that people held distinct identities tied to their places of settlement, which would be further delineated as life became increasingly settled (Monckton, 2013; Williamson, 2013).

By about 1,200 years ago, those living in the Windsor area shared their way of life with the people living in what would become southeastern Michigan and northwest Ohio but lived according to a different pattern than those living in south-central Ontario (Lennox & Dodd, 1991; Stothers & Abel, 2002). Spring was a time of gathering, when people reconnected to harvest spring spawning fish and to feast and hold ceremonies with the ancestors buried nearby (Killion et al., 2019; Lennox & Dodd, 1991; Stothers & Abel, 2002; Wright, 1977). The warm season, from spring until early autumn, was spent in large, multi-family settlements on the shores of the Detroit River. Houses were small, oval, bark-covered structures for one or two families each, which could be disassembled and moved to new locations (Ferris, 2013; Warrick, 2013). Here, the coastal marshes provided an abundance of animal and plant resources, as well as a defensive advantage in the event of the inter-group violence which was on the rise (Stewart, 2013; Warrick, 2013; Williamson, 2013).

Women of the villages gathered clay from well-known spots along the riverbank, prepared it to remove impurities and strengthen it, then shaped the vessels and fired them in shallow pits covered in brush and wood, situated a good distance away from the settlement to avoid setting structures alight (Kapches, 2013). In most cases women made pots for themselves and their daughters and decorated them with motifs with personal or ancestral significance; children learned to make pots by watching their mothers, and by playing with clay to make small, rudimentary pinch pots of their own (Kapches, 2013; St John & Ferris, 2019; Williamson, 2013).

Both directly and indirectly, favoured wild plants were encouraged to establish themselves close to re-inhabited settlements, whether through replanting them just outside the village or by depositing food waste in nearby middens (Monkton 2013). These husbanded plants included raspberries, plums, elderberries, and other fruits along with chenopod, sumac, cattail, and spikenard. Techniques developed in husbanding wild plants began to be applied to new crops which had spread to Ontario from central America along exchange networks developed over the preceding millennia: first maize, then later squash, beans, sunflowers, and tobacco (Carroll, 2013; Monckton, 2013; St John & Ferris, 2019; Stothers & Abel, 2002; Williamson, 2013).

Deep storage pits were excavated to cache surplus food in large ceramic pots for later use (Ferris, 2013; Kapches, 2013). With the arrival of autumn, people dispersed from the warm season villages to small, one- or two-family cabins in the interior, located to take advantage of nut harvests, and as a base from which to set trap lines and for sugaring in winter (Ferris, 2013; Lennox & Dodd, 1991; Warrick, 2013). The autumn nut harvest was also an opportunity to hunt terrestrial animals such as deer, turkeys, squirrels, and raccoons, all of which were attracted to nut groves for their own subsistence purposes (Foreman, 2011). The colder months were also the most intensive time for deer hunting using blinds, drives, and corrals in addition to the bow and arrow (Needs-Howarth, 2013). In addition to meat, deer were a critical source of hides for clothes and shoes, antlers for tools, bones for awls and needles, and marrow and grease for food flavouring; a surplus of hides could potentially have been exchanged with those living to the east around Lake Ontario (Foreman, 2011; Needs-Howarth, 2013).

In the following centuries maize and other imported crops, initially consumed only at feast times or as a minor supplement to husbanded or wild local plant foods, began to form an increasingly significant part of the daily diet (Monckton, 2013; Stothers & Abel, 2002; Williamson, 2013). The greater investment in time required to grow large quantities of these domesticates conflicted with the timed gathering of other food resources: spring planting occurred around the time of fish spawning runs, and the autumn harvest conflicted with nut gathering and deer hunting (Foreman, 2011).

As a result, warm season settlements were located in places with good ground for crop planting, as well as access to a wide variety of aquatic foods which would be available for most of the season (Foreman, 2011; Needs-Howarth, 2013; Stothers & Abel, 2002). Women and children would catch turtles and amphibians and gather shellfish from the rich marsh environments; deer, squirrels, raccoons, turkeys, and other animals attracted to the crops were hunted in small numbers year-round rather than primarily in the autumn (Foreman, 2011; Lennox & Dodd, 1991; Needs-Howarth, 2013). The crops did not require constant monitoring and so smaller groups still spent time hunting and fishing at satellite camps, with locally available fish from the Detroit River forming an increasingly important part of subsistence (Foreman, 2011; Lennox & Dodd, 1991).

Warm season residences began to resemble the longhouses of the peoples to the east, though with a smaller footprint and different internal structure. Settlements were surrounded by palisades and sometimes by earthworks to add some measure of protection and were inhabited for more months out of the year (Ferris, 2013; Lennox & Dodd, 1991; St John & Ferris, 2019; Stothers & Abel, 2002). The increased time spent living in large communities had an effect on social organisation, with more emphasis placed on matrilineal descent and identification with lineage groups (Carroll, 2013; Ferris, 2013; Spence, 2013; Williamson, 2013). Inter-community conflict borne out of stronger internal group identities and competition for access to exchange networks was partially mitigated through lavish feasting and gift giving, maintaining social networks across the lower Great Lakes region (Carroll, 2013; Jamieson, 2013; Killion et al., 2019; Spence, 2013; Stothers & Abel, 2002). Political leaders were men, selected by influential women, responsible for diplomacy with nearby settlements, scheduling the seasonal round, organising raids, and other tasks, and governance was by consensus rather than by decree (Jamieson, 2013).

By the early 1500s, pressure from the westward expansion of Iroquoian peoples living around Lake Ontario caused many of those living in the Windsor area to relocate west and south for several decades, beginning to return to the area just before the onset of profound changes set in motion by European contact (C.A.R.F., 1992; Lennox & Dodd, 1991).

4 Archaeological Potential Modelling

4.1 Introduction

Archaeological resources are not randomly distributed across the landscape. Human land use and resource exploitation follow patterns of resource distribution and are influenced by a variety of specific cultural, environmental and geomorphological factors. Consequently, specific areas within a general landscape will have been more or less intensively utilized through time. Through the preparation of a potential model, researchers attempt to identify the specific factors that contributed to the patterning of human land and resource exploitation. The goal is to build a model which reflects a plausible potential use of the land within a given cultural landscape.

This section discusses the criteria around which the City of Windsor's Indigenous archaeological site potential model was developed. It is based primarily on environmental and geomorphological criteria which would have influenced Indigenous land use. Although social factors have also been taken into consideration, these are difficult to re-create or interpret given both the time and cultural differences that separate the researcher from the people who lived here in the more distant past.

The archaeological potential model was developed using an ArcGIS® Geographic

Information System to summarize and map various data sets as separate but complementary layers. Modelling criteria were then derived through analysis of these layers, and these criteria were applied to produce a final, composite layer which maps archaeological site potential in Windsor.

Digital spatial data sets were obtained from the City of Windsor and the Province of Ontario (Land Information Ontario). These included environmental data such as bedrock and surficial geology, hydrography and wetlands, topography, soils, and landforms. They also included cultural and historical data such as the road network, railways, and early settlements. Through the research process, many additional datasets were reviewed and incorporated in order to inform the development of the model.

4.2 Environmental Layers

4.2.1 Hydrography

Hydrographic features, including major rivers, creeks and their tributaries, as well as other bodies of water, such as ponds and wetlands already existed as layers on the digital base mapping, yet when overlaid on the ortho-imagery, there are clearly historical or intermittent watercourses that are not included. Therefore, it became necessary to improve the resolution of hydrographic features by digitizing data from other sources, such as historical maps.

Another potential source of error in the hydrographic dataset comes from the extensive improvements to the drainage networks within the City, such as agricultural tiling and the rerouting of streams. As such, various historical Department of Militia and Defense topographic maps dating to the first half of the twentieth century, recorded at a scale of 1:63,360 and modern National Topographic Survey maps, recorded at a scale of 1:50,000, were consulted for additional missing watercourses. Lastly, historical and modern aerial photography and ortho-imagery was consulted for areas where research would dictate that a water source should be close by. Digital versions of these maps were imported into GIS software and georeferenced using present lot boundaries, as well as modern landmarks, such as roads. The final watercourse dataset was then cross-referenced against historical mapping, whereby any streams not present in the modern dataset but shown on historical maps were added. Lastly, given the large amount of suspected wetland loss in Essex County since settlement, it was determined that a layer representing the full pre-settlement wetland extent would be necessary to evaluate pre-settlement period land use. This dataset was provided by Ducks Unlimited Canada, and was created using a model which combined edaphic variables such as drainage and soil type with local topography (Ducks Unlimited Canada, 2010; Snell, 1987). While these efforts greatly improved the resolution of the hydrographic layer, it was recognized that a small percentage of site locations may have been influenced by water sources than could not be practically resolved through available mapping.

Another important consideration is the location of former strandlines within the City during various hydrographic highstands. As discussed in Section 3.2.2, the two major former shorelines present in Windsor are those dating to the Main Algonquin and Nipissing highstands of the Huron-Michigan and Erie basins. To approximate their location for the purposes of this study, they were mapped (Figure A3) using the following elevations above mean sea level in accordance with published observations (Herdendorf, 2013; Lewis et al., 2012; Morrison, 2017; Pengelly et al., 1997; Thompson et al., 2011): Main Algonquin - 186 m asl (Morrison, 2017; Thompson et al., 2011) and Nipissing phase Lake Erie - 180 m asl (Lewis et al., 2012; Pengelly et al., 1997).

Initially, elevational data at 1 m and 5 m contour intervals were drawn from a LiDAR-based Digital Terrain Model (DEM) obtained from Land Information Ontario with an error range of ± 0.5 m. The high resolution of this data set rendered it unsuitable for contour mapping, since it captured too much detail of the cultural landscape (i.e., buildings, roads, etc.). To create more suitable topographical mapping, a custom DEM had to be developed. Terrestrial contour lines were digitized from 1909 NTS 1:63,360 map series (Windsor, Belle River, Amherstburg and Essex Sheets), while bathymetric data from the Ontario Ministry of Natural Resources and Forestry was used for below modern water-level topography. These were then rasterized and smoothed using a standard geostatistical interpolation function (regularized-spline with tension). While derived from mapping over a century-old, the resulting model (Figure A3) preserves the topography of the Windsor study area prior to major recent development, which was a problem encountered when trying to use modern remotely sensed products.

Given that coastal environments are highly dynamic and there are no mapped paleo-strandlines in Windsor, this level of accuracy was deemed to be quite sufficient. Given the low topographical relief across the City of Windsor, even modest fluctuations in water plane elevation may produced significant lateral movement of the shoreline (Figure A3).

4.2.2 Soils

Digital soils data were acquired from the Geomatics Service Centre, Ontario Ministry of Agriculture, Food and Rural Affairs. This layer is essentially a digital version of the soils mapping contained in the Ontario Soil Survey Report for Essex County (Richards et al., 1949).

The soil survey for Essex County had mapped some 44 discrete soil series polygons within the City of Windsor at 1:63,360 scale (Richards et al., 1949). This array of mapped soils made it difficult to interpret gross City-wide trends. Accordingly, the soil series were re-grouped in order to provide mapped summaries of relevant attributes, including soil texture, drainage, and agricultural capability. The soil texture layer discriminated between the following, from coarsest to finest grained: sand, sandy loam, fine sandy loam, loam, clay loam, clay, and organic. The soil drainage layer discriminated between the following: rapidly drained, well drained, imperfectly drained, poorly drained, very poorly drained, and variably drained. The soil capability for agriculture layer discriminated between: Class 1, having no significant limitations for agriculture (none in Windsor); Class 2, having moderate limitations that restrict the range of crops or require moderate conservation practices; Class 3, having moderately severe limitations that restrict the range of crops or require special conservation practices; Class 4, having severe limitations that restrict the range of crops or require special conservation practices (none in Windsor; Class 5, having very severe limitations that restrict their capability in producing perennial forage crops, and improvement practices are feasible; Class 6, which are capable only of producing perennial forage crops, and improvement practices are not feasible (none in Windsor); and Class 7, having no capability for arable culture or permanent pasture (Canada Land Inventory, 1965).

The objective in aggregating the soils data this way was to facilitate its use as proxy measures for physiographic attributes for which there was no digital mapping, such as preferred growing conditions for various tree species (Burger, 1993; Crins et al., 2009; Hills, 1958; Wester et al., 2018). The soil texture layer reveals the strong correlation between parent materials associated with certain surficial (Quaternary) deposits and soils.

As noted in Section 3.2.4, the soil capability for agriculture layer reveals that most of Windsor (98%) is arable farmland (Class 2 and 3). This indicates that availability of good quality soil would generally not have been a concern for Indigenous farmers. It also indicates that the substrate would generally have not been a significant constraint on the development of climax forest, although as noted in Section 3.3, local conditions such as edaphic variability may have locally favoured certain vegetative associations over others.

4.3 Pre-Contact Indigenous Modelling Criteria

For the purposes of inductively modeling potential for the discovery of pre-contact Indigenous archaeological sites, based on the locations of previously registered sites, the total number of archaeological sites in Windsor to date is 115, of which twenty five have Indigenous components. Of the Indigenous sites, eleven lack artifacts that would allow dating or attribution of cultural affiliation. Understanding roughly when a site was occupied is important for modeling in order to tie settlement trends to contemporary environments. Eight sites are listed as isolated artifact finds, typically projectile points lost while hunting. While they may confirm the presence of Indigenous people in an area if they are temporally diagnostic tools, the relative randomness of their distribution limits their utility for understanding contemporary land-use patterns. Three sites are described as artifact scatters or campsites and three are registered as villages. Four sites include human burials, including one village. The nature of the remaining eight sites is undetermined. Having reviewed all the sites with Indigenous components, the total number of substantial and datable Indigenous occupation sites most useful for inductive modeling was fourteen. All registered Indigenous archaeological sites were included in the project GIS as a discrete layer and considered for purposes of evaluating the validity of the model.

While the number of registered Indigenous sites in Windsor was insufficient to permit development of an inductive model to extrapolate archaeological potential based on locations of known sites, any identified land-use trends should also be consistent with expectations arising from deductive modeling. The following deductive model paints a general picture of pre-contact Indigenous land use throughout the millennia in Windsor, based on an understanding of regional site types, ages, and evolving land-use patterns.

Throughout much of prehistory, the inhabitants of Windsor were hunter-gatherers who practised an annual subsistence round to exploit a broad range of natural resources for food and raw materials for such needs as shelter construction and tool fabrication. Assuming that access to natural resources influenced and constrained the movement and settlement of Indigenous peoples, our goal was to understand what these resources were, how they may have been distributed, how their use and distribution may have changed over time, and how the landscape itself may have constrained movement and access to resources as well as settlement location. Given the requirements of this study, and our limited ability to precisely resolve details of past environments, we began by considering the relative merits of the physiographic areas, as it could be demonstrated that these represented certain constellations of environmental attributes. We proceeded chronologically in this investigation since certain aspects of Windsor had changed dramatically through the period of human occupation.

4.3.1 Late Pleistocene/Early Holocene (ca. 13,000 – 11,000 cal BP)

Hunter-gatherer bands have occupied Windsor from as early as 13,000 years ago, but currently the oldest firm evidence is two isolated finds dating to around 11,500 cal. BP. Both are situated inland, one close to the estimated elevation of the Main Algonquin highstand and one slightly below that. The age would suggest these findspots date towards the beginning of the Middle Holocene lowstand, so they may have been associated with coastal campsites later inundated by the Nipissing highstand. At that time, the boreal woodlands likely offered a rather limited selection of floral resources, hence subsistence would have been primarily oriented towards hunting and fishing. Contemporary foragers, with base camps situated in proximity to lakeshore resources such as fish and waterfowl, would have ranged widely in pursuit of other game. It is expected that contemporary archaeological sites in Windsor will be either additional findspots of chipped stone projectile points lost while hunting or small scatters of chipped stone debitage indicative of ephemeral cold season interior campsites.

Notes from Father Jack Lee's 1968-69 survey of Essex County also record the discovery of seven of early projectile points in the Turkey Creek valley (Baumann, 1978). Unfortunately, these sites have not been registered, and their exact nature and location is unclear.

4.3.2 Middle Holocene (ca. 9,000 – 5,000 cal BP)

After about 12,000 cal. BP, the shorelines of Lake Erie and Lake St. Clair receded significantly from their current locations and remained so until after 6,000 cal. BP. Hunter-gatherer bands would have established warm season base camps at river mouths adjacent to receding Great Lakes shorelines where resources such as spawning fish could support small communities of perhaps 35 to 50 people. Such sites would now be submerged or eradicated by the later rise of Lake Erie waters during the Nipissing highstand around 6,000 cal. BP. Resources may have been initially quite limited, as the forest evolved from a conifer-dominated community to a more mixed community with nut-producers like oak. Although the ability of interior habitats to sustain hunter-gatherer bands through the warm season improved over time, reduced cold season carrying capacity would require bands to spread out their population over the winter. During the cold seasons, these bands likely dispersed themselves by smaller kinship groups into interior hunting territories. Such hunting territories would likely have been organized on a sub-watershed basis, with individual families occupying adjacent stream catchment areas. Riparian wetlands and swamps would have provided fuel, building materials, roots and tubers, and small game. Archaeological evidence of such sites may be difficult to distinguish from warm season hunting camps, although the sustained occupation of a site over several months would likely leave a more substantial artifact assemblage. In Windsor, there are three findspots and one camp dating between about 9,000 and 5,000 cal. BP. Like the earlier examples, the findspots are likely associated with coastal campsites later inundated by the Nipissing highstand. The campsite must postdate the Nipissing highstand, since it is situated below the estimated high-water elevation and may have actually been situated near the shore of Lake St. Clair when it was occupied.

4.3.3 Late Holocene (ca. 5,000 – 400 cal. BP)

Coastal sites begin to appear in Windsor after the Nipissing highstand, including two between Black Oak Heritage Park and the Detroit River and one near the Ambassador Bridge. A fourth findspot is situated in the headwaters of the Little River near the airport. Coastal locations remain popular through the millennium leading up to the colonial period when Indigenous communities began farming. However, the search for better drained soils suitable for agriculture seems to have also led farming communities inland, as illustrated by the E.C. Row (AbHs-7) and Lucier (AbHs-1) settlements, which are situated in close proximity to each other on slightly elevated, better drained soil in the Turkey Creek watershed (Lennox & Molto, 1995).

4.3.4 Trails

Indigenous transportation networks, while technically a cultural factor for potential mapping, are closely related to many of the environmental themes, and as a result, are strong indicators of archaeological potential. Wherever possible, these trails would have been oriented so as to provide access to food and water resources and utilize dry, accessible landscapes.

A few Indigenous trail alignments were recorded for Essex County in the eighteenth century. The main trail ran along the Detroit River frontage close to the shoreline, corresponding generally to the alignment of Riverside Drive in the north and the former Front Road through Sandwich on the west. A cross-country trail, corresponding roughly to Huron Church Line and Talbot Rd. (Highway 3), ran across Essex County from the narrowest part of the river toward Point Pelee. For much of this distance, the alignment made use of a low relief gravel moraine to elevate the trail above the surrounding marshlands (Clarke, 1983, p. 81; Lajeunesse, 1960).

4.3.5 Summary of Modeling Criteria

To summarize our deductive modelling observations, the sequence of highstands and lowstands of lakes Huron, Erie, and St. Clair, and the associated size and position of the Detroit River, have been significant factors influencing Indigenous land-use in Windsor since the end of the Pleistocene. Changing water levels have also likely resulted in the eradication of significant coastal macroband camps dating to the Middle Holocene lowstand that spanned six millennia. While the layout of the interior drainage systems has remained relatively the same, especially since about 4,000 cal. BP, they too have been affected by the major changes in regional hydrology. The bio-physical landscape has similarly been affected by the changing hydrology and the climatic regimes which were a major driver thereof. The physiography of Windsor, although generally modest in topographical relief, nevertheless contributed to the development of an evolving mosaic of forest biomes. In addition, the distribution of well-drained soils appears to have become a factor influencing Indigenous settlement in the millennium before European contact when maize agriculture was added to the foraging economy.

Having considered all the environmental parameters reviewed above, and subjecting key parameters to iterative buffering trials, it was determined that a buffer of 250 metres from a historic or current water source captures all of the sites (n = 20). While the sample size is insufficient to support further statistical testing, this is clearly a very robust capture rate.

In light of these considerations, ultimately four water-based criteria were chosen as the most useful predictors of pre-contact Indigenous archaeological potential (In a relatively small area such as a city, especially one like Windsor with very limited topographical/geo-physical variability, other factors were decided to be excluded as irrelevant or as redundant due to overlaps). The following criteria were used to create the pre-contact Indigenous archaeological potential layer. All rivers, major streams, and lakeshores (current and former) were buffered by 250 metres. Verified wetlands were buffered 200 metres outward and 50 metres inward from the border. Registered sites were buffered by 250 metres for villages and large settlements and 100 metres for camps and other small sites.

5 Model Evaluation

The modelling exercise undertaken above presents an approximation of the overall distribution of Indigenous archaeological resources in Windsor. The purpose of this exercise has been to provide land-use planners and heritage resource managers with a theoretically supported estimate of the scope of a resource for which there is limited substantive data available. Given the hypothetical nature of such a model, however, potential users must be fully aware of its limitations in order to employ it appropriately.

The unknown but undoubtedly complex distribution of sites in Windsor can be described in terms of a geographical continuum of density, or potential for discovery, ranging from none to very high. In this study, the continuum has been subdivided into two classes: areas that demonstrate archaeological potential and areas that do not demonstrate potential. Through a deductive and inductive modelling procedure, involving interpretation of the changing pre-contact landscape and the expected land-use patterns of its pre-contact and historic human occupants, Windsor has been tentatively partitioned into zones representing these categories. Since the principal orientation of the model revolves around access to water for travel and subsistence, it is anticipated that certain site classes, sacred sites for example, may not conform to the mapped zonation. Residual sites of this kind, and sites in localized zones of potential that could not be resolved at this mapping scale, can be expected to occur throughout Windsor. The validity and utility of archaeological site potential models can be assessed in terms of predictive capacity or gain. Predictive gain has been explicitly defined as follows (Kvamme, 1988, p. 326):

$$Gain = 1 - \left(\frac{\text{percentage of total area covered by model}}{\text{percentage of total sites within model area}} \right)$$

where the total sites variable would represent all known and unknown archaeological sites in Windsor. Of course, since the total number of sites is never known, the evaluation of gain cannot be based on a random sample of sites. One way of dealing with this problem is to undertake a random sample of the study area in the hope that this will constitute a suitable proxy for a random sample of sites. In most cases, where there is reason to believe that site distributions may be non-random, the confidence of this approach can often be improved by stratifying the sample into hypothetical density classes. For example, the site potential model for Windsor has suggested that sites may be non-randomly distributed and has defined two zones to predict the nature of the distribution. A stratified random sample of the City suggested the model was effective at this point for capturing Indigenous sites. An alternative approach for evaluating gain is to employ relatively large samples or data acquired through some sort of preliminary investigation (Altscul & Nagle, 1988, pp. 265–268; Kvamme, 1988, pp. 403–404; Rose et al., 1988, pp. 173–255). Systematic archaeological survey, undertaken in Windsor in the context of the pre-development approvals process, will continue to accumulate just this sort of information, and once the site sample has grown even further, the gain statistic can eventually be evaluated. This is one reason why it is recommended that, where any part of a development application falls into the zone of archaeological potential, the entire application should be subject to assessment. This will continue to afford the opportunity of examining lands beyond the archaeological potential zone, thereby improving the site sample and avoiding the self-fulfilling prophesy of only finding sites where one looks for them.

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