



Supporting Document 1-9

Stage 1 Archaeological Assessment

Eastern Ontario Waste Handling Facility Future Development Environmental Assessment

GFL Environmental Inc.

Moose Creek, Ontario

May 5, 2022

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Acknowledgements

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**STAGE 1 ARCHAEOLOGICAL ASSESSMENT
EASTERN ONTARIO WASTE HANDLING FACILITY FUTURE DEVELOPMENT
PART OF LOTS 13-16, CONCESSION 10
AND LOTS 16-19 CONCESSION 9
(FORMER TOWNSHIP OF ROXBOROUGH, COUNTY OF DUNDAS)
TOWNSHIP OF NORTH STORMONT
UNITED COUNTIES OF STORMONT, DUNDAS AND GLENGARRY, ONTARIO**

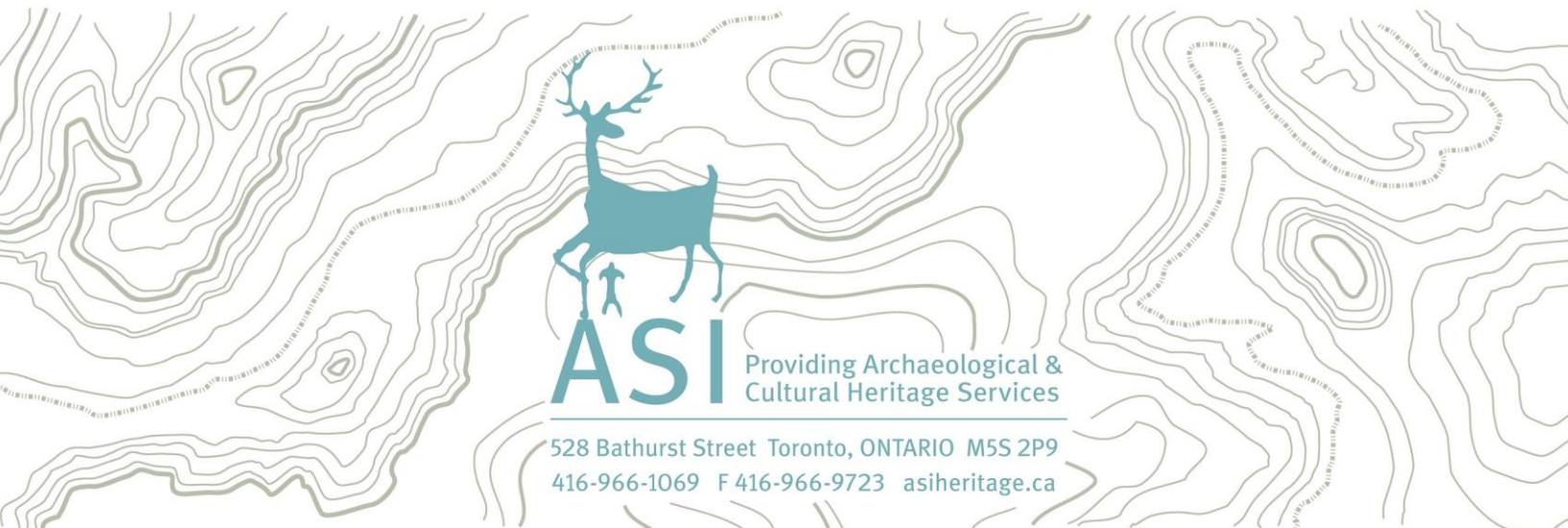
REVISED REPORT

Prepared for:

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5 May 2022



**Stage 1 Archaeological Assessment
Eastern Ontario Waste Handling Facility Future Development
Part of Lots 13-16, Concession 10
and Lots 16-19 Concession 9
(Former Township of Roxborough, County of Dundas)
Township of North Stormont
United Counties of Stormont, Dundas and Glengarry, Ontario**

EXECUTIVE SUMMARY

ASI was contracted by HDR Corporation to conduct a Stage 1 Archaeological Assessment (Background Research and Property Inspection) as part of the Eastern Ontario Waste Handling Facility Future Development (EOWHF) in the Township of North Stormont. This project involves the future development of the existing EOWHF landfill and associated composting facilities to the neighbouring parcels.

The Stage 1 background study determined that there are no previously registered archaeological sites are located within one kilometre of the Study Area and that it is within a historical peat bog which was drained for agricultural use and peat harvesting in the twentieth century. The property inspection confirmed that the Study Area does not exhibit archaeological potential.

In light of these results, the following recommendations are made:

1. The Study Area does not retain archaeological potential on account of deep and extensive land disturbance and permanently low and wet conditions. These lands do not require further archaeological assessment;
2. Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands; and,
3. Since the potential always exists to miss important information in an archaeological survey; if any artifacts of Indigenous interest or human remains are encountered during the development of the subject property, please contact:

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TABLE OF CONTENTS

| | |
|---|-----|
| TABLE OF CONTENTS | iii |
| 1.0 PROJECT CONTEXT..... | 1 |
| 1.1 Development Context..... | 1 |
| 1.2 Historical Context | 1 |
| 1.2.1 <i>Indigenous Land Use and Settlement</i> | 1 |
| 1.2.2 <i>Euro-Canadian Land Use: Township Survey and Settlement</i> | 6 |
| 1.2.3 <i>Historical Map Review</i> | 7 |
| 1.2.4 <i>Twentieth-Century Mapping Review</i> | 8 |
| 1.3 Archaeological Context..... | 8 |
| 1.3.1 <i>Current Land Use and Field Conditions</i> | 9 |
| 1.3.2 <i>Geography</i> | 9 |
| 1.3.3 <i>Previous Archaeological Research</i> | 11 |
| 2.0 FIELD METHODS: PROPERTY INSPECTION | 11 |
| 3.0 ANALYSIS AND CONCLUSIONS..... | 12 |
| 3.1 Analysis of Archaeological Potential..... | 12 |
| 3.2 Analysis of Property Inspection Results..... | 13 |
| 3.3 Conclusions..... | 13 |
| 4.0 RECOMMENDATIONS..... | 13 |
| 5.0 ADVICE ON COMPLIANCE WITH LEGISLATION | 15 |
| 6.0 REFERENCES CITED | 16 |
| 7.0 MAPS | 23 |
| 8.0 IMAGES..... | 29 |
| Appendix A..... | 32 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1: EOWHF Study Area | 24 |
| Figure 2: Study Area (Approximate Location) Overlaid on the 1863 Historical County Map of Dundas County | 25 |
| Figure 3: Study Area (Approximate Location) Overlaid on the 1881 Illustrated Historical Atlas of the Counties of Stormont, Dundas and Glengarry | 25 |
| Figure 4: Study Area (Approximate Location) Overlaid on the 1927 NTS - Alexandira Sheet | 26 |
| Figure 5: Study Area (Approximate Location) Overlaid on the 1954 Aerial Photograph of Stormont | 26 |
| Figure 6: Study Area - Surficial Geology..... | 27 |
| Figure 7: Study Area - Soil Drainage | 27 |
| Figure 8: Results of Stage 1..... | 28 |

LIST OF PLATES

| | |
|---|----|
| Plate 1: (SE) Sod farm with irrigation ditch in foreground..... | 29 |
| Plate 2: (E) Access road, disturbed, and farm field..... | 29 |
| Plate 3: (SE) Disturbed area associated with access road construction | 29 |
| Plate 4: (SE) Highway 138 right-of-way (ROW), disturbed, and reclaimed agricultural land | 29 |
| Plate 5: (NW) Reclaimed agricultural land..... | 30 |
| Plate 6: (W) Access road and commercial peat harvesting facility, disturbed | 30 |
| Plate 7: (SE) Current peat harvesting with heavy equipment and mounds of excavated organic material | 30 |



Plate 8: (E) Access road, current facility and peat extraction operation, disturbed.....30
Plate 9: (SE) Field recently cleared of trees in the process of being drained31
Plate 10: (SE) Drainage ditch separating field and treed area31



1.0 PROJECT CONTEXT

Archaeological Services Inc. (ASI) was contracted by HDR Corporation to conduct a Stage 1 Archaeological Assessment (Background Research and Property Inspection) as part of the Eastern Ontario Waste Handling Facility (EOWHF) Future Development in the Township of North Stormont (Figure 1). This project involves expanding the current EOWHF landfill and associated composting facilities to the neighbouring parcels.

All activities carried out during this assessment were completed in accordance with the *Ontario Heritage Act* (Ontario Heritage Act, R.S.O. c. O.18, 1990, as amended in 2018) and the 2011 *Standards and Guidelines for Consultant Archaeologists (S & G)*, administered by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI 2011), formerly the Ministry of Tourism, Culture and Sport.

1.1 Development Context

All work has been undertaken as required by the *Environmental Assessment Act*, RSO (Environmental Assessment Act, R.S.O., 1990 as amended 2010) and regulations made under the Act, and are therefore subject to all associated legislation. This project is being conducted in accordance with the Municipal Engineers' Association document *Municipal Class Environmental Assessment* (Municipal Class Environmental Assessment, 2000 as amended in 2007, 2011 and 2015).

Authorization to carry out the activities necessary for the completion of the Stage 1 archaeological assessment was granted by HDR Corporation on December 20th 2019.

1.2 Historical Context

The purpose of this section, according to the S & G, Section 7.5.7, Standard 1, is to describe the past and present land use and the settlement history and any other relevant historical information pertaining to the Study Area. A summary is first presented of the current understanding of the Indigenous land use of the Study Area. This is then followed by a review of the historical Euro-Canadian settlement history.

1.2.1 Indigenous Land Use and Settlement

Eastern Ontario has been occupied by human populations since the retreat of the Laurentide glacier, approximately 13,500 before present (BP) (Ferris, 2013, p. 13). Populations at this time would have been highly mobile, inhabiting a boreal-parkland similar to the modern sub-arctic. By approximately 10,000 BP, the environment had progressively warmed (Edwards & Fritz, 1988), and populations now occupied less extensive territories (Ellis & Deller, 1990, pp. 62–63).

By 10,000 BP, the ice margin had retreated northward from Georgian Bay and the pro-glacial Lake Algonquin was drained through the North Bay outlet (Karrow & Warner, 1990, p. Fig 2.9). From approximately 10,000-5,500 BP, the Great Lakes basins experienced low-water levels and so it is therefore likely that many sites that would have been located on those former shorelines and are now submerged. From approximately 10,000 to 8,000 BP, eastern Ontario was occupied by populations whose subsistence was likely focused within the boreal forest environment (J. V. Wright, 2001, pp. 101, 105,



106). Groups may have had seasonal prolonged residency at fords to take advantage of migrating animal herds, made vulnerable by the crossing, but otherwise likely subsisted at large in the forest environment (J. V. Wright, 2001, pp. 112–113).

By approximately 8,000 BP, subsistence is believed to have shifted to an increased reliance on aquatic resources, likely anadromous fish (J. V. Wright, 2001, p. 125). It is likely that contact existed between populations in north-central Ontario and those in southern Ontario (J. V. Wright, 2001, p. 123). Such communication networks would certainly have extended into eastern Ontario.

Lithic sites that likely date to the Late Palaeoindian or Early Archaic period have been reported for the Ottawa Valley area (eg. Swayze, 2005; Swayze & McGhee, 2011).

By approximately 6,000 BP, evidence exists for the highly specialized production of ground-stone and native copper artifacts. This is coupled with evidence for population growth and extensive exchange networks (Ellis et al., 1990, pp. 88, 90). Material culture is indicative of influences from populations in the St. Lawrence basin of southeastern Ontario and southern Quebec, however, a number of sites in the Trent Valley may indicate a more westward extension of this influence and indicate a connection between the populations in the Ottawa Valley and those in the St. Lawrence basin (Ellis et al., 1990, p. 90; Ramsden, 1997). Trapping and fishing appear to have been a main-stay of subsistence. The combined habitation-burial sites are suggestive of decreased mobility (Ellis et al., 1990, p. 91). This use of the Ottawa River Valley as a special place for burial should be seen as deliberate and reflective of the cosmology of these people (Parker Pearson, 1999, p. 141).

Around 5,000 BP, isostatic rebound of the continent caused the Lake Huron basin to flood in-land as far as Lake Nipissing (though the exact strandline is debated). This isostatic rebound also affected the watershed boundaries causing the upper Great Lakes to drain through the modern St. Clair River drainage rather than its previous drainage down the Ottawa River (Jackson et al. 2000). This drastic change to the waterways of Ontario certainly had profound implications for the human geography of the entire Great Lakes basin.

Between approximately 4,800 through 4,000 BP, populations in eastern Ontario had greater variability in their diet, and began inhabiting larger sites with overall greater cultural complexity (Ellis et al., 1990, p. 120). Evidence exists for infrastructure such as fish weirs as well as established cemeteries (Ellis et al., 1990, 2009). At this time period, the Great Lakes watershed was experiencing the Nipissing high-water phase. Around 5,000 BP, isostatic rebound of the continent caused the Lake Huron basin to flood in-land as far as Lake Nipissing (though the exact strandline is debated). This isostatic rebound also affected the watershed boundaries causing the upper Great Lakes to drain through the modern St. Clair River drainage rather than its previous drainage down the Ottawa River (Jackson et al., 2000). This drastic change to the waterways of Ontario certainly had profound implications for the human geography of the entire Great Lakes basin.

Between 3,000-2,500 BP, populations continued to practice residential mobility and to harvest seasonally available resources, including spawning fish. Exchange and interaction networks broaden at this time (Spence et al., 1990, pp. 136, 138) and by approximately 2,000 BP, evidence exists for macro-community camps, focusing on the seasonal harvesting of resources (Spence et al., 1990, pp. 155, 164). It is also during this period that maize was first introduced into southern Ontario, though it would have only supplemented people's diet (Birch & Williamson, 2013, pp. 13–15). Groups likely retreated to interior camps during the winter.



The Woodland period begins around 2500 BP and exchange and interaction networks broaden at this time (Spence et al., 1990, pp. 136, 138) and by approximately 2,000 BP, evidence exists for macro-community camps, focusing on the seasonal harvesting of resources (Spence et al., 1990, pp. 155, 164). By 1500 BP there is macro botanical evidence for maize in southern Ontario, and it is thought that maize only supplemented people's diet. There is earlier phytolith evidence for maize in central New York State by 2300 BP - it is likely that once similar analyses are conducted on Ontario ceramic vessels of the same period, the same evidence will be found (Birch & Williamson, 2013, pp. 13–15). Groups likely retreated to interior camps during the winter. It is generally understood that these populations were Algonquian-speakers during these millennia of settlement and land use.

In southern Ontario, from the beginning of the Late Woodland period at approximately 1,000 BP, lifeways became more similar to that described in early historical documents. Between approximately 1000-1300 Common Era (CE), the communal site is replaced by the village focused on horticulture. Seasonal disintegration of the community for the exploitation of a wider territory and more varied resource base was still practised (Williamson, 1990, p. 317). By 1300-1450 CE, this episodic community disintegration was no longer practised and populations now communally occupied sites throughout the year (Dodd et al., 1990, p. 343). From 1450-1649 CE this process continued with the coalescence of these small villages into larger communities (Birch & Williamson, 2013). Through this process, the socio-political organization of the First Nations, as described historically by the French and English explorers who first visited southern Ontario, was developed. By 1600 CE, the communities within Simcoe County had formed the Confederation of Nations encountered by the first European explorers and missionaries. In the 1640s, the traditional enmity between the Haudenosaunee¹ and the Huron-Wendat (and their Algonkian allies such as the Nipissing and Odawa) led to the dispersal of the Huron-Wendat.

Algonquian-speaking groups were historically documented wintering with the Huron-Wendat, some who abandoned their country on the shores of the St. Lawrence because of attacks from the Haudenosaunee (Thwaites 1896-1901, 27:37). Other Algonquian groups were recorded along the northern and eastern shores and islands of Lake Huron and Georgian Bay - the "Ouasouarini" [Chippewa], the "Outchougai" [Outchougai], the "Atchiligouan" [Achiligouan] near the mouth of the French River and north of Manitoulin Island the "Amikouai, or the nation of the Beaver" [Amikwa; Algonquian] and the "Oumisagai" [Missisauga; Chippewa] (Thwaites 1896-1901, 18:229, 231). At the end of the summer 1670, Father Louys André began his mission work among the Mississagué, who were located on the banks of a river that empties into Lake Huron approximately 30 leagues from the Sault (Thwaites 1896-1901, 55:133-155).

Historically, the main Algonquin communities included the Kichesipirini or "Big River people", with their main village on Morrison Island; the Waweskarini (literally wawashkesh irini or "deer people"), or the "Petite Nation des Algonquins", who lived along the rivers immediately west of Montreal; the Matouweskarini ("Madawaska people"), who lived in the Madawaska River region west of Ottawa; the Kinouchibiriniouek (Kinozhe sipi iriniwag or "Pike river people"), who lived in the Bonnechere River watershed near Renfrew; and the Onontcharonon, or people of Iroquet, who lived south and east of Ottawa (Morrison, 2005, pp. 14–15).

¹ The Haudenosaunee are also known as the New York Iroquois or Five Nations Iroquois and after 1722 Six Nations Iroquois. They were a confederation of five distinct but related Iroquoian-speaking groups – the Seneca, Onondaga, Cayuga, Oneida, and Mohawk. Each lived in individual territories in what is now known as the Finger Lakes district of Upper New York. In 1722 the Tuscarora joined the confederacy.



The earliest recorded form of the name ‘Algonquin’ is the name ‘Aloumequin’ which dates to 1603. The name ‘Algonquain’ appears in 1632 (Day and Trigger 1978:797). The name ‘Algonquins’ is used by the modern name Algonquins of Ontario and it is this name that will be used in this report. The Algonquins were primarily hunter-fishers. While this was of the utmost economic importance, protocol was strictly guided by Algonquin cosmology and understanding of the spiritualism in the natural world. Some Algonquins also practiced limited horticulture on lots cleared by slash-and-burn (Whiteduck 2002). Control of the waterways was also an important facet of the Algonquin economy, as sovereignty and tolls were exacted for right-of-passage. Such tolls may be seen as comparable to modern day visas and/or tariffs, and were important elements of the Algonquins’ place and position in the geo-political world of the seventeenth century (Whiteduck 2002). The Algonquin were referred to by the seventeenth century French as “la petite Nation.” This refers to a tradition that the Algonquins had previously (prior to the sixteenth century) constituted a much larger group which had been fragmented in a battle near Trois Rivières (Day & Trigger, 1978, p. 794).

In 1646, war broke out between the Haudenosaunee and the Algonquins (Day and Trigger 1978:794). During this period Algonquins, Nipissings, and Hurons found refuge in various locations including French settlements at Trois-Rivières, Quebec City, Sillery, and Montreal; others went to the Lake St. John region to the east. Other Nipissings and Algonquins, remained in their traditional territories, avoiding the unsafe lower Ottawa valley in summer (Joan Holmes & Associates, 1993; Morrison, 2005). Algonquins did not completely abandon the Ottawa valley, but withdrew to its interior locations between 1650 and 1675. Algonquins used the Ottawa River for trade purposes from about 1654. During the last quarter of the 17th century, Algonquins were reported at numerous locations within the French sphere of influence.

Shortly after dispersal of the Huron-Wendat, Ojibwa began to expand into southern Ontario and Michigan from east shore of Georgian Bay, west along the north shore of Lake Huron, and along the northeast shore of Lake Superior and onto the Upper Peninsula of Michigan (Rogers, 1978, pp. 760–762). This history was constructed by Rogers using both Anishinaabek oral tradition and the European documentary record, and notes that it included Chippewa, Ojibwa, Mississauga, and Saulteaux or “Southeastern Ojibwa” groups. Ojibwa, likely Odawa, were first encountered by Samuel de Champlain in 1615 along the eastern shores of Georgian Bay. Etienne Brule later encountered other groups and by 1641, Jesuits had journeyed to Sault Sainte Marie (Thwaites, 1896, p. 11:279) and opened the Mission of Saint Peter in 1648 for the occupants of Manitoulin Island and the northeast shore of Lake Huron. The Jesuits reported that these Algonquian peoples lived “solely by hunting and fishing and roam as far as the “Northern sea” to trade for “Furs and Beavers, which are found there in abundance” (Thwaites 1896-1901, 33:67), and “all of these Tribes are nomads, and have no fixed residence, except at certain seasons of the year, when fish are plentiful, and this compels them to remain on the spot” (Thwaites 1896-1901, 33:153). Algonquian-speaking groups were historically documented wintering with the Huron-Wendat, some who abandoned their country on the shores of the St. Lawrence because of attacks from the Haudenosaunee (Thwaites 1896-1901, 27:37).

Other Algonquian groups were recorded along the northern and eastern shores and islands of Lake Huron and Georgian Bay - the “Ouasouarini” [Chippewa], the “Outchougai” [Outchougai], the “Atchiligouan” [Achiligouan] near the mouth of the French River and north of Manitoulin Island the “Amikouai, or the nation of the Beaver” [Amikwa; Algonquian] and the “Oumisagai” [Mississauga; Chippewa] (Thwaites 1896-1901, 18:229, 231). At the end of the summer 1670, Father Louys André began his mission work among the Mississagué, who were located on the banks of a river that empties into Lake Huron approximately 30 leagues from the Sault (Thwaites 1896-1901, 55:133-155).



After the Huron had been dispersed, the Haudenosaunee began to exert pressure on Ojibwa within their homeland to the north. While their numbers had been reduced through warfare, starvation, and European diseases, the coalescence of various Anishinaabek groups led to enhanced social and political strength (Thwaites 1896-1901, 52:133) and Sault Sainte Marie was a focal point for people who inhabited adjacent areas both to the east and to the northwest as well as for the Saulteaux, who considered it their home (Thwaites 1896-1901, 54:129-131). The Haudenosaunee established a series of settlements at strategic locations along the trade routes inland from the north shore of Lake Ontario. From east to west, these villages consisted of Ganneious, on Napanee Bay, an arm of the Bay of Quinte; Quinte, near the isthmus of the Quinte Peninsula; Ganaraske, at the mouth of the Ganaraska River; Quintio, at the mouth of the Trent River on the north shore of Rice Lake; Ganatsekwyagon (or Ganestiquiagon), near the mouth of the Rouge River; Teyaiagon, near the mouth of the Humber River; and Quinaouatoua, on the portage between the western end of Lake Ontario and the Grand River (Konrad, 1981, p. 135). The inhabitants of these villages were agriculturalists, growing maize, pumpkins and squash, but their central roles were that of portage starting points and trading centres for Iroquois travel to the upper Great Lakes for the annual beaver hunt (Konrad, 1974; Williamson et al., 2008, pp. 50–52). Ganatsekwyagon, Teyaiagon, and Quinaouatoua were primarily Seneca; Ganaraske, Quinte and Quintio were likely Cayuga, and Ganneious was Oneida, but judging from accounts of Teyaiagon, all of the villages might have contained peoples from a number of the Iroquois constituencies (ASI, 2013).

Peace was achieved between the Haudenosaunee and the Anishinaabek Nations in August of 1701 when representatives of more than twenty Anishinaabek Nations assembled in Montreal to participate in peace negotiations (Johnston, 2004, p. 10). During these negotiations captives were exchanged and the Iroquois and Anishinaabek agreed to live together in peace. Peace between these nations was confirmed again at council held at Lake Superior when the Iroquois delivered a wampum belt to the Anishinaabek Nations.

From the beginning of the eighteenth century to the assertion of British sovereignty in 1763, there is no interruption to Anishinaabek control and use of southern Ontario. While hunting in the territory was shared, and subject to the permission of the various nations for access to their lands, its occupation was by Anishinaabek until the assertion of British sovereignty, the British thereafter negotiating treaties with them. Eventually, with British sovereignty, tribal designations changed (Smith, 1975, pp. 221–222; Surtees, 1985, pp. 20–21). According to Rogers (1978), by the twentieth century, the Department of Indian Affairs had divided the “Anishinaubag” into three different tribes, despite the fact that by the early eighteenth century, this large Algonquian-speaking group, who shared the same cultural background, “stretched over a thousand miles from the St. Lawrence River to the Lake of the Woods.”

In 1763, following the fall of Quebec, New France was transferred to British control at the Treaty of Paris. The British government began to pursue major land purchases to the north of Lake Ontario in the early nineteenth century, the Crown acknowledged the Mississaugas as the owners of the lands between Georgian Bay and Lake Simcoe and entered into negotiations for additional tracts of land as the need arose to facilitate European settlement.

The eighteenth century saw the ethnogenesis in Ontario of the Métis, when Métis people began to identify as a separate group, rather than as extensions of their typically maternal First Nations and paternal European ancestry (Métis National Council, n.d.b). Métis populations were predominantly located north and west of Lake Superior, however, communities were located throughout Ontario (MNC n.d.b; Stone & Chaput, 1978, p. 607,608). During the early nineteenth century, many Métis families moved towards locales around southern Lake Huron and Georgian Bay, including Kincardine, Owen Sound, Penetanguishene, and Parry Sound (MNC n.d.a). Recent decisions by the Supreme Court of Canada (*R. v. Powley*, 2003; *Daniels v. Canada (Indian Affairs and Northern Development)*, 2016) have reaffirmed that



Métis people have full rights as one of the Indigenous people of Canada under subsection 91(24) of the Constitution Act, 1867.

In August 1783 Sir John Johnson, Superintendent General of Indian Affairs convinced the Mississaugas of the Quinte region to a land cession. Johnson turned the task over to Captain William Crawford. Crawford's Purchases were made on behalf of the Crown, and the Six Nations in October 1783, and involved the land along the north shore of eastern Lake Ontario and the St. Lawrence River. It is reported that the cost paid to the Mississauga chiefs was clothing "for all their families", guns "for those who did not have any", powder and ball for winter hunting, 12 lace hats and red cloth sufficient for 12 coats. Chief Mynass, who assisted Crawford with the deal, also sold his own lands (Surtees, 1984, pp. 22–25). A second deal likely occurred with the Mississaugas over "the land at the bottom of the Bay".

These purchases were designed to provide land to Loyalists who fought on behalf of the British during the American Revolution, including Indigenous allies, namely Six Nations, and United Empire Loyalists. (Ministry of Indigenous Affairs, 2020).

By the mid-nineteenth century, Algonquin and Nippissing groups were forced to petition the government for the creation of reserve lands within their traditional territories of the Ottawa Valley due to the wave of settlement (for example Algonquin Chief Pierre Shawanepinesi in Bedford township in the 1840s), however most were not successful. Some grants were even revoked to support the growing lumber industry (The Algonquins of Ontario, 2013). There are presently ten federally recognized Algonquin communities however the Algonquins of Pikwakanagan Reserve at Golden Lake Reserve near Renfrew is the only one in Ontario, though it is acknowledged that Wahgoshig, Matachewan and Temagami are of at least partially Algonquin descent (Morrison, 2005, p. 1).

Although the land in question for the Crawford Purchase was occupied by Algonquin people, they were not included in the negotiations (Huitema, n.d.). The Algonquin challenged the treaty in 1836 however no action was taken to recognize the treaty lands as within their traditional territory (Aboriginal Affairs and Northern Development Canada, 2016; ASI & Geomatics International Inc., 1999; Hessel, 1987, p. 69; Walker & Walker, 1968, p. 7). This area is within the current Algonquins of Ontario land claim for their unceded traditional territory. In 2016, an agreement in principle was ratified, including a transfer of \$300-million to the AOO and approximately 48,000 hectares to Algonquin ownership. The Algonquin claim is one of the largest in Canadian history (Algonquins of Ontario, 2013b, 2013a; Indigenous and Northern Affairs Canada, 2016).

1.2.2 Euro-Canadian Land Use: Township Survey and Settlement

Historically, the Study Area is located in the Township of Roxborough, County of Dundas, in Lots 13-16, Concession 10 and Lots 16-19, Concession 9.

The S & G stipulates that areas of early Euro-Canadian settlement (pioneer homesteads, isolated cabins, farmstead complexes), early wharf or dock complexes, pioneer churches, and early cemeteries are considered to have archaeological potential. Early historical transportation routes (trails, passes, roads, railways, portage routes), properties listed on a municipal register or designated under the *Ontario Heritage Act* or a federal, provincial, or municipal historic landmark or site are also considered to have archaeological potential.



For the Euro-Canadian period, the majority of early nineteenth century farmsteads (i.e., those that are arguably the most potentially significant resources and whose locations are rarely recorded on nineteenth century maps) are likely to be located in proximity to water. The development of the network of concession roads and railroads through the course of the nineteenth century frequently influenced the siting of farmsteads and businesses. Accordingly, undisturbed lands within 100 m of an early settlement road are also considered to have potential for the presence of Euro-Canadian archaeological sites.

The first Europeans to arrive in the area were transient merchants and traders from France and England, who followed Indigenous pathways and set up trading posts at strategic locations along the well-traveled river routes. All of these occupations occurred at sites that afforded both natural landfalls and convenient access, by means of the various waterways and overland trails, into the hinterlands. Early transportation routes followed existing Indigenous trails, both along the lakeshore and adjacent to various creeks and rivers (ASI 2006).

Roxborough Township

The land within Roxborough Township was settled by Scottish Loyalists arriving from the adjoining Glengarry County between 1800 and 1810. After the arrival of these early pioneers, settlement of the township slowed until after the War of 1812 when a large influx of settlers arrived into the northern townships. In the 1880s the arrival of both the Canadian Pacific and the Ottawa and New York Central Railways brought moderate prosperity. Farm products as well as harvested trees, such as the white pine, were transported widely. Farming was, and continues to be, the major industry in the township. Prior to World War II dairy farms, as well as hay, corn, and fodder crops, were primarily the domain of family farms. Since then this has given way to a few larger business farms. The population of Roxborough was just under 3,000 in 1980. In 1998 the townships of Finch and Roxborough were officially amalgamated, creating the Municipality of North Stormont (Mika and Mika 1983; Stormont, Dundas and Glengarry Historical Society 2005).

Development of Moose Creek Bog

The Moose Creek Bog was a large (1,683 ha) swampy area that has been drained and is being developed. Drainage ditches associated with the bog began in 1894 when Charles A. Bigger, Ontario Land Division Surveyor, designed a series of drains to reclaim an extensive area of what was then considered “unproductive” swampland. The last of these drains built was the Fraser Creek Drain which is noted in the 1900 Bylaw #8 of the Township of Roxborough. The drain was ready by November 15 1900 and it was cleared in 1904, repaired in 1914 and supplementary work was done 1945-46, 1948 and 1955 (P. Wright, 1999, p. 8).

In 1910, the north section of the existing Waste Handling Facility Study Area was classed as slash land while the south was described as wasteland, marsh or swamps (P. Wright, 1999, p. 8).

1.2.3 Historical Map Review

The 1863 *Historical County Map of Dundas County* and the 1881 *Illustrated Historical Atlas of the Counties of Stormont, Dundas and Glengarry* were examined to determine the presence of historic features within the Study Area during the nineteenth century (Figure 2-3) (H. Belden & Co., 1881; Walling & Gray, 1862, p. 186).



It should be noted, however, that not all features of interest were mapped systematically in the Ontario series of historical atlases, given that they were financed by subscription, and subscribers were given preference with regard to the level of detail provided on the maps. Moreover, not every feature of interest would have been within the scope of the atlases.

In addition, the use of historical map sources to reconstruct/predict the location of former features within the modern landscape generally proceeds by using common reference points between the various sources. These sources are then geo-referenced in order to provide the most accurate determination of the location of any property on historic mapping sources. The results of such exercises are often imprecise or even contradictory, as there are numerous potential sources of error inherent in such a process, including the vagaries of map production (both past and present), the need to resolve differences of scale and resolution, and distortions introduced by reproduction of the sources. To a large degree, the significance of such margins of error is dependent on the size of the feature one is attempting to plot, the constancy of reference points, the distances between them, and the consistency with which both they and the target feature are depicted on the period mapping.

No owners, features indicating structures or land use are present on the 1863 map. The 1881 map notes that the Lots 14-16, Concession 10 is Government owned Land and Lots 16-19, Concession 9 is owned by the Canada Company. Lot 13, Concession 10 is owned by Hosea Smith. No buildings are noted or hints to the land usage are present on the 1881 atlas map.

1.2.4 Twentieth-Century Mapping Review

The 1927 topographic sheet was examined to determine the extent and nature of development and land uses within the Study Area (Figures 4) (Department of National Defence, 1927). The map shows the area as primarily forested with Moose Creek and a tributary running through the Study Area. Highway 417 and Highway 138 are not present at this time.

The 1954 aerial photograph was also examined (Figure 5) (Hunting Survey Corporation Limited, 1954). The aerial photograph shows Highway 138 as being completed and the Study Area is primarily forested with some cleared areas to the east and the northwest. A large linear feature, perhaps a drainage channel, crosses into the Study Area.

The nearby landfill site was approved in 1999 and operations began shortly after this time (Ontario Ministry of the Environment, Conservation and Parks, 2020). Based on the modern aerial images, the landfill has expanded from the south to north in four stages within existing site area.

1.3 Archaeological Context

This section provides background research pertaining to previous archaeological fieldwork conducted within and in the vicinity of the Study Area, its environmental characteristics (including drainage, soils or surficial geology and topography, etc.), and current land use and field conditions. Three sources of information were consulted to provide information about previous archaeological research: the site record forms for registered sites available online from the MHSTCI through “Ontario’s Past Portal”; published and unpublished documentary sources; and the files of ASI.



1.3.1 Current Land Use and Field Conditions

A review of available Google satellite imagery since 2005 shows that the Study Area is a working sod farm (Manderley farm). Only a few significant changes have been made to the Study Area with a treed area in the northeastern corner being cleared and turned into farmland by 2014 and Concession Road 7 was connected to Highway 138 in 2010 with a large construction laydown area. The cycle of growing and harvesting the sod is visible in the aerial photos in the forms of strips of black exposed soil and green sod cover. In the southern area an active commercial peat harvesting operation can also be seen being developed with the area being a treed or scrubby area in 2014 and gradually cleared and developed with access roads and a series of mounds of excavated material. The peat harvesting process involves installing additional drainage, and installation of access roads and other invasive infrastructure before harvesting the organic material three to three and a half metres down to the clay that represents the Champlain Sea deposit (L. Fedec, personal communication, May 3, 2022; Tetra Tech, 2018).

A Stage 1, systematic property inspection was conducted on April 27, 2020 that noted the Study Area is located in the community of Moose Creek, Township of North Stormont. The area is located near Highway 417 and Highway 138. The area is surrounded by farm fields and the Study Area is almost divided by the current waste handling facility to the northwest. Part of the Study Area is covered by the existing commercial peat harvesting operation which is noted as a network of access roads and mounds of excavated organic material. The property inspection also confirmed that the area is generally low-lying and very flat in nature – which is consistent with reclaimed and drained swamps.

1.3.2 Geography

In addition to the known archaeological sites, the state of the natural environment is a helpful indicator of archaeological potential. Accordingly, a description of the physiography and soils are briefly discussed for the Study Area.

The S & G stipulates that primary water sources (lakes, rivers, streams, creeks, etc.), secondary water sources (intermittent streams and creeks, springs, marshes, swamps, etc.), ancient water sources (glacial lake shorelines indicated by the presence of raised sand or gravel beach ridges, relic river or stream channels indicated by clear dip or swale in the topography, shorelines of drained lakes or marshes, cobble beaches, etc.), as well as accessible or inaccessible shorelines (high bluffs, swamp or marsh fields by the edge of a lake, sandbars stretching into marsh, etc.) are characteristics that indicate archaeological potential.

Water has been identified as the major determinant of site selection and the presence of potable water is the single most important resource necessary for any extended human occupation or settlement. Since water sources have remained relatively stable in Ontario since 5,000 BP (Karrow & Warner, 1990, p. Figure 2.16), proximity to water can be regarded as a useful index for the evaluation of archaeological site potential. Indeed, distance from water has been one of the most commonly used variables for predictive modeling of site location.

The AOO state that archaeological sites within the Algonquin Traditional Territory typically have a minimal archaeological footprint. Since eastern Ontario was characterized by glacial lakes and/or inland seas, paleo-shorelines and associated archaeological sites are often located further inland from modern shorelines. Algonquin cosmology understood that the natural world was filled with spirits or Manitous. Such Manitous were found in the rivers, and maintaining their benevolence was of regular importance



while travelling through the country. Manitous could be identified at places with ‘power’ and may especially be found at places such as waterfalls, caves or canyons which are prone to reverberation, echo, or other noise (Whiteduck, 2002).

Other geographic characteristics that can indicate archaeological potential include: elevated topography (eskers, drumlins, large knolls, and plateaux), pockets of well-drained sandy soil, especially near areas of heavy soil or rocky ground, distinctive land formations that might have been special or spiritual places, such as waterfalls, rock outcrops, caverns, mounds, and promontories and their bases. There may be physical indicators of their use, such as burials, structures, offerings, rock paintings or carvings. Resource areas, including; food or medicinal plants (migratory routes, spawning areas) are also considered characteristics that indicate archaeological potential (S & G, Section 1.3.1).

The Study Area is located on the former seabed of the Champlain Sea. The Champlain Sea was a large inland arm of the Atlantic Ocean stretching inland as far as modern day Kingston and Pembroke. The Champlain Sea formed at approximately 13,000 BP when an ice barrier at modern day Quebec City melted and the inland glacial Lake Candona was flooded by the Goldthwait Sea. The Champlain Sea persisted until approximately 10,600 BP when, due to isostatic rebound of the continent, it receded to the modern Lake Champlain and the extinct Lampsilis Lake (Pintal, 2012, p. 221; Robinson, 2012, p. 197). The geography of the Champlain Sea strand is difficult to determine precisely. The sea levels in Quebec have been reconstructed at approximately 175 m above sea level (Karrow, 2006), however, in parts of New York State and Vermont State, the Champlain Sea strands have been documented at elevations of approximately 91 m above sea level (D. H. Chapman, 1937; Rayburn, 2004) and 107 m above sea level (Springston & DeSimone, 2007). Tetra Tech mapped the project area on the Champlain Seabed noting that no eskers are within the Study Area (2018, Figure 5; Appendix A)

The Study Area is located within the peat and muck organic deposits and clay plain deposits of the Winchester Clay Plain of eastern Ontario (L. J. Chapman & Putnam, 1984). The Winchester Clay Plain region comprises a total of approximately 930 km² between the Glengarry Till Plain and the sand plains of the United Counties of Prescott and Russell (Chapman and Putnam 1984:203). The Winchester Clay Plain is a generally flat area located almost entirely within the drainage basin of the South Nation River. Clay plains are dominant however there are a number of places with low drumlins, areas of shallow soil over bedrock, and several thousand acres of bog. The Study Area is located in the Moose Creek Bog and in close proximity to the Fraser Drain.

The Study Area contains Bearbrook clay, which is poorly-drained, and its topography ranges from level and flat to gently undulation. The surface soil of the cultivated fields in the area is low in humus and characterized as plastic when wet and very hard when dry. Very little uncleared land remains but original vegetation was of the swamp-forest type, primarily red maple, elm, white and black ash, with other species present depending on drainage. The Winchester Clay Plain is considered to be one of the better agricultural districts in Ontario, outside of the bogs there is very little wooded land (Chapman and Putnam 1984:204).

Figure 6 depicts surficial geology for the Study Area. The surficial geology mapping demonstrates that the Study Area is primarily underlain by organic deposits and small pocket of massive-well laminated soils are present in the eastern corner (Ontario Geological Survey, 2010). Soils in the Study Area consist of silt and clay, minor sand and gravel, and peat, muck and marl; the soil is very poor drained. (Figure 7). No naturally occurring watercourses cross the Study Area, however, based on the historic mapping Moose Creek originally flowed through the Study Area (Figure 4). The Fraser Drain, completed in 1900, brackets



the Study Area and the existing Waste Facility. The Study Area is located within the Moose Creek watershed.

Tetra Tech wrote an extensive geology and hydrogeology report for this project and in it they note that “the site is underlain by 3.0 to 3.5 m thick peat layer, followed by a continuous deposit of marine silty clay from the Champlain sea ranging in thickness from 5.4 to 19.3m” (Tetra Tech, 2018, p. 8). This confirms that this area was the seabed for the Champlain Sea and the extensive peat layers indicate that there was not a nearby area of raised elevation which would affect the drainage and could indicate archaeological potential (Appendix A).

1.3.3 Previous Archaeological Research

In Ontario, information concerning archaeological sites is stored in the Ontario Archaeological Sites Database (OASD) maintained by the MHSTCI. This database contains archaeological sites registered within the Borden system. Under the Borden system, Canada has been divided into grid blocks based on latitude and longitude. A Borden block is approximately 13 km east to west, and approximately 18.5 km north to south. Each Borden block is referenced by a four-letter designator, and sites within a block are numbered sequentially as they are found. The Study Area under review is located in Borden block *BhFr* and *BhFs*.

According to the OASD, no previously registered archaeological sites are located within one kilometre of the Study Area (MHSTCI 2019).

According to the background research, one previous report was completed within 50 m of the Study Area.

In 1999 Mount McGovern Co. Ltd completed a Stage 1 Archaeological Investigation of the proposed Roxborough Landfill Site. The results indicated that there was low potential for prehistoric and historic resources due to extensive disturbance and the present state of the Moose Creek Bog exhibits low preservation qualities. A Stage 2 assessment was not recommended (P. Wright, 1999).

2.0 FIELD METHODS: PROPERTY INSPECTION

A Stage 1 property inspection must adhere to the S & G, Section 1.2, Standards 1-6, which are discussed below. The entire property and its periphery must be inspected. The inspection may be either systematic or random. Coverage must be sufficient to identify the presence or absence of any features of archaeological potential. The inspection must be conducted when weather conditions permit good visibility of land features. Natural landforms and watercourses are to be confirmed if previously identified. Additional features such as elevated topography, relic water channels, glacial shorelines, well-drained soils within heavy soils and slightly elevated areas within low and wet areas should be identified and documented, if present. Features affecting assessment strategies should be identified and documented such as woodlots, bogs or other permanently wet areas, areas of steeper grade than indicated on topographic mapping, areas of overgrown vegetation, areas of heavy soil, and recent land disturbance such as grading, fill deposits and vegetation clearing. The inspection should also identify and document structures and built features that will affect assessment strategies, such as heritage structures or landscapes, cairns, monuments or plaques, and cemeteries.



The Stage 1 archaeological assessment property inspection was conducted under the field direction of Johanna Kelly (P1017) of ASI, on April 27, 2020, in order to gain first-hand knowledge of the geography, topography, and current conditions and to evaluate and map archaeological potential of the Study Area. The property inspection was systemic with only some areas within the GFL facility having restricted access due to health and safety concerns raised by our site escort due to the risk of fast moving, heavy equipment within the waste facility and the peat harvesting operation. The restricted areas were visibility disturbed and well defined, so it did not have a negative impact on our inspection. The property inspection was a visual inspection only and did not include excavation or collection of archaeological resources. Fieldwork was only conducted when weather conditions were deemed suitable and seasonally appropriate, per S & G Section 1.2., Standard 2. Previously identified features of archaeological potential were examined; additional features of archaeological potential not visible on mapping were identified and documented as well as any features that will affect assessment strategies. Field observations are compiled onto the existing conditions of the Study Area in Section 7.0 (Figure 8) and associated photographic plates are presented in Section 8.0 (Plates 1-10).

3.0 ANALYSIS AND CONCLUSIONS

The historical and archaeological contexts have been analyzed to help determine the archaeological potential of the Study Area. These data are presented below in Section 3.1. Results of the analysis of the Study Area property inspection are presented in Section 3.2.

3.1 Analysis of Archaeological Potential

The S & G, Section 1.3.1, lists criteria that are indicative of archaeological potential. The Study Area meets the following criteria indicative of archaeological potential:

- Water sources: primary, secondary, or past water source (Moose Creek).

According to the S & G, Section 1.4 Standard 1e, no areas within a property containing locations listed or designated by a municipality can be recommended for exemption from further assessment unless the area can be documented as disturbed. The United Counties of Stormont, Dundas and Glengarry Official Plan was consulted and no properties within the Study Area are Listed or Designated under the Ontario Heritage Act (United Counties of Stormont, Dundas and Glengarry, 2018).

These criteria are indicative of potential for the identification of Indigenous and Euro-Canadian archaeological resources, depending on soil conditions and the degree to which soils have been subject to deep disturbance.

The use of the Moose Creek as an indicator of higher archaeological potential is not applicable for this project as the Study Area is located within a historic, acidic and low oxygen bog before it was drained in the 1900s. This bog was, seemingly, not a navigable water route or even a source of potable water; the soil in this area would be low fertility and even when drained the ground would be spongy and difficult to traverse which significantly reduces the likelihood that this region was actively used by the Indigenous or Euro-Canadians. The Champlain Sea which later became the bog created a large and perpetual low and wet area that has very low archaeological potential. The active peat harvesting operation in the Study Area adds a separate layer of low archaeological potential in form of extensive ground disturbance following the draining activity that occurred in the early 1900s.



3.2 Analysis of Property Inspection Results

The background research determined that the Study Area is within the historical peat bog and permanently low and wet (S & G, Section 1.3.1 and S & G, Section 2.1.2 a. i).

The property inspection determined that the remainder of the Study Area is within a historical peat bog which was low and wet before draining occurred in the 1900s. The bog has been and continues to be subjected to deep soil disturbance associated with the peat harvesting operation and according to the S & G Section 1.3.2 do not retain archaeological potential (Plates 2, 3 and 6-8; Figure 8: areas highlighted in yellow). These areas do not require further survey.

3.3 Conclusions

The Stage 1 background study determined that there are no previously registered archaeological sites located within one kilometre of the Study Area and that it is within a historical peat bog which was drained for agricultural use in the twentieth century. The systemic property inspection confirmed that the Study Area does not exhibit archaeological potential.

4.0 RECOMMENDATIONS

In light of these results, the following recommendations are made:

1. The Study Area does not retain archaeological potential on account of deep and extensive land disturbance and permanently low and wet conditions. These lands do not require further archaeological assessment;
2. Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands; and,
3. Since the potential always exists to miss important information in an archaeological survey; if any artifacts of Indigenous interest or human remains are encountered during the development of the subject property, please contact:

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NOTWITHSTANDING the results and recommendations presented in this study, ASI notes that no archaeological assessment, no matter how thorough or carefully completed, can necessarily predict, account for, or identify every form of isolated or deeply buried archaeological deposit. In the event that archaeological remains are found during subsequent construction activities, the consultant archaeologist, approval authority, and the Cultural Programs Unit of the MHSTCI should be immediately notified.



5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

ASI also advises compliance with the following legislation:

- This report is submitted to the Ministry of Heritage, Sport, Tourism and Culture Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, RSO 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological field work and report recommendations ensure the conservation, preservation and protection of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Heritage, Sport, Tourism and Culture Industries, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.
- It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological field work on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act*.
- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the *Ontario Heritage Act*.
- The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.



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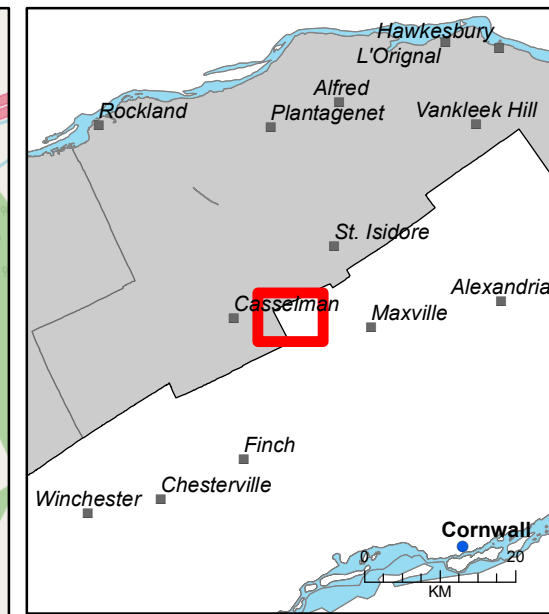


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7.0 MAPS





 STUDY AREA

Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA
 Projection: NAD 1983 UTM Zone 17N
 Scale: 1:25,000
 Page Size: 11 x 17



ASI PROJECT NO.: 19EA-262
 DATE: 2020-05-14
 DRAWN BY: ESB
 FILE: 19EA262_Fig1

 **Providing Archaeological & Cultural Heritage Services**
 528 Bathurst Street Toronto, ONTARIO M5S 2P9
 T 416-966-1069 F 416-966-9723 asiheritage.ca

Figure 1: EOWHF Study Area

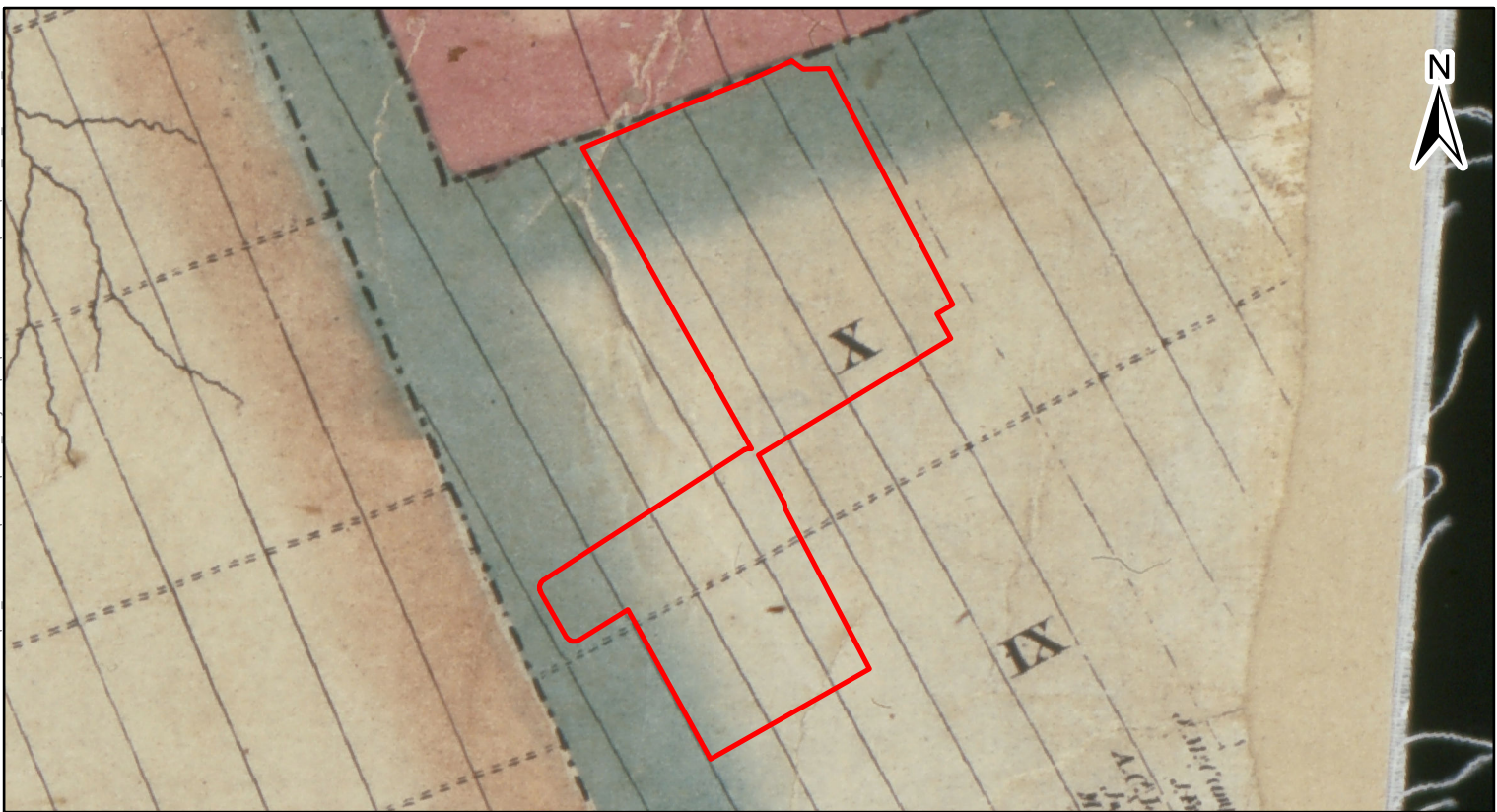


Figure 2: Study Area (Approximate Location) Overlaid on the 1863 Historical County Map of Dundas County

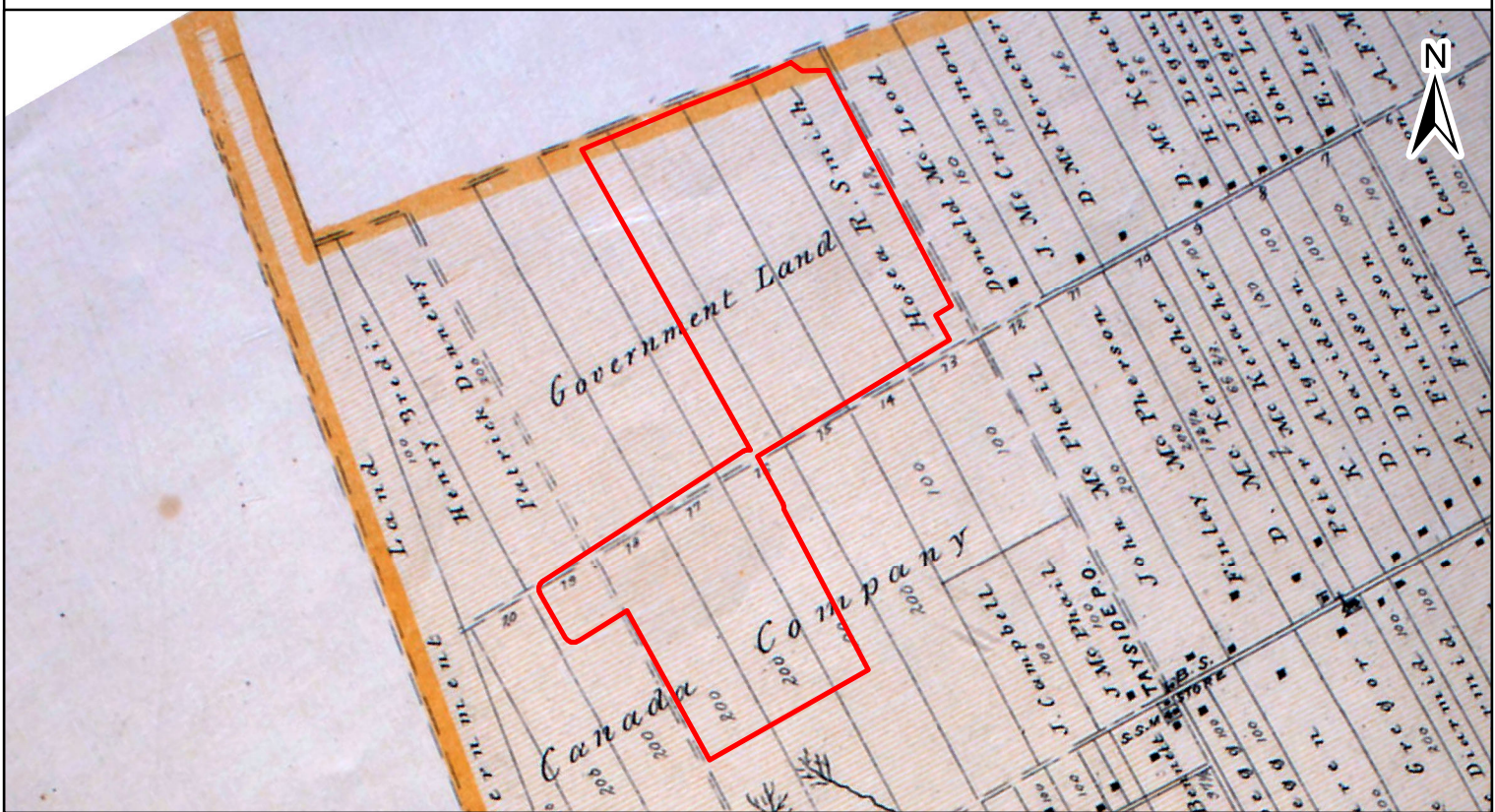


Figure 3: Study Area (Approximate Location) Overlaid on the 1881 Illustrated Historical Atlas of the Counties of Stormont, Dundas and Glengarry

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|--|--|--|--|
|  |  STUDY AREA | Fig. 2: D.P. Putnam. Historical County Map of Dundas County. 1863; Fig. 3: Historical Map of Stormont, Dundas and Glengarry Projection: NAD 1983 UTM Zone 18N Scale: 39,895 Page Size: 8.5 x 11 |  <p>0 1.25 Kilometers</p> <p>ASI PROJECT NO.: 19EA_262 DATE: 2020-05-14</p> <p>DRAWN BY: ESB FILE: 19EA_262_Historic_Feb5</p> |
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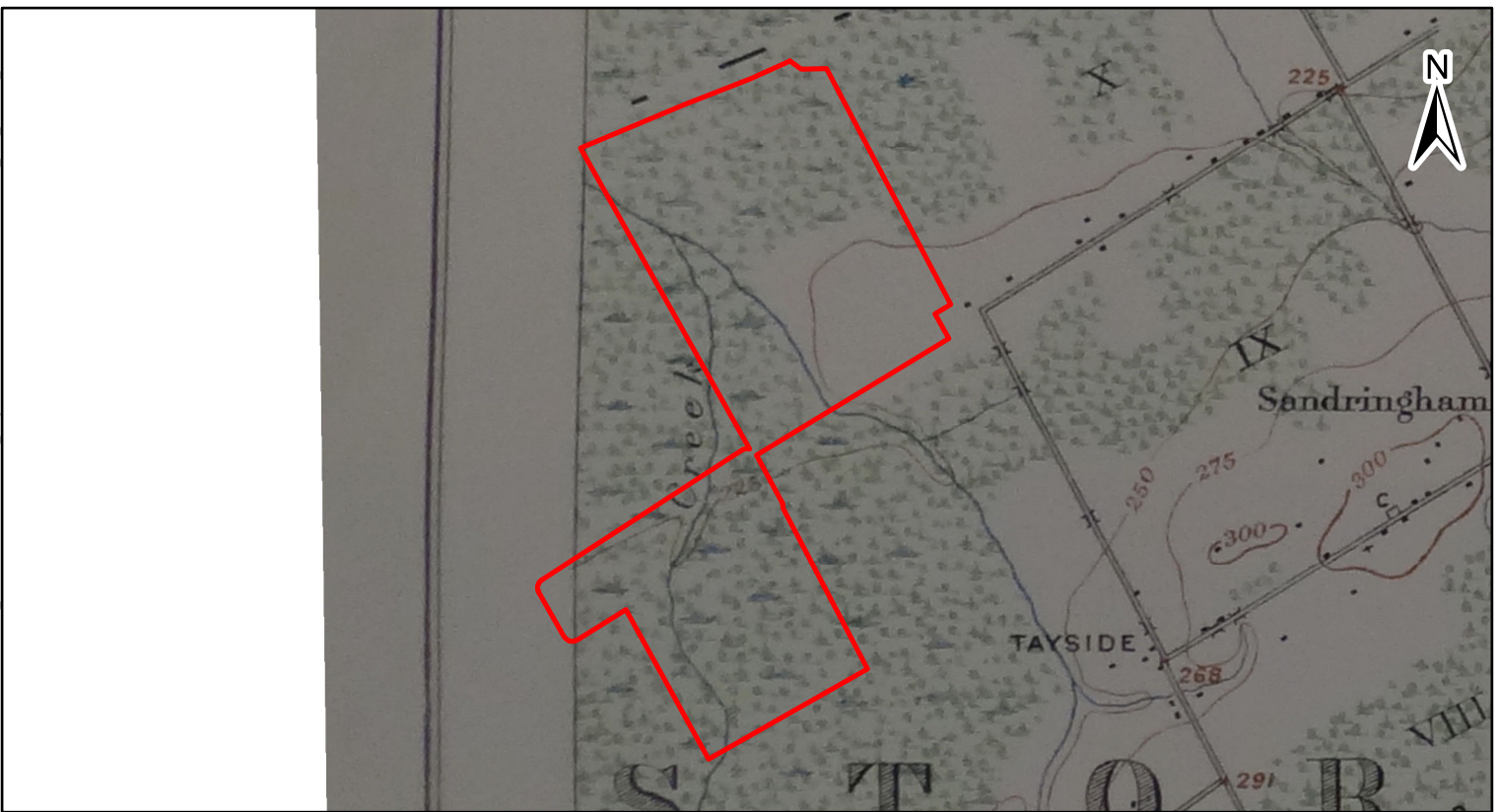


Figure 4: Study Area (Approximate Location) Overlaid on the 1927 NTS - Alexandria Sheet

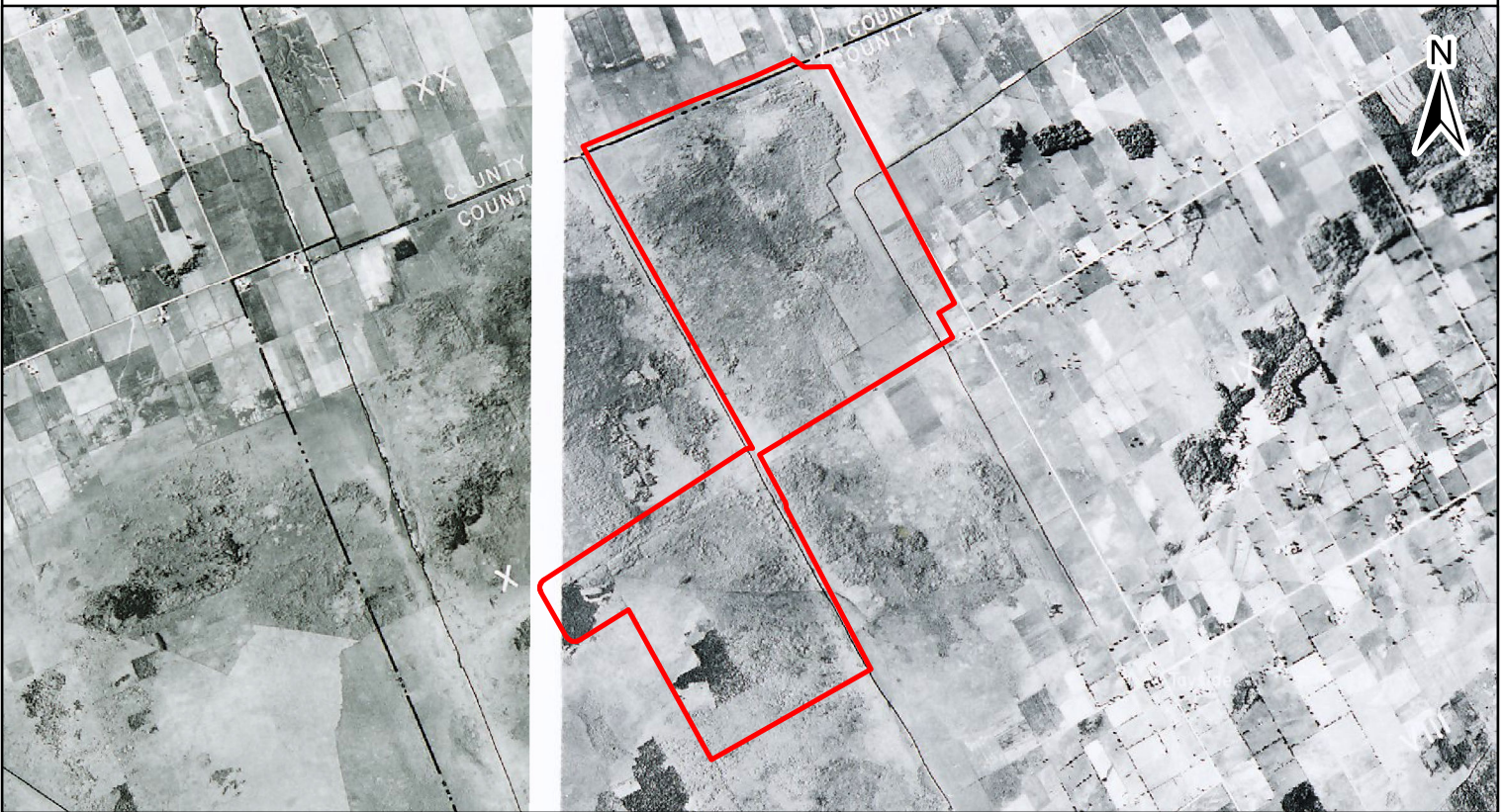


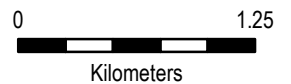
Figure 5: Study Area (Approximate Location) Overlaid on the 1954 Aerial Photograph of Stormont



 STUDY AREA

Fig. 4: National Topographic System, Alexandria Sheet, 1927;
 Fig. 5: Aerial Photography of the County of Stormont, 1954.

Projection: NAD 1983 UTM Zone 18N
 Scale: 39,895
 Page Size: 8.5 x 11



ASI PROJECT NO.: 19EA_262 DRAWN BY: ESB
 DATE: 2020-05-14 FILE: 19EA_262_Historic_Feb5

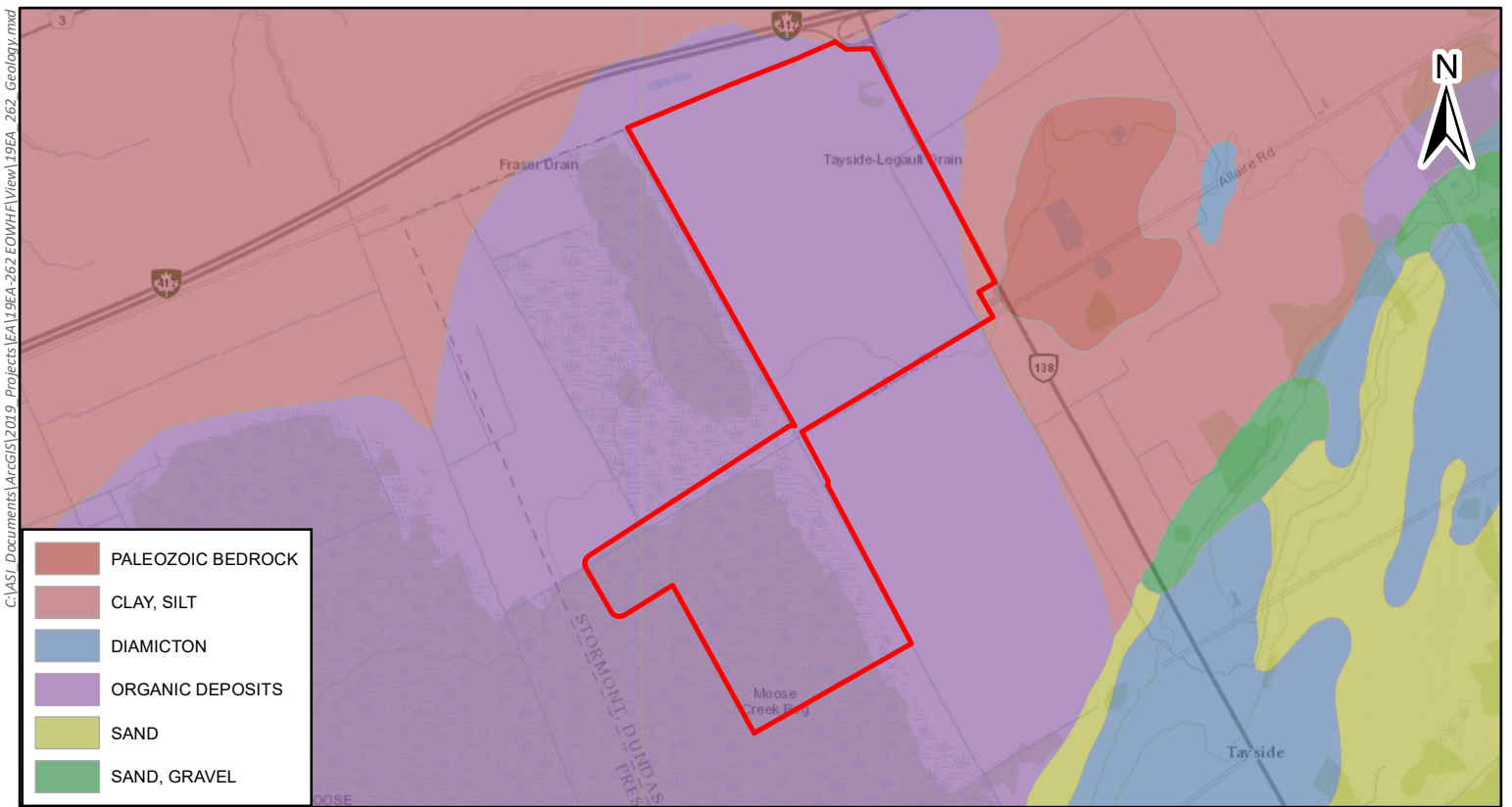


Figure 6: Study Area - Surficial Geology

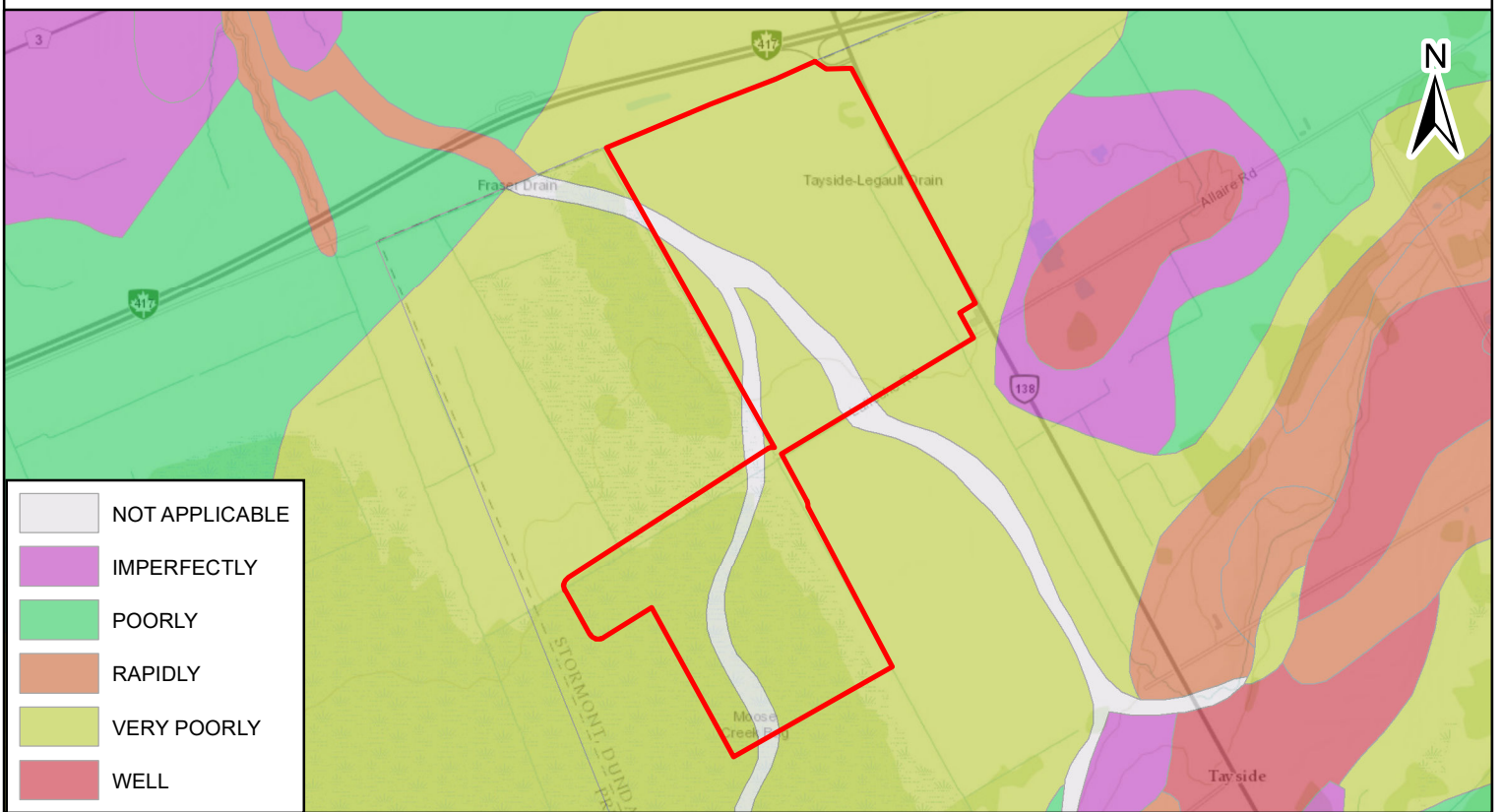
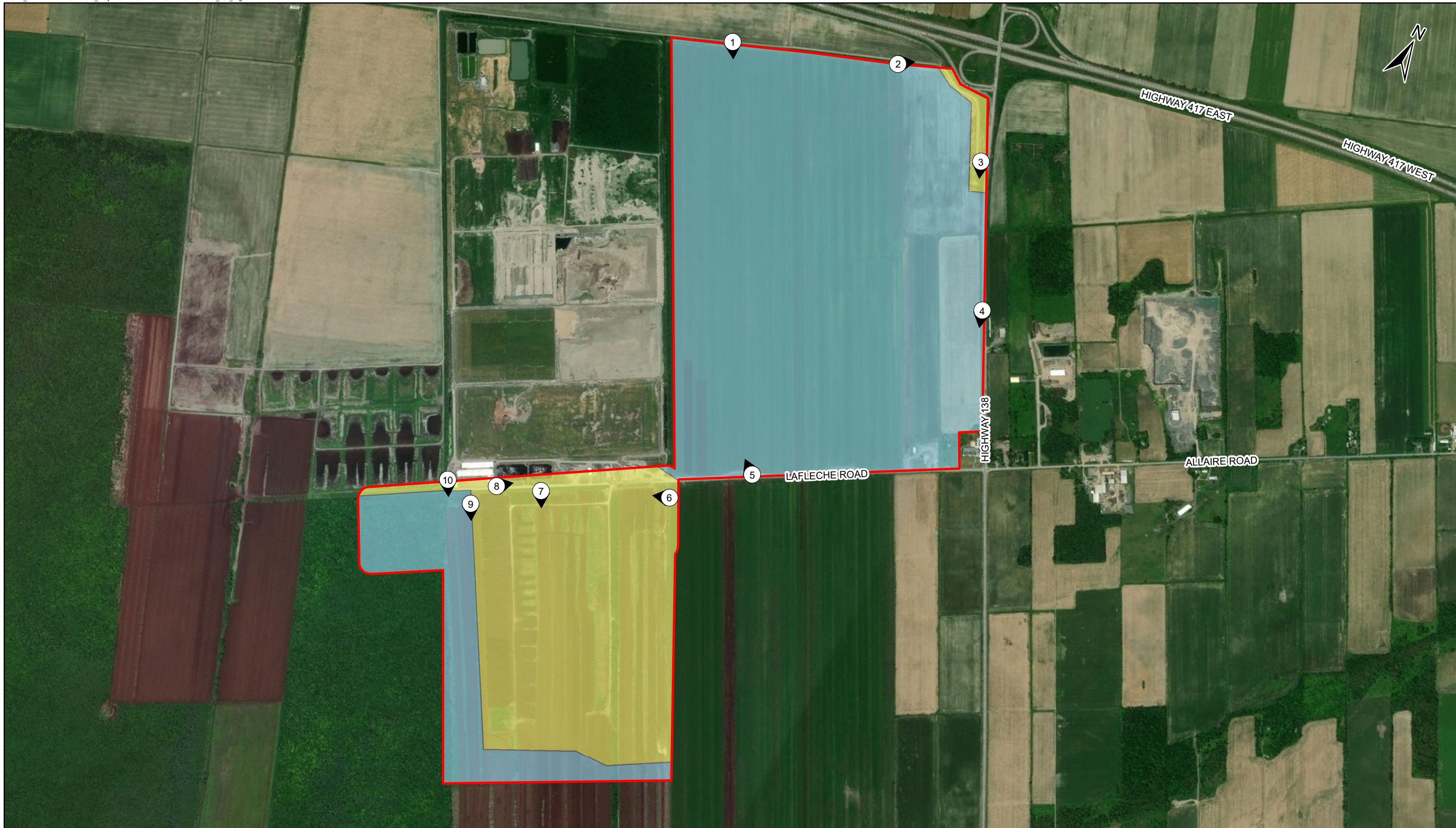


Figure 7: Study Area - Soil Drainage

| | | | |
|--|------------|--|--|
| | STUDY AREA | Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, | |
| | | Projection: NAD 1983 UTM Zone 18N Scale: 40,000 Page Size: 8.5 x 11 | ASI PROJECT NO.: 19EA_262 DRAWN BY: ESB DATE: 2020-05-14 FILE: 19EA_262_Geology |



| | | | | |
|--|--|-------------------------|--|------------------------------|
| | | STUDY AREA | | LOW AND WET: NO POTENTIAL |
| | | DISTURBED: NO POTENTIAL | | PHOTO LOCATION AND DIRECTION |

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Projection: NAD 1983 UTM Zone 18N
 Scale: 1:15,000
 Page Size: 11 x 17

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| 0 | 750 |
| | |
| Metres | |
| ASI PROJECT NO.: 19EA_262 DATE: 2020-05-14 | DRAWN BY: ESB FILE: 19EA_262_Stg1 |

Figure 8: Results of Stage 1

8.0 IMAGES



Plate 1: (SE) Sod farm with irrigation ditch in foreground



Plate 2: (E) Access road, disturbed, and farm field



Plate 3: (SE) Disturbed area associated with access road construction



Plate 4: (SE) Highway 138 right-of-way (ROW), disturbed, and reclaimed agricultural land



Plate 5: (NW) Reclaimed agricultural land



Plate 6: (W) Access road and commercial peat harvesting facility, disturbed



Plate 7: (SE) Current peat harvesting with heavy equipment and mounds of excavated organic material



Plate 8: (E) Access road, current facility and peat extraction operation, disturbed



Plate 9: (SE) Field recently cleared of trees in the process of being drained



Plate 10: (SE) Drainage ditch separating field and treed area

Appendix A





Supporting Document 1-4

Geology and Hydrogeology Existing Conditions Report

Eastern Ontario Waste Handling Facility Landfill
Expansion Environmental Assessment

GFL Environmental Inc.

Moose Creek, Ontario

May 16, 2018

Prepared by:

Tetra Tech
1205 Rue Ampère, Suite 310
Boucherville, QC J4B 7M6



6 Detailed Study Area: On-site Study Area

6.1 Local Topography and Drainage

The site is located in the northwest corner of Roxborough Township, to the south of Highway 417 and about 1.3 km to the west of Highway 138. The site is located at the northeast corner of the feature known as the Moose Creek Bog, and is flat lying and poorly drained (Golder 1998). The upper peat layer was previously removed from the land to the east of the site for commercial purposes. Drainage has been enhanced locally by the construction of ditching. The site is bounded on the east side by the Fraser Municipal drain. Development in the area of the site consists of scattered rural residential. The closest communities are the Hamlet of Tayside about 2.5 km to the southeast and the Town of Casselman approximately 5.7 km to the northwest (Golder 1998).

6.2 Local Bedrock Geology

The geology underlying the On-site Study Area is based on historical borehole log information as well as the WWIS wells located on site when additional to the GFL monitoring wells (**Figure 1** and **Table 3**). The stratigraphy interpreted from the borehole logs is illustrated on two cross-sections shown on **Figures 6 and 7**. A summary of the borehole geology is presented in **Table 1** and the groundwater monitoring well construction details are provided in **Table 2**. **Table 3** provides the geology from the twelve WWIS wells located On-site.

The near surface bedrock underlying the site consists mainly of shale and limestone deposits of the Shadow Lake Formation of the Ottawa Group. The shale overlies the limestone unit. The bedrock surface generally slopes from the north to the south across the site from an elevation of approximately 55 masl in the north to 43 masl in the south and ranging between 10.5 and 24.7 mbgl. This is consistent with the regional bedrock geology map of the area.

6.3 Local Surficial Geology

The surficial geology underlying the On-site Study Area reflects the characteristics of the regional surficial geology. The site is underlain by a 3.0 to 3.5 m thick peat layer, followed by a continuous deposit of marine silty clay from the Champlain sea ranging in thickness from 5.4 to 19.3 m. The upper part of the silty clay is weathered grey-brown whereas the remainder of the unit is unweathered grey-silty clay. The upper weathered silty clay is generally less than 2 metres thick.

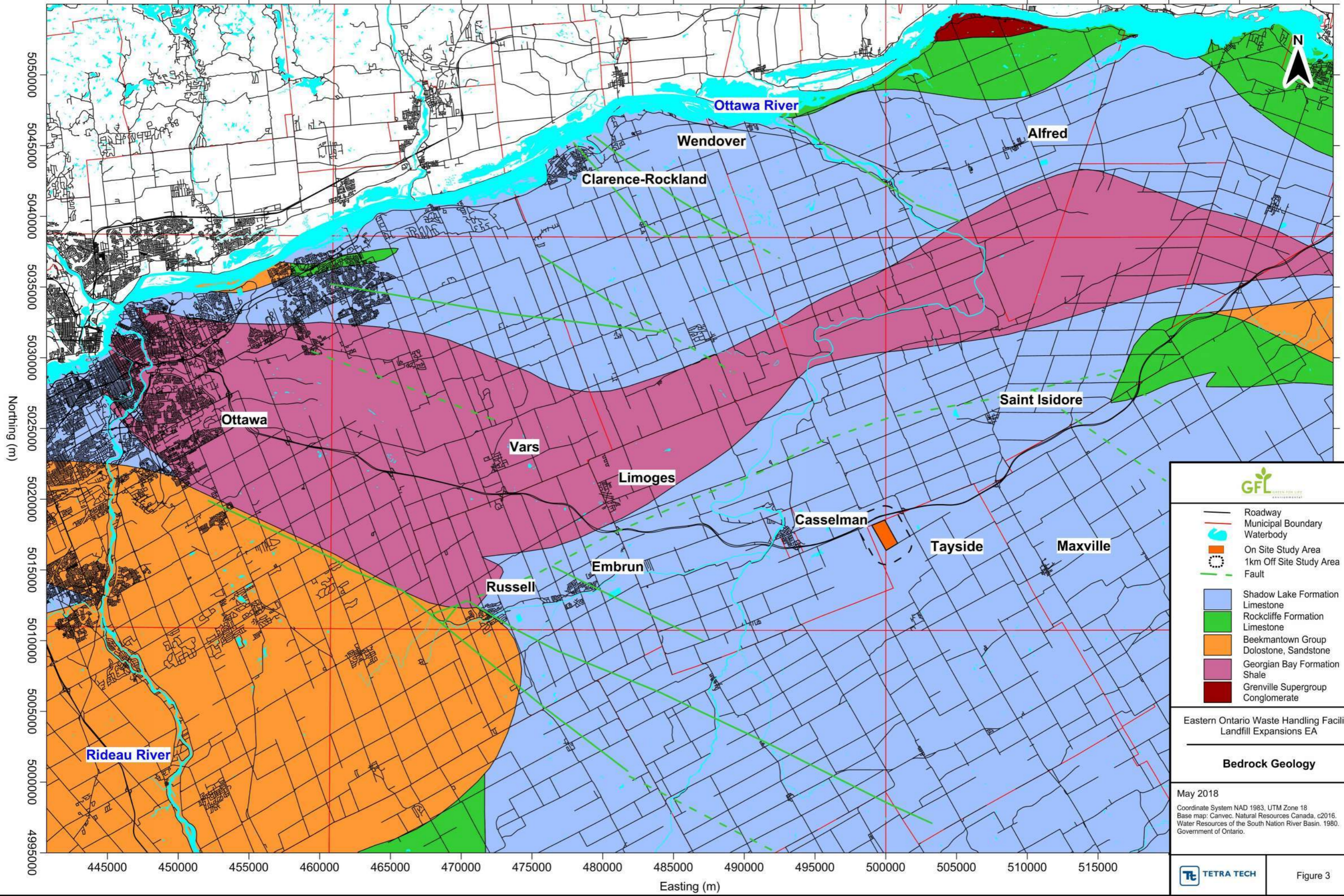
The silty clay deposit is mainly underlain by a sandy silt glacial till layer which overlies the bedrock. The glacial till total thickness varies throughout the site between a few millimetres to 11.4 m. Two types of glacial till materials are encountered beneath the site including the upper glacial till, often comprising compacted sand and gravel, sand, sand/or silty sand, and is more typical of an ablation till. The deeper glacial till unit comprises very dense sandy silt with gravel, cobbles and clay, which is typical of a basal till. The ablation till is not always present between the silty clay and the basal till, when present its thickness varies between 0.7 m and 3.2 m. The basal till is present in most of the boreholes and its thickness varies between 0.6 m and 10.6 m.

6.4 Local Hydrogeology

Groundwater Elevations, Flow Directions, and Hydraulic Gradients

The groundwater monitoring program is carried out three times annually at the EOWHF according to the requirements set out in the Environmental Compliance Approval (ECA) No. A420018 and 4299.9U8V6.

W:\Projects\CGY\88969\ENW\030368\Data\Surren\Figure 1 - Site Location_REV01.srf



GFL
GREEN FOR LIFE
ENVIRONMENTAL

— Roadway
 — Municipal Boundary
 Waterbody
 On Site Study Area
 1km Off Site Study Area
 Fault

Shadow Lake Formation Limestone
 Rockcliffe Formation Limestone
 Beekmantown Group Dolostone, Sandstone
 Georgian Bay Formation Shale
 Grenville Supergroup Conglomerate

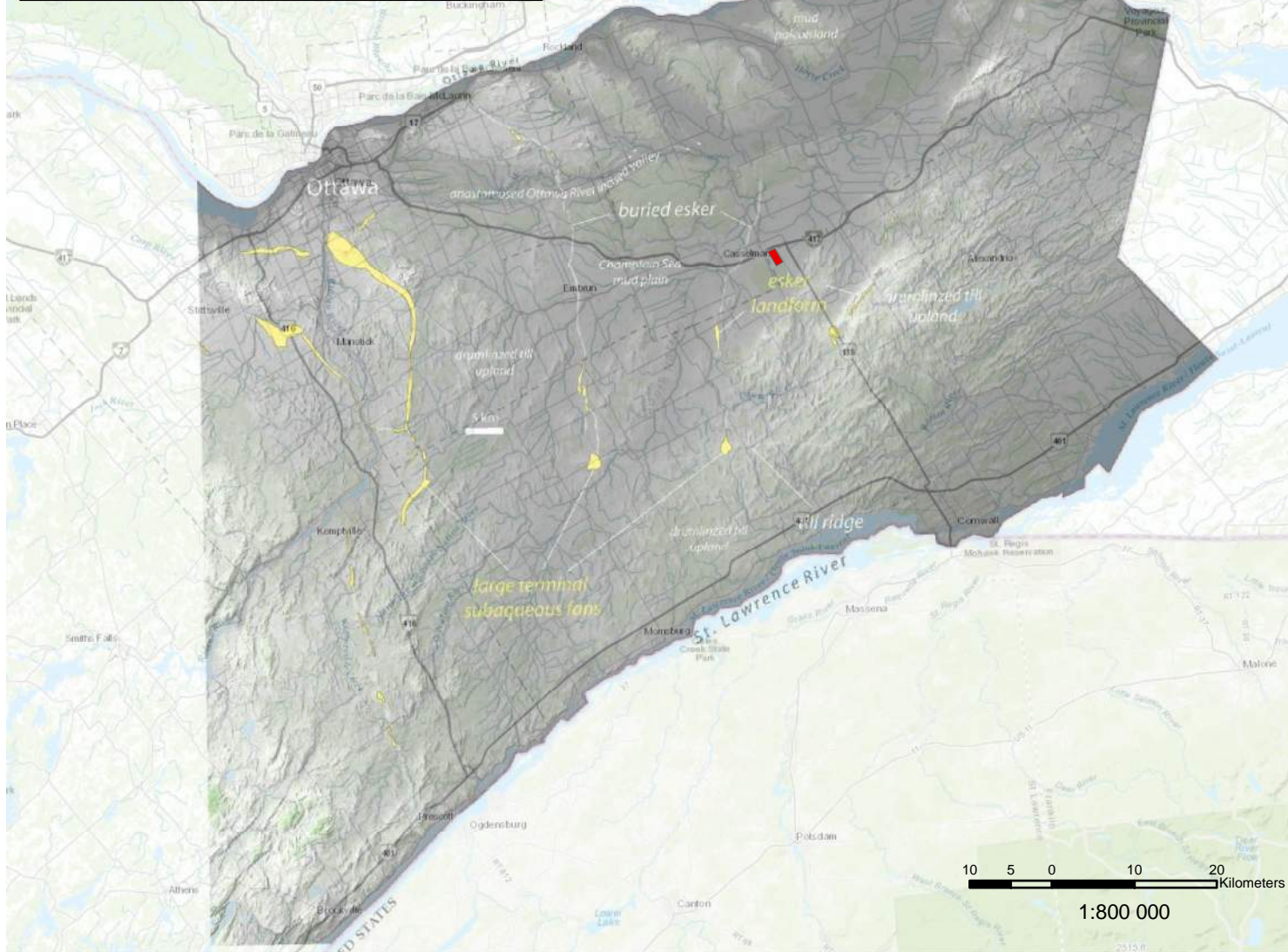
Eastern Ontario Waste Handling Facility Landfill Expansions EA


Bedrock Geology

May 2018
 Coordinate System NAD 1983, UTM Zone 18
 Base map: Canvec, Natural Resources Canada, c2016.
 Water Resources of the South Nation River Basin, 1980.
 Government of Ontario.

TETRA TECH

Figure 3



 On Site Study Area

Eastern Ontario Waste Handling Facility

Eskers in the Champlain Sea Bed

EOWHF Landfill Expansion EA

Date: May 2018

Source: Russel et al. 2011



Figure 5