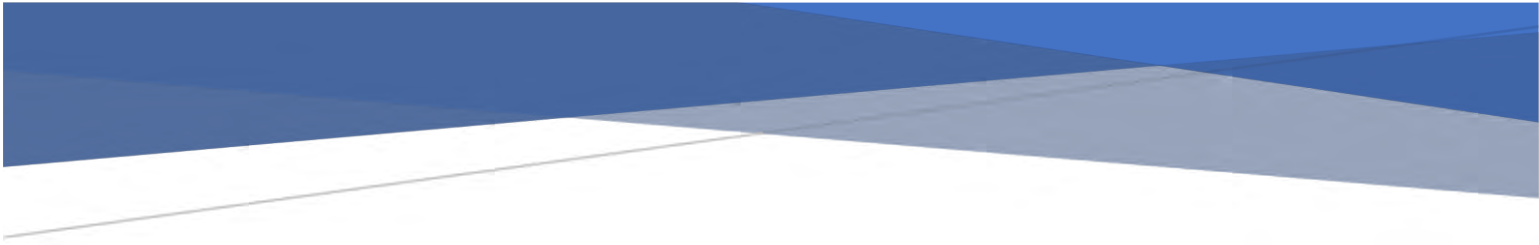


Appendix **E**

W12A Landfill Benthic Water Quality Report



W12A LANDFILL BENTHIC WATER QUALITY REPORT JUNE 5, 2018

Submitted on July 04, 2018

Prepared for: Aecom and the City of London Ontario

Prepared by: Dave Johnson, Principal, StraightUp Environmental Consulting

EXECUTIVE SUMMARY

On June 5, 2018, StraightUp Environmental collected Benthic samples from eight sites around the W12A landfill site as part of the environmental study for the proposed landfill expansion (Table 2). Along with the Benthic samples, water chemistry with a Sonde and substrate characteristics were also recorded (Table 3).

Aquatic invertebrates have the longest history of use in biomonitoring programs. In typical unpolluted temperate streams of North America, certain insect taxa predominate. Mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera) are the most common insects in these undisturbed streams. In rivers disturbed by urbanization, agriculture, forestry, and other perturbations, flies (Diptera), and especially midges (family Chironomidae) predominate.

Traditionally, water quality monitoring actions have focused on physical and chemical measurements. It is widely recognized that the use of other indicators, in addition and complimentary to traditional chemical and physical water quality monitoring techniques, can greatly enhance the assessment and management of aquatic ecosystems.

Consequently, biological monitoring, or biomonitoring, is an important tool in assessing the condition of aquatic ecosystems. Information on and understanding of environmental change is necessary to allow for the protection and remediation of ecosystems. The best way to identify measurement parameters that can serve as vital signs of ecosystems, and define the limits of their variation, is through long term biomonitoring. The resulting data sets are analyzed to provide the basis for defining normal limits of variation or diagnosing ecosystem impairment.

The City of London requested that StraightUp Environmental follow the BioMAP protocol to assess the current water quality. This protocol uses a biotic Water Quality Index ($WQI_{(d)}$) as well as a set of summary metrics to determine the condition of the health of the watercourse (Table 1.0).

All of the sites sampled are classified as Creeks; less than 4m bank full width. All sites on these Creeks seem to be rain dependant with the exception of site W12A-3B. The Creek was dry in-between Site W12A-3A and W12A-3B. Site W12A-3B has other feeder Creeks and appears to have year round flow.

If the WQI rating falls below 14, then the Creek is considered impaired. (Table 1) **All of the sites sampled scored way below 14 and are considered impaired.** The highest score recorded was at site **W12A-3B** and only had a **WQI rating of 3.45**, the lowest score recorded was at site **W12A-2B**, it had a **WQI rating of 1.11**.

StraightUp Environmental chose to use the Hilsenhoff Biotic Index (Genus-Species level) instead of the Family Biotic Index (FBI) as it is obviously more accurate and taxon are already taken to the lowest level. This index was developed by Hilsenhoff (1988). This index is based on the taxon's tolerance to organic pollution. Each of the taxon are assigned a number from 0-10 for its tolerance to organic pollution, 0 being intolerant to organic pollution and 10 being very tolerant to organic pollution. **All of the sites sampled indicate "severe organic pollution likely"** with the best rating at site **W12A-3B**, it had an **HBI rating of 7.28** and the worst rating was at site **W12A-2B**, its rating was **9.95**.

Conductivity, TDS and Salinity levels were extremely high at sites W12A-1B, W12A-2A, W12A-2B, W12A-3A and W12A-4B with **conductivity reaching 5791uS/cm, TDS 3.81 and Salinity of 3.23 at site W12A-2A.** (Table 3) These sites are impacted by the existing Landfill site through drainage or tile coming from within the existing landfill.

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1.0. Introduction

On June 5, 2018, StraightUp Environmental collected benthic macroinvertebrate samples from the area around the current W12A Landfill site. Four Creeks/Drains were chosen for this study and samples were taken from two sites per watercourse.

In addition to the biological monitoring; water temperature, conductivity, TDS, salinity, dissolved oxygen, pH levels along with the substrate characteristics were recorded.

The City of London requested that StraightUp Environmental follow the BioMAP protocol to assess the current water quality. This protocol uses a biotic Water Quality Index ($WQI_{(d)}$) as well as a set of summary metrics to determine the condition of the health of the watercourse (Table 1.0).

TABLE 1.0: CLASSIFICATION OF WATER QUALITY BASED ON THE BioMAP

BioMAP WQI_d		
	Unimpaired	Impaired
Creeks	>16	<14
Streams	>12	<10
Rivers	>9	<7

(Griffiths, 1999)

2.0: Methods

2.1: Sample Collection

In June of 2018, benthic invertebrate samples were collected from 8 sites on the W12A Landfill site location as part of the Environmental Studies for the proposed Expansion of W12A Landfill (Table 2.0). All samples from sites were collected on June 05, 2018.

Two quantitative samples were collected at each site using a Surber Sampler with an enclosed area of 0.05 m². One qualitative sample was also collected at each site using a 500µm D-Net and the “kick and sweep” method, sampling through the different habitat and substrate at each site location.

For each sample, the sediment, debris and organisms were immediately placed into one litre mason jars, preserved with 10% formalyn solution, and labelled with the site code, stream name and date.

Along with the benthic sampling, the following information was provided from each site:

- substrate characteristics
- water depth
- velocity
- temperature
- conductivity
- pH
- DO
- TDS
- algae

TABLE 2.0: LOCATION OF BENTHIC SAMPLING SITES ON W12A

SITE CODE	UTM east	UTM north	DESCRIPTION
W12A-1A	467681	4744858	Approx. 100 meters upstream of Manning Drive at 2 nd culvert
W12A-1B	482712	4746915	Downstream of the culvert on Manning Drive
W12A-2A	481291	4746760	Upstream of Culvert on Manning Drive
W12A-2B	481295	4746746	Downstream of Culvert on Manning Drive
W12A-3A	480500	4747572	Downstream of Culvert on White Oak Rd.
W12A-3B	479820	4747952	Upstream of Culvert on Scotland Drive, West of White Oak Road
W12A-4A	481525	4748129	South of the Culvert on Scotland Drive
W12A-4B	479820	4747952	North of the Culvert on Scotland Drive

2.2. SAMPLE PROCESSING

Benthic macroinvertebrate samples were processed by StraightUp Environmental. Our lab received the samples and examined the submission sheet to match the number of jars for each sample and confirmed the samples received. Our taxonomists ensured that the correct number of jars and labels matched the submission sheets. The samples were washed free of the ethanol through a 500µm sieve prior to sorting and identification.

2.3. Subsampling

Subsampling is accomplished by stacking 3 sieves; 4mm, 2mm and a 500mic. on top of each other and flushing thoroughly with running water. Both the 4mm and the 2mm sieve have all bugs counted and the 500mic sieve was 25% sampled and multiplied by four.

2.4. Detailed Identification

All of the benthic macroinvertebrates were identified to the lowest practical level (Table 2.1). Taxonomic resolution was dependent upon the condition and maturity of the specimen. A list of the taxonomic keys used is identified in Appendix A.

2.5. Quality Assurance and Quality Control Measures

StraightUp Environmental incorporates a list of QA/QC procedures for all of its benthic projects to ensure the accuracy of all data:

- Samples were inspected, enumerated and logged upon arrival
- Taxonomic identifications are based on the most updated taxonomic keys
- Sorted specimens are preserved in 70% ethanol, labelled and stored at StraightUp's laboratory indefinitely
- Sediments and debris are preserved with 70% ethanol, labelled and stored for up to 3 months
- To ensure the accuracy of the data entry, the spreadsheets are compared to the field and bench sheets by a second person

2.6. Data Interpretation and Reporting

The identification and enumeration of the benthic macroinvertebrates was performed by StraightUp Environmental. The detailed list summarizing the density and taxa for each of the samples using an Excel spreadsheet was reported per 0.05m² as shown in Appendix B and a list of taxonomic keys used is in Appendix A.

2.7. BioMAP Water Quality Index (WQI_d)

The BioMAP WQI_d is an abundance-weighted mean sensitivity value of the benthic organisms occurring at a site. The required taxonomic resolution from (Table 2.1) is used to determine the quality of the water. Each of the taxa is given sensitivity values from 0-4 with 4 being the most sensitive to anthropological changes.

The WQI_d was calculated as follows:

$$\left[\sum_{i=1}^n e^{sv_i} * \ln(x_i + 1) \right] \div \left[\sum_{i=1}^n \ln(x_i + 1) \right]$$

Where, sv_i is the sensitivity value of the i^{th} taxon

x_i is the density of the i^{th} taxon

n is the total number of taxa in the sample

For streams, bank full widths of less than 4 meters such as the monitoring sites on Trib C, a $WQI_{(d)} > 16$ would indicate unimpaired and < 14 would indicate impaired water quality (Griffiths, 1999)

If the index falls between 14 and 16, the water quality cannot be classified solely by using this index and therefore a weight of evidence approach is used including Simpson's Indices (family level) and Hilsenhoff's modified biotic index.

TABLE 2.1: BIOMAP'S REQUIRED TAXONOMIC RESOLUTION FOR THE IDENTIFICATION OF BENTHIC MACROINVERTEBRATES (GRIFFITHS, 1993)

Taxon	Required taxonomic resolution
Insects	Genus
Beetles	Genus
Elmidae	Species (adults)
Caddisflies	Genus
Dragonflies	Species
Mayflies	Genus
Baetis	Species
Stenonema	Species
Stoneflies	Genus/Species
Capniidae	Genus
True Flies	Genus
Chironomidae	Genus
Simuliidae	Family
Mites	Family
Crustaceans	Genus
Amphipods	Genus
Gammarus	Species
Crayfish	Genus
Molluscs	Genus
Annelids	Species
Flatworms	Genus

2.8. Hilsenhoff's Modified Family Level Biotic Index (Bode et al., 1991, 1996; Mandaville 2002)

This index was developed by Hilsenhoff (1988). Each taxa has a tolerance to organic pollution value ranging from 0 (intolerant) to 10 (tolerant), (Table 2.2). Its intent is for rapid field assessment of organic pollution. Tolerance values used are from

<http://lakes.chebucto.org/ZOOBENTH.BENTHOS/tolerance.html>

The Modified Family Biotic Index was calculated as follows:

$$(\sum x_i t_i) \div n$$

where, x_i is the number of individuals within a taxon

t_i is the tolerance value of the taxon

n is the total number of organisms in the sample

TABLE 2.2: HILSENHOFF'S FAMILY LEVEL BIOTIC INDEX

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

(Hilsenhoff, 1988)

3.0 RESULTS

3.1. Watercourse Characteristics

Canopy coverage was close to 50% for sites W12A-3B and W12A-4B. All other sites had zero canopy coverage. All of the sites sampled had no riffle or run and consisted mainly of still water pools

The forecast in the morning was sunny with highs of 22°C and clouded over in the afternoon with a few showers.

Conductivity at site W12A-2A was 5791us/cm, which is extremely high, the TDS was 3.81 and salinity was 3.23, these are also very high and would obviously contribute to the high continuity. TDS refers to the total dissolved solids and the salinity refers to the amount of salt in the water. Five out of the eight sites had extremely high levels of TDS and salinity. (Table 3.0)

Table 3.0: SUMMARY OF THE PHYSICAL DATA AND CHEMISTRY FROM TRIB C

Reach	Boulder %	Cobble %	Gravel %	Sand %	Silt %	Clay %
W12A-1A	0	0	10	10	75	5
W12A-1B	0	10	25	10	55	0
W12A-2A	0	20	20	20	20	20
W12A-2B	10	30	30	10	10	10
W12A-3A	0	5	10	30	50	5
W12A-3B	25	25	20	10	15	5
W12A-4A	0	0	20	25	50	5
W12A-4B	0	20	40	10	30	0
Reach	Riffle (%)		Run (%)		Pool (%)	
W12A-1A	0		0		100	
W12A-1B	0		0		100	
W12A-2A	0		0		100	
W12A-2B	0		0		100	
W12A-3A	0		0		100	
W12A-3B	0		0		100	
W12A-4A	0		0		100	
W12A-4B	10		10		80	

Reach		Bank Full Width (m)			Depth (cm)		Velocity (cm/s)	
W12A-1A								
• Centre point		1.9			10		0	
• Downstream		1.7			10		0	
• Upstream		1.9			10		0	
W12A-1B								
• Centre point		1.9			11		0	
• Downstream		1.9			9		0	
• Upstream		1.9			8		0	
W12A-2A								
• Centre point		3.1			25		0	
• Downstream		3.1			20		0	
• Upstream		2.7			18		0	
W12A-2B								
• Centre point		3.1			20		0	
• Downstream		2.9			18		0	
• Upstream		2.9			16		0	
W12A-3A								
• Centre point		3.3			13		0	
• Downstream		2.4			15		0	
• Upstream		2.7			12		0	
W12A-3B								
• Centre point		2.1			10		0	
• Downstream		2.2			8		0	
• Upstream		2.0			9		0	
W12A-4A								
• Centre point		0.8			10		0	
• Downstream		0.9			11		0	
• Upstream		0.7			12		0	
W12A-4B								
• Centre point		3.3			120		0	
• Downstream		3.0			110		0	
• Upstream		3.4			100		0	
Reach	Temperature (°C)	Conductivity (µS/cm)	TDS	Salinity	Dissolved Oxygen	pH	Turbidity	Algae
W12A-1A	15.85	649	0.422	0.32	5.82	7.44	Turbid	Sparse
W12A-1B	14.67	2013	1.311	1.04	7.21	7.48	Turbid	Sparse
W12A-2A	19.14	5791	3.81	3.23	5.94	6.80	Turbid	Sparse
W12A-2B	16.47	1701	1.106	0.87	5.89	7.27	Turbid	Sparse
W12A-3A	15.33	2156	1.403	1.11	3.78	6.97	Turbid	Sparse
W12A-3B	15.59	469	0.304	0.23	8.73	7.51	Turbid	Sparse
W12A-4A	14.56	651	0.423	0.32	6.39	7.06	Turbid	Sparse
W12A-4B	13.57	2048	1.329	1.05	7.12	7.30	Turbid	Sparse

3.2: Benthic Water Quality Results

All of the watercourses sampled are dependant on rainfall and all contained dry spots except for site 3B. **All of the sites** sampled have a **WQI** rating of **IMPAIRED** and all have a **Hilsenhoff Biotic Index** rating of **VERY POOR QUALITY (SEVERE ORGANIC POLLUTION LIKELY)**. The watercourses are all classified as Creeks according to Griffith and WQI readings of less then 14 would indicate impaired.(Table 4.0)

Site 2B had the worst ratings with the **WQI being 1.11** and the **BIOTIC INDEX of 9.95**. This site was dry downstream and contained many Bluntnose minnows, Fathead minnows, Common shiners and Brook Sticklebacks which contributed to the lack of insects in the three samples taken.

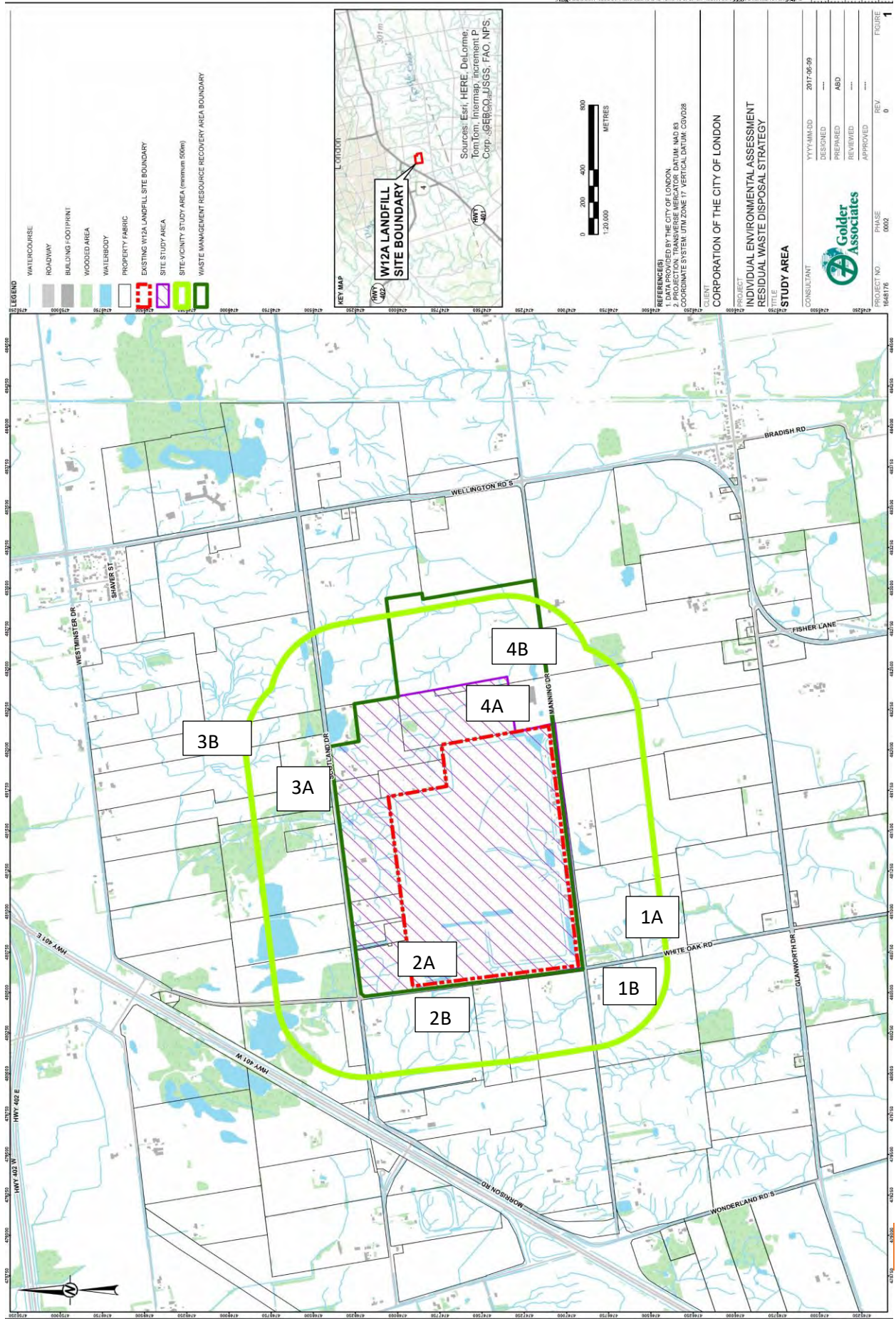
Hilsenhoff's Biotic Index was used instead of the Family Biotic Index as the bugs are already taken to the Genus-Species Level and is obviously more accurate.

Table 4.0: Results

Site:	W12A-1A	W12A-1B	W12A-2A	W12A-2B	W12A-3A	W12A-3B	W12A-4A	W12A-4B
Total Taxa	10	27	8	7	11	11	19	18
Average BioMap WQI	1.36	2.46	1.29	1.11	1.722	3.449	2.69	3.09
Hilsenhoff Biotic Index	9.34	8.81	9.65	9.95	8.5	7.281	8.85	8.66
EPT Richness (%)	0.126	0.195	0.265	0	0.5	0.151	0	0
Percentage Oligochaetes	4.79	35.28	22.22	18.64	65.5	6.184	55.93	33.17
Percentage Chironomidae	86.76	41.33	75.40	81.36	0	20.06	27.12	45.19
Percentage Insects	94.70	59.84	69.84	81.36	1.5	23.53	28.47	73.08
Simpsons diversity	0.760	0.309	0.336	0.083	0.071	0.431	0.13	0.217
Simpsons index of diversity	0.240	0.690	0.664	0.917	0.929	0.569	0.87	0.783
Simpsons reciprocal	1.32	3.230	2.98	12.058	14.169	2.320	7.66	4.611

4.0. Site Map

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5.0. Site Photo

Site W12A-4B-downstream



Site: W12A-4B-upstream



Site: W12A-4A-upstream



Site: W12A-4A-downstream



Site: W12A-3A-downstream



Site: W12A-3A-upstream



Site: W12A-2B-downstream



Site: W12A-2A-upstream



Site: W12A-1A-downstream



Site: W12A-2B-downstream



Site: W12A-1B-upstream



Site W12A-1A: Upstream



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7.0. Benthic Data

W12A-1A

Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes				1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabates				0
agabus				2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebrionporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae				
ancyrionxy variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4

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stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
halipus				1
peltodytes				2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				
helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa	x	4	2	1
Palmacorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4

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Brachycentridae:				
Brachycentrus				3
micasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protoptila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Diplectrona				4
Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Triaenodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3

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Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cynellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3
Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagrion				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile				1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exsulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Corduliidae:				
Cordulia				1
Epitheca				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1

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Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1
Plathemis				0
Sympetrum				1
Tramea				1
Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Dipheter				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Procloeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis				1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Eurylophella aestiva				1
Eurylophella bicolor				3
Eurylophella coxalis				3
Eurylophella funeralis				4
Eurylophella lutulenta				1
Eurylophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemerella guttulata				3
Ephemerella simulans				2
Ephemerella varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrantha				3
Pentagenia				3

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Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocota				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2
Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphloplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:		1		
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivipara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroeuria abnormis				2
Acroeuria carolinensis				3
Acroeuria evoluta				2
Acroeuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3

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Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				
Atherix				3
Ceratopogonidae	x	22	34	0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanypus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus	x	134	242	0
Cladopelma				1
Cladotanytarsus				2
Clinotanypus				1
Coelotanypus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicrotendipes	x	42	56	0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	x	74	82	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterbouriella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanypus				2
Nilothauma				1
Odontomesa				2

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Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladus				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametrioctenemus				3
Paratanytarsus				1
Paratendipes				2
Pentaneura				2
Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Potthastia				1
Procladius	x	34	24	0
Prodiamesa				3
Protanypus				0
Psectrocladius				1
Psectrotanypus				0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladus				3
Sublettea				2
Sympotthastia				3
Syndiamesa				3
Synorthocladus				3
Tanypus	x			1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus				2
Xylotopus				2
Zalutschia				0
Zavreliomyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae				1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2
Stratiomyidae				0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus				0
Tipulidae:				
Antocha				3
Cryptolabis				4

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Dactylobois				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx				2
Gammaridae:				
Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalala	x	2	2	2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes				2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea				1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium				1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum				2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquoidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranthus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2

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Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnati				1
Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria				1
Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0
Physidae:				
Physella				0
Planorbidae:				
Gyraulus				1
Helisoma				1
Planorbella				0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis				2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
Lumbriculidae				0
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetosus				3
Isochaetides freyi				1
Limnodrilus	x	22	16	0
Potamotheix bavaricus				2
Potamotheix moldaviensis				2
Potamotheix vejovskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0

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Platyhelminthes:				0
FLATWORMS:				
Alloeoecola				1
Tricladida				3
Total sum/0.05m2		331	456	
Total Taxa	10			
BioMap WQI		1.373292815	1.345766854	
Avareage	1.359529834			
Hilsenhoff Biotic Index	9.340479193			
EPT Richness (%)	0.126103405			
Percentage Oligocheates	4.791929382			
Percentage Chironomidae	86.7591425			
Percentage Insects	94.703657			
Simpsons diversity	0.760082309			
Simpsons index of diversity	0.239917691			
Simpsons reciprocal	1.315646987			

W12A-1B

Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
Chauliodes				1
Corydalis				2
Nigronia				3
SIALIDAE				
Sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
Petrophila				2
Other				0
BEETLES:				
DYROPIDAE:				
Helichus				2
DYTISCIDAE:				
Acilius				0
agabates				0
agabus				2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2	X		4	2
nebraporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae		1		
dubiraphia larvae	X	29	16	
ancyrionxy variegata				2
dubiraphia bivittata		3		0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastidius				2

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optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
haliplus	X			1
peltodytes		3		2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				
helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa	X	15	18	1
Palmarcorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				

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Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protoptila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Diplectrona				4
Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Trienodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3

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Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cynellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3
Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagron				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile				1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exsulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria	1			2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Corduliidae:				
Cordulia				1
Epitheca				1
Helocordulia				2

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Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1
Platthemis				0
Sympetrum				1
Tramea				1
Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Diphetor				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Procloeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis				1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Euryophella aestiva				1
Euryophella bicolor				3
Euryophella coxalis				3
Euryophella funeralis				4
Euryophella lutulenta				1
Euryophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemera guttulata				3
Ephemera simulans				2
Ephemera varia				3

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Hexagenia atrocauda				3
Hexagenia				1
Litobranchna				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocuta				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2
Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphloplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:			1	
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivpara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3
Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2

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Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				
Atherix				3
Ceratopogonidae				0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanytus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus	X	54	62	0
Cladopelma				1
Cladotanytarsus				2
Clinotanytus				1
Coelotanytus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicrotendipes		2		0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	X	38	38	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterbouriella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3

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Natarsia				3
Nilotanypus				2
Nilothauma				1
Odontomesa				2
Orthocladius	X	3		
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametrioctenemus				3
Paratanytarsus				1
Paratendipes	X			2
Pentaneura				2
Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Pothastia				1
Procladius				0
Prodiamesa				3
Protanypus				0
Psectrocladius				1
Psectrotanypus	X			0
Pseudochironomus	X	12	3	1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympothastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus	X			1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus				2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae		1		0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae	X	1	1	1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2
Stratiomyidae	X			0
Syrphidae				0
Tabanidae:				
Chrysops				2

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Tabanus	X		1	0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylobis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx				2
Gammaridae:				
Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalala	X	8	6	2
CRAZFISHES:				
Cambaridae:				
Cambarus				1
Orconectes	X		7	2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea				1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium				1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatum				2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquoidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranthus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1

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Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnatia				1
Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria	X	1		1
Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0
Physidae:				
Physella			2	0
Planorbidae:				
Gyraulus				1
Helisoma				1
Planorbella				0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis			1	2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
Lumbriculidae				0
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetosus				3
Isochaetides freyi				1
Limnodrilus	X	78	103	0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2
Potamothenix vejvodskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1

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Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeochoela				1
Tricladida				3
Total sum/0.05m2		235	245	
Total Taxa	27			
BioMap WQI		2.226431242	2.68476166	
avareage	2.455596451			
HBI rate	8.812865497			
EPT Richness (%)	0.194931774			
Percentage Oligochaetes	35.28265107			
Percentage Chironomidae	41.32553606			
Percentage Insects	59.84405458			
Simpsons diversity	0.309588135			
Simpsons index of diversity	0.690411865			
Simpsons reciprocal	3.230097945			

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Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes				1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabates				0
agabus				2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebrionporus				2
neoporus				2
neoscutopterous				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae				
ancyrionxy variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1

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dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
haliphus				1
peltodytes				2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				
helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa				1
Palmarcorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovellia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				

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Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protophila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Diplectrona				4
Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Triaenodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4

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Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cynellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3
Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagrion				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile				1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exsulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3

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Corduliidae:				
Cordulia				1
Epithea				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1
Platthemis				0
Sympetrum				1
Tramea				1
Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Dipheter				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Procloeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis		1		1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Eurylophella aestiva				1
Eurylophella bicolor				3
Eurylophella coxalis				3
Eurylophella funeralis				4
Eurylophella lutulenta				1
Eurylophella temporalis				1
Serratella serratoides				4
Serratella				3

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Ephemeridae:				
Ephemera guttulata				3
Ephemera simulans				2
Ephemera varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrancha				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocota				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2
Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphloplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:				
Allocapnia granulata				2
allocalpnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivipara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3

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Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Cloperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				
Atherix				3
Ceratopogonidae	x	2	3	0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanytus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskii				1
Chironomus	x	84	82	0
Cladopelma				1
Cladotanytarsus				2
Clinotanytus				1
Coelotanytus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicortendipes				0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	x	28	22	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterbouriella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1

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Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanypus				2
Nilothauma				1
Odontomesa				2
Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametriochnemus				3
Paratanytarsus				1
Paratendipes				2
Pentaneura				2
Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trignonus				0
Polypedilum tritum				0
Potthastia				1
Procladius				0
Prodiamesa				3
Protanypus				0
Psectrocladius	x	27	13	1
Psectrotanypus	x	12	17	0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympotthastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus				1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus				2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae				1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2

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Stratiomyidae				0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus	x	2	1	0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylobis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx				2
Gammaridae:				
Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalala				2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes				2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea				1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumelium				1
Musculium securis				1
musculium transversum				2
Pisidium				1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum				2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquoidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1

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Proptera alata				0
Ptychobranthus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnatia				1
Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria				1
Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0
Physidae:				
Physella				0
Planorbidae:				
Gyraulus				1
Helisoma				1
Planorbella				0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis				2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
Lumbriculidae				0
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetosus				3
Isochaetides freyi				1
Limnodrilus	x	36	48	0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2

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Potamothrix vej dovskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligocheate				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeocoela				1
Tricladida				3
Total sum/0.05m2		192	186	
Total Taa	8			
BioMap WQI		1.342268159	1.237976286	
avareage	1.290122223			
HBI rate	9.645502646			
EPT Richness (%)	0.264550265			
Percentage Oligocheates	22.22222222			
Percentage Chironomidae	75.3968254			
Percentage Insects	69.84126984			
Simpsons diversity	0.335586638			
Simpsons index of diversity	0.664413362			
Simpsons reciprocal	2.979856425			

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Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes				1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabates				0
agabus				2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebrionporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae				
ancronxy variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
haliphus				1
peltodytes				2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				

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helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa				1
Palmarcorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phyllocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protoptila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Dipletrona				4

W12A LANDFILL BENTHIC WATER QUALITY REPORT JUNE 5,2018

Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Trienodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cynellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3

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Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagrion				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile				1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Corduliidae:				
Cordulia				1
Epithea				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1
Platthemis				0
Sympetrum				1
Tramea				1

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Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis	x			2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Dipheter				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Proclaeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis				1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Euryophella aestiva				1
Euryophella bicolor				3
Euryophella coxalis				3
Euryophella funeralis				4
Euryophella lutulenta				1
Euryophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemerella guttulata				3
Ephemerella simulans				2
Ephemerella varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrantha				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocota				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2

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Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphloplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:				
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivpara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3
Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				

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Atherix				3
Ceratopogonidae				0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanypus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus	x	29	48	0
Cladopelma				1
Cladotanytarsus				2
Clinotanypus				1
Coelotanypus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicrotendipes				0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	x	12	51	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterborniella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanypus				2
Nilothauma				1
Odontomesa				2
Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametriocnemus				3
Paratanytarsus				1
Paratendipes				2
Pentaneura				2

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Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Pothastia				1
Procladius				0
Prodiamesa				3
Protanypus				0
Psectrocladius	x		4	1
Psectrotanypus	x			0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympothastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus				1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus				2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae				1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2
Stratiomyidae				0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus				0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylobis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx				2
Gammaridae:				

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Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalaea				2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes				2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea				1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium				1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum				2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata silicoidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranthus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnatia				1
Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria				1

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Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0
Physidae:				
Physella				0
Planorbidae:				
Gyraulus				1
Helisoma				1
Planorbella				0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis	x			2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
Lumbriculidae				0
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetus				3
Isochaetides freyi				1
Limnodrilus	x	10	23	0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2
Potamothenix vejvodskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeocoela				1
Tricladida				3
Total sum/0.05m2		51	126	
Total Taxa	7			
BioMap WQI		1	1.218950612	
avareage	1.109475306			
HBI rate	9.95480226			
EPT Richness (%)	0			
Percentage Oligochaetes	18.6440678			
Percentage Chironomidae	81.3559322			
Percentage Insects	81.3559322			
Simpsons diversity	0.0829315			
Simpsons index of diversity	0.9170685			
Simpsons reciprocal	12.05814433			

W12A-3A-2018				
Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes	W12A LANDFILL BENTHIC WATER QUALITY REPORT JUNE 5,2018			1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabetes				0
agabus				2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebrionporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae				
ancronxy variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
halipus				1
peltodytes				2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				
helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0

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Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa				1
Palmacorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protophila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Diplectrona				4
Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2

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Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Triaenodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cynellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3
Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3

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Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagrion				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile	x			1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Corduliidae:				
Cordulia				1
Epithea				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1
Plathemis				0
Sympetrum				1
Tramea				1
Macromiidae:				
Didymops				2
Macromia				2

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MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Dipheter				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Procloeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis		1		1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Eurylophella aestiva				1
Eurylophella bicolor				3
Eurylophella coxalis				3
Eurylophella funeralis				4
Eurylophella lutulenta				1
Eurylophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemerella guttulata				3
Ephemerella simulans				2
Ephemerella varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrantha				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocota				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2
Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3

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Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphloplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:				
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivipara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3
Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				
Atherix				3
Ceratopogonidae	x		2	0
Chaoboridae:				
Chaoborus				0

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Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanytus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus				0
Cladopelma				1
Cladotanytarsus				2
Clinotanytus				1
Coelotanytus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicrotendipes				0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes				0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterborniella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanytus				2
Nilothauma				1
Odontomesa				2
Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametriocnemus				3
Paratanytarsus				1
Paratendipes				2
Pentaneura				2
Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3

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Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Potthastia				1
Procladius				0
Prodiamesa				3
Protanypus				0
Psectrocladius				1
Psectrotanypus				0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympotthastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus				1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus				2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae				1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2
Stratiomyidae				0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus				0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylobis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx				2
Gammaridae:				
Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalalidae:				

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Hyallela	x			2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes			1	2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea	x	12	9	1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium			1	1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum				2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquioidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranhus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnatia				1
Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria				1
Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0

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Physidae:				
Physella	x		17	0
Planorbidae:				
Gyraulus	x	3	4	1
Helisoma				1
Planorbella	x	6	13	0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis				2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
Lumbriculidae				0
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetosus				3
Isochaetides freyi				1
Limnodrilus	x	53	78	0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2
Potamothenix vejdvskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeochoela				1
Tricladida				3
Total sum/0.05m2		74	126	
Total Taxa	11			
BioMap WQI		1.686754559	1.757344314	
avareage	1.722049436			
HBI rate	8.5			
EPT Richness (%)	0.5			
Percentage Oligochaetes	65.5			
Percentage Chironomidae	0			
Percentage Insects	1.5			
Simpsons diversity	0.070578222			
Simpsons index of diversity	0.929421778			
Simpsons reciprocal	14.16867664			

W12A-3B-2018

Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
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PREPARED BY: DAVE JOHNSON, PRINCIPAL, STRAIGHTUP ENVIRONMENTAL CONSULTING

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Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes				1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabetes				0
agabus	x	12	8	2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebioporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae				
ancyrionxy variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
haliphus				1
peltodytes				2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2

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cymbiodyta				1
enochrus				0
helochares				
helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa				1
Palmacorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protophila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				

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Arctopsyche				4
Cheumatopsyche				1
Diplectrona				4
Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
Hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Trienodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cynellus				1
Neureclipsis				2
Nyctiophylax				2

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Polycentropus				
Psychomyiidae:				
Lype				3
Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagron				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile				1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Corduliidae:				
Cordulia				1
Epitheca				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1

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Platheimis				0
Sympetrum				1
Tramea				1
Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Diphetor				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Procloeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis		2		1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Eurylophella aestiva				1
Eurylophella bicolor				3
Eurylophella coxalis				3
Eurylophella funeralis				4
Eurylophella lutulenta				1
Eurylophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemerella guttulata				3
Ephemerella simulans				2
Ephemerella varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrantha				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocota				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2

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Stenonema vicarium				3
Isonychiidae:				
Isonychia				2
Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphloplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parametetus				3
Siphonurus				2
STONEFLIES:				
Capniidae:				
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivpara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3
Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2

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Taeniopteryx				3
TRUE FLIES:				
Athericidae:				
Atherix				3
Ceratopogonidae				0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanypus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus	x	18	16	0
Cladopelma				1
Cladotanytarsus				2
Clinotanypus				1
Coelotanypus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicrotendipes				0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	x	37	42	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterbouriella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanypus				2
Nilothauma				1
Odontomesa				2
Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametriocnemus				3

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Paratanytarsus				1
Paratendipes				2
Pentaneura				2
Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Potthastia				1
Procladius	x	7	13	0
Prodiamesa				3
Protanypus				0
Psectrocladius				1
Psectrotanypus				0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympotthastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus				1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus				2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae				1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae		1		2
Stratiomyidae				0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus				0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylolabis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3

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Crangonyx rivularis				3
Crangonyx	x	123	143	2
Gammaridae:				
Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalidae				2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes				2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea				1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium				1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum				2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquoidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranchus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrrus)				2
Cincinnatia				1
Fontigens				3
Potamopyrgus				1
Probythinella				2

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Lymnaeidae:				
Bulinnea				1
Fossaria	x	5	3	1
Lymnaea				1
Pseudosuccinea	x	25	29	0
Radix				1
Stagnicola				0
Physidae:				
Physella	x	75	63	0
Planorbidae:				
Gyraulus				1
Helisoma				1
Planorbella				0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis				2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
Lumbriculidae				0
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetosus				3
Isochaetides freyi				1
Limnodrilus				0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2
Potamothenix vejvodskyi	x	23	18	2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeocoela				1
Tricladida				3
Total sum		328	335	
Total Taxa	11			
BioMap WQI		3.529334961	3.367681375	
avareage	3.448508168			
HBI rate	7.280542986			
EPT Richness (%)	0.150829563			
Percentage Oligochaetes	6.184012066			
Percentage Chironomidae	20.06033183			
Percentage Insects	23.52941176			
Simpsons diversity	0.430974013			
Simpsons index of diversity	0.569025987			
Simpsons reciprocal	2.320325519			

Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
W12A LANDFILL BENTHIC WATER QUALITY REPORT JUNE 5,2018				
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes				1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabetes				0
agabus			1	2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus	x			1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus				1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebrionporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae			1	
ancyrionyx variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
halipus				1
peltodytes				2
HYDROPHILIDAE:				
anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				

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helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa				1
Palmarcorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others	x			0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protoptila				2
Goeridae:				
Goera				3
Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Dipletrona				4

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Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Trienodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				
Cyrnellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3

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Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagrion				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile				1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exsulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Corduliidae:				
Cordulia				1
Epithea				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0
Leucorrhinia				0
Libellula				1
Perithemis				1
Platthemis				0
Sympetrum				1
Tramea				1

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Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Dipheter				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Proclaeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis				1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Eurylophella aestiva				1
Eurylophella bicolor				3
Eurylophella coxalis				3
Eurylophella funeralis				4
Eurylophella lutulenta				1
Eurylophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemera guttulata				3
Ephemera simulans				2
Ephemera varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrantha				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocota				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3
Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2

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Leptohiphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphonecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:				
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivpara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3
Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				
Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				

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Atherix				3
Ceratopogonidae	x	2		0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Acricotopus				1
Apsectrotanypus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus	x	31	16	0
Cladopelma				1
Cladotanytarsus				2
Clinotanytus				1
Coelotanytus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Diamesa				3
Dicrotendipes				0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	x	17	12	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterborniella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropsectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanytus				2
Nilothauma				1
Odontomesa				2
Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2
Paralauterborniella				0
Paramerina				
Parametriocnemus				3
Paratanytarsus				1
Paratendipes				2
Pentaneura				2

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Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Pothastia				1
Procladius				0
Prodiamesa				3
Protanypus				0
Psectrocladius				1
Psectrotanypus				0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympothastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus				1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus	x		4	2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae				1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2
Stratiomyidae	x			0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus				0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylobis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula	x			
Crustaceans:				
AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx	x	16	8	2
Gammaridae:				

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Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalidae				2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes	x			2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea	x		8	1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium		2		1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum		4		2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquoidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranthus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnatia				1
Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria				1

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Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0
Physidae:				
Physella				0
Planorbidae:				
Gyraulus	x		1	1
Helisoma				1
Planorbella	x	4	4	0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobdella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis				2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
enchytraeidae	x	17	24	1
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetus				3
Isochaetides freyi				1
Limnodrilus	x	48	76	0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2
Potamothenix vejovskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeocoela				1
Tricladida				3
Total sum		141	155	
Total Taxa	19			
BioMap WQI		2.643788232	2.732480815	
avareage	2.688134524			
HBI rate	8.85084758			
EPT Richness (%)	0			
Percentage Oligochaetes	55.93220339			
Percentage Chironomidae	27.11864407			
Percentage Insects	28.47457627			
Simpsons diversity	0.130604288			
Simpsons index of diversity	0.869395712			
Simpsons reciprocal	7.656716418			

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Macroinvertebrate	Qualitative	Quantitative 1	Quantitative 2	BioMAP sensitivity value
Insects:				
ALDERFLIES:				
CORYDALIDAE:				
chauliodes				1
corydalis				2
nigronia				3
SIALIDAE				
sialis				2
AQUATIC MOTHS:				
PYRALIDAE:				
petrophila				2
other				0
BEETLES:				
DYROPIDAE:				
helichus				2
DYTISCIDAE:				
acilius				0
agabates				0
agabus				2
bidessonotus				1
celina				0
colymbetes				1
copelatus				3
coptotomus lenticus				1
coptotomus longulus				1
coptotomus loticus				2
cybister				0
desmopachria				0
dytiscus				1
graphoderus				0
heterosternuta				3
hydrocolus				1
hydroporus	x			1
hydrovatus				0
hygrotus				0
illybius				2
laccophilus				0
laccornis				1
liodessus				2
lioporeus				3
matus2				2
nebrionporus				2
neoporus				2
neoscutopterus				0
oreodytes				2
rhantus				0
sanfilippodytes				3
stictotarsus				2
uvarus				2
ELMIDAE:				
Optioservus larvae				
Stenelmis larvae				
dubiraphia larvae				
ancyrionxy variegata				2
dubiraphia bivittata				0
dubiraphia minima				1
dubiraphia quadrinotata				1
dubiraphia vittata				2
macronychus galbratus				2
microcylloepus pusillus				3
optioservus fastiditus				2
optioservus ovalis				2
optioservus trivittatus				3
promoresia elegans				3
promoresia tardella				4
stenelmis bicarinata				2
stenelmis crenata				2
stenelmis musgravei				1
stenelmis quadramaculata				0
stenelmis sandersoni				2
stenelmis vittipennis				2
GYRINIDAE:				
dineutes				2
gyrinus				1
HALIPLIDAE:				
haliplus				1
peltodytes				2
HYDROPHILIDAE:				

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anacaena				2
berosus				0
crenitis				2
cymbiodyta				1
enochrus				0
helochares				
helocombus				0
helophorus				1
hydrobius				1
Hydrochara				0
Hydrochus				1
Hydrophilus				3
Laccobius				1
Paracymus				2
Sperchopsis				3
Tropisternus				0
Lampyridae				1
Limnichidae:				
Lutrochus				3
Psephenidae:				
Ectopria				3
Psephenus				3
Ptilodactylidae:				
Anchytarsus				3
Scirtidae				
Micrasema				4
BUGS:				
Belostomatidae:				
Belostoma				0
Lethocerus				0
Corixidae:				
Callicorixa				2
Corisella				0
Hesperocorixa	2	2		1
Palmarcorixa				2
Sigara grossolineata				2
Sigara lineata				2
Sigara mathesoni				3
Sigara trilineata				2
Sigara others				0
Trichocorixa calva				3
Trichocorixa others				1
Gerridae:				
Aquarius				3
Gerris				1
Limnoporus				1
Metrobates				2
Neogerris				0
Rheumatobates				1
Trepobates				1
Mesoveliidae:				
Mesovelia				1
Nepidae:				
Nepa				1
ranatra				0
Notonectidae:				
Buenoa				0
Notonecta				0
Pleidae:				
Neoplea				0
Veliidae:				
Microvelia				0
Rhagovelia				2
CADDISFLIES:				
Apataniidae:				
Apatania				4
Beraeidae:				
Beraea				4
Brachycentridae:				
Brachycentrus				3
micrasema				4
Calamoceratidae:				
Heteroplectron				3
Dipseudopsidae:				
Phylocentropus				2
Glossosomatidae:				
Agapetus				4
Glossosoma				4
Protophila				2
Goeridae:				
Goera				3

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Helicopsychidae:				
Helicopsyche				2
Hydropsychidae:				
Arctopsyche				4
Cheumatopsyche				1
Diplectrona				4
Homoplectra				4
Hydropsyche alhedra				3
Hydropsyche alvata				1
Hydropsyche betteni				2
Hydropsyche bronta				3
Hydropsyche cuanis				2
Hydropsyche dicantha				2
Hydropsyche hageni				2
Hydropsyche morosa				2
Hydropsyche immature				
Hydropsyche placoda				2
Hydropsyche scalaris				2
Hydropsyche slossonae				3
Hydropsyche sparna				3
Hydropsyche ventura				4
Hydropsyche welkeri				3
Macrostemum				2
Parapsyche				4
Potamyia				1
Hydroptilidae:				
Agraylea				1
Hydroptila				2
Ithytrichia				4
Leucotrichia				3
Mayatrichia				2
Neotrichia				2
Ochrotrichia				2
Orthotrichia				
Oxyethira				1
Stactobiella				4
Lepidostomatidae:				
Lepidostoma				4
Theliopsyche				4
Leptoceridae:				
Ceraclea				1
Leptocerus				0
Mystacides				1
Nectopsyche				1
Oecetis				2
Setodes				2
Trienodes				1
Limnephilidae:				
Anabolia				1
Asynarchus				1
Chyranda				4
Frenesia				4
Glyphopsyche				1
Hesperophylax				4
Hydatophylax				4
Ironoquia				2
Lenarchus				1
Limnephilus moestus				3
Limnephilus				1
Nemotaulius				1
Onocosmoecus				4
Platycentropus				2
Pseudostenophylax				4
Psychoglypha				4
Pycnopsyche				3
Molannidae:				
Molanna				2
Odontoceridae:				
Marilia				3
Psilotreta				4
Philopotamidae:				
Chimarra				3
Dolophilodes				4
Wormaldia				4
Phryganeidae:				
Agrypnia				1
Banksiola				0
Fabria				1
Oligostomis				3
Phryganea				1
Ptilostomis				2
Polycentropodidae:				

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Cynellus				1
Neureclipsis				2
Nyctiophylax				2
Polycentropus				
Psychomyiidae:				
Lype				3
Psychomyia				3
Rhyacophilidae:				
Rhyacophila fenestra				3
rhyacophila lobifera				3
Rhyacophila				4
Sericostomatidae:				
Agarodes				3
Uenoidae:				
Neophylax				4
DAMSELFLIES:				
Calopterygidae:				
Calopteryx aequabilis				2
Calopteryx maculata				3
Hetaerina				2
Coenagrionidae:				
Amphiagrion				1
Argia apicalis				1
Argia fumipennis				3
Argia moesta				2
Argia sedula				2
Argia tibialis				3
Argia translata				1
Chromagrion				2
Coenagrion				0
Enallagma antennatum				1
Enallagma aspersum				0
Enallagma basidens				0
Enallagma boreale				1
Enallagma carunculatum				1
Enallagma civile		1		1
Enallagma clausum				0
Enallagma cyathigerum				1
Enallagma ebrium				1
Enallagma exsulans				3
Enallagma geminatum				2
Enallagma hageni				0
Enallagma signatum				1
Enallagma vesperum				1
Ischnura				1
Nehalennia				1
Lestidae:				
Archilestes				2
Lestes				1
DRAGONFLIES:				
Aeshnidae:				
Aeshna				2
Anax				0
Basiaeschna				1
Boyeria				2
Nasiaeschna				1
Cordulegastridae:				
Cordulegaster				3
Cordulidae:				
Cordulia				1
Epithea				1
Helocordulia				2
Neurocordulia				2
Somatochlora				3
Gomphidae:				
Arigomphus				1
Dromogomphus				2
Gomphurus				2
Gomphus				3
Hagenius				2
Ophiogomphus				3
Phanogomphus				1
Stylogomphus				3
Stylurus				3
Libellulidae:				
Erythemis				1
Ladona				0

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Leucorrhinia				0
Libellula				1
Perithemis				1
Plathemis				0
Sympetrum				1
Tramea				1
Macromiidae:				
Didymops				2
Macromia				2
MAYFLIES:				
Ameletidae:				
Ameletus				4
Arthropleidae:				
Arthroplea				3
Baetidae:				
Acentrella				3
acerpenna macdunnoughi				3
Acerpenna pygmaea				2
Baetis brunneicolor				3
Baetis flavistriga				1
Baetis intercalaris				2
Baetis				2
baetis rusticans				
Baetis tricaudatus				4
Callibaetis				0
Centroptilum				3
Diphetor				3
Heterocloeon				2
Plauditus armillatus				2
Plauditus cestus				3
Plauditus cingulatus				2
Plauditus dubius				1
Plauditus punctiventris				3
Plauditus virilis				1
Procloeon				2
Pseudocentroptiloides				3
Pseudocloeon frondalis				2
Pseudocloeon longipalpus				1
Pseudocloeon propinquus				2
Baetiscidae:				
Baetisca				2
Caenidae:				
Brachycercus				2
Caenis anceps				2
Caenis				1
Ephemerellidae:				
Attenella				2
Dannella				3
Dentatella bartoni				1
Drunella				4
Ephemerella aurivillii				4
Ephemerella				3
Eurylophella aestiva				1
Eurylophella bicolor				3
Eurylophella coxalis				3
Eurylophella funeralis				4
Eurylophella lutulenta				1
Eurylophella temporalis				1
Serratella serratoides				4
Serratella				3
Ephemeridae:				
Ephemera guttulata				3
Ephemera simulans				2
Ephemera varia				3
Hexagenia atrocauda				3
Hexagenia				1
Litobrantha				3
Pentagenia				3
Heptageniidae:				
Anepeorus				1
Epeorus				4
Heptagenia				3
Leucrocuta				3
Nixe				3
Rhithrogena				4
Stenacron				2
Stenonema exiguum				1
Stenonema femoratum				1
Stenonema ithaca				2
Stenonema luteum				2
Stenonema mediopunctatum				3

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Stenonema modestum				2
Stenonema pulchellum				1
Stenonema terminatum				2
Stenonema vicarium				3
Isonychiidae:				
Isonychia				2
Leptohyphidae:				
Tricorythodes				2
Leptophlebiidae:				
Choroterpes				3
Habrophlebia				
Habrophlebiodes				2
Leptophlebia				1
Paraleptophlebia				3
Metretopodidae:				
Siphonoplecton				2
Oligoneuriidae:				
Homoeoneuria				2
Polymitarcyidae:				
Ephoron				3
Potamanthidae:				
Anthropotamus				2
Pseudironidae:				
Pseudiron				2
Siphonuridae:				
Parameletus				3
Siphonurus				2
STONEFLIES:				
Capniidae:				
Allocapnia granulata				2
allocapnia minima				2
Allocapnia pygmaea				3
Allocapnia recta				4
Allocapnia rickeri				3
Allocapnia vivpara				2
Capnia				4
Paracapnia				3
Chloroperlidae:				
Alloperla				4
Haploperla				3
Suwallia				4
Sweltsa				4
Leuctridae:				
Leuctra				4
Paraleuctra				4
Nemouridae:				
Amphinemura				4
Nemoura				3
Ostrocerca				4
Paranemoura				4
Podmosta				4
Prostoia				3
Shipsa				3
Soyedina				4
Peltoperlidae:				
Peltoperla				3
Tallaperla				3
Perlidae:				
Acroneuria abnormis				2
Acroneuria carolinensis				3
Acroneuria evoluta				2
Acroneuria lycorias				2
Agnetina				3
Attaneuria				2
Neoperla				3
Paragnetina				3
Perlesta				2
Perlinella				3
Perlodidae:				
Arcynopteryx				4
Clioperla				3
Cultus				4
Helopicus				
Isogenoides				4
Isoperla bilineata				2
Isoperla nana				2
Isoperla				4
Malirekus				4
Pteronarcyidae:				
Pteronarcys				3
Taeniopterygidae:				

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Oemopteryx				4
Strophopteryx				4
Taeniopteryx burksi				2
Taeniopteryx				3
TRUE FLIES:				
Athericidae:				
Atherix				3
Ceratopogonidae	x			0
Chaoboridae:				
Chaoborus				0
Chironomidae:				
Ablabesmyia				2
Aricotopus				1
Apsectrotanypus				4
Brillia parva				4
Brillia				2
Brundiniella				4
Cardiocladius				2
Chaetocladius				1
Chernovskia				1
Chironomus	x	58	46	0
Cladopelma				1
Cladotanytarsus				2
Clinotanypus				1
Coelotanypus				1
Conchapelopia				2
Corynoneura				2
Cricotopus (C.) tremulus-gp				3
Cricotopus (C.) trifascia				3
Cricotopus (C.) others				2
Cricotopus(Isocladius)				0
Cryptochironomus				1
Cryptotendipes				2
Demicryptochironomus				1
Damesa				3
Dicrotendipes				0
Diplocladius				3
Doncricotopus				3
Einfeldia				0
Endochironomus				0
Epoicocladius				2
Eukiefferiella claripennis-gp				1
Eukiefferiella				3
Glyptotendipes	x	36	16	0
Harnischia				1
Heleniella				4
Helopelopia				3
Heterotanytarsus				0
Heterotrissocladius hirtapex				2
Heterotrissocladius				1
Hydrobaenus				1
Labrundinia				1
Larsia				1
Lauterbouriella				0
Limnophyes				1
Lipiniella				1
Macropelopia				3
Meropelopia				3
Metriocnemus				3
Microchironomus				1
Microcricotopus				1
Micropectra				3
Microtendipes				2
Monodiamesa				1
Nanocladius				3
Natarsia				3
Nilotanypus				2
Nilothauma				1
Odontomesa				2
Orthocladius				
Pagastia				3
Pagastiella				0
Parachaetocladius				3
Parachironomus				1
Paracladopelma doris				3
Paracladopelma doris-gp				2
Paracladopelma galaptera				0
Paracladopelma nais				2
Paracladopelma nereis				3
Paracladopelma undine				2
Paracladopelma winnelli				2
Parakiefferiella				2

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Paralauterborniella				0
Paramerina				
Parametrioctenemus				3
Paratanytarsus				1
Paratendipes				2
Pentaneura				2
Phaenopsectra				1
Polypedilum albicorne				3
Polypedilum angulum				
Polypedilum aviceps				3
Polypedilum fallax				1
Polypedilum flavum (convictum)				2
Polypedilum halterale				0
Polypedilum illinoense				1
Polypedilum laetum				2
Polypedilum nubeculosum				2
Polypedilum scalaenum				1
Polypedilum trigonus				0
Polypedilum tritum				0
Pothastia				1
Procladius				0
Prodiamesa				3
Protanypus				0
Psectrocladius	x			1
Psectrotanypus	x		4	0
Pseudochironomus				1
Rheocricotopus				2
Rheopelopia				3
Rheotanytarsus				3
Robackia				2
Saetheria				2
Stempellina				2
Stempellinella				3
Stenochironomus				2
Stictochironomus				2
Stilocladius				3
Sublettea				2
Sympotthastia				3
Syndiamesa				3
Synorthocladius				3
Tanypus				1
Tanytarsus				2
Thienemanniella				2
Thienemannimyia				2
Tribelos				1
Trissopelopia				2
Tvetenia				2
Unniella				
Xenochironomus	x	24	4	2
Xylotopus				2
Zalutschia				0
Zavrelimyia				2
Culicidae				0
Dixidae				1
Dolichopodidae				2
Empididae				2
Ephydriidae			1	1
Muscidae				1
Psychodidae				0
Ptychopteridae				1
Simuliidae				2
Stratiomyidae				0
Syrphidae				0
Tabanidae:				
Chrysops				2
Tabanus				0
Tipulidae:				
Antocha				3
Cryptolabis				4
Dactylolabis				3
Dicranota				3
Erioptera				1
Helius				1
Hexatoma				2
Limnophila				2
Limonia				2
Ormosia				3
Pedicia				3
Pilaria				1
Pseudolimnophila				3
Tipula				
Crustaceans:				

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AMPHIPODS:				
Crangonyctidae:				
Crangonyx gracilis-cmpx				3
Crangonyx rivularis				3
Crangonyx	x	42	6	2
Gammaridae:				
Gammarus fasciatus				2
Gammarus lacustris				3
Gammarus pseudolimnae				3
Hyalidae:				
Hyalidae				2
CRAYFISHES:				
Cambaridae:				
Cambarus				1
Orconectes				2
Palaemonetidae:				
Palaemonetes				3
ISOPODS:				
Asellidae:				
Caecidotea	x	12		1
Lirceus				2
Molluscs:				
BIVALVES:				
Dreissenidae:				
Dreissena				1
Sphaeriidae:				
musculium lacustre				1
Musculium partumeium				1
Musculium securis				1
musculium transversum				2
Pisidium				1
Sphaerium fabale				3
Sphaerium occidentale				0
Sphaerium rhomboideum				1
Sphaerium simile				1
Sphaerium striatinum	x	6	6	2
Unionidae:				
Actinonaias carinata				2
Actinonaias ligamentina				3
Alasmidonta marginata				3
Alasmidonta viridis				3
Amblema plicata				2
Anodontoides ferussacianus				3
Carunculina parva				1
Cyclonaias tuberculata				2
Elliptio dilatata				1
Epioblasma(=Dysnomia)				2
Fusconaia flava				1
Lampsilis cardium				3
Lampsilis fasciola				3
Lampsilis radiata siliquioidea				1
Lampsilis ventricosa				1
Lasmigona complanata				1
Lasmigona compressa				3
Lasmigona costata				2
Leptodea fragilis				1
Ligumia nasuta				0
Ligumia recta				2
Obliquaria reflexa				1
Obovaria subrotunda				2
Pleurobema coccineum				1
Proptera alata				0
Ptychobranthus fasciolaris				3
Pyganodon (=Anodonta,in part)				1
Quadrula pustulosa				1
Quadrula quadrula				2
Simpsoniconcha ambigua				2
Strophitus undulatus				3
Truncilla				2
Villosa fabalis				2
Villosa iris				2
SNAILS:				
Ancylidae:				
Ferrissia fragilis				0
Ferrissia parallela				1
Ferrissia rivularis				2
Bithyniidae:				
Bithynia				1
Hydrobiidae:				
Amnicola				2
Birgella (=Somatogyrus)				2
Cincinnati				1

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Fontigens				3
Potamopyrgus				1
Probythinella				2
Lymnaeidae:				
Bulinnea				1
Fossaria				1
Lymnaea				1
Pseudosuccinea				0
Radix				1
Stagnicola				0
Physidae:				
Physella	x		6	0
Planorbidae:				
Gyraulus			2	1
Helisoma				1
Planorbella	x		4	0
Planorbula				1
Promenetus				2
Pleuroceridae:				
Elimia (=Goniobasis)				2
Pleurocera				1
Valvatidae:				
Valvata				2
Viviparidae:				
Campeloma				1
Cipangopaludina				1
Viviparus				1
Annelids:				
LEECHES:				
Erpobdellidae:				
Dina dubia				1
Dina parva				0
Erpobdella				1
Mooreobdella				2
Nepheleopsis				2
Hirudinidae:				
Haemopsis				1
Macrobodella				0
Glossiphoniidae:				
Alboglossiphonia				2
Batrachobdella				2
Glossiphonia				2
Helobdella elongata				1
Helobdella fusca				2
Helobdella papillata				1
Helobdella stagnalis				2
Helobdella triserialis				2
Placobdella				1
Theromyzon				
WORMS:				
enchytraeidae	x	10	8	1
Tubificidae:				
Aulodrilus				2
Bothrioneurum				2
Branchiura				0
Ilyodrilus				0
Isochaetides curvisetosus				3
Isochaetides freyi				1
Limnodrilus	x	60	60	0
Potamothenix bavaricus				2
Potamothenix moldaviensis				2
Potamothenix vejdvskyi				2
Quistadrilus				0
Rhyacodrilus				3
Spirosperma				1
Tasserkidrilus				2
Tubifex				0
Oligochaete				
no cheate				0
Platyhelminthes:				0
FLATWORMS:				
Alloeochoela				1
Tricladida				3
Total sum/0.05m2		248	164	
Total Taxa	18			
BioMap WQI		3.517806795	2.65488626	
avareage	3.086346528			
HBI rate	8.658653846			
EPT Richness (%)	0			
Percentage Oligochaetes	33.17307692			
Percentage Chironomidae	45.19230769			
Percentage Insects	73.07692308			

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Simpsons diversity	0.216856849			
Simpsons index of diversity	0.783143151			
Simpsons reciprocal	4.611336955			

Appendix **F**

Plant Species List

BOTANICAL NAME		COMMON NAME	COEFFICIENT OF CONSERVATISM	WET- NESS INDEX	WEED- INESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSE- WIC STATU S	GLOBAL STATUS	LOCAL STATUS MIDD
<u>PTERIDOPHYTES</u>		<u>FERNS & ALLIES</u>								
Dryopteridaceae		Wood Fern Family								
<i>Dryopteris</i>	<i>carthusiana</i>	Spinulose Wood Fern	5	-2		S5			G5	X
<i>Dryopteris</i>	<i>cristata</i>	Crested Wood Fern	7	-5		S5			G5	X
<i>Onoclea</i>	<i>sensibilis</i>	Sensitive Fern	4	-3		S5			G5	X
<i>Polystichum</i>	<i>acrostichoides</i>	Christmas Fern	5	5		S5			G5	X
Equisetaceae		Horsetail Family								
<i>Equisetum</i>	<i>arvense</i>	Field Horsetail	0	0		S5			G5	C
<i>Equisetum</i>	<i>hyemale</i> var. <i>affine</i>	Scouring-rush	2	-2		S5			G5T5	C
<u>GYMNOSPERMS</u>		<u>CONIFERS</u>								
Cupressaceae		Cedar Family								
<i>Juniperus</i>	<i>virginiana</i>	Eastern Red Cedar	4	3		S5			G5	X
<i>Thuja</i>	<i>occidentalis</i>	Eastern White Cedar	4	-3		S5			G5	X
Pinaceae		Pine Family								
<i>Picea</i>	<i>abies</i>	Norway Spruce		5	-1	SE3			G?	I
<i>Picea</i>	<i>glauca</i>	White Spruce	6	3		S5			G5	I
<i>Pinus</i>	<i>banksiana</i>	Jack Pine	9	3		S5			G5	I
<i>Pinus</i>	<i>nigra</i>	Austrian Pine		-5	-1	SE2			G?	
<i>Pinus</i>	<i>resinosa</i>	Red Pine	8	3		S5			G5	IR
<i>Pinus</i>	<i>strobus</i>	Eastern White Pine	4	3		S5			G5	X
<i>Pinus</i>	<i>sylvestris</i>	Scotch Pine		5	-3	SE5			G?	IR
<u>DICOTYLEDONS</u>		<u>DICOTS</u>								
Aceraceae		Maple Family								
<i>Acer</i>	<i>negundo</i>	Manitoba Maple	0	-2		S5			G5	C
<i>Acer</i>	<i>platanoides</i>	Norway Maple		5	-3	SE5			G?	IU
<i>Acer</i>	<i>saccharinum</i>	Silver Maple	5	-3		S5			G5	C
<i>Acer</i>	<i>saccharum</i>	Sugar Maple	4	3		S5			G5T?	C
<i>Acer X</i>	<i>freemanii</i>	Freeman's Maple								

Anacardiaceae		Sumac or Cashew Family								
<i>Toxicodendron</i>	<i>radicans ssp. negundo</i>	Poison-ivy	5	-1		S5			G5T	X
<i>Rhus</i>	<i>hirta</i>	Staghorn Sumac	1	5		S5			G5	C
Apiaceae		Carrot or Parsley Family								
<i>Angelica</i>	<i>atropurpurea</i>	Dark-purple Alexanders	6	-5		S5			G5	C
<i>Daucus</i>	<i>carota</i>	Wild Carrot		5	-2	SE5			G?	IC
<i>Sium</i>	<i>suave</i>	Hemlock Water-parsnip	4	-5		S5			G5	C
Apocynaceae		Dogbane Family								
<i>Apocynum</i>	<i>cannabinum</i>	Indian Hemp		1		S5			G5T	C
<i>Vinca</i>	<i>minor</i>	Periwinkle		5	-2	SE5			G?	IR
Aquifoliaceae		Holly Family								
<i>Nemopanthus</i>	<i>mucronatus</i>	Mountain-holly	8	-5		S5			G5	X
Aristolochiaceae		Duchman's-pipe Family								
<i>Aristolochia</i>	<i>clematitis</i>	Birthwort		5	-1	SE1			G?	
Asclepiadaceae		Milkweed Family								
<i>Asclepias</i>	<i>incarnata ssp. incarnata</i>	Swamp Milkweed	6	-5		S5			G5T5	C
<i>Asclepias</i>	<i>syriaca</i>	Common Milkweed	0	5		S5			G5	C
Asteraceae		Composite or Aster Family								
<i>Achillea</i>	<i>millefolium var. millefolium</i>	Common Yarrow		3	-1	SE?			G5T?	
<i>Ambrosia</i>	<i>artemisiifolia</i>	Common Ragweed	0	3		S5			G5	C
<i>Ambrosia</i>	<i>trifida</i>	Giant Ragweed	0	-1		S5			G5	C
<i>Arctium</i>	<i>minus</i>	Common Burdock		5	-2	SE5			G?T?	IC
<i>Artemisia</i>	<i>vulgaris</i>	Common Mugwort		5	-1	SE5			G?	IR
<i>Symphyotrichum</i>	<i>cordifolium</i>	Heart-leaved Aster	5	5		S5			G5	C
<i>Symphyotrichum</i>	<i>ericoides var. pansus</i>	Mayflowered Aster	4	4		S1			G5T?	
<i>Symphyotrichum</i>	<i>lanceolatum</i>	Tall White Aster	3	-3		S5			G5T?	C
<i>Symphyotrichum</i>	<i>lateriflorum</i>	Calico Aster	3	-2		S5			G5T5	C
<i>Eurybia</i>	<i>macrophylla</i>	Large-leaved Aster	5	5		S5			G5	C
<i>Symphyotrichum</i>	<i>puniceum var. puniceum</i>	Purple-stemmed Aster	6	-5		S5			G5T?	X
<i>Bidens</i>	<i>frondosa</i>	Devil's Beggar-ticks	3	-3		S5			G5	X
<i>Carduus</i>	<i>nutans ssp. nutans</i>	Musk Thistle		5	-1	SE?			G?T?	
<i>Centaurea</i>	<i>jacea</i>	Brown Knapweed		5	-1	SE5			G?	I
<i>Centaurea</i>	<i>biebersteinii</i>	Spotted Knapweed		5	-3	SE5			G?	I
<i>Leucanthemum</i>	<i>vulgare</i>	Ox-eye Daisy		5	-1	SE5			G?	
<i>Cichorium</i>	<i>intybus</i>	Chicory		5	-1	SE5			G?	IC
<i>Cirsium</i>	<i>arvense</i>	Canada Thistle		3	-1	SE5			G?	IC
<i>Cirsium</i>	<i>vulgare</i>	Bull Thistle		4	-1	SE5			G5	I
<i>Erigeron</i>	<i>annus</i>	Eastern Daisy Fleabane	0	1		S5			G5	
<i>Erigeron</i>	<i>philadelphicus ssp. philadelphicus</i>	Philadelphia Fleabane	1	-3		S5			G5T?	C
<i>Inula</i>	<i>helenium</i>	Elecampane		5	-2	SE5			G?	I
<i>Lactuca</i>	<i>serriola</i>	Prickly Lettuce		0	-1	SE5			G?	I
<i>Rudbeckia</i>	<i>hirta</i>	Black-eyed Susan	0	3		S5			G5	C
<i>Solidago</i>	<i>altissima</i>	Tall Goldenrod	1	3		S5				U
<i>Solidago</i>	<i>caesia</i>	Blue-stem Goldenrod	5	3		S5			G5	X

<i>Solidago</i>	<i>canadensis</i>	Canada Goldenrod	1	3		S5			G5	X
<i>Solidago</i>	<i>flexicaulis</i>	Zig-zag Goldenrod	6	3		S5			G5	X
<i>Solidago</i>	<i>gigantea</i>	Giant Goldenrod	4	-3		S5			G5	X
<i>Solidago</i>	<i>juncea</i>	Early Goldenrod	3	5		S5			G5	X
<i>Solidago</i>	<i>nemoralis ssp. nemoralis</i>	Gray Goldenrod	2	5		S5			G5T?	X
<i>Sonchus</i>	<i>arvensis ssp. arvensis</i>	Field Sow-thistle			-1	SE5			G?T?	I
<i>Tanacetum</i>	<i>vulgare</i>	Common Tansy		5	-1	SE5			G?	I
<i>Taraxacum</i>	<i>officinale</i>	Common Dandelion		3	-2	SE5			G5	IC
<i>Tragopogon</i>	<i>dubius</i>	Doubtful Goat's-beard		5	-1	SE5			G?	I
<i>Tussilago</i>	<i>farfara</i>	Coltsfoot		3	-2	SE5			G?	IC
<i>Xanthium</i>	<i>strumarium</i>	Tumor-curing Cocklebur	2	0		S5			G?	C
Balsaminaceae		Touch-me-not Family								
<i>Impatiens</i>	<i>capensis</i>	Spotted Touch-me-not	4	-3		S5			G5	C
Berberidaceae		Barberry Family								
<i>Caulophyllum</i>	<i>thalictroides</i>	Blue Cohosh	6	5		S5			G	X
<i>Podophyllum</i>	<i>peltatum</i>	May-apple	5	3		S5			G5	X
Betulaceae		Birch Family								
<i>Carpinus</i>	<i>caroliniana ssp. virginiana</i>	Blue Beech	6	0		S5			G5T	C
<i>Corylus</i>	<i>americana</i>	American Hazel	5	4		S5			G5	C
<i>Ostrya</i>	<i>virginiana</i>	Hop Hornbeam - Ironwood	4	4		S5			G5	C
Brassicaceae		Mustard Family								
<i>Alliaria</i>	<i>petiolata</i>	Garlic Mustard		0	-3	SE5			G5	IC
<i>Nasturtium</i>	<i>officinale</i>	Water-cress		-5	-1	SE?			G?	I
Caprifoliaceae		Honeysuckle Family								
<i>Lonicera</i>	<i>tatarica</i>	Tartarian Honeysuckle		3	-3	SE5			G?	I
<i>Sambucus</i>	<i>nigra ssp. canadensis</i>	Common Elderberry	5	-2		S5			G5	X
<i>Sambucus</i>	<i>racemosa var. racemosa</i>	Red-berried Elderberry	5	2		S5			G5T4T5	X
<i>Silene</i>	<i>vulgaris</i>	Catchfly		5	-1	SE5			G?	I
<i>Viburnum</i>	<i>acerifolium</i>	Maple-leaved Viburnum	6	5		S5			G5	X
<i>Viburnum</i>	<i>lentago</i>	Nannyberry	4	-1		S5			G5	C
<i>Viburnum</i>	<i>opulus</i>	Guelder Rose		0	-1	SE4			G5	IR
<i>Viburnum</i>	<i>rafinesquianum</i>	Downy Arrow-wood	7	5		S5			G5	X
Caryophyllaceae		Pink Family								
<i>Stellaria</i>	<i>graminea</i>	Grass-leaved Stitchwort		5	-2	SE5			G?	I
Celastraceae		Staff-tree Family								
<i>Euonymus</i>	<i>obovata</i>	Running Strawberry-bush	6	5		S5			G5	C
Chenopodiaceae		Goosefoot Family								
<i>Chenopodium</i>	<i>album var. album</i>	Lamb's Quarters		1	-1	SE5			G5T5	I
Convolvulaceae		Morning-glory Family								
<i>Convolvulus</i>	<i>arvensis</i>	Field Bindweed		5	-1	SE5			G?	I
Cornaceae		Dogwood Family								
<i>Cornus</i>	<i>racemosa</i>	Red Panicked Dogwood/Gray Dogwood	2	-2		S5			G5?	X
<i>Cornus</i>	<i>sericea</i>	Red-osier Dogwood	2	-3		S5			G5	C
Cucurbitaceae		Gourd Family								

<i>Echinocystis</i>	<i>lobata</i>	Prickly Cucumber	3	-2		S5			G5	X
Dipsacaceae		Teasel Family								
<i>Dipsacus</i>	<i>fullonum ssp. sylvestris</i>	Wild Teasel		5	-1	SE5			G?T?	IC
Elaeagnaceae		Oleaster Family								
<i>Elaeagnus</i>	<i>angustifolia</i>	Russian Olive		4	-1	SE3			G?	
Fabaceae		Pea Family								
<i>Coronilla</i>	<i>varia</i>	Variable Crown-vetch		5	-2	SE5			G?	I
<i>Gleditsia</i>	<i>triacanthos</i>	Honey Locust	3	0		S2			G5	I
<i>Lotus</i>	<i>corniculatus</i>	Bird's-foot Trefoil		1	-2	SE5			G?	I
<i>Medicago</i>	<i>lupulina</i>	Black Medick		1	-1	SE5			G?	IC
<i>Medicago</i>	<i>sativa ssp. sativa</i>	Alfalfa		5	-1	SE5			G?T?	IC
<i>Melilotus</i>	<i>alba</i>	White Sweet-clover		3	-3	SE5			G?	IC
<i>Melilotus</i>	<i>officinalis</i>	Yellow Sweet-clover		3	-1	SE5			G?	IC
<i>Robinia</i>	<i>pseudo-acacia</i>	Black Locust		4	-3	SE5			G5	IC
<i>Trifolium</i>	<i>pratense</i>	Red Clover		2	-2	SE5			G?	I
<i>Trifolium</i>	<i>repens</i>	White Clover		2	-1	SE5			G?	I
<i>Vicia</i>	<i>cracca</i>	Tufted Vetch		5	-1	SE5			G?	I
Fagaceae		Beech Family								
<i>Fagus</i>	<i>grandifolia</i>	American Beech	6	3		S5			G5	C
<i>Quercus</i>	<i>alba</i>	White Oak	6	3		S5			G5	C
<i>Quercus</i>	<i>macrocarpa</i>	Bur Oak	5	1		S5			G5	C
<i>Quercus</i>	<i>rubra</i>	Red Oak	6	3		S5			G5	C
Geraniaceae		Geranium Family								
<i>Geranium</i>	<i>maculatum</i>	Spotted Crane's-bill	6	3		S5			G5	X
<i>Geranium</i>	<i>robertianum</i>	Herb-robert		5	-2	SE5			G5	IC
Grossulariaceae		Currant Family								
<i>Ribes</i>	<i>americanum</i>	Wild Black Currant	4	-3		S5			G5	C
<i>Ribes</i>	<i>rubrum</i>	Red Currant		5	-2	SE5			G4G5	IR
<i>Ribes</i>	<i>triste</i>	Wild Red Currant	6	-5		S5			G5	X
Guttiferae		St. John's-wort Family								
<i>Hypericum</i>	<i>perforatum</i>	Common St. John's-wort		5	-3	SE5			G?	IC
Hamamelidaceae		Witch-hazel Family								
<i>Hamamelis</i>	<i>virginiana</i>	Witch-hazel	6	3		S5			G5	X
Hippocastanaceae		Buckeye Family								
<i>Aesculus</i>	<i>hippocastanum</i>	Horse Chestnut		5	-1	SE2			G?	IR
Hydrophyllaceae		Water-leaf Family								
<i>Hydrophyllum</i>	<i>virginianum</i>	Virginia Water-leaf	6	-2		S5			G5	C
Juglandaceae		Walnut Family								
<i>Carya</i>	<i>cordiformis</i>	Bitternut hickory	6	0		S5			G5	X
<i>Carya</i>	<i>ovata</i>	Shagbark Hickory	6	3		S5			G5	X
<i>Juglans</i>	<i>regia</i>	English Walnut		5	-1	SE1			G?	
Lamiaceae		Mint Family								
<i>Glechoma</i>	<i>hederacea</i>	Creeping Charlie		5	-2	SE5			G?	I
<i>Leonurus</i>	<i>cardiaca ssp. cardiaca</i>	Common Motherwort		5	-2	SE5			G?T?	IC

<i>Lycopus</i>	<i>americanus</i>	Cut-leaved Water-horehound	4	-5		S5			G5	C
<i>Prunella</i>	<i>vulgaris ssp. vulgaris</i>	Common Heal-all		0	-1	SE3			G5T?	
Lythraceae		Loosestrife Family								
<i>Lythrum</i>	<i>salicaria</i>	Purple Loosestrife		-5	-3	SE5			G5	IC
Moraceae		Mulberry Family								
<i>Morus</i>	<i>alba</i>	White Mulberry		0	-3	SE5			G?	I
Oleaceae		Olive Family								
<i>Fraxinus</i>	<i>americana</i>	White Ash	4	3		S5			G5	C
<i>Fraxinus</i>	<i>nigra</i>	Black Ash	7	-4		S5			G5	X
<i>Fraxinus</i>	<i>pennsylvanica</i>	Red Ash	3	-3		S5			G5	C
<i>Ligustrum</i>	<i>vulgare</i>	Common Privet		1	-2	SE5			G?	I
<i>Syringa</i>	<i>vulgaris</i>	Common Lilac		5	-2	SE5			G?	I
Onagraceae		Evening-primrose Family								
<i>Circaea</i>	<i>lutetiana ssp. canadensis</i>	Enchanter's Nightshade	3	3		S5			G5T5	X
<i>Epilobium</i>	<i>ciliatum ssp. ciliatum</i>	Ciliate Willow-herb	3	3		S5			G5T?	X
<i>Epilobium</i>	<i>hirsutum</i>	Great Hairy Willow-herb		-4	-2	SE5			G?	I
<i>Oenothera</i>	<i>biennis</i>	Common Evening-primrose	0	3		S5			G5	R1
Oxalidaceae		Wood Sorrel Family								
<i>Oxalis</i>	<i>stricta</i>	Upright Yellow Wood-sorrel	0	3		S5			G5	X
Papaveraceae		Poppy Family								
<i>Chelidonium</i>	<i>majus</i>	Celandine		5	-3	SE5			G?	I
Plantaginaceae		Plantain Family								
<i>Plantago</i>	<i>lanceolata</i>	Ribgrass		0	-1	SE5			G5	IC
<i>Plantago</i>	<i>major</i>	Common Plantain		-1	-1	SE5			G5	IC
Polygonaceae		Smartweed Family								
<i>Polygonum</i>	<i>persicaria</i>	Lady's-thumb		-3	-1	SE5			G?	I
<i>Rumex</i>	<i>crispus</i>	Curly-leaf Dock		-1	-2	SE5			G?	IC
Primulaceae		Primrose Family								
<i>Lysimachia</i>	<i>nummularia</i>	Moneywort		-4	-3	SE5			G?	I
Ranunculaceae		Buttercup Family								
<i>Anemone</i>	<i>canadensis</i>	Canada Anemone	3	-3		S5			G5	C
<i>Ranunculus</i>	<i>acris</i>	Tall Buttercup			-2	SE5			G5	IC
<i>Ranunculus</i>	<i>aquatilis var. diffusus</i>	White Water-crowfoot				S5			G5T	
Rhamnaceae		Buckthorn Family								
<i>Rhamnus</i>	<i>cathartica</i>	Common Buckthorn		3	-3	SE5			G?	IC
<i>Frangula</i>	<i>alnus</i>	Glossy Buckthorn		-1	-3	SE5			G?	IU
Rosaceae		Rose Family								
<i>Agrimonia</i>	<i>gryposepala</i>	Tall Hairy Agrimony	2	2		S5			G5	C
<i>Amelanchier</i>	<i>arborea</i>	Downy Juneberry		3		S5			G5	C
<i>Crataegus</i>	<i>species</i>	Hawthorn species								
<i>Crataegus</i>	<i>monogyna</i>	English Hawthorn		5	-1	SE5			G5	I
<i>Fragaria</i>	<i>vesca ssp. americana</i>	Woodland Strawberry	4	4		S5			G5T?	X
<i>Fragaria</i>	<i>virginiana</i>	Virginia Strawberry	2	1		SU			G5T?	C
<i>Geum</i>	<i>aleppicum</i>	Yellow Avens	2	-1		S5			G5	X

<i>Geum</i>	<i>canadense</i>	White Avens	3	0		S5			G5	X
<i>Malus</i>	<i>pumila</i>	Common Crabapple		5	-1	SE5			G5	I
<i>Potentilla</i>	<i>norvegica ssp. norvegica</i>	Cinquefoil	0			SU			G5T?	X
<i>Potentilla</i>	<i>simplex</i>	Old-field Cinquefoil	3	4		S5			G5	X
<i>Prunus</i>	<i>serotina</i>	Black Cherry	3	3		S5			G5	C
<i>Prunus</i>	<i>virginiana</i>	Choke Cherry	2	1		S5			G5T?	C
<i>Pyrus</i>	<i>communis</i>	Common Pear		5	-1	SE4			G5	I
<i>Rosa</i>	<i>multiflora</i>	Multiflora Rose		3	-3	SE4			G?	I
<i>Rubus</i>	<i>idaeus</i>	Red Raspberry	0		-2	SE1			G5T5	
<i>Spiraea</i>	<i>alba</i>	Narrow-leaved Meadow-sweet	3	-4		S5			G5	X
Rubiaceae		Madder Family								
<i>Cephalanthus</i>	<i>occidentalis</i>	Eastern Buttonbush	7	-5		S5			G5	X
<i>Galium</i>	<i>mollugo</i>	White Bedstraw		5	-2	SE5			G?	I
<i>Galium</i>	<i>triflorum</i>	Sweet-scented Bedstraw	4	2		S5			G5	X
Rutaceae		Rue Family								
<i>Zanthoxylum</i>	<i>americanum</i>	American Prickly-ash	3	5		S5			G5	C
Salicaceae		Willow Family								
<i>Populus</i>	<i>balsamifera ssp. balsamifera</i>	Balsam Poplar	4	-3		S5			G5T?	X
<i>Populus</i>	<i>deltoides ssp. deltoides</i>	Eastern Cottonwood	4	-1		SU			G5T?	X
<i>Populus</i>	<i>tremuloides</i>	Trembling Aspen	2	0		S5			G5	X
<i>Salix</i>	<i>species</i>	Willow species								
<i>Salix</i>	<i>discolor</i>	Pussy Willow	3	-3		S5			G5	X
<i>Salix</i>	<i>eriocephala</i>	Missouri Willow	4	-3		S5			G5	X
<i>Salix</i>	<i>exigua</i>	Sandbar Willow	3	-5		S5			G5	C
<i>Salix</i>	<i>fragilis</i>	Crack Willow		-1	-3	SE5			G?	I
<i>Salix</i>	<i>nigra</i>	Black Willow	6	-5		S4?			G5	X
<i>Salix</i>	<i>petiolaris</i>	Slender Willow	3	-4		S5			G4	X
<i>Salix X</i>	<i>rubens</i>	Reddish Willow		-4	-3	SE4			HYB	IR
Scrophulariaceae		Figwort Family								
<i>Chelone</i>	<i>glabra</i>	Turtlehead	7	-5		S5			G5	X
<i>Linaria</i>	<i>vulgaris</i>	Butter-and-eggs		5	-1	SE5			G?	IC
<i>Verbascum</i>	<i>thapsus</i>	Common Mullein		5	-2	SE5			G?	IC
<i>Veronica</i>	<i>officinalis</i>	Common Speedwell		5	-2	SE5			G5	I
Solanaceae		Nightshade Family								
<i>Solanum</i>	<i>dulcamara</i>	Bitter Nightshade		0	-2	SE5			G?	IC
Tiliaceae		Linden Family								
<i>Tilia</i>	<i>americana</i>	American Basswood	4	3		S5			G5	C
Ulmaceae		Elm Family								
<i>Celtis</i>	<i>occidentalis</i>	Common Hackberry	8	1		S4			G5	X
<i>Ulmus</i>	<i>americana</i>	White Elm	3	-2		S5			G5?	X
Urticaceae		Nettle Family								
<i>Urtica</i>	<i>dioica ssp. dioica</i>	European Stinging Nettle		-1	-1	SE2			G5T?	IR
Verbenaceae		Vervain Family								
<i>Verbena</i>	<i>hastata</i>	Blue Vervain	4	-4		S5			G5	C

<i>Verbena</i>	<i>urticifolia</i>	White Vervain	4	-1		S5			G5	X
Violaceae		Violet Family								
<i>Viola</i>	<i>pubescens</i>	Downy Yellow Violet	5	4		S5			G5	C
<i>Viola</i>	<i>sororia</i>	Woolly Blue Violet	4	1		S5			G5	X
Vitaceae		Grape Family								
<i>Parthenocissus</i>	<i>inserta</i>	Inserted Virginia-creeper	3	3		S5			G5	X
<i>Vitis</i>	<i>riparia</i>	Riverbank Grape	0	-2		S5			G5	C
<u>MONOCOTYLEDONS</u>		<u>MONOCOTS</u>								
Alismataceae		Water-plantain Family								
<i>Alisma</i>	<i>plantago-aquatica</i>	Common Water-plantain	3	-5		S5			G5	C
<i>Sagittaria</i>	<i>latifolia</i>	Broad-leaved Arrowhead	4	-5		S5			G5	C
Araceae		Arum Family								
<i>Symplocarpus</i>	<i>foetidus</i>	Skunk-cabbage	7	-5		S5			G5	C
Cyperaceae		Sedge Family								
<i>Carex</i>	<i>aquatilis</i>	Aquatic Sedge	7	-5		S5			G5	VU
<i>Carex</i>	<i>communis</i>	Fibrous Rooted Sedge	6	5		S5			G5	C
<i>Carex</i>	<i>crinita</i>	Fringed Sedge	6	-4		S5			G5	C
<i>Carex</i>	<i>gracillima</i>	Graceful Sedge	4	3		S5			G5	C
<i>Carex</i>	<i>intumescens</i>	Bladder Sedge	6	-4		S5			G5	C
<i>Carex</i>	<i>pennsylvanica</i>	Pennsylvania Sedge	5	5		S5			G5	C
<i>Carex</i>	<i>plantaginea</i>	Plantain-leaved Sedge	7	5		S5			G5	C
<i>Carex</i>	<i>platyphylla</i>	Broad-leaved Sedge	7	5		S5			G5	
<i>Carex</i>	<i>rosea</i>	Stellate Sedge	5	5		S5			G5	C
<i>Carex</i>	<i>spicata</i>	Spiked Sedge		5	-1	SE5			G?	IC
<i>Carex</i>	<i>vulpinoidea</i>	Fox Sedge	3	-5		S5			G5	C
<i>Cyperus</i>	<i>odoratus</i>	Fragrant Umbrella Sedge	5	-3		S5			G5	R5
<i>Eleocharis</i>	<i>acicularis</i>	Needle Spike-rush	5	-5		S5			G5	VU
<i>Scirpus</i>	<i>atrovirens</i>	Dark-green Bulrush	3	-5		S5			G5?	C
<i>Scirpus</i>	<i>cyperinus</i>	Wool-grass	4	-5		S5			G5	C
<i>Schoenoplectus</i>	<i>tabernaemontani</i>	American Great Bulrush/softstem bulr	5	-5		S5			G?	C
Iridaceae		Iris Family								
<i>Iris</i>	<i>versicolor</i>	Multi-coloured Blue-flag	5	-5		S5			G5	X
Juncaceae		Rush Family								
<i>Juncus</i>	<i>articulatus</i>	Jointed Rush	5	-5		S5			G5	VU
<i>Juncus</i>	<i>effusus var. solutus</i>	Soft Rush	4	-5		S5			G5T?	X
<i>Juncus</i>	<i>tenuis</i>	Path Rush	0	0		S5			G5	X
Lemnaceae		Duckweed Family								
<i>Lemna</i>	<i>minor</i>	Lesser Duckweed	2	-5		S5			G5	X
<i>Lemna</i>	<i>trisulca</i>	Star Duckweed	4	-5		S5			G5	X
Liliaceae		Lily Family								
<i>Erythronium</i>	<i>americanum ssp. americanum</i>	Yellow Dog's-tooth Violet	5	5		S5			G5T5	X
<i>Maianthemum</i>	<i>racemosum ssp. racemosum</i>	False Solomon's Seal	4	3		S5			G5T	X
<i>Trillium</i>	<i>grandiflorum</i>	White Trillium	5	5		S5			G5	X
Poaceae		Grass Family								

<i>Agrostis</i>	<i>gigantea</i>	Red-top		0	-2	SE5			G4G5	IC
<i>Agrostis</i>	<i>stolonifera</i>	Redtop		-3		S5			G5	C
<i>Bromus</i>	<i>inermis</i> ssp. <i>inermis</i>	Awnless Brome		5	-3	SE5			G4G5T?	IC
<i>Dactylis</i>	<i>glomerata</i>	Orchard Grass		3	-1	SE5			G?	IC
<i>Elymus</i>	<i>repens</i>	Quack Grass		3	-3	SE5			G?	IC
<i>Glyceria</i>	<i>striata</i>	Fowl Meadow Grass	3	-5		S5			G5	X
<i>Hordeum</i>	<i>jubatum</i> ssp. <i>jubatum</i>	Squirrel-tail Grass		-1	-1	SE5			G5T?	I
<i>Phalaris</i>	<i>arundinacea</i>	Reed Canary Grass	0	-4		S5			G5	X
<i>Phleum</i>	<i>pratense</i>	Timothy		3	-1	SE5			G?	IC
<i>Phragmites</i>	<i>australis</i>	Common Reed	0	-4		S5			G5	X
<i>Poa</i>	<i>palustris</i>	Fowl Meadow Grass	5	-4		S5			G5	X
<i>Poa</i>	<i>pratensis</i> ssp. <i>pratensis</i>	Kentucky Bluegrass	0	1		S5			G5T	C
<i>Setaria</i>	<i>pumila</i>	Yellow Foxtail		0	-1	SE5			G?	I
<i>Setaria</i>	<i>viridis</i>	Green Foxtail			-1	SE5			G?	I
Typhaceae		Cattail Family								
<i>Typha</i>	<i>angustifolia</i>	Narrow-leaved Cattail	3	-5		S5			G5	X
<i>Typha</i>	<i>latifolia</i>	Broad-leaved Cattail	3	-5		S5			G5	X
FLORISTIC SUMMARY & ASSESSMENT										
Species Diversity										
Total Species:		232								
Native Species:		144	62.07%							
Exotic Species		88	37.93%							
Total Taxa in Region (List Region, Source)		10000								
% Regional Taxa Recorded		2.32%								
Regionally Significant Species		enter manually								
S1-S3 Species		enter manually								
S4 Species		1								
S5 Species		140								
Co-efficient of Conservatism and Floral Quality Index										
Co-efficient of Conservatism (CC) (average)		3.91								
CC 0 to 3	lowest sensitivity	57	39.58%							
CC 4 to 6	moderate sensitivity	74	51.39%							
CC 7 to 8	high sensitivity	12	8.33%							
CC 9 to 10	highest sensitivity	1	0.69%							
Floral Quality Index (FQI)		46.92								
Presence of Weedy & Invasive Species										
mean weediness		-1.72								
weediness = -1	low potential invasiveness	44	50.00%							
weediness = -2	moderate potential invasiveness	25	28.41%							
weediness = -3	high potential invasiveness	19	21.59%							



Presence of Wetland Species										
<i>average wetness value</i>		0.83								
<i>upland</i>		60	25.86%							
<i>facultative upland</i>		56	24.14%							
<i>facultative</i>		41	17.67%							
<i>facultative wetland</i>		40	17.24%							
<i>obligate wetland</i>		32	13.79%							

Appendix **G**

ELC Community Descriptions

Natural Heritage Feature ID	Property ID	ELC Code	ELC Inclusion/ Complex	Size of Feature (ha)	ELC Description	Significant Feature	Significance
	3298 Scotland Dr	CUP3-2	CUM1-1		This cultural plantation community was located at the southern end of the property along Scotland Drive. Forest canopy cover was dominant at greater than 60% cover and dominant species included white pine (<i>Pinus strobus</i>) and Norway spruce (<i>Picea abies</i>). Sub-canopy cover included White pine, American elm (<i>Ulmus americana</i>), red-osier dogwood (<i>Cornus sericea</i>) and black cherry (<i>Prunus serotina</i>). Ground cover was dominated by garlic mustard (<i>Alliaria petiolata</i>) and Pennsylvania sedge (<i>Carex pensylvanica</i>). A cultural meadow inclusion was present within the community.	Significant Woodland	Municipal
	3298 Scotland Dr	MAM2-2	MAS2		property. Ground cover species were dominant at over 60% cover with the most frequent species being reed canary grass (<i>Phalaris arundinacea</i>) and broad-leaved cattail (<i>Typha latifolia</i>), with vervain species (<i>Verbena sp.</i>). Sub canopy species included willow species (<i>Salix sp</i>). A mineral shallow marsh inclusion was present within the community.		
	3137 Scotland Dr	CUM1-1	CUW1/SWT2-2		This cultural meadow community was located surrounding a pond and along the roadside in the north east end of the property. Ground cover was dominant at greater than 60% cover with the most frequent species being kentucky blue grass (<i>Poa pratensis</i>), bird's-foot trefoil (<i>Lotus corniculata</i>), tall goldenrod (<i>Solidago altissima</i>) and heath aster (<i>Symphyotrichum ericoides</i>). This community was complexed with a willow mineral thicket swamp and a mineral cultural woodland inclusion was also present.		
	3137 Scotland Dr	CUM1-1	MAM2		This cultural meadow community was located surrounding a pond and along the roadside in the north east end of the property. Ground cover was dominant at greater than 60% cover with the most frequent species being kentucky blue grass (<i>Poa pratensis</i>), tall goldenrod (<i>Solidago altissima</i>), bird's-foot trefoil (<i>Lotus corniculata</i>), and heath aster (<i>Symphyotrichum ericoides</i>). A mineral shallow marsh inclusion was present within this community.		
	3405 Scotland Dr	CUP3	OA0/CUM1-1		This cultural plantation community was located along the southern side of a pond in the northern portion of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included Scot's pine (<i>Pinus sylvestris</i>), eastern white cedar (<i>Thuja occidentalis</i>) and sugar maple (<i>Acer saccharum</i>). The shrub layer consisted of common buckthorn (<i>Rhamnus cathartica</i>), tartarian honeysuckle (<i>Lonicera tatarica</i>) and red-osier dogwood (<i>Cornus sericea</i>). Ground cover was dominated by smooth brome grass (<i>Bromus inermis</i>), common dandelion (<i>Taraxicum officianale</i>) and wild carrot (<i>Daucus carota</i>). This community was complexed with a cultural meadow and an open aquatic inclusion was also present.		

	3438 Manning Dr	FOD2-3			This dry-fresh hickory deciduous forest community was located at the northern end of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included shagbark hickory (<i>Carya ovata</i>). The sub-canopy consisted of shagbark hickory and black walnut (<i>Juglans nigra</i>). The shrub layer was comprised of common buckthorn (<i>Rhamnus cathartica</i>), and choke cherry (<i>Prunus virginiana</i>), while ground cover was dominated by young shagbark hickory, garlic mustard (<i>Alliaria petiolata</i>), and timothy (<i>Phleum pratense</i>).		
	3465 Scotland Dr	CUM1-1	MAS2/CUT1		Ground cover was dominant at greater than 60% cover with the most frequent species being smooth brome grass (<i>Bromus inermis</i>), canada goldenrod (<i>Solidago canadensis</i>), kentucky bluegrass (<i>Poa pratensis</i>), and spiked sedge (<i>Carex spicata</i>). The shrub layer was comprised of common buckthorn (<i>Rhamnus cathartica</i>), gray dogwood (<i>Cornus racemosa</i>), common apple (<i>Malus pumila</i>) and hawthorn species (<i>Crataegus sp</i>). The tree layer was comprised of sparse white ash (<i>Fraxinus americana</i>), black walnut (<i>Juglans nigra</i>) and eastern cottonwood (<i>Populus deltoides</i>). This community was complexed with a mineral cultural thicket and a mineral shallow marsh inclusion was also present.		
	3483 Westminster Dr	CUT1			This mineral cultural thicket was located in the southeastern portion of the property. Tall shrub layer species were dominant in this community at over 60% cover with the most frequent species being common buckthorn (<i>Rhamnus cathartica</i>) and hawthorn species (<i>Crataegus sp</i>), while the general shrub layer was dominated by common buckthorn, gray dogwood (<i>Cornus racemosa</i>) and tartarian honeysuckle (<i>Lonicera tatarica</i>). Ground cover consisted of Pennsylvania sedge (<i>Carex pensylvanica</i>), yellow trout-lily (<i>Erythronium americanum</i>) and wild strawberry (<i>Fragaria virginiana</i>).		
	3483 Westminster Dr	FOD5			of the natural feature. Forest canopy cover was dominant at greater than 60% cover and dominant species included sugar maple (<i>Acer saccharum</i>), green ash (<i>Fraxinus pennsylvanica</i>), and American beech (<i>Fagus grandifolia</i>). The sub-canopy was dominated by American beech. The shrub layer was comprised of common buckthorn (<i>Rhamnus cathartica</i>), tartarian honeysuckle (<i>Lonicera tatarica</i>) and gray dogwood (<i>Cornus racemosa</i>). Ground cover consisted of Pennsylvania sedge (<i>Carex pensylvanica</i>) yellow trout-lily (<i>Erythronium americanum</i>), and garlic mustard (<i>Alliaria petiolata</i>).		
	3483 Westminster Dr	FOD2-4			This deciduous forest was located in the southern portion of the property adjacent to Scotland Drive. Forest canopy cover was dominant at greater than 60% cover and dominant species included white oak (<i>Quercus alba</i>), ironwood (<i>Ostrya virginiana</i>), and red oak (<i>Quercus rubra</i>). The sub-canopy was comprised of ironwood, sugar maple (<i>Acer saccharum</i>), and white oak. The shrub layer was dominated by common buckthorn (<i>Rhamnus cathartica</i>) and black cherry (<i>Prunus serotina</i>). Ground cover consisted primarily of yellow trout-lily (<i>Erythronium americanum</i>).		

	3483 Westminster Dr	FOD2-4			end of the natural feature. Forest canopy cover was dominant at greater than 60% cover and dominant species included red oak (<i>Quercus rubra</i>), white oak (<i>Quercus alba</i>), and American beech (<i>Fagus grandifolia</i>). The sub-canopy was dominated by sugar maple (<i>Acer saccharum</i>), ironwood (<i>Ostrya virginiana</i>), and common buckthorn (<i>Rhamnus cathartica</i>). The shrub layer was comprised of common buckthorn, black cherry (<i>Prunus serotina</i>), and gray dogwood (<i>Cornus racemosa</i>). Ground cover was comprised of yellow trout-lily (<i>Erythronium americanum</i>) and common speedwell (<i>Veronica officinalis</i>).		
	3483 Westminster Dr	SWD	SWT2-5		centre of the natural feature. The canopy layer was dominated by green ash (<i>Fraxinus pennsylvanica</i>), hybrid white willow (<i>Salix x fragilis</i>) and silver maple (<i>Acer saccharinum</i>), while the sub-canopy consisted of green ash, sugar maple (<i>Acer saccharum</i>) and common buckthorn (<i>Rhamnus cathartica</i>). The shrub layer was dominated by gray dogwood (<i>Cornus racemosa</i>), common red raspberry (<i>Rubus idaeus</i>) and common buckthorn. Ground cover was dominated by reed canary grass (<i>Phalaris arundinacea</i>). A red-osier mineral thicket swamp inclusion was present within the community.		
	3483 Westminster Dr	MAM2	SWT2		This mineral meadow marsh community was located in the north portion of the property. Ground cover species were dominant at over 60% cover with the most frequent species being common reed (<i>Phragmites australis</i>), reed canary grass (<i>Phalaris arundinacea</i>), and sedge species (<i>Carex sp</i>). The shrub layer comprised of gray dogwood (<i>Cornus racemosa</i>), common red raspberry (<i>Rubus idaeus</i>), spiraea species (<i>Spiraea sp</i>), and sandbar willow (<i>Salix exigua</i>). The sparse canopy layer consisted of green ash (<i>Fraxinus pennsylvanica</i>), sugar maple (<i>Acer saccharum</i>), black willow (<i>Salix nigra</i>) and common buckthorn (<i>Rhamnus cathartica</i>). A mineral thicket swamp inclusion was present within the community.		
	3483 Westminster Dr	OAD	MAS2/SWT2-5		This open water community was located in the centre of the natural feature near the western portion of the property. The mineral shallow marsh inclusion and red-osier mineral thicket swamp situated along the north and eastern sides of the open water community. The shrub layer consisted of red-osier dogwood (<i>Cornus sericea</i>), gray dogwood (<i>Cornus racemosa</i>), and common buckthorn (<i>Rhamnus cathartica</i>), while the ground cover was dominated by broad-leaved cattail (<i>Typha latifolia</i>) and reed canary grass (<i>Phalaris arundinacea</i>).		
	3502 Manning Dr	CUM1-1	Treerow		This cultural meadow community was located throughout the property. Ground cover was dominant at greater than 60% cover with the most frequent species being kentucky blue grass (<i>Poa pratensis</i>), common reed (<i>Phragmites australis</i>), smooth brome grass (<i>Bromus inermis</i>) and reed canary grass (<i>Phalaris arundinacea</i>). A planted treerow consisting of balsam poplar (<i>Populus balsamifera</i>), Norway spruce (<i>Picea abies</i>), white oak (<i>Quercus alba</i>) and sandbar willow (<i>Salix exigua</i>).		

	3502 Scotland Dr	CUP3			This cultural plantation community was located along the central portion of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included white pine (<i>Pinus strobus</i>), Norway spruce (<i>Picea abies</i>) and Scot's pine (<i>Pinus sylvestris</i>). The sub-canopy consisted of sugar maple (<i>Acer saccharum</i>) and green ash (<i>Fraxinus pennsylvanica</i>). The shrub layer was dominated by common buckthorn (<i>Rhamnus cathartica</i>), black cherry (<i>Prunus virginiana</i>) and tartarian honeysuckle (<i>Lonicera tatarica</i>), while the ground layer consisted of garlic mustard (<i>Alliaria petiolata</i>) and wooly blue violet (<i>Viola sororia</i>).		
	3502 Scotland Dr	FOD5-5	SWT2-5/SWD2		This deciduous forest was located in the south west portion of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included sugar maple (<i>Acer saccharum</i>), shagbark hickory (<i>Carya ovata</i>), American beech (<i>Fagus grandifolia</i>), and red oak (<i>Quercus rubra</i>), while the sub-canopy consisted of sugar maple, shagbark hickory, and green ash (<i>Fraxinus pennsylvanica</i>). The shrub layer consists of sugar maple, American beech, common buckthorn (<i>Rhamnus cathartica</i>), and black cherry (<i>Prunus virginiana</i>). The ground cover was comprised of young sugar maple, yellow trout-lily (<i>Erythronium americanum</i>) and white trillium (<i>Trillium grandiflorum</i>). Inclusions of a red-osier mineral thicket swamp and an ash mineral deciduous swamp ecosite were present within this community.		
	3583 Westminster Dr	FOD5-5	MAM2/CUT		This deciduous forest was located throughout the southern and extends towards the northern portion of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included sugar maple (<i>Acer saccharum</i>), shagbark hickory (<i>Carya ovata</i>), red oak (<i>Quercus rubra</i>) and American beech (<i>Fagus grandifolia</i>). The sub-canopy consisted of sugar maple, shagbark hickory, red oak and ironwood (<i>Ostrya virginiana</i>). The shrub layer was dominated by sugar maple, American beech, black cherry (<i>Prunus virginiana</i>), and common buckthorn (<i>Rhamnus cathartica</i>). The ground cover was comprised of yellow trout-lily (<i>Erythronium americanum</i>), wooly blue violet (<i>Viola sororia</i>), white trillium (<i>Trillium grandiflorum</i>) and young sugar maple. This community was complexed with a mineral cultural thicket and a mineral meadow marsh inclusion was also present.		
	3583 Westminster Dr	SWT2			layer was dominant at over 60% coverage with the most frequent species being meadow willow (<i>Salix petiolaris</i>), red-osier dogwood (<i>Cornus sericea</i>), wild black currant (<i>Ribes americanum</i>), and common buckthorn (<i>Rhamnus cathartica</i>). Ground cover was comprised of watercress (<i>Nasturtium officinale</i>), sedge species (<i>Carex species</i>), skunk cabbage (<i>Symplocarpus foetidus</i>) and sensitive fern (<i>Onoclea sensibilis</i>).		
	3595 Scotland Dr	CUM1-1			This cultural meadow community was located throughout the property. Ground cover was dominant at greater than 60% cover with the most frequent species being smooth brome grass (<i>Bromus inermis</i>), orchard grass (<i>Dactylis glomerata</i>), and Canada thistle (<i>Cirsium arvense</i>). The sparse shrub layer was comprised of red-osier dogwood (<i>Cornus sericea</i>) and common buckthorn (<i>Rhamnus cathartica</i>).		

	3666 Scotland Dr	CUT1			This mineral cultural thicket was located in the northern portion of the property. Tall shrub layer species were dominant in this community at over 60% cover with the most frequent species being common buckthorn (<i>Rhamnus cathartica</i>) and gray dogwood (<i>Cornus racemosa</i>). The sparse canopy layer consisted of sugar maple (<i>Acer saccharum</i>) and eastern cottonwood (<i>Populus deltoides</i>).		
	3666 Scotland Dr	CUM1-1			This cultural meadow community was located in the southern portion the property. Ground cover was dominant at greater than 60% cover with the most frequent species being kentucky blue grass (<i>Poa pratensis</i>), brown knapweed (<i>Centaurea jacea</i>), bird's-foot trefoil (<i>Lotus corniculatus</i>) and Canada goldenrod (<i>Solidago canadensis</i>).		
	3666 Scotland Dr	FOD5-5			This deciduous forest was located in the northern end of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included sugar maple (<i>Acer saccharum</i>), bitternut hickory (<i>Carya cordiformis</i>), and red oak (<i>Quercus rubra</i>). The shrub layer was comprised of common buckthorn (<i>Rhamnus cathartica</i>) and downy arrowwood (<i>Viburnum rafinesquianum</i>). The sparse ground layer consisted of sedge species (<i>Carex sp</i>), may apple (<i>Podophyllum peltatum</i>), moss species, and tall hairy agrimony (<i>Agrimonia gryposepala</i>).		
	3691 Manning Dr	CUM1-1	OAD		was dominant at greater than 60% cover with the most frequent species being kentucky blue grass (<i>Poa pratensis</i>), tall goldenrod (<i>Solidago altissima</i>), common dandelion (<i>Taraxicum officinale</i>), and Canada thistle (<i>Cirsium arvense</i>). The shrub layer was comprised primarily of young planted Norway spruce (<i>Picea abies</i>) as well as sparse white oak (<i>Quercus alba</i>), Freeman's maple (<i>Acer x freemanii</i>) and balsam poplar (<i>Populus balsamifera</i>). The sparse canopy layer included white cedar (<i>Thuja occidentalis</i>) and Norway spruce. An open aquatic inclusion was present within this community.		
	3696 Scotland Dr	FOD5-5	MAM2/SWT2		This deciduous forest was located throughout the eastern and central portions of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included sugar maple (<i>Acer saccharum</i>), shagbark hickory (<i>Carya ovata</i>), American beech (<i>Fagus grandifolia</i>), and red oak (<i>Quercus rubra</i>). The sub-canopy consisted of sugar maple, shagbark hickory, American elm (<i>Ulmus americana</i>) and green ash (<i>Fraxinus pennsylvanica</i>). The shrub layer was comprised of young sugar maple, American beech, common buckthorn (<i>Rhamnus cathartica</i>) and gray dogwood (<i>Cornus racemosa</i>). Ground cover was dominated by young sugar maple, yellow trout-lily (<i>Erythronium americanum</i>), creeping bentgrass (<i>Agrostis stolonifera</i>) and reed canary grass (<i>Phalaris arundinacea</i>). This community was complexed with a mineral meadow marsh and a mineral thicket swamp inclusion was also present. Surveys were completed from the roadside.		
	3713 Scotland Dr	CUM1-1	CUT1		This cultural meadow community was located throughout the property. Ground cover was dominant at greater than 60% cover with the most frequent species being kentucky blue grass (<i>Poa pratensis</i>), orchard grass (<i>Dactylis glomerata</i>) and smooth brome grass (<i>Bromus inermis</i>). This community was complexed with a mineral cultural thicket.		

	3713 Scotland Dr	CUT1	CUM1-1		This mineral cultural thicket was located in the central and northeastern portions of the property. Shrub layer species were dominant in this community at over 60% cover with the most frequent species being common buckthorn (<i>Rhamnus cathartica</i>), gray dogwood (<i>Cornus racemosa</i>) and hawthorn species (<i>Crataegus sp</i>). The sparse canopy layer consisted of freeman's maple (<i>Acer x freemanii</i>), sugar maple (<i>Acer saccharum</i>), choke cherry (<i>Prunus virginiana</i>) and Norway maple (<i>Acer platanoides</i>). A cultural meadow inclusion was present within this community.		
	3713 Scotland Dr	SAS1	MAM2-2/MAS2		This submergent shallow aquatic community was located in the northeast portion of the property. Dominant plant species included white water buttercup (<i>Ranunculus aquatilis</i>), small duckweed (<i>Lemna minor</i>), water plantain (<i>Alisma plantago-aquatica</i>), and pondweed species (<i>Potamogeton sp.</i>). The ground cover surrounding this community consisted of needle spikerush (<i>Eleocharis acicularis</i>), reed canary grass (<i>Phalaris arundinacea</i>), and water sedge (<i>Carex aquatilis</i>). This community was complexed with a mineral shallow marsh and a reed canary grass mineral meadow marsh inclusion was also present.		
	3900 Scotland Dr	FOD5-5	SWT2		This deciduous forest was located in the southern end of the property. Forest canopy cover was dominant at greater than 60% cover and dominant species included sugar maple (<i>Acer saccharum</i>), bitternut hickory (<i>Carya cordiformis</i>), American basswood (<i>Tilia americana</i>), and shagbark hickory (<i>Carya ovata</i>). The sub-canopy was comprised of sugar maple, american basswood, and red oak (<i>Quercus rubra</i>). The shrub layer consisted of common buckthorn (<i>Rhamnus cathartica</i>), gray dogwood (<i>Cornus racemosa</i>), mountain holly (<i>Nemopanthus mucronatus</i>) and riverbank grape (<i>Vitis riparia</i>). Ground cover was dominated by narrow-leaved cattail (<i>Typha angustifolia</i>), broad-leaved cattail (<i>Typha latifolia</i>) and purple loosestrife (<i>Lythrum salicaria</i>). This community was complexed with a mineral thicket swamp.		
	4166 Scotland Dr	CUW1			This cultural woodland community was located in the eastern portion of the property. Dominant tree species present were black locust (<i>Robinia pseudoacacia</i>), black walnut (<i>Juglans nigra</i>), green ash (<i>Fraxinus pennsylvanica</i>) and sugar maple (<i>Acer saccharum</i>). The sub-canopy was comprised of black locust and black walnut. The dominant shrub species present were common buckthorn (<i>Rhamnus cathartica</i>), staghorn sumac (<i>Rhus typhina</i>) and riverbank grape (<i>Vitis riparia</i>). Ground cover was dominated by smooth brome grass (<i>Bromus inermis</i>) and wild carrot (<i>Daucus carota</i>).		
	5861 White Oak Rd	CUM1-1	CUW1		This cultural meadow community was located in the east end of the property. Ground cover was dominant at greater than 60% cover with the most frequent species being early goldenrod (<i>Solidago juncea</i>), devil's beggarticks (<i>Bidens frondosa</i>), smooth brome grass (<i>Bromus inermis</i>), and wild carrot (<i>Daucus carota</i>). The shrub layer was comprised of common buckthorn (<i>Rhamnus cathartica</i>), and tartarian honeysuckle (<i>Lonicera tatarica</i>). The sub-canopy consisted of eastern white cedar (<i>Thuja occidentalis</i>), Manitoba maple (<i>Acer negundo</i>), while the sparse canopy was dominated by freeman's maple (<i>Acer freemanii</i>) and horse chestnut (<i>Aesculus hippocastanum</i>). A cultural woodland inclusion was present within this community.		



	6100 White Oak Rd	CUM1-1	OAO		This cultural meadow community was located in the north end of the property. Ground cover was dominant at greater than 60% cover with the most frequent species being smooth brome grass (<i>Bromus inermis</i>), goldenrod species (<i>Solidago sp.</i>), and common dandelion (<i>Taraxicum officinale</i>). An open aquatic inclusion was present within the community.		
	6100 White Oak Rd	CUP3	CUM1-1		property. Forest canopy cover was dominant at greater than 60% cover and dominant species present was white pine (<i>Pinus strobus</i>). The sub-canopy was comprised of white pine, green ash (<i>Fraxinus pennsylvanica</i>), and Manitoba maple (<i>Acer negundo</i>). The shrub layer consisted of common buckthorn (<i>Rhamnus cathartica</i>), red-osier dogwood (<i>Cornus sericea</i>), and choke cherry (<i>Prunus virginiana</i>). Sparse ground cover consisted of garlic mustard (<i>Alliaria petiolata</i>), woodland strawberry (<i>Fragaria vesca</i>), and ground ivy (<i>Glechoma hederacea</i>). A cultural meadow inclusion was present within the community.		
	6100 White Oak Rd	MAM2-2	SWT2-2		This reed canary grass mineral meadow marsh was located in northwest portion of the property. Ground cover species were dominant at over 60% cover with the most frequent species being reed canary grass (<i>Phalaris arundinacea</i>) and common reed (<i>Phragmites australis</i>). The shrub layer was comprised of pussy willow (<i>Salix discolor</i>), red-osier dogwood (<i>Cornus sericea</i>), and common buckthorn (<i>Rhamnus cathartica</i>). A willow mineral thicket swamp inclusion was present within the community.		

Appendix **H**

Bat Habitat Assessment

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
3438 Manning Drive - FOD 2-3						
1	Shagbark Hickory (<i>Carya ovata</i>)	45	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482161	4747962
2	Shagbark Hickory (<i>Carya ovata</i>)	53	1	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482159	4747972
3	Shagbark Hickory (<i>Carya ovata</i>)	45	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482157	4747967
4	Shagbark Hickory (<i>Carya ovata</i>)	32	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482152	4747965
5	Shagbark Hickory (<i>Carya ovata</i>)	39	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482154	4747962
6	Shagbark Hickory (<i>Carya ovata</i>)	40	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482137	4747960
7	Shagbark Hickory (<i>Carya ovata</i>)	70	1	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482140	4747969
8	Shagbark Hickory (<i>Carya ovata</i>)	35	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482130	4747971
9	Shagbark Hickory (<i>Carya ovata</i>)	50	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482136	4747962
10	Shagbark Hickory (<i>Carya ovata</i>)	35	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482132	4747966
11	Shagbark Hickory (<i>Carya ovata</i>)	29	3	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482132	4747968
12	Shagbark Hickory (<i>Carya ovata</i>)	30	3	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482125	4747965
13	Shagbark Hickory (<i>Carya ovata</i>)	45	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482118	4747959
14	Shagbark	45	2	<ul style="list-style-type: none"> • Loose bark 	482113	4747950

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
	Hickory (<i>Carya ovata</i>)			<ul style="list-style-type: none"> • Decay Class 1 • Other snag within 10m 		
15	Shagbark Hickory (<i>Carya ovata</i>)	35	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482119	4747947
16	Shagbark Hickory (<i>Carya ovata</i>)	70	1	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482137	4747924
17	Shagbark Hickory (<i>Carya ovata</i>)	42	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482138	4747913
18	Shagbark Hickory (<i>Carya ovata</i>)	46	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482133	4747909
19	Shagbark Hickory (<i>Carya ovata</i>)	85	1	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482136	4747893
20	Shagbark Hickory (<i>Carya ovata</i>)	45	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482141	4747887
21	Shagbark Hickory (<i>Carya ovata</i>)	40	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482149	4747889
22	Shagbark Hickory (<i>Carya ovata</i>)	50	2	<ul style="list-style-type: none"> • Cavity • Loose bark • Decay Class 1 • Other snag within 10m 	482159	4747885
23	Shagbark Hickory (<i>Carya ovata</i>)	52	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482163	4747886
24	Shagbark Hickory (<i>Carya ovata</i>)	70	1	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482179	4747924
25	Shagbark Hickory (<i>Carya ovata</i>)	30	2	<ul style="list-style-type: none"> • Cavity • Loose bark • Decay Class 1 • Other snag within 10m 	482178	4747934
26	Shagbark Hickory (<i>Carya ovata</i>)	35	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482174	4747939
27	Shagbark Hickory	29	3	<ul style="list-style-type: none"> • Cavity • Loose bark 	482168	4747941

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
	(<i>Carya ovata</i>)			<ul style="list-style-type: none"> Decay Class 2 Other snag within 10m 		
3502 Scotland Drive – FOD5-5						
13	Shagbark Hickory (<i>Carya ovata</i>)	27	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 	481764	4748282
14	American Elm (<i>Ulmus americana</i>)	32	2	<ul style="list-style-type: none"> Loose bark Decay Class 3 	481763	4748282
15	Shagbark Hickory (<i>Carya ovata</i>)	34	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 	481763	4748284
16	Sugar Maple (<i>Acer saccharum</i>)	25	3	<ul style="list-style-type: none"> Decay Class 2 Cavity at top (chimney style 2m long by 30cm wide) 	481753	4748275
17	Sugar Maple (<i>Acer saccharum</i>)	25	3	<ul style="list-style-type: none"> Loose bark Cavity Decay Class 2 	481743	4748279
18	Shagbark Hickory (<i>Carya ovata</i>)	24	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 Other snag within 10m 	481811	4748260
19	Shagbark Hickory (<i>Carya ovata</i>)	24	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 	481806	4748269
20	Shagbark Hickory (<i>Carya ovata</i>)	28	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 	481881	4748296
21	Shagbark Hickory (<i>Carya ovata</i>)	30	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 	481861	4748228
22	Shagbark Hickory (<i>Carya ovata</i>)	36	2	<ul style="list-style-type: none"> Loose bark Decay Class 1 	481865	4748240
23	Ash species (<i>Fraxinus sp.</i>)	46	2	<ul style="list-style-type: none"> Loose bark Cavities Knot hole Decay Class 3 	481742	4748187
26	American Beech (<i>Fagus grandifolia</i>)	40	2	<ul style="list-style-type: none"> Two Cavities (20cm x 20cm and 30cm x 15cm) 	481766	4748192
3298 Scotland Drive – CUP3						
1	Eastern White Pine (<i>Pinus strobus</i>)	22	2	<ul style="list-style-type: none"> Loose bark Decay Class 2 Other snag within 10m 	482448	4748282
2	Eastern White Pine (<i>Pinus strobus</i>)	19	2	<ul style="list-style-type: none"> Loose bark Decay Class 2 	482442	4748282
3	Eastern White Pine (<i>Pinus</i>)	21	2	<ul style="list-style-type: none"> Loose bark Decay Class 2 	482439	4748282

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
	<i>strobilus</i>)					
3483 Westminster Drive – FOD5-5						
4	White Ash (<i>Fraxinus americana</i>)	18	4	<ul style="list-style-type: none"> • Loose bark • Cavity • Decay Class 3 	482195	4748257
5	White Ash (<i>Fraxinus americana</i>)	21	3	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	482184	4748299
6	Silver Maple (<i>Acer saccharinum</i>)	55	1	<ul style="list-style-type: none"> • Cavity • Decay Class 1 • Other snag within 10m 	482170	4748303
7	Hybrid White Willow (<i>Salix x fragilis</i>)	42	1	<ul style="list-style-type: none"> • Cavity • Decay Class 2 • Other snag within 10m 	482188	4748305
8	Hybrid White Willow (<i>Salix x fragilis</i>)	22	3	<ul style="list-style-type: none"> • Cavity (open chimney) • Decay Class 2 • Other snag within 10m 	482190	4748317
9	Hybrid White Willow (<i>Salix x fragilis</i>)	43	3	<ul style="list-style-type: none"> • Cavity (open chimney) • Decay Class 2 • Other snag within 10m 	482215	4748306
10	White Ash (<i>Fraxinus americana</i>)	23	1	<ul style="list-style-type: none"> • Cavity • Crack • Loose bark • Decay Class 3 • Other snag within 10m 	482188	4748336
11	White Ash (<i>Fraxinus americana</i>)	20	2	<ul style="list-style-type: none"> • Cavity • Loose bark • Decay Class 3 • Other snag within 10m 	482192	4748332
12	White Ash (<i>Fraxinus americana</i>)	19	1	<ul style="list-style-type: none"> • Crack • Loose bark • Decay Class 3 • Other snag within 10m 	482168	4748334
13	Balsam Poplar (<i>Populus balsamifera</i>)	21	1	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	482160	4748329
14	White Ash (<i>Fraxinus americana</i>)	18	2	<ul style="list-style-type: none"> • Loose bark • Other snag within 10m 	482157	4748320
15	Balsam Poplar (<i>Populus balsamifera</i>)	19	2	<ul style="list-style-type: none"> • Loose bark • Other snag within 10m 	482158	4748313
16	Oak species	34	1	<ul style="list-style-type: none"> • Cavity 	482147	4748313

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
	(<i>Quercus sp.</i>)			<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 		
17	White Ash (<i>Fraxinus americana</i>)	21	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	482149	4748315
18	Balsam Poplar (<i>Populus balsamifera</i>)	19	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 2 • Other snag within 10m 	482144	4748307
19	Balsam Poplar (<i>Populus balsamifera</i>)	29	1	<ul style="list-style-type: none"> • Cavities • Loose bark • Decay Class 3 • Other snag within 10m 	482148	4748309
20	Eastern White Pine (<i>Pinus strobus</i>)	22	2	<ul style="list-style-type: none"> • Loose bark • Knot hole • Decay Class 3 • Other snag within 10m 	482611	4748305
21	Sugar Maple (<i>Acer saccharum</i>)	36	1	<ul style="list-style-type: none"> • Cavities • Knot holes • Decay Class 3 • Other snag within 10m 	482658	4748285
22	White Oak (<i>Quercus alba</i>)	36	1	<ul style="list-style-type: none"> • Cavity • Knot holes • Decay Class 2 • Live tree • Interior • No leaf clusters 	482154	4748240
23	Hawthorn species (<i>Crataegus sp</i>)	18	3	<ul style="list-style-type: none"> • Cavity • Knot holes • Decay Class 2 	482123	4748265
24	Oak species (<i>Quercus sp</i>)	16	3	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Dead tree • Interior • No leaf clusters 	482140	4748333
25	Ironwood (<i>Ostrya virginiana</i>)	36	1	<ul style="list-style-type: none"> • Knot holes • Decay Class 1 	482082	4748329
26	Sugar Maple (<i>Acer saccharum</i>)	27	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	482070	4748345
27	Green Ash (<i>Fraxinus pennsylvanica</i>)	17	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 2 • Other snag within 10m 	482070	4748340
28	Oak species (<i>Quercus sp</i>)	16	3	<ul style="list-style-type: none"> • Loose bark • Decay Class 2 • Declining tree 	482081	4748345

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
				<ul style="list-style-type: none"> • Forest edge • Other snag within 10m • No leaf clusters 		
29	Oak species (<i>Quercus sp</i>)	49	1	<ul style="list-style-type: none"> • Cavity • Decay Class 3 • Dead tree • Forest edge • Other snag within 10m • No leaf clusters 	482105	4748354
30	Ironwood (<i>Ostrya virginiana</i>)	38	3	<ul style="list-style-type: none"> • Cavity • Decay Class 1 • Other snag within 10m 	482138	4748348
31	Trembling Aspen (<i>Populus tremuloides</i>)	19	2	<ul style="list-style-type: none"> • Cavities • Decay Class 3 • Other snag within 10m 	482139	4748356
3583 Westminster Drive – FOD5-5						
1	Shagbark Hickory (<i>Carya ovata</i>)	19	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	481656	4748210
2	Sugar Maple (<i>Acer saccharum</i>)	29	2	<ul style="list-style-type: none"> • Cavities • Decay Class 1 	481651	4748186
6	Shagbark Hickory (<i>Carya ovata</i>)	22	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 	481690	4748275
7	Shagbark Hickory (<i>Carya ovata</i>)	18	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	481699	4748269
9	Shagbark Hickory (<i>Carya ovata</i>)	34	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	481725	4748329
10	Shagbark Hickory (<i>Carya ovata</i>)	31	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	481731	4748335
11	Shagbark Hickory (<i>Carya ovata</i>)	36	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1 • Other snag within 10m 	481735	4748331
12	Green Ash (<i>Fraxinus pennsylvanica</i>)	25	2	<ul style="list-style-type: none"> • Loose bark • Crack • Decay Class 3 	481703	4748406
6100 White Oak Road – CUP3						
1	Eastern White Pine (<i>Pinus strobus</i>)	17	3	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 	480772	4746460

Tree ID#	Tree Species ID	dbh (cm)	Height Class	Snag Attributes	Easting	Northing
2	Eastern White Pine (<i>Pinus strobus</i>)	20	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 	480772	4746430
3	Eastern White Pine (<i>Pinus strobus</i>)	20	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	480770	4746420
4	Eastern White Pine (<i>Pinus strobus</i>)	18	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	480741	4746444
5	Eastern White Pine (<i>Pinus strobus</i>)	19	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	480735	4746445
6	Eastern White Pine (<i>Pinus strobus</i>)	22	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 	480748	4746470
7	Eastern White Pine (<i>Pinus strobus</i>)	23	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	480743	4746516
8	Eastern White Pine (<i>Pinus strobus</i>)	25	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	480753	4746524
9	Eastern White Pine (<i>Pinus strobus</i>)	21	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 3 • Other snag within 10m 	480734	4746551
10	Eastern White Pine (<i>Pinus strobus</i>)	24	2	<ul style="list-style-type: none"> • Loose bark • Decay Class 1-3 • Other snag within 10m 	480732	4746561
11	Eastern White Pine (<i>Pinus strobus</i>)	24	2	<ul style="list-style-type: none"> • Cavities • Loose bark • Knot hole • Decay Class 3 	480732	4746561

Appendix



Breeding Bird List

Common Name	Scientific Name	G-Rank ¹	S-Rank ²	SARA Status ³	COSEWIC Status ⁴	ESA Status ⁵	CASSARO Status ⁶	Area-sensitive Species ⁷	TRCA L-Rank ⁸	Conservation Priority Rank for Grand River Basin ⁹	Priority Species in the Lower Great Lakes/St. Lawrence Plain (BCR Region 13) ¹⁰	Priority Species in the Boreal Hardwood Transition Region (BCR Region 12) ¹²	OBBA 17MH84	AECOM Observations						
														BS-01	BS-02	BS-03	BS-04	BS-05	BS-06	Incidental
Green Heron	<i>Butorides virescens</i>	G5	S4B						L4	Level 4 Forest	Increase	Increase	FY							X
Canada Goose	<i>Branta canadensis</i>	G5	S5						L5		Decrease	Decrease	FY							X
Mallard	<i>Anas platyrhynchos</i>	G5	S5						L5		Maintain Current	Maintain Current	FY							H
Turkey Vulture	<i>Cathartes aura</i>	G5	S5B						L4	Level 3 Forest			FY							X
Sharp-shinned Hawk	<i>Accipiter striatus</i>	G5	S5				NAR	A	L3	Level 2 Forest			FY							X
Red-tailed Hawk	<i>Buteo jamaicensis</i>	G5	S5				NAR	A	L5				AE							X
Wild Turkey	<i>Meleagris gallopavo</i>	G5	S5						L3				FY							S
Killdeer	<i>Charadrius vociferus</i>	G5	S5B, S5N						L5		Increase	Increase	NE			A			S	FY
Spotted Sandpiper	<i>Actitis macularia</i>	G5	S5						L4	Level 3 Open Country	Increase	Maintain Current	T							FY
Mourning Dove	<i>Zenaidura macroura</i>	G5	S5						L5				NY						S	S
Eastern Wood-Pewee	<i>Contopus virens</i>	G5	S4B		SC	SC	SC		L4		Increase		T							S
Alder Flycatcher	<i>Empidonax aliorum</i>	G5	S5B						L3	Level 3 Forest					T					S
Willow Flycatcher	<i>Empidonax traillii</i>	G5	S5B						L4				FY	T	T					S
Eastern Kingbird	<i>Tyrannus tyrannus</i>	G5	S4B						L4	Level 3 Open Country	Increase		NE		S			P	H	S
Horned Lark	<i>Eremophila alpestris</i>	G5	S5B						L3	Level 3 Open Country			FY							S
Tree Swallow	<i>Tachycineta bicolor</i>	G5	S4B						L4			Increase	AE	X		X			X	
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	G5	S4B						L4	Level 2 Open Country	Increase	Increase	H				X		X	
Bank Swallow	<i>Riparia riparia</i>	G5	S4B			THR			L3	Level 1 Open Country	Increase	Increase	AE	X	X					
Barn Swallow	<i>Hirundo rustica</i>	G5	S4B		THR	THR	THR		L4	Level 3 Open Country	Recovery Objective	Recovery Objective	NY	X		X		X	H	X
American Crow	<i>Corvus brachyrhynchos</i>	G5	S5B						L5				AE			S			S	
Black-capped Chickadee	<i>Poecetes atricapillus</i>	G5	S5						L5	Level 4 Forest			CF			S				S
House Wren	<i>Troglodytes aedon</i>	G5	S5B						L5				CF					S		S
American Robin	<i>Turdus migratorius</i>	G5	S5B						L5				NY		S	S			A	S
Gray Catbird	<i>Dumetella carolinensis</i>	G5	S4B						L4	Level 4 Forest		Increase	NY					S		
Cedar Waxwing	<i>Bombycilla cedrorum</i>	G5	S5B						L5				FY							S
Red-eyed Vireo	<i>Vireo olivaceus</i>	G5	S5B						L4				NE							S
Yellow Warbler	<i>Dendroica petechia</i>	G5	S5B						L5				FY		T				S	S
Common Yellowthroat	<i>Geothlypis trichas</i>	G5	S5B						L4			Maintain Current	NB	T		T		T		S
Northern Cardinal	<i>Cardinalis cardinalis</i>	G5	S5						L5				FY	T	T	A		T		S
Indigo Bunting	<i>Passerina cyanea</i>	G5	S4B						L4				NY					S		
Chipping Sparrow	<i>Spizella passerina</i>	G5	S5B						L5				NY						S	S
Clay-coloured Sparrow	<i>Spizella pallida</i>	G5	S4B						L3	Level 1 Open Country				S						
Field Sparrow	<i>Spizella pusilla</i>	G5	S4B						L4	Level 3 Open Country	Increase	Assess/Maintain	CF	T	T				T	S
Savannah Sparrow	<i>Passerculus sandwichensis</i>	G5	S4B					A	L4	Level 1 Open Country	Increase		NY	T	A	T	T	A		S
Song Sparrow	<i>Melospiza melodia</i>	G5	S5B						L5			Increase	NY	T	T	T	S	T	A	A
Bobolink	<i>Dolichonyx oryzivorus</i>	G5	S4B		THR	THR	THR	A	L2	Level 2 Open Country	Recovery Objective	Recovery Objective	CF		CF	A	P	P		CF
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	G5	S4						L5				FY		T	CF	S	A	A	S
Eastern Meadowlark	<i>Sturnella magna</i>	G5	S4B		THR	THR	THR	A	L3	Level 2 Open Country	Recovery Objective		NE	T	P	T	T		S	S
Common Grackle	<i>Quiscalus quiscula</i>	G5	S5B						L5				FY							X
Brown-headed Cowbird	<i>Molothrus ater</i>	G5	S4B						L5				FY	S					H	
Orchard Oriole	<i>Icterus spurius</i>	G5	S4B							Level 3 Forest										S
Baltimore Oriole	<i>Icterus galbula</i>	G5	S4B						L5		Maintain Current		CF						S	
American Goldfinch	<i>Carduelis tristis</i>	G5	S5B						L5	Level 3 Open Country			FY		S			S	S	S

Appendix J

Species at Risk Screening

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1, 2}	Known Species Range ^{1, 2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Birds	Bank Swallow <i>Riparia riparia</i>	THR	No Status	THR	Bank swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs.	The bank swallow is found all across southern Ontario, with sparser populations scattered across northern Ontario. The largest populations are found along the Lake Erie and Lake Ontario shorelines, and the Saugeen River (which flows into Lake Huron).	OBBA	Moderate Probability Suitable habitat may be present within the study area.	Confirmed This species was observed during field investigations. No Suitable habitat was not identified.	Suitable habitat for this species was not identified. No further action is required.
Birds	Barn Swallow <i>Hirundo rustica</i>	THR	No Status	THR	Barn Swallows often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces. This species can typically be associated with the following ELC communities: TPO, CUM1, MAM, MAS, OAO, SAS1, SAM1, SAF1 ; containing or adjacent structures that are suitable for nesting.	The Barn Swallow may be found throughout southern Ontario and can range as far north as Hudson Bay, wherever suitable locations for nests exist.	OBBA, MNRF Aylmer District	High Probability Suitable habitat likely present within the study area (structures for nesting and foraging habitat present)	Confirmed This species was observed during field investigations. Candidate Barns and similar structures were identified in the study area, although nesting was not confirmed.	Should development encroach upon potential nesting habitat, additional surveys may be required. It is recommended that any vegetation clearing be completed outside of the breeding bird season (April 1st - August 31st).
Birds	Bobolink <i>Dolichonyx oryzivorus</i>	THR	No Status	THR	Historically, Bobolinks lived in North American tallgrass prairie and other open meadows. With the clearing of native prairies, Bobolinks moved to living in hayfields. Bobolinks often build their small nests on the ground in dense grasses. Both parents usually tend to their young, sometimes with a third Bobolink helping. This species can typically be associated with the following ELC communities: TPO, TPS, CUM1 and MAM2 .	The Bobolink breeds across North America. In Ontario, it is widely distributed throughout most of the province south of the boreal forest, although it may be found in the north where suitable habitat exists.	NHIC, OBBA, SARO online, MNRF Aylmer District	High Probability Suitable habitat likely present within agricultural lands and meadow habitat within the study area.	Confirmed This species was observed during field investigations. Confirmed Cultural meadow communities with extensive grass cover provide suitable habitat.	This species was observed during breeding bird surveys completed in 2018. Should the proposed development encroach upon suitable habitat, a Notice of Activity (NOA) will need to be prepared for the MNRF prior to commencing development in accordance with Section 23.6 of O. Reg. 242/08

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1, 2}	Known Species Range ^{1, 2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Birds	Eastern Meadowlark <i>Sturnella magna</i>	THR	No Status	THR	<p>Eastern Meadowlarks breed primarily in moderately tall grasslands, such as pastures and hayfields, but are also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Small trees, shrubs or fence posts are used as elevated song perches.</p> <p>This species can typically be associated with the following ELC communities: TPO, TPS, CUM1, CUS, and MAM2 with elevated song perches.</p>	In Ontario, the Eastern Meadowlark is primarily found south of the Canadian Shield but it also inhabits the Lake Nipissing, Timiskaming and Lake of the Woods areas.	NHIC, OBBA, SARO online, MNRF Aylmer District	<p>High Probability</p> <p>Suitable habitat may be present within agricultural lands and meadow habitat within the study area.</p>	<p>Confirmed</p> <p>This species was observed during field investigations.</p> <p>Confirmed</p> <p>Cultural meadow communities with extensive grass cover provide suitable habitat.</p>	<p>This species was observed during breeding bird surveys completed in 2018.</p> <p>Should the proposed development encroach upon suitable habitat, a Notice of Activity (NOA) will need to be prepared for the MNRF prior to commencing development in accordance with Section 23.6 of O. Reg. 242/08</p>
Birds	Eastern Wood-Pewee <i>Contopus virens</i>	SC	No Status	SC	<p>The Eastern Wood-Pewee can be found in every type of wooded community in eastern North America. The size of the forest does not appear to be an important factor in habitat selection as this species has been found in both small fragmented forests and larger forest tracks. 4</p> <p>This species can typically be associated with the following ELC communities: FOC, FOM, FOD, SWD, SWM and CUW.</p>	The Eastern Wood-Pewee Breed throughout central and eastern North America from Saskatchewan to Nova Scotia south along the Atlantic Coast to North Florida and the Gulf Coast. 4	OBBA	<p>High Probability</p> <p>Suitable habitat may be present within forested ecosystems in the study area.</p>	<p>Confirmed</p> <p>This species was observed during field investigations.</p> <p>Confirmed</p> <p>Forested communities provide suitable habitat.</p>	It is recommended that any vegetation clearing be completed outside of the breeding bird season (April 1st - August 31st).
Birds	Red-headed Woodpecker <i>Melanerpes erythrocephalus</i>	SC	THR Schedule 1	THR	<p>The Red-headed Woodpecker lives in open woodland and woodland edges, and is often found in parks, golf courses and cemeteries. These areas typically have many dead trees, which the bird uses for nesting and perching. This woodpecker regularly winters in the United States, moving to locations where it can find sufficient acorns and beechnuts to eat. A few of these birds will stay the winter in woodlands in southern Ontario if there are adequate supplies of nuts.</p> <p>This species can typically be associated with the following ELC communities: TPS, TPW, CUW, FOD1, FOD2, FOD4-1, FOD6, FOD7, and FOD9 that are open and have an abundance of dead trees.</p>	The Red-headed Woodpecker is found across southern Ontario, where it is widespread but rare. Outside Ontario, it lives in Alberta, Saskatchewan, Manitoba and Quebec, and is relatively common in the United States.	OBBA	<p>Moderate Probability</p> <p>Suitable habitat may be present within wooded ecosystems in the study area.</p>	<p>No</p> <p>This species was not observed during field investigations.</p> <p>No</p> <p>Suitable habitat was not identified.</p>	<p>This species was not observed during field investigations. Suitable habitat for this species was not identified.</p> <p>No further action is required.</p>

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1, 2}	Known Species Range ^{1, 2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Birds	Golden-winged Warbler <i>Vermivora chrysoptera</i>	SC	THR Schedule 1	THR	Golden-winged Warblers prefer to nest in areas with young shrubs surrounded by mature forest – locations that have recently been disturbed, such as field edges, hydro or utility right-of-ways, or logged areas.	The Golden-winged Warbler is found in southern Saskatchewan, Manitoba, Ontario, and Quebec, as well as the north-eastern United States. In Ontario, these birds breed in central-eastern Ontario, as far south as Lake Ontario and the St. Lawrence River, and as far north as the northern edge of Georgian Bay. Golden-winged Warblers have also been found in the Lake of the Woods area near the Manitoba border, and around Long Point on Lake Erie. Golden-winged Warblers spend the winter in Central America, some Caribbean islands, and the northern part of South America.	OBBA	Moderate Probability Suitable habitat may be present within wooded ecosites in the study area.	No This species was not observed during field investigations. No Suitable habitat was not identified.	This species was not observed during field investigations. Suitable habitat for this species was not identified. No further action is required.
Birds	Wood Thrush <i>Hylocichla mustelina</i>	SC	No Status	THR	The Wood Thrush can typically be found in the interior and along the edges of well-developed upland deciduous and mixed forests. Key elements of these forests include trees that are greater than 16 m in height, high variety of deciduous tree species, moderate subcanopy and shrub density, shade, fairly open forest floor, moist soils and decaying leaf litter. Wood Thrush is more likely to occur in larger forests but may also nest in 1 ha fragments and semi-wooded residential areas and parks. Smaller habitat fragments have lower fecundity when compared to larger fragments. ³ This species can typically be associated with the following ELC communities: FOD and FOM that are greater than 1 ha in size.	The Wood Thrush ranges across central and southern Ontario, southern Quebec, New Brunswick and southern Nova Scotia and the majority of the eastern United States. It winters in Central America between southern Mexico and Panama. ³	OBBA	Moderate Probability Suitable habitat may be present within forested ecosites in the study area.	No This species was not observed during field investigations. No Although deciduous forest communities may provide suitable habitat, the species was not detected during field investigations.	This species was not observed during breeding bird surveys completed in 2018. Therefore, it is unlikely that this species is present within the study area. No further actions are required.
Insects	Monarch <i>Danaus plexippus</i>	SC	No Status	SC	Throughout their life cycle, Monarchs use three different types of habitat. Only the caterpillars feed on milkweed plants and are confined to meadows and open areas where milkweed grows. Adult butterflies can be found in more diverse habitats where they feed on nectar from a variety of wildflowers. Monarchs spend the winter in Oyamel Fir forests found in central Mexico. This species can typically be associated with the following ELC communities: AI, TP and CUM where milkweed plants are present.	The Monarch's range extends from Central America to southern Canada. In Canada, Monarchs are most abundant in southern Ontario and Quebec where milkweed plants and breeding habitat are widespread. During late summer and fall, Monarchs from Ontario migrate to central Mexico where they spend the winter months. During migration, groups of Monarchs numbering in the thousands can be seen along the north shores of Lake Ontario and Lake Erie.	None	N/A	Confirmed This species was observed during field investigations. Confirmed Cultural meadow communities with milkweed provide suitable habitat.	This species was observed during field investigations completed in 2018. Habitat for this species is considered Significant Wildlife Habitat in accordance with the Provincial Policy Statement (2014) and will be addressed further in Section 3.5 and Appendix H.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1, 2}	Known Species Range ^{1, 2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Mammals	Little Brown Myotis (Bat) <i>Myotis lucifugus</i>	END	No Status	END	<p>Bats are nocturnal. During the day they roost in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimetres across) and this is how they access many roosting areas.</p> <p>Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. This species can typically be associated with any community where suitable roosting (i.e. cavity trees, houses, abandoned buildings, barns, etc.) habitat is available.</p>	The little brown bat is widespread in southern Ontario and found as far north as Moose Factory and Favourable Lake. Outside Ontario, this bat is found across Canada (except in Nunavut) and most of the United States.	SARO online, MNRF Aylmer District	Moderate Probability Forest communities present in the study area may contain cavity trees.	No This species was not observed during field investigations. Candidate Forest and swamp communities provide suitable habitat.	Should tree removal be required within Candidate habitat, further consultation with the MNRF is required. It is recommended that all vegetation clearing be completed outside of the bat roosting season (April 1st - September 30th).
Mammals	Eastern Small-footed Myotis <i>Myotis leibii</i>	END			<p>In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees.</p> <p>These bats often change their roosting locations every day. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies.</p> <p>In the winter, these bats hibernate, most often in caves and abandoned mines. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.</p>	The eastern small-footed bat has been found from south of Georgian Bay to Lake Erie and east to the Pembroke area. There are also records from the Bruce Peninsula, the Espanola area, and Lake Superior Provincial Park. Most documented sightings are of bats in their winter hibernation sites.	SARO online, MNRF Aylmer District	Moderate Probability Forest communities present in the study area may contain cavity trees.	No This species was not observed during field investigations. Candidate Forest and swamp communities provide suitable habitat.	Should tree removal be required within Candidate habitat, further consultation with the MNRF is required. It is recommended that all vegetation clearing be completed outside of the bat roosting season (April 1st - September 30th).
Mammals	Northern (Long-eared) Myotis (Bat) <i>Myotis septentrionalis</i>	END	No Status	END	<p>Northern long-eared bats are associated with boreal forests, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves or abandoned mines.</p> <p>This species can typically be associated with the following ELC communities: FOC, FOM, FOD, SWC, SWM and SWD where suitable roosting (i.e. cavity trees and trees with loose bark) habitat is available.</p>	<p>The northern long-eared bat is found throughout forested areas in southern Ontario, to the north shore of Lake Superior and occasionally as far north as Moosonee, and west to Lake Nipigon.</p> <p>This bat is found in all Canadian provinces as well as the Yukon and Northwest Territories.</p>	SARO online, MNRF Aylmer District	Moderate Probability Forest communities present in the study area may contain cavity trees.	No This species was not observed during field investigations. Candidate Forest and swamp communities provide suitable habitat.	Should tree removal be required within Candidate habitat, further consultation with the MNRF is required. It is recommended that all vegetation clearing be completed outside of the bat roosting season (April 1st - September 30th).

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1, 2}	Known Species Range ^{1, 2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Mammals	Tri-colored Bat <i>Perimyotis subflavus</i>	END	END Schedule 1	END	In Ontario, the Tri-colored Bat lives in forested habitats, forming day roosts and maternity colonies in older forest within foliage or in high tree cavities, occasionally also in barns or other structures. This species forages over water and along streams in forests. At the close of the summer season, this species congregate at a location to swarm, usually near caves, mines or underground locations where they will winter; it has a strong fidelity to its winter hibernation sites. This bat overwinters in caves, typically individually instead of as a group.	This bat is found in Southern Ontario and ranging as far north as Espanola, near Sudbury, having a scattered distribution. Its broad range sweeps from eastern North America down to Central America.	SARO online, MNRF Aylmer District	Moderate Probability Forest communities present in the study area may contain cavity trees.	No This species was not observed during field investigations. Candidate Forest and swamp communities provide suitable habitat.	Should tree removal be required within Candidate habitat, further consultation with the MNRF is required. It is recommended that all vegetation clearing be completed outside of the bat roosting season (April 1st - September 30th).
Mammals	Woodland Vole <i>Microtus pinetorum</i>	SC	SC Schedule 1	SC	In Ontario, the Woodland Vole lives in mature deciduous forest in the Carolinian region where there is a deep litter layer that allows it to burrow. This species can typically be associated with the following ELC communities: FOD with a deep leaf litter and loose soils.	In Ontario, it is known to exist at 30 sites from the Municipality of Chatham-Kent and Lambton County, east to Haldimand County, and north to Halton Regional Municipality and the City of Hamilton. Because it spends most of its time below ground, this species is difficult to spot and may have been missed at other locations in the province.	NHIC, SARO online	Moderate Probability Forest communities present in the study area may be suitable if deep litter layer and loose soils are present.	No This species was not observed during field investigations. No Suitable habitat was not identified.	This species was not observed during field investigations. Suitable habitat for this species was not identified. No further action is required.
Mosses	Spoon-leaved Moss <i>Bryoandersonia illecebra</i>	END	END Schedule 1	END	Spoon-leaved Moss grows in a range of habitat types but most Canadian populations are located on soil in low-lying areas that are seasonally flooded under trees or shrub thickets. It is often found in close proximity to a species of moss called narrow-leaved wetland plume moss, which is associated with swamps, marshes, and wet meadows. This species can typically be associated with the following ELC communities: SWD , SWT , MAS and MAM that are seasonally flooded.	Spoon-leaved Moss is found only in eastern North America, from southern Ontario south to Texas and Florida. In Canada, it is restricted to a few sites in southern Ontario – Elgin, Essex and Welland counties, and the Niagara Region.	NHIC, SARO online	Moderate Probability Wetland communities present in the study area may provide suitable habitat.	No This species was not observed during field investigations. No Although swamp and marsh communities may provide suitable habitat, the species was not detected during field investigations.	This species was not observed during botanical surveys completed in 2018. Therefore, it is unlikely that this species is present within the study area. No further actions are required.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1,2}	Known Species Range ^{1,2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Plants	Bird's-foot Violet <i>Viola pedata</i>	END	END Schedule 1	END	In Ontario, Bird's-foot Violet is found only in black oak savanna, a very rare vegetation type having widely spaced open-grown trees with an understorey of tallgrass prairie herbs. Natural disturbances caused by drought or fire are important for removing trees and shrubs that would otherwise shade out the tiny Bird's-foot Violet. This species can typically be associated with the following ELC communities: TPS1-1 and TPW1-1 .	In Canada, Bird's-foot Violet is found only in southern Ontario at a handful of sites. In 2001, the population was estimated to be fewer than 7,000 plants at only five locations.	NHIC	Low Probability Suitable habitat for this species was not identified through background review.	No This species was not observed during field investigations. No Suitable habitat was not identified.	This species was not observed during field investigations. Suitable habitat for this species was not identified. No further action is required.
Plants	Broad Beech Fern <i>Phegopteris hexagonoptera</i>	SC	SC Schedule 3	SC	The Broad Beech Fern prefers to grow in rich soils in deciduous forests, often in areas dominated by maple and beech trees. It requires moist soil and usually grows in full shade. This species can typically be associated with the following ELC communities: FOD5 and FOD6 with moist soils and closed canopies.	The Broad Beech Fern grows in eastern North America from the southern Great Lakes region west to southeast Kansas and northeast Oklahoma, south to northeast Texas and the Gulf Coast and east to the Atlantic coast. In Ontario, the species is found in forest remnants in southern Muskoka, along Lake Erie, and in the eastern Lake Ontario-St. Lawrence River region.	NHIC, SARO online	Low Probability Suitable habitat for this species was not identified through background review.	No This species was not observed during field investigations. No Suitable habitat was not identified.	This species was not observed during field investigations. Suitable habitat for this species was not identified. No further action is required.
Reptiles	Eastern Ribbonsnake <i>Thamnophis sauritus</i>	SC	SC Schedule 1	SC	The Eastern Ribbonsnake is usually found close to water, especially in marshes, where it hunts for frogs and small fish. A good swimmer, it will dive in shallow water, especially if it is fleeing from a potential predator. At the onset of cold weather, these snakes congregate in underground burrows or rock crevices to hibernate together. This species can typically be associated with the following ELC communities: FOC, FOM, FOD, SWC, SWM, SWD, MAM, MAS, OAO, SAS, SAM and SAF containing or near year round standing or flowing water.	The Eastern Ribbon Snake is found from southern Ontario west to Michigan and Wisconsin (isolated pockets), south to Illinois and Ohio, and east to New York State and Nova Scotia, where there is an isolated population. In Ontario, this snake occurs throughout southern and eastern Ontario and is locally common in parts of the Bruce Peninsula, Georgian Bay and eastern Ontario.	NHIC, ORAA, SARO online	Moderate Probability Suitable habitat may be present in the study area if year round standing water is present.	No This species was not observed during field investigations. No Although forest and swamp communities, as well as ponds within the wetland communities may provide suitable habitat, the species was not detected during field investigations.	This species was not observed during coverboard surveys and area searches completed in 2018. Therefore, it is unlikely that this species is present within the study area. No further actions are required.

Taxonomy	Species	ESA Status	SARA Status	COSEWIC Status	Preferred Habitat ^{1, 2}	Known Species Range ^{1, 2}	Source Identifying Species Record	Habitat Identified During Background	Species Observed During Field Investigations	Conclusions/ Recommendations
Reptiles	Milksnake <i>Lampropeltis triangulum</i>	No Status	SC Schedule 1	SC	<p>The Milksnake can be found in a range of habitats including rocky outcrops, fields and forest edges. In southern Ontario, it is often found in old farm fields and farm buildings where there is an abundance of mice. The Milksnake hibernates underground, in rotting logs or in the foundations of old buildings.</p> <p>This species can be associated with the following ELC communities: BL, TA, AL, RB, TP, CUM, FOC, FOM and FOD.</p>	The Milksnake range extends from Quebec and Maine south to Alabama and Georgia, and west to Minnesota and Iowa. In Ontario, it is widespread and locally common in southern Ontario, and can be found as far north as Lake Nipissing and Sault Ste. Marie.	ORAA	<p>Moderate Probability</p> <p>Suitable habitat may be present in the study area.</p>	<p>No</p> <p>This species was not observed during field investigations.</p> <p>No</p> <p>Suitable habitat was not identified.</p>	<p>This species was not observed during field investigations. Suitable habitat for this species was not identified.</p> <p>No further action is required.</p>
Reptiles	Snapping turtle <i>Chelydra serpentina</i>	SC	SC Schedule 1	SC	<p>Snapping Turtles spend most of their lives in water. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid summer, females travel overland in search of a suitable nesting site, usually gravelly or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.</p> <p>This species can typically be associated with the following ELC communities: OAO, SA near gravelly or sandy areas.</p>	The Snapping Turtle's range extends from Ecuador to Canada. In Canada this turtle can be found from Saskatchewan to Nova Scotia. It is primarily limited to the southern part of Ontario. The Snapping Turtle's range is contracting.	ORAA, SARO online	<p>Moderate Probability</p> <p>Wetland communities present in the study area may provide suitable habitat if open water is present.</p>	<p>No</p> <p>This species was not observed during field investigations.</p> <p>Candidate</p> <p>Although wetlands may provide suitable habitat, the species was not detected during field investigations. However, basking surveys were not conducted.</p>	Should development encroach upon candidate habitat, additional surveys may be required.

Appendix **K**

Significant Wildlife Habitat Screening

SWH Ecoregion 7E Criterion Schedule

Table 1.1 Seasonal Concentration Areas of Animals.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
Waterfowl Stopover and Staging Areas (Terrestrial) <u>Rationale:</u> Habitat important to migrating waterfowl.	American Black Duck Northern Pintail Gadwall Blue-winged Teal Green-winged Teal American Wigeon Northern Shoveler Tundra Swan	CUM1 CUT1 - Plus evidence of annual spring flooding from melt water or run-off within these Ecosites. - Fields with waste grain in the Long Point, Rondeau, Lk. St. Clair, Grand Bend and Pt. Pelee areas may be important to Tundra Swans.	<p>Fields with sheet water during Spring (mid- March to May).</p> <ul style="list-style-type: none">Fields flooding during spring melt and run-off provide important invertebrate foraging habitat for migrating waterfowl.Agricultural fields with waste grains are commonly used by waterfowl, these are not considered SWH unless they have spring sheet water available. <p><u>Information Sources</u></p> <ul style="list-style-type: none">Anecdotal information from the landowner, adjacent landowners or local naturalist clubs may be good information in determining occurrence.Reports and other information available from Conservation Authorities (CAs)Sites documented through waterfowl planning processes (eg. EHJV implementation plan)Field Naturalist ClubsDucks Unlimited CanadaNatural Heritage Information Centre (NHIC) Waterfowl Concentration Area	<p>Studies carried out and verified presence of an annual concentration of any listed species, evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi}</p> <ul style="list-style-type: none">Any mixed species aggregations of 100Ⓢor more individuals required.The area of the flooded field ecosite habitat plus a 100-300m radius buffer dependant on local site conditions and adjacent land use is the significant wildlife habitat ^{cxlviii}.Annual use of habitat is documented from information sources or field studies (annual use can be based on studies or determined by past surveys with species numbers and dates).SWHMIST^{cxlix} Index #7 provides development effects and mitigation measures.	<p>Low Probability;</p> <p>Candidate Habitat not present within the study area.</p> <p>The study area is not within close proximity to Long Point, Rondeau, Lk. St. Clair, Grand Bend or Point Pelee and does not contain historical records of aggregations of 100 or more individuals utilizing sheet water on fields.</p>	<p>No;</p> <p>Confirmed habitat was not observed during field investigations.</p>	No further action required.
Waterfowl Stopover and Staging Areas (Aquatic)	Northern Shoveler American Wigeon Gadwall Green-winged Teal	MAS1 MAS2 MAS3 SAS1	<p><u>Information Sources</u></p> <ul style="list-style-type: none">Environment CanadaNaturalist clubs often are aware of staging/stopover areas.	<p>Studies carried out and verified presence of:</p> <ul style="list-style-type: none">Aggregations of 100 Ⓢ or more of listed	<p>No;</p> <p>Candidate Habitat not present within</p>	<p>No;</p> <p>Confirmed habitat was not observed</p>	No further action required.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
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<p><u>Rationale:</u> Important for local and migrant waterfowl populations during the spring or fall migration or both periods combined. Sites identified are usually only one of a few in the eco-district.</p>	Blue-winged Teal Hooded Merganser Common Merganser Lesser Scaup Greater Scaup Long-tailed Duck Surf Scoter White-winged Scoter Black Scoter Ring-necked duck Common Goldeneye Bufflehead Redhead Ruddy Duck Red-breasted Merganser Brant Canvasback Ruddy Duck	SAM1 SAF1 SWD1 SWD2 SWD3 SWD4 SWD5 SWD6 SWD7	<ul style="list-style-type: none"> • OMNRF Wetland Evaluations indicate presence of locally and regionally significant waterfowl staging. • Sites documented through waterfowl planning processes (eg. EHJV implementation plan) • Ducks Unlimited projects • Element occurrence specification by Nature Serve: http://www.natureserve.org • Natural Heritage Information Centre (NHIC) Waterfowl Concentration Area 	<p>species for 7 days[ⓔ], results in > 700 waterfowl use days.</p> <ul style="list-style-type: none"> • Areas with annual staging of ruddy ducks, canvasbacks, and redheads are SWH ^{cxlix} • The combined area of the ELC ecosites and a 100m radius area is the SWH ^{cxlviii} • Wetland area and shorelines associated with sites identified within the SWHTG ^{cxlviii} Appendix K ^{cxlix} are significant wildlife habitat. • Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} • Annual Use of Habitat is Documented from Information Sources or Field Studies (Annual can be based on completed studies or determined from past surveys with species numbers and dates recorded). • SWH MIST^{cxlix} Index #7 provides development effects and mitigation measures. 	<p>the study area.</p> <p>Aquatic habitat within the study area is of insufficient size to support large numbers of waterfowl species.</p>	<p>during field investigations.</p>	
<p>Shorebird Migratory Stopover Area</p> <p><u>Rationale:</u> High quality shorebird stopover habitat is extremely rare and typically has a long history of</p>	Greater Yellowlegs Lesser Yellowlegs Marbled Godwit Hudsonian Godwit Black-bellied Plover American Golden-Plover Semipalmated Plover Solitary Sandpiper Spotted Sandpiper Semipalmated	BBO1 BBO2 BBS1 BBS2 BBT1 BBT2 SDO1 SDS2 SDT1 MAM1 MAM2	<p>Shorelines of lakes, rivers and wetlands, including beach areas, bars and seasonally flooded, muddy and un-vegetated shoreline habitats.</p> <p>Great Lakes coastal shorelines, including groynes and other forms of armour rock lakeshores, are extremely important for migratory shorebirds in May to mid-June</p>	<p>Studies confirming:</p> <ul style="list-style-type: none"> • Presence of 3 or more of listed species and > 1000^Í shorebird use days during spring or fall migration period. (shorebird use days are the accumulated number of shorebirds counted per day over the course of the fall or spring migration period) 	<p>No;</p> <p>Suitable shoreline habitat is not present within the study area.</p>	<p>No;</p> <p>Confirmed habitat was not observed during field investigations.</p>	<p>No further action required.</p>

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
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use.	Sandpiper Pectoral Sandpiper White-rumped Sandpiper Baird’s Sandpiper Least Sandpiper Purple Sandpiper Stilt Sandpiper Short-billed Dowitcher Red-necked Phalarope Whimbrel Ruddy Turnstone Sanderling Dunlin	MAM3 MAM4 MAM5	and early July to October. Sewage treatment ponds and storm water ponds do not qualify as a SWH, <u>Information Sources</u> <ul style="list-style-type: none"> Western hemisphere shorebird reserve network. Canadian Wildlife Service (CWS) Ontario Shorebird Survey. Bird Studies Canada Ontario Nature Local birders and naturalist clubs NHIC Shorebird Migratory Concentration Area 	<ul style="list-style-type: none"> Whimbrel stop briefly (<24hrs) during spring migration, any site with >100^l Whimbrel used for 3 years or more is significant. The area of significant shorebird habitat includes the mapped ELC shoreline ecosites plus a 100m radius area ^{cxlviii} Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} SWH MIST^{cxlix} Index #8 provides development effects and mitigation measures. 			
Raptor Wintering Area Rationale: Sites used by multiple species, a high number of individuals and used annually are most significant	Rough-legged Hawk Red-tailed Hawk Northern Harrier American Kestrel Snowy Owl Special Concern: Short-eared Owl Bald Eagle	Hawks/Owls Combination of ELC Community Series; need to have present one Community Series from each land class; Forest: FOD, FOM, FOC. Upland: CUM; CUT; CUS; CUW. Bald Eagle: Forest community Series: FOD, FOM, FOC, SWD, SWM or SWC on shoreline areas adjacent to large rivers or lakes with open water (hunting areas).	The habitat provides a combination of fields and woodlands that provide roosting, foraging and resting habitats for wintering raptors. Raptor wintering(hawk/owl) sites need to be > 20 ha ^{cxlviii, cxlix} with a combination of forest and upland. ^{xvi, xvii, xviii, xix, xx, xxi} Least disturbed sites, idle/fallow or lightly grazed field/meadow (>15ha) with adjacent woodlands ^{cxlix} Field area of the habitat is to be wind swept with limited snow depth or accumulation. Eagle sites have open water and large trees and snags available for roosting. <u>Information Sources:</u> <ul style="list-style-type: none"> OMNR Ecologist or Biologist Naturalist club Natural Heritage Information Center (NHIC) Raptor Winter Concentration Area Data from Bird Studies Canada, most notably for 	Studies confirm the use of these habitats by: <ul style="list-style-type: none"> One or more Short-eared Owls or; One of more Bald Eagles or; At least 10 individuals and two of listed hawk/owl species [Ⓔ]. To be significant a site must be used regularly (3 in 5 years) ^{cxlix} for a minimum of 20 days by the above number of birds[Ⓔ]. The habitat area for an Eagle winter site is the shoreline forest ecosites directly adjacent to the prime hunting area [Ⓔ]. Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} SWH MIST^{cxlix} Index #10 and #11 provides development effects and mitigation 	No; Candidate Habitat not present within the study area. Qualifying ecosites are present within the study area but are of insufficient size to support raptor wintering (hawks/owls). No shorelines adjacent to large rivers or lakes are present to support Bald Eagles.	No; Confirmed habitat was not observed during field investigations.	No further action required.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
			Short-eared Owls. <ul style="list-style-type: none"> Results of Christmas Bird Counts. Reports and other information available from Conservation Authorities. 	measures.			
Bat Hibernacula Rationale: Bat hibernacula are rare habitats in all Ontario landscapes.	Big Brown Bat Tri-colored Bat	Bat Hibernacula may be found in these ecosites: CCR1 CCR2 CCA1 CCA2 (Note: buildings are not considered to be SWH)	Hibernacula may be found in caves, mine shafts, underground foundations and Karsts. Active mine sites should not be considered as SWH. The locations of bat hibernacula are relatively poorly known. <u>Information Sources</u> <ul style="list-style-type: none"> OMNR for possible locations and contact for local experts Natural Heritage Information Center (NHIC) Bat Hibernaculum Ministry of Northern Development and Mines for location of mine shafts. Clubs that explore caves (eg. Sierra Club) University Biology Departments with bat experts. 	<ul style="list-style-type: none"> All sites with confirmed hibernating bats are SWH [㊟]. The area includes 200m radius around the entrance of the hibernaculum ^{cxlviii, ccvii}, [㊟] for most development types and 1000m for wind farms. Studies are to be conducted during the peak swarming period (Aug. – Sept.). Surveys should be conducted following methods outlined in the “Guideline for Wind Power Projects Potential Impacts to Bats and Bat Habitats”^{ccv}. SWH MIST^{cxlix} Index #1 provides development effects and mitigation measures. 	No; There are no caves, mine shafts, underground foundations or Karsts within the study area.	No; Confirmed habitat was not observed during field investigations.	No further action required.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
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<p>Bat Maternity Colonies</p> <p><u>Rationale:</u> Known locations of forested bat maternity colonies is extremely rare in all Ontario landscapes.</p>	Big Brown Bat Silver-haired Bat	<p>Maternity colonies considered SWH are found in forested Ecosites.</p> <p>All ELC Ecosites in ELC Community Series: FOD FOM SWD SWM</p>	<p>Maternity colonies can be found in tree cavities, vegetation and often in buildings^{xxii, xxv, xxvi, xxvii, xxxi} (buildings are not considered to be SWH). Maternity roosts are not found in caves and mines in Ontario^{xxii}.</p> <ul style="list-style-type: none"> Maternity colonies located in Mature deciduous or mixed forest stands^{ccix, ccx} with >10/ha large diameter (>25cm dbh) wildlife trees^{ccvii} Female Bats prefer wildlife tree (snags) in early stages of decay, class 1-3 ^{ccxiv} or class 1 or 2 ^{ccxii}. Silver-haired Bats prefer older mixed or deciduous forest and form maternity colonies in tree cavities and small hollows. Older forest areas with at least 21 snags/ha are preferred^{ccx} <p><u>Information Sources</u></p> <ul style="list-style-type: none"> OMNR for possible locations and contact for local experts University Biology Departments with bat experts. 	<ul style="list-style-type: none"> Maternity Colonies with confirmed use by; <ul style="list-style-type: none"> >10 Big Brown Bats^l >5 Adult Female Silver-haired Bats^l The area of the habitat includes the entire woodland or the forest stand ELC Ecosite containing the maternity colonies^l. Evaluation methods for maternity colonies should be conducted following methods outlined in the “Bats and Bat Habitats: Guidelines for Wind Power Projects”^{”ccv}. SWH MIST^{cxlix} Index #12 provides development effects and mitigation measures. 	<p>High Probability;</p> <p>Forest communities are present within the study area.</p>	<p>Candidate;</p> <p>A full bat habitat assessment was not completed, however candidate habitat was observed during a cavity tree assessment.</p>	<p>Candidate bat cavity trees were observed within the study area.</p> <p>Should vegetation removal occur that encroaches into the woodlands, additional surveys may be required. The MNRF <i>Species at Risk Bats within Treed Habitats</i> (2017) is the recommended protocol.</p> <p>It is recommended that any vegetation removal be conducted outside of the bat roosting season (April 1st - September 30th).</p>
<p>Turtle Wintering Areas</p> <p><u>Rationale:</u> Generally sites are the only known sites in the area. Sites with the highest number of individuals are most significant.</p>	Midland Painted Turtle <u>Special Concern:</u> Northern Map Turtle Snapping Turtle	<p>Snapping and Midland Painted turtles; ELC Community Classes; SW, MA, OA and SA. ELC Community Series; FEO and BOO</p> <p>Northern Map Turtle - Open Water areas such as deeper rivers or streams and lakes with current</p>	<p>For most turtles, wintering areas are in the same general area as their core habitat. Water has to be deep enough not to freeze and have soft mud substrates.</p> <ul style="list-style-type: none"> Over-wintering sites are permanent water bodies, large wetlands, and bogs or fens with adequate Dissolved Oxygen. ^{cix, cx, cxi, cxviii} Man-made ponds such as sewage lagoons or storm water ponds should not be considered SWH. 	<ul style="list-style-type: none"> Presence of 5 over-wintering Midland Painted Turtles is significant^l. One or more Northern Map Turtle or Snapping Turtle over-wintering within a wetland is significant^l. The mapped ELC ecosite area with the over wintering turtles is the SWH. If the hibernation site is within a stream or river, the deep-water pool where the turtles are over wintering is the SWH. 	<p>High Probability;</p> <p>Open water and wetland communities are present within the study area.</p>	<p>Candidate;</p> <p>Overwintering surveys were not completed, however, turtles were observed within the study area during field investigations.</p>	<p>Should development encroach into candidate habitat, additional surveys may be required.</p>

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
		can also be used as over-wintering habitat.	<u>Information Sources</u> <ul style="list-style-type: none"> EIS studies carried out by Conservation Authorities. Field Naturalist Clubs OMNRF Ecologist or Biologist Natural Heritage Information Center (NHIC) 	<ul style="list-style-type: none"> Over wintering areas may be identified by searching for congregations (Basking Areas) of turtles on warm, sunny days during the fall (Sept. – Oct.) or spring (Mar. – May) ^{cvii}. Congregation of turtles is more common where wintering areas are limited and therefore significant ^{cix, cx, cxi, cxii}. SWH MIST^{cxlix} Index #28 provides development effects and mitigation measures for turtle wintering habitat. 			
Reptile Hibernaculum <u>Rationale:</u> Generally sites are the only known sites in the area. Sites with the highest number of individuals are most significant.	<u>Snakes:</u> Eastern Gartersnake Northern Watersnake Northern Red-bellied Snake Northern Brownsnake Smooth Green Snake Northern Ring-necked Snake <u>Special Concern:</u> Milksnake Eastern Ribbonsnake	For all snakes, habitat may be found in any ecosite other than very wet ones. Talus, Rock Barren, Crevice and Cave, and Alvar sites may be directly related to these habitats. Observations of congregations of snakes on sunny warm days in the spring or fall is a good indicator.	For snakes, hibernation takes place in sites located below frost lines in burrows, rock crevices and other natural or naturalized locations. The existence of features that go below frost line; such as rock piles or slopes, old stone fences, and abandoned crumbling foundations assist in identifying candidate SWH. Areas of broken and fissured rock are particularly valuable since they provide access to subterranean sites below the frost line ^{xliv, l, li, lii, cxii} . Wetlands can also be important over-wintering habitat in conifer or shrub swamps and swales, poor fens, or depressions in bedrock terrain with sparse trees or shrubs with sphagnum moss or sedge hummock ground cover. <u>Information Sources</u> <ul style="list-style-type: none"> In spring, local residents or landowners may have observed the emergence of snakes on their property (e.g. old dug wells). Reports and other 	Studies confirming: <ul style="list-style-type: none"> Presence of snake hibernacula used by a minimum of five individuals of a snake sp. <u>or</u>; individuals of two or more snake spp. Congregations of a minimum of five individuals of a snake sp. <u>or</u>; individuals of two or more snake spp. near potential hibernacula (eg. foundation or rocky slope) on sunny warm days in Spring (Apr/May) and Fall (Sept/Oct)ⁱ. <u>Note:</u> If there are Special Concern Species present, then site is SWH <u>Note:</u> Sites for hibernation possess specific habitat parameters (e.g. temperature, humidity, etc.) and consequently are used annually, often by many of the same individuals of a local population [i.e. strong hibernation site fidelity.]. Other critical life processes (e.g. mating) often take place 	Moderate Probability; Suitable habitat features may be present in the study area. There is potential for burrows, rock crevices, rock piles, stone fences or crumbling foundations to be found in association with the study area.	No; Confirmed habitat was not observed during field investigations. A pile of concrete rubble was observed during field investigations. However, thresholds for numbers of species and/or individual snakes were not observed during field investigations.	No further action required.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
			information available from Conservation Authorities. <ul style="list-style-type: none"> Field Naturalist Clubs University herpetologists. Natural Heritage Information Center (NHIC) 	in close proximity to hibernacula. The feature in which the hibernacula is located plus a 30 m buffer is the SWH [®] <ul style="list-style-type: none"> SWH MIST^{cxlix} Index #13 provides development effects and mitigation measures for snake hibernacula. 			
Colonially - Nesting Bird Breeding Habitat (Bank and Cliff) Rationale: Historical use and number of nests in a colony make this habitat significant. An identified colony can be very important to local populations. All swallow population are declining in Ontario.	Cliff Swallow Northern Rough-winged Swallow (this species is not colonial but can be found in Cliff Swallow colonies).	Eroding banks, sandy hills, borrow pits, steep slopes, and sand piles, cliff faces, bridge abutments, silos, barns (Cliff Swallows). Habitat found in the following ecosites: CUM1 CUT1 CUS1 BLO1 BLS1 BLT1 CLO1 CLS1 CLT1	<ul style="list-style-type: none"> Any site or areas with exposed soil banks, undisturbed or naturally eroding that is not a licensed/permitted aggregate area. Does not include man-made structures (bridges or buildings) or recently (2 years) disturbed soil areas, such as berms, embankments, soil or aggregate stockpiles. Does not include a licensed/permitted Mineral Aggregate Operation. <u>Information Sources</u> <ul style="list-style-type: none"> Reports and other information available from Conservation Authorities Ontario Breeding Bird Atlas^{ccv} Bird Studies Canada; <i>NatureCounts</i> http://www.birdscanada.org/birdmon/ Field Naturalist Clubs. 	Studies confirming: <ul style="list-style-type: none"> Presence of 1 or more nesting sites with 8^{cxlvix} or more cliff swallow pairs and/or rough-winged swallow pairs during the breeding season. A colony identified as SWH will include a 50m radius habitat area from the peripheral nests^{ccvii} Field surveys to observe and count swallow nests are to be completed during the breeding season (May-June). Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} SWH MIST^{cxlix} Index #4 provides development effects and mitigation measures 	No; Although habitat may be present in the study area, it is likely to be man made and/or disturbed or recently disturbed and therefore does not qualify.	No; Confirmed habitat was not observed during field investigations. The study area does not contain suitable ecosites.	No further action required.
Colonially - Nesting Bird Breeding Habitat (Tree/Shrubs)	Great Blue Heron Black-crowned Night-Heron Great Egret Green Heron	SWM2 SWM3 SWM5 SWM6 SWD1 SWD2 SWD3 SWD4 SWD5 SWD6 SWD7 FET1	<ul style="list-style-type: none"> Nests in live or dead standing trees in wetlands, lakes, islands, and peninsulas. Shrubs and occasionally emergent vegetation may also be used. 	Studies confirming: <ul style="list-style-type: none"> Presence of 2[®] or more active nests of Great Blue Heron or other listed species.. 	High Probability; Suitable ecosites were identified within the study area.	No; No colony sites were observed during field investigations.	No further action required.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
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<p><u>Rationale:</u> Large colonies are important to local bird population, typically sites are only known colony in area and are used annually.</p>			<ul style="list-style-type: none"> Most nests in trees are 11 to 15 m from ground, near the top of the tree. <p><u>Information Sources</u></p> <ul style="list-style-type: none"> Ontario Breeding Bird Atlas ^{ccv}, colonial nest records. Ontario Heronry Inventory 1991 available from Bird Studies Canada or NHIC (OMNRF). Natural Heritage Information Center (NHIC) Mixed Wader Nesting Colony Aerial photographs can help identify large heronries. Reports and other information available from Conservation Authorities MNRF District Offices. Local naturalist clubs. 	<ul style="list-style-type: none"> The habitat extends from the edge of the colony and a minimum 300 m radius or extend of the Forest Ecosite containing the colony or any island <15.0ha with a colony is the SWH ^{cc, ccvii} Confirmation of active heronries are to be achieved through site visits conducted during the nesting season (April to August) or by evidence such as the presence of fresh guano, dead young and/or eggshells SWH MIST^{cxlix} Index #5 provides development effects and mitigation measures. 			
<p>Colonially - Nesting Bird Breeding Habitat (Ground)</p> <p><u>Rationale:</u> Colonies are important to local bird population, typically sites are only known colony in area and are used annually.</p>	<p>Herring Gull Great Black-backed Gull Little Gull Ring-billed Gull Common Tern Caspian Tern Brewer's Blackbird</p>	<p>Any rocky island or peninsula (natural or artificial) within a lake or large river (two-lined on a 1;50,000 NTS map).</p> <p>Close proximity to watercourses in open fields or pastures with scattered trees or shrubs (Brewer's Blackbird)</p> <p>MAM1 – 6; MAS1 – 3; CUM CUT CUS</p>	<ul style="list-style-type: none"> Nesting colonies of gulls and terns are on islands or peninsulas associated with open water or in marshy areas. Brewers Blackbird colonies are found loosely on the ground in or in low bushes in close proximity to streams and irrigation ditches within farmlands. <p><u>Information Sources</u></p> <ul style="list-style-type: none"> Ontario Breeding Bird Atlas ^{ccv}, rare/colonial species records. Canadian Wildlife Service Reports and other information available from Conservation Authorities Natural Heritage Information Center (NHIC) Colonial Waterbird Nesting Area 	<p>Studies confirming:</p> <ul style="list-style-type: none"> Presence of > 25 active nests for Herring Gulls or Ring-billed Gulls, >5 active nests for Common Tern or >2 active nests for Caspian Tern[®]. Presence of 5 or more pairs for Brewer's Blackbird[®] Any active nesting colony of one or more Little Gull, and Great Black-backed Gull is significant[®]. The edge of the colony and a minimum 150m radius area of habitat, or the extent of the ELC ecosites containing the colony or any island <3.0ha with a colony is the SWH ^{cc, ccvii} Studies would be done 	<p>Low Probability;</p> <p>Candidate Habitat not present within the study area.</p> <p>No rocky islands or peninsulas associated with a large lake or river are present within the study area.</p> <p>Suitable habitat may be present for Brewer's Blackbird</p>	<p>No;</p> <p>Confirmed habitat was not observed during field investigations.</p> <p>During breeding bird surveys target species were not observed.</p>	<p>No further action required.</p>

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
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			<ul style="list-style-type: none"> MNRF District Offices. Field Naturalist Clubs. 	during May/June when actively nesting. Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects” ^{ccxi} <ul style="list-style-type: none"> SWH MIST^{cxlix} Index #6 provides development effects and mitigation measures. 			
Migratory Butterfly Stopover Areas Rationale: Butterfly stopover areas are extremely rare habitats and are biologically important for butterfly species that migrate south for the winter.	Painted Lady Red Admiral <u>Special Concern</u> Monarch	Combination of ELC Community Series; need to have present one Community Series from each landclass: <u>Field:</u> CUM CUT CUS <u>Forest:</u> FOC FOD FOM CUP Anecdotally, a candidate site for butterfly stopover will have a history of butterflies being observed.	A butterfly stopover area will be a minimum of 10 ha in size with a combination of field and forest habitat present, and will be located within 5 km of Lake Erie and Ontario cxlix. <ul style="list-style-type: none"> The habitat is typically a combination of field and forest, and provides the butterflies with a location to rest prior to their long migration south xxxii, xxxiii, xxxiv, xxxv, xxxvi. The habitat should not be disturbed, fields/meadows with an abundance of preferred nectar plants and woodland edge providing shelter are requirements for this habitat ^{cxlviii, cxlix}. Stopover areas usually provide protection from the elements and are often spits of land or areas with the shortest distance to cross the Great Lakes xxxvii, xxxviii, xxxix, xl, xli. <u>Information Sources</u> <ul style="list-style-type: none"> MNRF district Offices Natural Heritage Information Center (NHIC) Agriculture Canada in Ottawa may have list of butterfly experts. Field Naturalist Clubs Toronto Entomologists 	Studies confirm: <ul style="list-style-type: none"> The presence of Monarch Use Days (MUD) during fall migration (Aug/Oct)xliii. MUD is based on the number of days a site is used by Monarchs, multiplied by the number of individuals using the site. Numbers of butterflies can range from 100-500/dayxxxvii, significant variation can occur between years and multiple years of sampling should occur xl, xlii. Observational studies are to be completed and need to be done frequently during the migration period to estimate MUD MUD of >5000 or >3000 with the presence of Painted Ladies or Red Admiral’s is to be considered significant.® SWH MIST ^{cxlix} Index #16 provides development effects and mitigation measures.	No; The study area is more than 5km away from Lake Ontario and Lake Erie.	No; Candidate habitat was not identified.	No further action required.

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		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
			Association <ul style="list-style-type: none"> Conservation Authorities 				
Landbird Migratory Stopover Areas Rationale: Sites with a high diversity of species as well as high numbers are most significant.	All migratory songbirds. Canadian Wildlife Service Ontario website: http://www.ec.gc.ca/nature/default.asp?lang=En&n=421B7A9D-1 All migrant raptors species: Ontario Ministry of Natural Resources: Fish and Wildlife Conservation Act, 1997. Schedule 7: Specially Protected Birds (Raptors)	All Ecosites associated with these ELC Community Series; FOC FOM FOD SWC SWM SWD	Woodlots need to be >5 ha [Ⓔ] in size and within 5 km iv, v, vi, vii, viii, ix, x, xi, xii, xiii, xiv, xv of Lake Ontario and Erie. If woodlands are rare in an area of shoreline, woodland fragments 2-5ha can be considered for this habitat. [Ⓔ] <ul style="list-style-type: none"> If multiple woodlands are located along the shoreline those Woodlands <2km from Lake Erie and Lake Ontario are more significant ^{cxlix}. Sites have a variety of habitats; forest, grassland and wetland complexes ^{cxlix}. The largest sites are more significant ^{cxlix} Woodlots and forest fragments are important habitats to migrating birds^{ccxviii}, these features located along the shore and located within 5km of Lake Erie and Lake Ontario are Candidate SWH ^{cxlviii}. <u>Information Sources</u> <ul style="list-style-type: none"> Bird Studies Canada Ontario Nature Local birders and naturalist club Ontario Important Bird Areas (IBA) Program 	Studies confirm: <ul style="list-style-type: none"> Use of the woodlot by >200 birds/day and with >35 spp with at least 10 bird spp. recorded on at least 5 different survey dates[Ⓔ]. This abundance and diversity of migrant bird species is considered above average and significant. Studies should be completed during spring (March to May) and fall (Aug to Oct) migration using standardized assessment techniques. Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} SWH MIST ^{cxlix} Index #9 provides development effects and mitigation measures. 	No; The study area is more than 5km away from Lake Ontario and Lake Erie.	No; Candidate habitat was not identified.	No further action required.
Deer Winter Congregation Areas Rationale: Deer movement	White-tailed Deer	All Forested Ecosites with these ELC Community Series; FOC	<ul style="list-style-type: none"> Woodlots >100 ha in size or if large woodlots are rare in a planning area woodlots>50ha [Ⓔ]. Deer movement during 	Studies confirm: <ul style="list-style-type: none"> Deer management is an MNRF responsibility, deer winter congregation areas considered significant will be mapped by MNRF ^{cxlviii}. 	Low Probability; Forested ecosites present within the study area are likely not large	No; Candidate habitat was not identified.	No further action required.

Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Found Within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
during winter in the southern areas of Ecoregion 7E are not constrained by snow depth, however deer will annually congregate in large numbers in suitable woodlands to reduce or avoid the impacts of winter conditions ^{cxlviii} .		FOM FOD SWC SWM SWD Conifer plantations much smaller than 50 ha may also be used.	winter in the southern areas Ecoregion 7E are not constrained by snow depth, however deer will annually congregate in large numbers in suitable woodlands ^{cxlviii} . <ul style="list-style-type: none"> Large woodlots > 100ha and up to 1500 ha are known to be used annually by densities of deer that range from 0.1-1.5 deer/ha ^{ccxxiv}. Woodlots with high densities of deer due to artificial feeding are not significant[©]. <u>Information Sources</u> <ul style="list-style-type: none"> MNRF District Offices. LIO/NRVIS 	<ul style="list-style-type: none"> Use of the woodlot by white-tailed deer will be determined by MNRF, all woodlots exceeding the area criteria are significant, unless determined not to be significant by MNRF[©] Studies should be completed during winter (Jan/Feb) when >20cm of snow is on the ground using aerial survey techniques^{ccxxiv}, ground or road surveys, or a pellet count deer density survey^{ccxxv}. SWH MIST ^{cxlix} Index #2 provides development effects and mitigation measures. 	enough to support significant numbers of deer.		

Table 1.2.1 Rare Vegetation Communities.

Rare Vegetation Community	CANDIDATE SWH			CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/Recommendations
	ELC Ecosite Code	Habitat Description	Detailed Information and Sources	Defining Criteria			
Cliffs and Talus Slopes Rationale: Cliffs and Talus Slopes are extremely rare habitats in Ontario.	Any ELC Ecosite within Community Series: TAO CLO TAS CLS TAT CLT	A Cliff is vertical to near vertical bedrock >3m in height. A Talus Slope is rock rubble at the base of a cliff made up of coarse rocky debris	Most cliff and talus slopes occur along the Niagara Escarpment. <u>Information Sources</u> <ul style="list-style-type: none">The Niagara Escarpment Commission has detailed information on location of these habitats.OMNRF DistrictsNatural Heritage Information Center (NHIC) has location information available their websiteField Naturalist ClubsConservation Authorities	<ul style="list-style-type: none">Confirm any ELC Vegetation Type for Cliffs or Talus Slopes lxxviiiSWH MIST^{cxlix} Index #21 provides development effects and mitigation measures.	No; No cliff or talus communities were identified within the study area.	No; Candidate habitat was not identified.	No further action required.
Sand Barren Rationale: Sand barrens are rare in Ontario and support rare species. Most Sand Barrens have been lost due to cottage development and forestry	ELC Ecosites: SBO1 SBS1 SBT1 Vegetation cover varies from patchy and barren to continuous meadow (SBO1), thicket-like (SBS1), or more closed and treed (SBT1). Tree cover always ≤ 60%.	Sand Barrens typically are exposed sand, generally sparsely vegetated and caused by lack of moisture, periodic fires and erosion. Usually located within other types of natural habitat such as forest or savannah. Vegetation can vary from patchy and barren to tree covered but less than 60%.	A sand barren area >0.5ha in size [Ⓔ] . <u>Information Sources</u> <ul style="list-style-type: none">OMNRF Destricts.Natural Heritage Information Center (NHIC) has location information available on their websiteField Naturalist ClubsConservation Authorities	<ul style="list-style-type: none">Confirm any ELC Vegetation Type for Sand Barrens lxxviiiSite must not be dominated by exotic or introduced species (<50% vegetative cover exotics) [Ⓔ].SWHMIST^{cxlix} Index #20 provides development effects and mitigation measures.	No; No sand barren communities were identified within the study area.	No; Candidate habitat was not identified.	No further action required.
Alvar Rationale: Alvars are extremely rare habitats in Ecoregion 7E.	ALO1 ALS1 ALT1 FOC1 FOC2 CUM2 CUS2 CUT2-1 CUW2 Five Alvar	An alvar is typically a level, mostly unfractured calcareous bedrock feature with a mosaic of rock pavements and bedrock overlain by a thin veneer of soil. The hydrology of alvars is complex, with alternating	An Alvar site > 0.5 ha in size ^{lxxv} . Alvar is particularly rare in Ecoregion 7E where the only known sites are found in the western islands of Lake Erie. ^{cxix} <u>Information Sources</u> <ul style="list-style-type: none">Alvars of Ontario (2000), Federation of Ontario Naturalists ^{lxxvi}.	Field studies identify four of the five [Ⓔ] Alvar Indicator Species ^{lxxv} at a Candidate Alvar site is Significant. <ul style="list-style-type: none">Site must not be dominated by exotic or introduced species (<50% vegetative cover exotics).The alvar must be in excellent condition and fit in with surrounding landscape with few conflicting land	No; No alvar communities were identified within the study area.	No; Candidate habitat was not identified.	No further action required.

Rare Vegetation Community	CANDIDATE SWH			CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/Recommendations
	ELC Ecosite Code	Habitat Description	Detailed Information and Sources	Defining Criteria			
	<p>Indicator Species:</p> <p>1)<i>Carex crawei</i> 2)<i>Panicum philadelphicum</i> 3)<i>Elocharis compressa</i> 4)<i>Scutellaria parvula</i> 5)<i>Trichostema brachiatum</i></p> <p>These indicator species are very specific to Alvars within Ecoregion 7E®.</p>	<p>periods of inundation and drought. Vegetation cover varies from sparse lichen-moss associations to grasslands and shrublands and comprising a number of characteristic or indicator plant. Undisturbed alvars can be phyto- and zoogeographically diverse, supporting many uncommon or are relict plant and animals species. Vegetation cover varies from patchy to barren with a less than 60% tree cover ^{lxxviii}.</p>	<ul style="list-style-type: none"> Ontario Nature – Conserving Great Lakes Alvars^{ccviii}. Natural Heritage Information Center (NHIC) has location information available on their website OMNRF Staff. Field Naturalist Clubs. Conservation Authorities. 	<p>uses ^{lxxv}.</p> <ul style="list-style-type: none"> SWH MIST^{cxlix} Index #17 provides development effects and mitigation measures. 			
<p>Old Growth Forest</p> <p>Rationale: Due to historic logging practices and land clearance for agriculture, old growth forest is rare in Ecoregion 7E.</p>	<p>Forest Community Series: FOD FOC FOM SWD SWC SWM</p>	<p>Old-growth forests are characterized by heavy mortality or turnover of over-storey trees resulting in mosaic of gaps that encourage development of multi-layered canopy and an abundance of snags and downed woody debris.</p>	<ul style="list-style-type: none"> Woodland area is >0.5 ha®. <p><u>Information Sources</u></p> <ul style="list-style-type: none"> OMNRF Forest Resource Inventory mapping OMNRF Districts. Field Naturalist Clubs Conservation Authorities Sustainable Forestry Licence (SFL) companies will possibly know locations through field operations. Municipal forestry departments 	<p>Field Studies will determine:</p> <ul style="list-style-type: none"> If dominant trees species of the ecosite are >140 years old, then area containing these trees is Significant Wildlife Habitat ^{cxlviii}. The forested area containing the old growth characteristics will have experienced no recognizable forestry activities (cut steps will not be present) The area of forest ecosites combined or an eco-element within an ecosite that contain the old growth characteristics is the SWH. Determine ELC vegetation types for the forest area containing the old growth characteristics^{lxxviii}. SWH MIST^{cxlix} Index #23 provides development effects and mitigation measures. 	<p>Moderate Probability;</p> <p>Forested ecosites are present within the study area.</p>	<p>No;</p> <p>Candidate habitat was not identified as the age of trees observed does meet the criteria for old-growth forest.</p>	<p>No further action required.</p>
<p>Savannah</p> <p>Rationale: Savannahs are extremely</p>	<p>TPS1 TPS2 TPW1 TPW2</p>	<p>A Savannah is a tallgrass prairie habitat that has tree cover between 25 –</p>	<p>No minimum size to site ® Site must be restored or a natural site. Remnant sites such as railway right of ways</p>	<p>Field studies confirm one or more of the Savannah indicator species listed in ^{lxxv} Appendix N should be present ®. Note: Savannah plant spp. list from Ecoregion</p>	<p>No;</p> <p>No savannah communities were</p>	<p>No;</p> <p>Candidate habitat was not identified.</p>	<p>No further action required.</p>

Rare Vegetation Community	CANDIDATE SWH			CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/Recommendations
	ELC Ecosite Code	Habitat Description	Detailed Information and Sources	Defining Criteria			
rare habitats in Ontario.	CUS2	60%. In ecoregion 7E, known Tallgrass Prairie and savannah remnants are scattered between Lake Huron and Lake Erie, near Lake St. Clair, north of and along the Lake Erie shoreline, in Brantford and in the Toronto area (north of Lake Ontario).	are not considered to be SWH. <u>Information Sources</u> <ul style="list-style-type: none"> Natural Heritage Information Center (NHIC) has location data available on their website. OMNRF Districts. Field Naturalists Clubs. Conservation Authorities. 	7E should be used <ul style="list-style-type: none"> Area of the ELC Ecosite is the SWH. Site must not be dominated by exotic or introduced species (<50% vegetative cover exotics). SWH MIST^{cxlix} Index #18 provides development effects and mitigation measures. 	identified within the study area.		
Tallgrass Prairie <u>Rationale:</u> Tallgrass Prairies are extremely rare habitats in Ontario.	TPO1 TPO2	A Tallgrass Prairie has ground cover dominated by prairie grasses. An open Tallgrass Prairie habitat has < 25% tree cover. In ecoregion 7E, known Tallgrass Prairie and savannah remnants are scattered between Lake Huron and Lake Erie, near Lake St. Clair, north of and along the Lake Erie shoreline, in Brantford and in the Toronto area (north of Lake Ontario). ^{cc}	No minimum size to site ⑥. Site must be restored or a natural site. Remnant sites such as railway right of ways are not considered to be SWH. <u>Information Sources</u> <ul style="list-style-type: none"> OMNRF Districts. Natural Heritage Information Center (NHIC) has location data available on their website. Field Naturalists Clubs. Conservation Authorities 	Field studies confirm one or more of the Prairie indicator species listed in ^{lxxv} Appendix N should be present ⑥. Note: Prairie plant spp. list from Ecoregion 7E should be used <ul style="list-style-type: none"> Area of the ELC Ecosite is the SWH Site must not be dominated by exotic or introduced species (<50% vegetative cover exotics). SWH MIST^{cxlix} Index #19 provides development effects and mitigation measures. 	No; No tallgrass prairie communities were identified within the study area.	No; Candidate habitat was not identified.	No further action required.
Other Rare Vegetation Communities <u>Rationale:</u> Plant communities that often contain rare species which depend on the habitat for survival.	Provincially Rare S1, S2 and S3 vegetation communities are listed in Appendix M of the SWHTG ^{cxlviii} . Any ELC Ecosite Code that has a possible ELC Vegetation Type that is Provincially	Rare Vegetation Communities may include beaches, fens, forest, marsh, barrens, dunes and swamps.	ELC Ecosite codes that have the potential to be a rare ELC Vegetation Type as outlined in appendix M ^{cxlviii} The OMNRF/NHIC will have up to date listing for rare vegetation communities. <u>Information Sources</u> <ul style="list-style-type: none"> OMNRF Districts. 	Field studies should confirm if an ELC Vegetation Type is a rare vegetation community based on listing within Appendix M of SWHTG ^{cxlviii} . <ul style="list-style-type: none"> Area of the ELC Vegetation Type polygon is the SWH. SWH MIST ^{cxlix} Index #37 provides development effects and mitigation measures. 	No; No rare vegetation communities were identified within the study area.	No; Candidate habitat was not identified.	No further action required.

Rare Vegetation Community	CANDIDATE SWH			CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/Recommendations
	ELC Ecosite Code	Habitat Description	Detailed Information and Sources	Defining Criteria			
	Rare is Candidate SWH.		<ul style="list-style-type: none">• Natural Heritage Information Center (NHIC) has location data available on their website.• Field Naturalists Clubs.• Conservation Authorities•				

Table 1.2.2 Specialized Habitats of Wildlife considered SWH.

Specialized Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
Waterfowl Nesting Area <u>Rationale:</u> Important to local waterfowl populations, sites with greatest number of species and highest number of individuals are significant.	American Black Duck Northern Pintail Northern Shoveler Gadwall Blue-winged Teal Green-winged Teal Wood Duck Hooded Merganser Mallard	All upland habitats located adjacent to these wetland ELC Ecosites are Candidate SWH: MAS1 MAS2 MAS3 SAS1 SAM1 SAF1 MAM1 MAM2 MAM3 MAM4 MAM5 MAM6 SWT1 SWT2 SWD1 SWD2 SWD3 SWD4 Note: includes adjacency to Provincially Significant Wetlands	A waterfowl nesting area extends 120 m ^{cxlix} from a wetland (> 0.5 ha) or a wetland (>0.5 ha) with small wetlands (<0.5ha) within 120m or a cluster of 3 or more small (<0.5 ha) wetlands within 120 m of each individual wetland where waterfowl nesting is known to occur ^{cxlix} . <ul style="list-style-type: none">Upland areas should be at least 120m wide so that predators such as racoons, skunks, and foxes have difficulty finding nests.Wood Ducks and Hooded Mergansers utilize large diameter trees (>40cm dbh) in woodlands for cavity nest sites. <u>Information Sources</u> <ul style="list-style-type: none">Ducks Unlimited staff may know the locations of particularly productive nesting sites.OMNRF Wetland Evaluations for indication of significant waterfowl nesting habitat.Reports and other information available from Conservation Authorities	Studies confirmed: <ul style="list-style-type: none">Presence of 3 or more nesting pairs for listed species excluding Mallards[®] , or;Presence of 10 or more nesting pairs for listed species including Mallards[®]Any active nesting site of an American Black Duck is considered significant.Nesting studies should be completed during the spring breeding season (April - June). Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi}A field study confirming waterfowl nesting habitat will determine the boundary of the waterfowl nesting habitat for the SWH, this may be greater or less than 120 m ^{cxlviii} from the wetland and will provide enough habitat for waterfowl to successfully nest.SWH MIST^{cxlix} Index #25 provides development effects and mitigation measures.	Moderate Probability; Wetland communities adjacent to upland habitat were identified within the study area.	No; Although both open and wooded upland communities adjacent to wetlands meet width thresholds, species and abundance thresholds were not observed during field investigations.	No further action required.
Bald Eagle and Osprey Nesting, Foraging and Perching Habitat <u>Rationale:</u> Nest sites are fairly uncommon in Ecoregion 7E and are used	Osprey Special Concern Bald Eagle	ELC Forest Community Series: FOD, FOM, FOC, SWD, SWM and SWC directly adjacent to riparian areas – rivers, lakes, ponds and wetlands	Nests are associated with lakes, ponds, rivers or wetlands along forested shorelines, islands, or on structures over water. <ul style="list-style-type: none">Osprey nests are usually at the top a tree whereas Bald Eagle nests are typically in super canopy trees in a notch within the tree’s canopy.Nests located on man-made objects are not to be included as SWH (e.g. telephone poles and constructed nesting platforms).	Studies confirm the use of these nests by: <ul style="list-style-type: none">One or more active Osprey or Bald Eagle nests in an area^{cxlviii} .Some species have more than one nest in a given area and priority is given to the primary nest with alternate nests included within the area of the SWH.For an Osprey, the active	Moderate Probability; Qualifying vegetation communities adjacent to ponds and wetlands are present within the study area.	No; No nest sites were observed and target species were not identified during breeding bird surveys.	No further action required.

Specialized Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
<p>annually by these species. Many suitable nesting locations may be lost due to increasing shoreline development pressures and scarcity of habitat.</p>			<p><u>Information Sources</u></p> <ul style="list-style-type: none"> Natural Heritage Information Center (NHIC) compiles all known nesting sites for Bald Eagles in Ontario. MNRF values information (LIO/NRVIS) will list known nesting locations, Note: data from NRVIS is provided as a point and does not represent all the habitat. Nature Counts, Ontario Nest Records Scheme data. OMNRF Districts. Check the Ontario Breeding Bird Atlas ^{ccv} or Rare Breeding Birds in Ontario for species documented Reports and other information available from Conservation Authorities Field naturalist Clubs 	<p>nest and a 300 m radius around the nest or the contiguous woodland stand is the SWH ^{ccvii}, maintaining undisturbed shorelines with large trees within this area is important^{*cxlviii}.</p> <ul style="list-style-type: none"> For a Bald Eagle the active nest and a 400-800 m radius around the nest is the SWH. ^{cvi, ccvii} Area of the habitat from 400-800m is dependant on site lines from the nest to the development and inclusion of perching and foraging habitat ^{cvi} To be significant a site must be used annually. When found inactive, the site must be known to be inactive for $\geq$ 3 years or suspected of not being used for >5 years before being considered not significant. ^{ccvii} Observational studies to determine nest site use, perching sites and foraging areas need to be done from mid March to mid August. Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} SWH MIST^{cxlix} Index #26 provides development effects and mitigation measures 			
<p>Woodland Raptor Nesting Habitat</p> <p>Rationale: Nests sites for these species are rarely identified; these area sensitive habitats are often used annually by</p>	<p>Northern Goshawk Cooper’s Hawk Sharp-shinned Hawk Red-shouldered Hawk Barred Owl Broad-winged Hawk</p>	<p>May be found in all forested ELC Ecosites.</p> <p>May also be found in SWC, SWM, SWD and CUP3</p>	<p>All natural or conifer plantation woodland/forest stands combined >30ha or with >4 ha of interior habitat ^{lxxxviii, lxxxix, xc, xci, xciii, xciv, xcv,xcvi, cxxxiii}. Interior habitat determined with a 200m buffer^{cxlviii}</p> <ul style="list-style-type: none"> Stick nests found in a variety of intermediate-aged to mature conifer, deciduous or mixed forests within tops or crotches of trees. Species such as Coopers hawk nest along forest edges sometimes on peninsulas or small off-shore 	<p>Studies confirm:</p> <ul style="list-style-type: none"> Presence of 1 or more active nests from species list is considered significant^{*cxlviii}. Red-shouldered Hawk and Northern Goshawk – A 400m radius around the nest or 28 ha habitat area would be applied where optimal habitat is irregularly shaped around the nest) ^{ccvii}. Barred Owl – A 200m radius around the nest is the SWH 	<p>No;</p> <p>Forest communities identified within the study area are not large enough to meet the size requirement for significance.</p>	<p>No;</p> <p>Candidate habitat was not identified.</p>	<p>No further action required.</p>

Specialized Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
these species.			<p>islands.</p> <ul style="list-style-type: none"> In disturbed sites, nests may be used again, or a new nest will be in close proximity to old nest. <p><u>Information Sources</u></p> <ul style="list-style-type: none"> OMNRF Districts. Check the Ontario Breeding Bird Atlas ^{ccv} or Rare Breeding Birds in Ontario for species documented. Check data from Bird Studies Canada. Reports and other information available from Conservation Authorities 	<p>^{ccvii}.</p> <ul style="list-style-type: none"> Broad-winged Hawk and Coopers Hawk,— A 100m radius around the nest is the SWH^{ccvii}. Sharp-Shinned Hawk – A 50m radius around the nest is the SWH^{ccvii}. Conduct field investigations from mid-March to end of May. The use of call broadcasts can help in locating territorial (courting/nesting) raptors and facilitate the discovery of nests by narrowing down the search area. SWH MIST^{cxlix} Index #27 provides development effects and mitigation measures. 			
<p>Turtle Nesting Areas</p> <p><u>Rationale:</u> These habitats are rare and when identified will often be the only breeding site for local populations of turtles.</p>	<p>Midland Painted Turtle</p> <p><u>Special Concern Species</u> Northern Map Turtle Snapping Turtle</p>	<p>Exposed mineral soil (sand or gravel) areas adjacent (<100m) ^{cxlviii} or within the following ELC Ecosites:</p> <p>MAS1 MAS2 MAS3 SAS1 SAM1 SAF1 BOO1 FEO1</p>	<ul style="list-style-type: none"> Best nesting habitat for turtles are close to water and away from roads and sites less prone to loss of eggs by predation from skunks, raccoons or other animals. For an area to function as a turtle-nesting area, it must provide sand and gravel that turtles are able to dig in and are located in open, sunny areas. Nesting areas on the sides of municipal or provincial road embankments and shoulders are not SWH. Sand and gravel beaches adjacent to undisturbed shallow weedy areas of marshes, lakes, and rivers are most frequently used. <p><u>Information Sources</u></p> <ul style="list-style-type: none"> Use Ontario Soil Survey reports and maps to help find suitable substrate for nesting turtles (well-drained sands and fine gravels). Check the Ontario Herpetofaunal Atlas records (or other similar atlases) for uncommon turtles; location information may help to find 	<p>Studies confirm:</p> <ul style="list-style-type: none"> Presence of 5 or more nesting Midland Painted Turtles® One or more Northern Map Turtle or Snapping Turtle nesting is a SWH®. The area or collection of sites within an area of exposed mineral soils where the turtles nest, plus a radius of 30-100m around the nesting area dependant on slope, riparian vegetation and adjacent land use is the SWH. ^{cxlviii} Travel routes from wetland to nesting area are to be considered within the SWH as a part of the 30-100m area of habitat. ^{cxlix} Field investigations should be conducted in prime nesting season typically late spring to early summer. Observational studies observing the turtles nesting 	<p>Moderate Probability;</p> <p>Suitable ecosites are present within the study area. Exposed mineral soil is present <100m from suitable ecosites.</p>	<p>No;</p> <p>Confirmed habitat was not identified. Although turtles were observed within the study area, no nesting was observed.</p>	No further action required.

Specialized Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
			<p>potential nesting habitat for them.</p> <ul style="list-style-type: none"> Natural Heritage Information Center (NHIC) Field Naturalist Clubs 	<p>is a recommended method.</p> <ul style="list-style-type: none"> SWH MIST ^{cxlix} Index #28 provides development effects and mitigation measures for turtle nesting habitat. 			
<p>Seeps and Springs</p> <p>Rationale: Seeps/Springs are typical of headwater areas and are often at the source of coldwater streams.</p>	Wild Turkey Ruffed Grouse Spruce Grouse White-tailed Deer Salamander spp.	Seeps/Springs are areas where ground water comes to the surface. Often they are found within headwater areas within forested habitats. Any forested Ecosite within the headwater areas of a stream could have seeps/springs.	<p>Any forested area (with <25% meadow/field/pasture) within the headwaters of a stream or river system ^{cxvii, cxlix}.</p> <ul style="list-style-type: none"> Seeps and springs are important feeding and drinking areas especially in the winter will typically support a variety of plant and animal species ^{cxix, cxx, cxxi, cxxii, cxlii, cxiv}. <p><u>Information Sources</u></p> <ul style="list-style-type: none"> Topographical Map. Thermography. Hydrological surveys conducted by Conservation Authorities and MOE. Field Naturalists Clubs and landowners. Municipalities and Conservation Authorities may have drainage maps and headwater areas mapped. 	<p>Field Studies confirm:</p> <ul style="list-style-type: none"> Presence of a site with 2 or more[®] seeps/springs should be considered SWH. The area of a ELC forest ecosite or ecoelement within ecosite containing the seeps/springs is the SWH. The protection of the recharge area considering the slope, vegetation, height of trees and groundwater condition need to be considered in delineation the habitat ^{cxlviii}. SWH MIST ^{cxlix} Index #30 provides development effects and mitigation measures 	Moderate Probability; Forested ecosites are present within the study area.	No; Confirmed habitat was not observed during field investigations.	No further action required.
<p>Amphibian Breeding Habitat (Woodland).</p> <p>Rationale: These habitats are extremely important to amphibian biodiversity within a landscape and often represent the only breeding habitat for local amphibian populations</p>	Eastern Newt Blue-spotted Salamander Spotted Salamander Gray Treefrog Spring Peeper Western Chorus Frog Wood Frog	<p>All Ecosites associated with these ELC Community Series; FOC FOM FOD SWC SWM SWD</p> <p>Breeding pools within the woodland or the shortest distance from forest habitat are more significant because they are more likely to be used due to reduced risk to migrating amphibians</p>	<ul style="list-style-type: none"> Presence of a wetland, pond or woodland pool(including vernal pools) >500m² within or adjacent (within 120m) to a woodland (no minimum size).clxxxii, lxiii, lxv, lxvi, lxvii, lxviii, lxix, lxx. Some small wetlands may not be mapped and may be important breeding pools for amphibians. Woodlands with permanent ponds or those containing water in most years until mid-July are more likely to be used as breeding habitat ^{cxlviii} <p><u>Information Sources</u></p> <ul style="list-style-type: none"> Ontario Herpetofaunal Summary Atlas (or other similar atlases) for records Local landowners may also provide assistance as they may hear spring- 	<p>Studies confirm;</p> <ul style="list-style-type: none"> Presence of breeding population of 1 or more of the listed salamander species or 2 or more of the listed frog species with at least 20 individuals (adults, juveniles, eggs/larval masses) lxxi or 2 or more of the listed frog species wioth Call Level Codes of 3 [®]. A combination of observation study and call count survey will be required during the sping (March-June) when amphibians are concentrated around suitable breeding habitat within or near the woodland/wetlands. The habitat is the wetland 	Moderate Probability; Forested and swamp ecosites are present within the study area.	Confirmed; Thresholds for species and individuals were met in the Silver Swamp LSW during amphibian breeding surveys.	<p>As stated in the PPS 2014, development and site alteration is not permitted within Significant Wildlife Habitat (SWH). Additionally, the PPS (2014) states that development is not permitted within adjacent lands to Significant Wildlife Habitat unless “ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions”.</p> <p>It is recommended that the proposed development occur outside of confirmed habitat in order to comply with the PPS (2014).</p>

Specialized Wildlife Habitat	Wildlife Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite Codes	Habitat Criteria and Information Sources	Defining Criteria			
			time choruses of amphibians on their property. <ul style="list-style-type: none"> • OMNRF Districts and wetland evaluations • Field Naturalist Clubs • Canadian Wildlife Service Amphibian Road Call Survey • Ontario Vernal Pool Association: http://www.ontariovernalpools.org 	area plus a 230m radius of area. If a wetland area is adjacent to a woodland, a travel corridor connecting the wetland to the woodland is to be included in the habitat. <ul style="list-style-type: none"> • SWH MIST cxlix Index #14 provides development effects and mitigation measures. 			
Amphibian Breeding Habitat (Wetlands) Rationale: Wetlands supporting breeding for these amphibian species are extremely important and fairly rare within Central Ontario landscapes.	Eastern Newt American Toad Spotted Salamander Four-toed Salamander Blue-spotted Salamander Gray Treefrog Western Chorus Frog Northern Leopard Frog Pickerel Frog Green Frog Mink Frog Bullfrog	ELC Community Classes SW, MA, FE, BO, OA and SA. Typically these wetland ecosites will be isolated (>120m) from woodland ecosites, however larger wetlands containing predominantly aquatic species (e.g. Bull Frog) may be adjacent to woodlands.	<ul style="list-style-type: none"> • Wetlands>500m2 (about 25m diameter))^{ccvii}, supporting high species diversity are significant; some small or ephemeral habitats may not be identified on MNRF mapping and could be important amphibian breeding habitats^{clxxxii}. • Presence of shrubs and logs increase significance of pond for some amphibian species because of available structure for calling, foraging, escape and concealment from predators. • Bullfrogs require permanent water bodies with abundant emergent vegetation. <u>Information Sources</u> <ul style="list-style-type: none"> • Ontario Herpetofaunal Summary Atlas (or other similar atlases) • Canadian Wildlife Service Amphibian Road Surveys and Backyard Amphibian Call Count. • OMNRF Districts and wetland evaluations. • Reports and other information available from Conservation Authorities. 	Studies confirm: <ul style="list-style-type: none"> • Presence of breeding population of 1 or more of the listed newt/salamander species or 2 or more of the listed frog/toad species with at least 20 individuals (adults or eggs masses)^{lxxi} or 2 or more of the listed frog/toad species with Call Level Codes of 3[ⓔ]. or; Wetland with confirmed breeding Bullfrogs are significant[ⓔ]. • The ELC ecosite wetland area and the shoreline are the SWH. • A combination of observational study and call count surveys^{cviii} will be required during the spring (March-June) when amphibians are concentrated around suitable breeding habitat within or near the wetlands. • If a SWH is determined for Amphibian Breeding Habitat (Wetlands) then Movement Corridors are to be considered as outlined in Table 1.4.1 of this Schedule. • SWH MIST^{cxlix} Index #15 provides development effects and mitigation measures. 	High Probability; Qualifying ecosites are present within the study area.	No; Confirmed habitat was not observed during field investigations. Thresholds for species and individuals were not met during amphibian breeding surveys.	No further action required.

Table 1.3. Habitats of Species of Conservation Concern considered SWH.

Wildlife	Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite	Habitat Criteria and Information Sources	Defining Criteria			
Woodland Area-Sensitive Bird Breeding Habitat Rationale: Large, natural blocks of mature woodland habitat within the settled areas of Southern Ontario are important habitats for area sensitive interior forest song birds.	Yellow-bellied Sapsucker Red-breasted Nuthatch Veery Blue-headed Vireo Northern Parula Black-throated Green Warbler Blackburnian Warbler Black-throated Blue Warbler Ovenbird Scarlet Tanager Winter Wren Pileated Woodpecker <u>Special Concern:</u> Cerulean Warbler Canada Warbler	All Ecosites associated with these ELC Community Series; FOC FOM FOD SWC SWM SWD	<ul style="list-style-type: none">Habitats where interior forest breeding birds are breeding, typically large mature (>60 yrs old) forest stands or woodlots >30 ha. cv, cxxxi, cxxxii, cxxxiii, cxxxiv, cxxxv, cxxxvi, cxxxvii, cxxxviii, cxxxix, cxl, cxli, cxlii, cxliii, cxliv, cxlv, cxlvi, cl, cli, clii, cliii, cliv, clv, clvi, clvii, clviii, clix, clxiv <u>Information Sources</u> <ul style="list-style-type: none">Local birder clubs.Canadian Wildlife Service (CWS) for the location of forest bird monitoring .Bird Studies Canada conducted a 3-year study of 287 woodlands to determine the effects of forest fragmentation on forest birds and to determine what forests were of greatest value to interior speciesReports and other information available from Conservation Authorities	Studies confirm: <ul style="list-style-type: none">Presence of nesting or breeding pairs of 3 or more of the listed wildlife species. ⑥<u>Note:</u> any site with breeding Cerulean Warblers or Canada Warbler is to be considered SWH.⑥Conduct field investigations in spring and early summer when birds are singing and defending their territories.Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi}SWH MIST cxlix Index #34 provides development effects and mitigation measures.	No; Forested ecosites within the study area are not large enough to provide interior forest habitat.	No; Confirmed habitat was not observed during field investigations.	No further action required.
Marsh Breeding Bird Habitat Rationale: Wetlands for these bird species are typically productive and fairly rare in Southern Ontario landscapes.	American Bittern Virginia Rail Sora Common Moorhen American Coot Pied-billed Grebe Marsh Wren Sedge Wren Common Loon Green Heron Trumpeter Swan Special Concern: Black Tern Yellow Rail	MAM1 MAM2 MAM3 MAM4 MAM5 MAM6 SAS1 SAM1 SAF1 FEO1 BOO1 For Green Heron: All SW, MA and CUM1 sites.	<ul style="list-style-type: none">Nesting occurs in wetlands.All wetland habitat is to be considered as long as there is shallow water with emergent aquatic vegetation present cxxiv.For Green Heron, habitat is at the edge of water such as sluggish streams, ponds and marshes sheltered by shrubs and trees. Less frequently, it may be found in upland shrubs or forest a considerable distance from water. <u>Information Sources</u> <ul style="list-style-type: none">OMNRF District and wetland evaluations.Field Naturalist clubsNatural Heritage Information	Studies confirm: <ul style="list-style-type: none">Presence of 5 or more nesting pairs of Sedge Wren or Marsh Wren or breeding by any combination of 4 or more of the listed species ⑥.<u>Note:</u> any wetland with breeding of 1 or more Black Terns, Trumpeter Swan, Green Heron or Yellow Rail is SWH ⑥.Area of the ELC ecosite is the SWH.Breeding surveys should be done in May/June when these species are actively nesting in wetland habitats.Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”	High Probability; Qualifying wetland ecosites are present within the study area.	No; Confirmed habitat was not observed during field investigations.	No further action required.

Wildlife	Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite	Habitat Criteria and Information Sources	Defining Criteria			
			<p>Centre (NHIC) Records.</p> <ul style="list-style-type: none"> • Reports and other information available from Conservation Authorities. • Ontario Breeding Bird Atlas. 	<ul style="list-style-type: none"> • SWH MIST Index #35 provides development effects and mitigation measures 			
<p>Open Country Bird Breeding Habitat</p> <p>Rationale: This wildlife habitat is declining throughout Ontario and North America. Species such as the Upland Sandpiper have declined significantly the past 40 years based on CWS (2004) trend records.</p>	<p>Upland Sandpiper Grasshopper Sparrow Vesper Sparrow Northern Harrier Savannah Sparrow</p> <p>Special Concern Short-eared Owl</p>	CUM1 CUM2	<p>Large grassland areas (includes natural and cultural fields and meadows) >30 ha ^{clx, clxi, clxii, clxiii, clxiv, clxv, clxvi, clxvii, clxviii, clxix}.</p> <ul style="list-style-type: none"> • Grasslands not Class 1 or 2 agricultural lands, and not being actively used for farming (i.e. no row cropping or intensive hay or livestock pasturing in the last 5 years) [Ⓔ]. • Grassland sites considered significant should have a history of longevity, either abandoned fields, mature hayfields and pasturelands that are at least 5 years or older. • The Indicator bird species are area sensitive requiring larger grassland areas than the common grassland species. <p>Information Sources Agricultural land classification maps, Ministry of Agriculture. Local bird clubs. Ontario Breeding Bird Atlas EIS Reports and other information available from Conservation Authorities.</p>	<p>Field Studies confirm:</p> <ul style="list-style-type: none"> • Presence of nesting or breeding of 2 or more of the listed species. [Ⓔ] • A field with 1 or more breeding Short-eared Owls is to be considered SWH. • The area of SWH is the contiguous ELC ecosite field areas. • Conduct field investigations of the most likely areas in spring and early summer when birds are singing and defending their territories. • Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} • SWH MIST ^{cxlix} Index #32 provides development effects and mitigation measures 	Moderate Probability; Suitable cultural meadow habitat that meets size thresholds is present within the study area.	No; Species and number thresholds were not met during breeding bird surveys.	No further action required.
Shrub/Early	<u>Indicator Spp:</u>	CUT1	Large field areas succeeding	Field Studies confirm:	No;	No;	No further action required.

Wildlife	Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite	Habitat Criteria and Information Sources	Defining Criteria			
Successional Bird Breeding Habitat Rationale: This wildlife habitat is declining throughout Ontario and North America. The Brown Thrasher has declined significantly over the past 40 years based on CWS (2004) trend records ^{cxlix} .	Brown Thrasher Clay-coloured Sparrow <u>Common Spp.</u> Field Sparrow Black-billed Cuckoo Eastern Towhee Willow Flycatcher Special Concern: Yellow-breasted Chat Golden-winged Warbler	CUT2 CUS1 CUS2 CUW1 CUW2 Patches of shrub ecosites can be complexed into a larger habitat for some bird species	to shrub and thicket habitats >10ha ^{clxiv} in size. • Shrub land or early successional fields, not class 1 or 2 agricultural lands, not being actively used for farming (i.e. no row-cropping, haying or live-stock pasturing in the last 5 years) ^㉔ . • Shrub thicket habitats (>10 ha) are most likely to support and sustain a diversity of these species ^{clxxiii} . • Shrub and thicket habitat sites considered significant should have a history of longevity, either abandoned fields or pasturelands. Information Sources Agricultural land classification maps, Ministry of Agriculture. Local bird clubs. Ontario Breeding Bird Atlas Reports and other information available from Conservation Authorities.	<ul style="list-style-type: none"> • Presence of nesting or breeding of 1 of the indicator species and at least 2 of the common species. ^㉔ • A habitat with breeding Yellow-breasted Chat or Golden-winged Warbler is to be considered as Significant Wildlife Habitat. ^㉔ • The area of the SWH is the contiguous ELC ecosite field/thicket area. • Conduct field investigations of the most likely areas in spring and early summer when birds are singing and defending their territories • Evaluation methods to follow “Bird and Bird Habitats: Guidelines for Wind Power Projects”^{ccxi} • SWH MIST • ^{cxlix} Index #33 provides development effects and mitigation measures. 	Although suitable ecosites are present within the study area they do not meet the size criteria for significance.	Confirmed habitat was not observed during field investigations.	
Terrestrial Crayfish; Rationale: Terrestrial Crayfish are only found within SW Ontario in Canada and their habitats are very rare. ^{ccii}	Chimney or Digger Crayfish; (<i>Fallicambarus fodiens</i>) Devil Crawfish or Meadow Crayfish; (<i>Cambarus Diogenes</i>)	MAM1 MAM2 MAM3 MAM4 MAM5 MAM6 MAS1 MAS2 MAS3 SWD SWT SWM	Wet meadow and edges of shallow marshes (no minimum size) should be surveyed for terrestrial crayfish. • Constructs burrows in marshes, mudflats, meadows, the ground can’t found far from water. • Both species are a semi-terrestrial burrower which spends most of its life within burrows consisting of a network of tunnels. Usually the soil is not too moist so that the tunnel is well formed. <u>Information Sources</u> <ul style="list-style-type: none"> • Information sources from “Conservation Status of Freshwater Crayfishes” by Dr. Premek Hamr for the WWF and CNF March 1998 	Studies Confirm: • Presence of 1 or more individuals of species listed or their chimneys (burrows) in suitable meadow marsh, swamp or moist terrestrial sites ^{cci} • Area of ELC ecosite or an Habitat ecoelement area of meadow marsh or swamp within the larger ecosite area is the SWH. • Surveys should be done April to August in temporary or permanent water. Note the presence of burrows or chimneys are often the only indicator of presence, observance or collection of individuals is very difficult ^{cci} • SWH MIST ^{cxlix} Index #36 provides development effects and mitigation measures.	Moderate Probability; Suitable wetland ecosites are present within the study area.	Confirmed; Chimneys were observed in suitable habitat during field investigations.	As stated in the PPS 2014, development and site alteration is not permitted within Significant Wildlife Habitat (SWH). Additionally, the PPS (2014) states that development is not permitted within adjacent lands to Significant Wildlife Habitat unless “ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions”. It is recommended that the proposed development occur outside of confirmed habitat in order to comply

Wildlife	Species	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat within the Study Area	Confirmed Habitat within the Study Area	Conclusions/ Recommendations
		ELC Ecosite	Habitat Criteria and Information Sources	Defining Criteria			
							with the PPS (2014).
Special Concern and Rare Wildlife Species Rationale: These species are quite rare or have experienced significant population declines in Ontario.	All Special Concern and Provincially Rare (S1-S3, SH) plant and animal species. Lists of these species are tracked by the Natural Heritage Information Centre (NHIC).	All plant and animal element occurrences (EO) within a 1 or 10km grid. Older element occurrences were recorded prior to GPS being available, therefore location information may lack accuracy	<ul style="list-style-type: none"> When an element occurrence is identified within a 1 or 10 km grid for a Special Concern or provincially Rare species; linking candidate habitat on the site needs to be completed to ELC Ecosites lxxviii Information Sources Natural Heritage Information Centre (NHIC) will have Special Concern and Provincially Rare (S1-S3, SH) species lists with element occurrences data. NHIC Website “Get Information” : http://nhic.mnr.gov.on.ca Ontario Breeding Bird Atlas• Expert advice should be sought as many of the rare spp. have little information available about their requirements. 	Studies Confirm: <ul style="list-style-type: none"> Assessment/inventory of the site for the identified special concern or rare species needs to be completed during the time of year when the species is present or easily identifiable. The area of the habitat to the finest ELC scale that protects the habitat form and function is the SWH, this must be delineated through detailed field studies. The habitat needs be easily mapped and cover an important life stage component for a species e.g. specific nesting habitat or foraging habitat. SWH MIST Index #37 provides development effects and mitigation measures. 	High Probability; There are records of Special Concern and rare species within or in the vicinity of the study area.	Confirmed; Rare species or species of Special Concern were observed within the study area (Monarch within CUM1-1 on properties: 3298 Scotland Dr 3137 Scotland Dr 3405 Scotland Dr 3465 Scotland Dr 3502 Manning Dr 3595 Scotland Dr 3666 Scotland Dr 3691 Manning Dr 3713 Scotland Dr 6100 White Oak Rd; Eastern Wood-pewee within FOD5-5 on property 3583 Westminster Dr)	As stated in the PPS 2014, development and site alteration is not permitted within Significant Wildlife Habitat (SWH). Additionally, the PPS (2014) states that development is not permitted within adjacent lands to Significant Wildlife Habitat unless “ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions”. It is recommended that the proposed development occur outside of confirmed habitat in order to comply with the PPS (2014).

Table 1.4 Animal Movement Corridors

Habitat	SPECIES	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Present within the Study Area	Conclusions/ Recommendations
		ELC Eco-sites	Habitat Criteria and Information Sources	Defining Criteria			
Amphibian Movement Corridors Rationale: Movement corridors for amphibians moving from their terrestrial habitat to breeding habitat can be extremely important for local populations.	Eastern Newt American Toad Spotted Salamander Four-toed Salamander Blue-spotted Salamander Gray Treefrog Western Chorus Frog Northern Leopard Frog Pickerel Frog Green Frog Mink Frog Bullfrog	Corridors may be found in all ecosites associated with water. <ul style="list-style-type: none">Corridors will be determined based on identifying the significant breeding habitat for these species in Table 1.1	<p>Movement corridors between breeding habitat and summer habitat ^{clxxiv, clxxv, clxxvi, clxxvii, clxxviii, clxxix, clxxx, clxxxi}.</p> <p>Movement corridors must be determined when Amphibian breeding habitat is confirmed as SWH from Table 1.2.2 (Amphibian Breeding Habitat – Wetland) of this Schedule ⑥.</p> <p>Information Sources</p> <ul style="list-style-type: none">•MNR District Office.•Natural Heritage Information Centre (NHIC).•Reports and other information available from Conservation Authorities.•Field Naturalist Clubs.	<ul style="list-style-type: none">• Field Studies must be conducted at the time of year when species are expected to be migrating or entering breeding sites.* Corridors should consist of native vegetation, with several layers of vegetation. Corridors unbroken by roads, waterways or bodies, and undeveloped areas are most significant cxlix• Corridors should have at least 15m of vegetation on both sides of waterway cxlix or be up to 200m wide cxlix of woodland habitat and with gaps <20m cxlix .• Shorter corridors are more significant than longer corridors, however amphibians must be able to get to and from their summer and breeding habitat cxlix.• SWH MIST cxlix Index #40 provides development effects and mitigation measures	Moderate Probability; Qualifying ecosties are present within the study area.	No; Confirmed habitat was not observed during field investigations. Amphibian Breeding Habitat – Wetland was not confirmed during amphibian breeding surveys.	No further action required.

Table 1.5 Significant Wildlife Habitat Exceptions for Ecodistricts within Eco-Region 7E

Habitat	SPECIES	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Present within the Study Area	Conclusions/ Recommendations
		ELC Eco-sites	Habitat Criteria and Information Sources	Defining Criteria			
7E-2	Bat Migratory Stopover Area Rationale: Stopover areas for long distance migrant bats are important during fall migration. Hoary Bat Eastern Red Bat Silver-haired Bat	No specific ELC types.	<ul style="list-style-type: none">• Long distance migratory bats typically migrate during late summer and early fall from summer breeding habitats throughout Ontario to southern wintering areas. Their annual fall migration may concentrate these species of bats at stopover areas.• This is the only known bat migratory stopover habitats based on current information. <p>Information Sources</p> <ul style="list-style-type: none">• OMNRF for possible	<ul style="list-style-type: none">• Long Point (42°35’N, 80°30’E, to 42°33’N, 80°03’E) has been identified as a significant stop-over habitat for fall migrating Silver-haired Bats, due to significant increases in abundance, activity and feeding that	No; Candidate habitat not present within the study area.	No; Confirmed habitat was not observed during field investigations.	No further action required.

Habitat	SPECIES	CANDIDATE SWH		CONFIRMED SWH	Candidate Habitat Present Within the Study Area	Confirmed Habitat Present within the Study Area	Conclusions/ Recommendations
		ELC Eco-sites	Habitat Criteria and Information Sources	Defining Criteria			
			locations and contact for local experts <ul style="list-style-type: none"> • University of Waterloo, Biology Department 	was documented during fall migration ^{ccxv} . <ul style="list-style-type: none"> • The confirmation criteria and habitat areas for this SWH are still being determined. • SWH MIST ^{cxlix} Index #38 provides development effects and mitigation measures 			

D.06 Land Use Existing Conditions and Impact
Assessment Report; completed by MHBC

LAND USE EXISTING CONDITIONS AND IMPACT ASSESSMENT

W12A Landfill Expansion Environmental Assessment

DRAFT

3502 Manning Drive
London

Date:

December 2020

Prepared for:

City of London

Prepared by:

MacNaughton Hermesen Britton Clarkson Planning Limited (MHBC)

630 Colborne Street, Suite 202

London ON N6B 2V2

T: 519 858 2797 x223

F: 519 858 2920

MHBC File: 08227'A'

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Abbreviations

Terms of Reference	ToR
Environment Assessment	EA
Environmental Assessment Study Report	EASR
Cubic Metres	m ³
Metres Above Sea Level	masl
City of London	City
Provincial Policy Statement	PPS
New City of London Official Plan	The London Plan
Zoning By-law Z.-1	Zoning By-law
Waste and Resource Management Zone	WRM Zone
Agricultural Zone	AG Zone
Environmental Review Zone	ER Zone
Open Space Zone	OS Zone
Resource Extraction Zone	EX Zone

1.0 Introduction

The City of London is proposing an expansion of the existing W12A Landfill site (the Project) located at 3502 Manning Drive, London. The existing landfill property is described as part of Lots 18, 19 and 20, Concession 6 in the former Township of Westminster. Generally, this property is located in a predominately agricultural area of London, south of the City's Urban Growth Boundary.

The environment is considered in broad terms to include the natural, social, cultural, and economic aspects of the environment. This Report presents the existing conditions and impact assessment for the land use component of the Environment Assessment (EA) for the proposed W12A Landfill expansion. This assessment has been conducted in accordance with the requirements set out in the approved Terms of Reference (ToR) for the EA, dated February 2019.

This Report is a supporting document to the Environmental Assessment Study Report (EASR). As discussed in Section 3.0 of this Report, the preferred expansion alternative identified through the EA process is the vertical expansion above the existing landfill footprint.

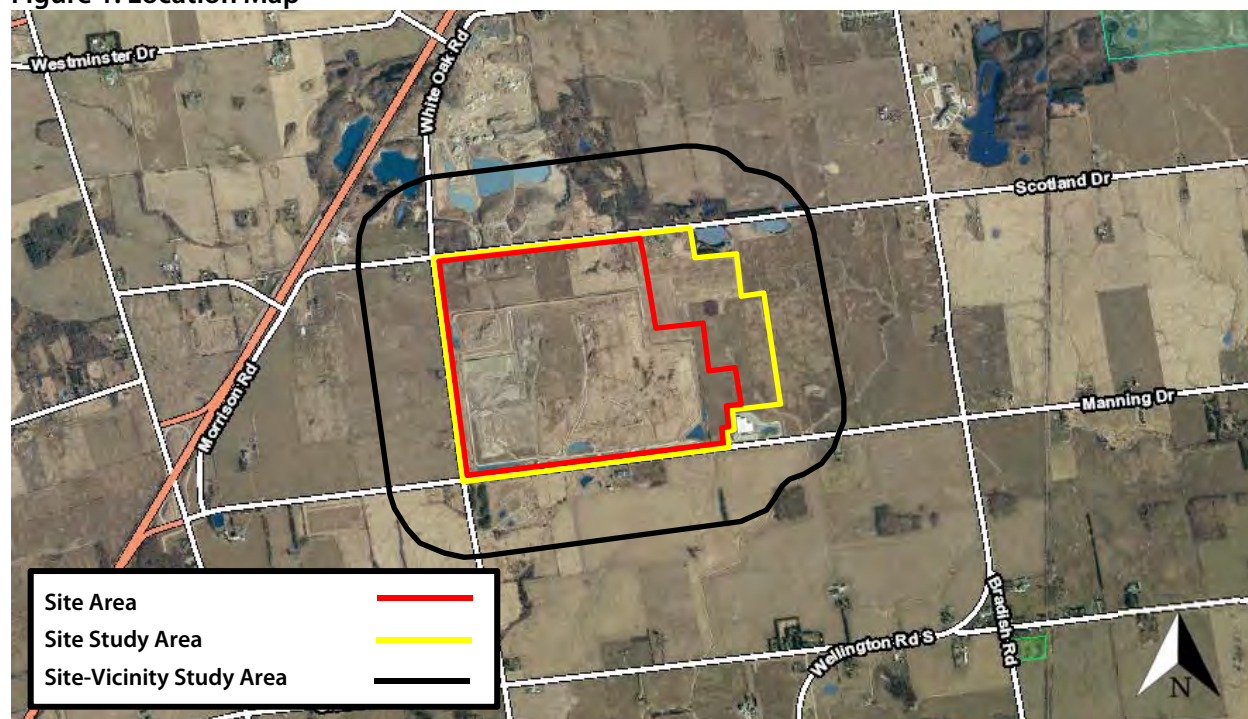
2.0 Existing Conditions

2.1 Land Use

The following provides an overview of existing land uses surrounding the W12A Landfill within the Site Area, Site Study Area and Site-Vicinity Study Area, as defined through the EA process. The boundaries of each of these study areas are described below and illustrated on Figure 1 of this Report:

- The Site Area encompasses the existing W12A Landfill site and adjacent lands required for the proposed landfill expansion;
- The Site Study Area represents the limit of property considered in conjunction with the evaluation of EA study alternatives; and
- The Site-Vicinity Study Area includes an area with a radius of 500 m around the Site Study Area.

Figure 1: Location Map



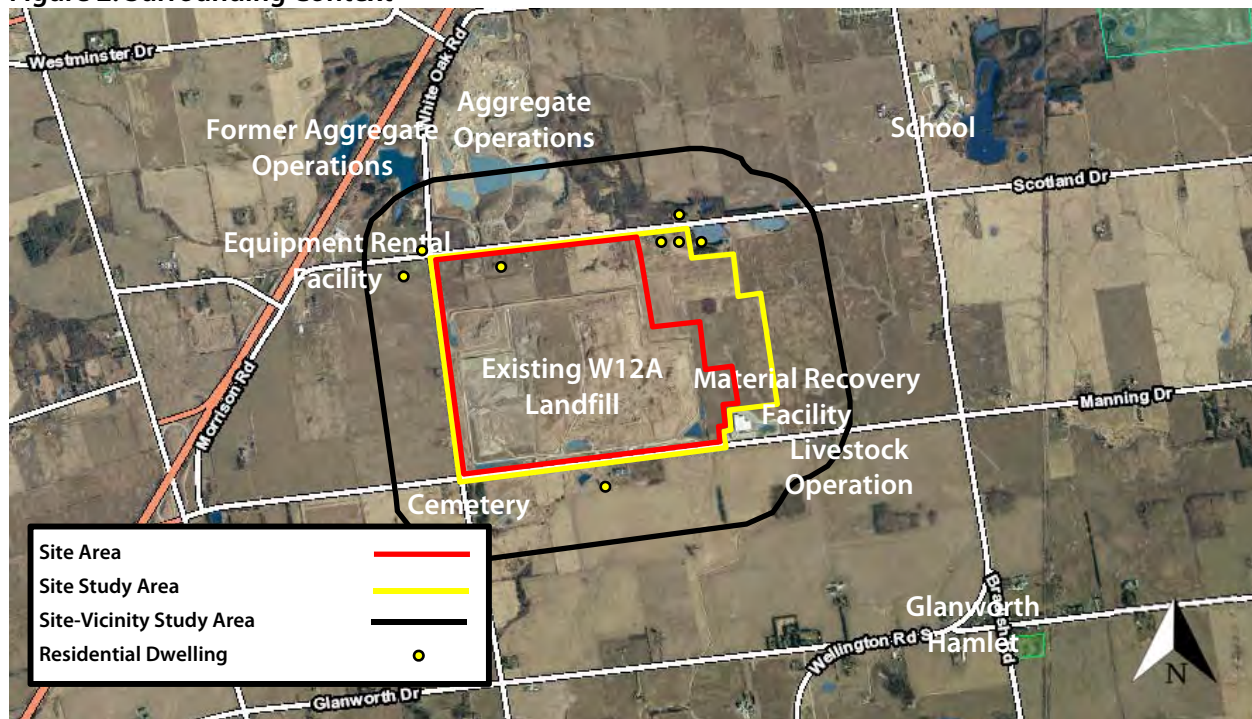
2.1.1 Description of Existing Land Uses

Figure 2 of this Report illustrates the general land uses in the vicinity of the existing landfill facility. Land uses within the Site-Vicinity Study Area are summarized in the following discussion. The identification of land use activities in this defined area was based primarily on a field survey undertaken by vehicle (i.e., ‘windshield survey’) on October 8, 2019, an examination of aerial imagery, and discussions with the City of London.

Existing Land Uses (Site-Vicinity Study Area):

North: A portion of the land base between the existing landfill berm and Scotland Drive is actively cultivated for cash crop production (soybeans). The remaining lands are considered fallow with hilly topography observed between the berm and Scotland Drive. These lands do not appear to have been used for agricultural production. Westcliff Pit, operated by AAROC Aggregates, and the Bre-Ex Gravel Pit, operated by Brekelmens Holdings, are located on the north side of Scotland Drive (gravel pit). Soybean and corn production were also observed on the north side of Scotland Drive. Further, storage for non-agricultural activities was visible at 3405 Scotland Drive, and rural residential dwellings are located at that property, as well as 3465, 3561, 3465 and 3801 Scotland Drive. The property at 3405 Scotland Drive includes a large pond; the property at 3465 Scotland Drive includes a demolished barn.

Figure 2: Surrounding Context



Source: City of London Maps, 2020

East: Lands east of the proposed landfill expansion are under active cultivation for conventional cash crop production (corn, soybeans, wheat rotation). There is a vacant industrial storage building at the intersection of Scotland Drive and Wellington Road South. In terms of crops, typical cash crops (corn and soybeans) are found along Wellington Road South. A rural residential dwelling at 5751 Wellington Road South shows evidence of a previous farmstead (bank barn foundation and roofless silo). Rural residential dwellings are also located at 5595, 5615 and 5751 Wellington Road South.

South: A livestock operation (beef) is located at 3243 Manning Drive, approximately 400 m southeast of the Material Recovery Facility (MRF), which is situated at 3438 Manning Drive. The house on the property is vacant. Large agricultural parcels were in conventional cash crop production (corn). There is also an agricultural operation located at 3691 Manning Drive, which includes a large driving shed with solar panels, a bank barn, roofless silo and rural residential dwelling surrounded by cash crop production (corn). Livestock was not visible at this location. The Islamic Cemetery of London (6100 White Oak Road) is also located south of the existing landfill.

West: There is a dilapidated barn/storage building located at 4025 Manning Drive. Large agricultural parcels were in cash crop production (soybeans). There is evidence of a farmstead at 5861 White Oak Road (treeline, foundation of buildings). There is also an existing farmstead at 4067 Scotland Drive, which includes a small barn, Quonset hut, ancillary structures and a rural residential dwelling. This property appears to be used for

storage rather than active agricultural production. A rural residential dwelling is located at 5435 White Oak Road with evidence of a previous farmstead (stand-alone silo, barn foundation).

In general, the lands surrounding the W12A Landfill within the Site-Vicinity Study Area are characterized by a mix of agricultural uses, with a limited number of residential uses. Additionally, an institutional use is located to the south of the landfill site and aggregate extraction operations are located north of the Site Area. There are also a variety of natural heritage and open space areas dispersed throughout the Site-Vicinity Study Area (e.g., drainage corridors, woodlots).

As detailed in the W12A Landfill Annual Status Report for 2019, dated March 2020, the City owns a majority of the parcels within the Site-Vicinity Study Area to the east of the Site Area, as well as a number of parcels to the west and north of the Site Area. Several residential dwellings have been removed from these properties.

3.0 Project Description

3.1 General Description

The Project incorporates a vertical expansion over 106.3 ha of the existing landfill footprint, which has a total approved footprint area of 107 ha. In effect, implementation of this Project would result in 13.8 million m³ of additional airspace for waste and daily cover, with a highest ridge elevation of waste of 318.43 masl (approximately 43 m above ground elevation).

Additionally, the boundary of the existing landfill site is proposed to be expanded to accommodate additional on-site buffering and additional waste management activities. In comparison to existing conditions, the following modifications are proposed within this expanded boundary (Site Area):

- The northern boundary of the landfill property would be extended approximately 310 m to the Scotland Drive corridor for buffering purposes, with the eastern buffer width extended approximately 60 m. At this time, with the exception of a boundary fence, no infrastructure is proposed for these buffer areas. These lands would be seeded and left fallow, unless there is a future need for contingency measures or other infrastructure within these areas; and
- An eastern expansion of the existing landfill adjacent along the Manning Drive frontage to interface with the adjacent MRF property (approximately extension width: 145 m). Lands in this expansion area would accommodate a new small vehicle Waste and Resource Material Drop-off Area. It is anticipated that this new facility would include a new scale and scalehouse, a grade-separated small vehicle drop-off for waste, a grade-separated

small vehicle drop-off for recyclable materials, an area for drop-off of brush, tires and large items, and a new Household Special Waste depot.

Collectively, the proposed modifications would increase the landfill boundary from approximately 140.0 ha to approximately 192.4 ha.

4.0 Impact Assessment

The compatibility of the Project with surrounding land uses was assessed with consideration for (1) the proposed operational practices and (2) predictive assessments related to potential nuisance effects. The methodology and findings of this assessment are described below.

4.1 Current Land Use

Based on the characterization of the Site-Vicinity Study Area identified in Section 2.0 of this Report, this area is predominately comprised of farmland and natural heritage areas, with a limited number of associated farm dwellings. There is also a cemetery located south of the landfill facility and a resource extraction operation situated north of this facility.

4.1.1 Methodology

The assessment of current and future land uses in the Site Area and Site-Vicinity Study Area was predicated on a study methodology designed at the outset of the evaluation. Generally, this methodology integrated: a review of the regulatory context and planning policy framework applicable to these areas; data collected during a field survey, an analysis of aerial photography; and information obtained through interviews with City of London (City) staff. The evaluation process was carried out between September 2019 and August 2020. Through this review, land uses that may be sensitive to the potential impacts of landfilling activities were highlighted and identified.

The following data sources were evaluated for this assessment:

- Policy documents and guidelines applicable to the Site Area and Site-Vicinity Study Area:
 - Provincial Policy Statement (2020);
 - City of London Official Plan (1989);
 - City of London Official Plan (The London Plan);
 - City of London Zoning By-law Z.-1;
 - Land Use Compatibility, Guideline D-1; and
 - Land Use On or Near Landfills and Dumps, Guideline D-4.

- Information collected from a field survey of the Site Area and Site-Vicinity Study Area conducted on October 8, 2019, including:
 - Photographs of land uses and properties within the area;
 - Documentation of existing land uses; and
 - Identification of any planning notice signage (no signs were identified).
- Digital sources to supplement the characterization of existing conditions:
 - GIS parcel fabric mapping from the City of London;
 - Google Earth imagery; and
 - Aerial photography from the City of London.
- Interviews and discussions carried out with City staff in September 2019 to identify planning issues and any potential development activity within the Site-Vicinity Study Area.
- Study reports completed to inform the EA, including:
 - W12A Landfill Expansion Environmental Assessment – Biology: Existing Conditions and Impact Assessment Report;
 - Heritage Impact Assessment: W12A Landfill Expansion EA;
 - Air Quality Existing Conditions and Impact Assessment: W12A Landfill Expansion EA; and
 - Stormwater Management Report.
- W12A Landfill Annual Status Report: January 1, 2019 to December 31, 2019.

4.1.2 Policy Overview

The following summarizes the land use policy framework applicable to the Site Area and Site-Vicinity Study Area, and presents our assessment of the Project relative to this policy framework. The findings of this evaluation have consideration for the above-referenced data sources.

4.1.2.1 Provincial Policy Statement, 2020

The 2020 Provincial Policy Statement (PPS) came into effect on May 1, 2020 under Section 3 of the *Planning Act*. The PPS provides overall policy direction on matters of provincial interest related to land use planning and development, and sets the policy foundation for regulating the development and use of land. In this respect, Section 3 of the Planning Act requires that all decisions affecting planning matters “shall be consistent with” policy statements issued under the Planning Act.

The PPS provides a vision for land use planning in Ontario that focuses growth within settlement areas, and encourages an efficient use of land, resources, and public investment in infrastructure. To support this vision, the PPS defines a number of policies to promote strong, liveable, healthy and resilient communities and to promote Ontario’s long-term prosperity, environmental health and social well-being.

The Project has been evaluated with regard to the policy direction and provisions of the PPS. Based on this analysis, it is our opinion that specific policies in Section 1.0 (Building Strong Healthy Communities) and Section 2.0 (Wise Use and Management of Resources) are particularly relevant to the proposed landfill expansion. Commentary regarding these policies is provided in the following section of this Report.

Policy Context

In the context of the 2020 PPS, in our opinion, the activities associated with the W12A Landfill and the Project would be considered a 'waste management system'. It is also our opinion that a landfill would be classified as a 'major facility' under the terms of the PPS. Section 6.0 of the PPS defines these relevant terms as follows:

"Waste management system: means sites and facilities to accommodate solid waste from one or more municipalities and includes recycling facilities, transfer stations, processing sites and disposal sites.

Major facilities: means facilities which may require separation from sensitive land uses, including but not limited to airports, manufacturing uses, transportation infrastructure and corridors, rail facilities, marine facilities, sewage treatment facilities, waste management systems, oil and gas pipelines, industries, energy generation facilities and transmission systems, and resource extraction activities."

Additionally, in the context of the PPS, in our opinion, the Site-Vicinity Study Area would be classified as a prime agricultural area. Prime agricultural areas are defined as follows in Section 6:

"Prime agricultural area: means areas where prime agricultural lands predominate. This includes areas of prime agricultural lands in associated Canada Land Inventory Class 4 through 7 Lands, and additional areas where there is a local concentration of farms which exhibit characteristics of ongoing agriculture. Prime agricultural areas may be identified by the Ontario Ministry of Agriculture and Food using guidelines developed by the Province as amended from time to time. A prime agricultural area may also be identified through an alternative agricultural land evaluation system approved by the Province."

Further, Section 6 defines prime agricultural land as:

"Prime agricultural land: means specialty crop areas and/or Canada Land Inventory Class 1, 2 and 3 lands, as amended from time to time, in this order of priority for protection."

Policy Review

Given the nature and scale of the Project and the surrounding development context, in our opinion, the following policies contained within Sections 1.0 and 2.0 of the PPS have specific relevance to the development proposal:

Policy 1.1.1 prescribes that healthy, liveable and safe communities are sustained by:

- "a) promoting efficient development and land use patterns which sustain the financial well-being of the Province and municipalities over the long term;
- c) avoiding development and land use patterns which may cause environmental or public health and safety concerns;"

In our opinion, the proposed landfill expansion would promote an efficient land use pattern to help to sustain the financial well-being of the Province and the City of London over the long term. In this regard, the proposed expansion is expected to increase the available capacity of the landfill by 25 years, which will allow the City to continue to efficiently use these lands for the local disposal of waste. Further, the expansion is expected to create a public disposal option for nearby municipalities. It is anticipated that this service arrangement would provide a financial benefit to the City.

With respect to health and safety, in conjunction with the EA, noise, odour and air quality studies were conducted to assess the potential impacts of the proposed landfill expansion on adjacent sensitive land uses. Generally, it is concluded in these associated reports that the identified landfill expansion is expected to meet all Provincial criteria with respect to noise, odour and air quality. Noise and air quality monitoring programs for the W12A landfill have been proposed to verify emission rates for air quality indicators and to verify that planned mitigation measures are implemented as planned and are effective. Additionally, the vertical expansion alternative selected in conjunction with the EA would not result in the encroachment of the landfill towards existing sensitive land uses.

Provided the impact mitigation recommended in the aforementioned studies is implemented in project planning, in our opinion the proposed landfill expansion would satisfy Policy 1.1.1.

Policy 1.2.1 states that a coordinated, integrated and comprehensive approach should be used when addressing planning matters within, and across, municipalities, and with other orders of government, including:

- "d) infrastructure, multimodal transportation systems, public service facilities and waste management systems."*

In our opinion, the planned expansion of the W12A Landfill site has been carried out in a coordinated and comprehensive manner. In this regard, the associated EA process was carried out in accordance with an approved ToR and integrated an extensive public consultation program. In addition, the EA study process incorporates a detailed review of environment features including: atmosphere; biology; geology and hydrogeology; surface water; agriculture; archaeology; cultural heritage; land use; agriculture; socio-economic; visual; design and operations, and transportation.

Policy 1.2.6.1 of the PPS provides direction regarding land use compatibility for major facilities:

“Major facilities and sensitive land uses shall be planned and developed to avoid, or if avoidance is not possible, minimize and mitigate any potential adverse effects from odour, noise and other contaminants, minimize risk to public health and safety, and to ensure the long-term operational and economic viability of major facilities in accordance with provincial guidelines, standards and procedures.”

Section 6.0 of the PPS defines ‘sensitive uses’ as follows:

“Sensitive land uses: means buildings, amenity areas, or outdoor spaces where routine or normal activities occurring at reasonably expected times would experience one or more adverse effects from contaminant discharges generated by a nearby major facility. Sensitive land uses may be a part of the natural or built environment. Examples may include, but are not limited to: residences, day care centres, and educational and health facilities.”

As outlined in this Report, the City has implemented measures to reduce the potential impacts of the existing W12A Landfill on sensitive land uses in the vicinity of the site (i.e., dwelling removal). The applicable Official Plan policy framework also largely restricts the introduction of new sensitive land uses in the vicinity of this facility, as discussed in the following sections of this Report. Further, pursuant to this Policy, the Project has been evaluated relative to applicable components of the Land Use Compatibility (D-Series) Guidelines administered by the Ministry of Environment, Conservation and Parks (Ministry).

Based on our review of the published D-Series Guidelines, in our opinion, Guideline D-4 (Land Use On or Near Landfills and Dumps) relates most directly to the proposed landfill expansion project. This Guideline identifies restrictions and controls on land use in the vicinity of landfills and dumps, in order to protect the health, safety, convenience and welfare of residents near such facilities. As set out in the Synopsis to this Guideline, the direction provided in this document is to complement existing Ministry abatement programs for landfills, and is a direct application of Guideline D-1: "Land Use Compatibility."

Application of Guideline D-4 extends to all proposals for land use on, or near, operating and non-operating landfills, that contain municipal solid waste, industrial solid waste and/or sewage sludges. Pursuant to Section 5.1 of the Guideline, the Ministry will normally recommend against

proposals for sensitive land use adjacent to operating landfills, and on land used for waste disposal purposes where there are completed or partially completed fill areas.

In accordance with Section 5.1.1 of the Guideline, the following are considered sensitive land uses for operating landfills:

“Any existing or committed land use which includes:

- a. a permanent structure used in animal husbandry; or
- b. agricultural land used for pasturing livestock; or
- c. a permanent structure where:
 - i. a person sleeps, or
 - ii. a person is present on a full time basis;but not including food or motor vehicle service facilities adjacent to a highway, utility operations, scrap yards, heavy industrial uses, gravel pits, quarries, mining or forestry activities; or
- d. cemeteries”

Additionally, Section 5.1.2 identifies that compatible land uses for operating landfills may include:

- “a. utilities and above grade transportation routes except major highways;
- b. fences;
- c. wood harvesting and other forestry activities;
- d. certain farming activities;
- e. industrial uses, including incinerators permitted to operate under O. Reg. 347;
- f. gravel pits and quarries, and other mining activities(provided the landfill water table is not affected); or
- g. such land uses which would not be threatened by any hazard to public health or safety and would not be impaired by nuisance effects.”

The Impact Assessment provided in Sections 4.2 and 4.3 of this Report was carried out with regard for Guideline D-4 in order to determine potential impacts associated with the proposed landfill expansion. As discussed in these Sections, the Project is not expected to generate adverse impacts on any sensitive land uses within the Site-Vicinity Study Area. In light of these considerations, in our opinion, the Project would be compatible with the local development context and has regard for the D-Series Guidelines.

Given these key considerations, it is our opinion that the proposed expansion is consistent with the direction defined in Policy 1.2.6.1.

Policy 1.6.10.1 prescribes requirements for the provision and location of waste management systems;

“Waste management systems need to be provided that are of an appropriate size and type to accommodate present and future requirements, and facilitate, encourage and promote reduction, reuse and recycling objectives.

Waste management systems shall be located and designed in accordance with provincial legislation and standards.”

The EA has been carried out to evaluate options for expansion of the W12A Landfill, and to identify a preferred landfill expansion alternative that can effectively accommodate present and future requirements.

Policy 2.1.1 of the PPS directs that natural features and areas shall be protected for the long term.

The potential impacts of the Project on natural heritage features within the Site-Vicinity Study Area were investigated, as documented in the Draft W12A Landfill Expansion Environmental Assessment - Biology: Existing Conditions and Impact Assessment Report, dated November 2020. As discussed in this report, this investigation examined the potential impacts of the proposed landfill expansion on aquatic and terrestrial ecosystems identified within the study area. Generally, it is concluded in Section 4 of the report that the Project avoids many potential impacts by locating the landfill expansion within the existing footprint. Additionally, a mitigation and monitoring plan is recommended in the report to mitigate potential direct and indirect impacts of the Project on natural features during the construction, operations, closure and post-closure phases. Provided that the recommended mitigation program is implemented in project planning, in our opinion the proposed landfill expansion would satisfy Policy 2.1.1.

Policy 2.2 of the PPS defines policies serving to protect, improve or restore the quality and quantity of water. To address these provisions, a Stormwater Management Report, dated October 2020, was completed. This report generally concludes that the proposed works are predicted to result in surface water quality conditions that are comparable to existing conditions and meet Provincial requirements. A monitoring program is also recommended in these reports to help minimize potential stormwater management and surface water impacts associated with landfill operations following implementation of the Project.

A Groundwater Existing Conditions and Impact Assessment, dated November 2020, was also completed. Generally, it is concluded in this study report that the proposed expansion project is not expected to affect: the groundwater supply available to water supply wells in the area; groundwater baseflow to off-site watercourses or other natural environment features in the area of the landfill, or; off-site groundwater levels that support vegetation. Mitigation and monitoring programs are also recommended in this report (1) to meet groundwater quality objectives at the landfill boundary and (2) to continue the existing landfill groundwater monitoring program.

Provided the identified monitoring programs and mitigation measures are implemented, in our opinion the Project would satisfy Policy 2.2.

Policy 2.3 of the PPS integrates a series of policies relating to Agriculture. MHBC completed an assessment of these policies in conjunction with an evaluation of an assessment of Project-related impacts on agricultural land and operations within the Site-Vicinity Study Area. This evaluation was detailed in the Agricultural Resources Existing Conditions and Impact Assessment Report: W12A Landfill Expansion Environmental Assessment, dated November 2020.

In our opinion, specific policies contained within Policy 2.3 are particularly relevant to this proposed landfill expansion. These policies are identified below:

1. Policy 2.3.1 states that prime agricultural areas shall be protected for long-term use for agriculture;
2. Policy 2.3.3 addresses permitted land use in prime agricultural areas:
 - Policy 2.3.3.1 states that, "In prime agricultural areas, permitted uses and activities are: agricultural uses, agriculture-related uses and on-farm diversified uses";
 - Policy 2.3.3.2 prescribes that all types, sizes and intensities of agricultural uses and normal farm practices shall be promoted and protected in prime agricultural areas, in accordance with provincial standards; and
 - Policy 2.3.3 states that new land uses shall comply with the Minimum Distance Separation (MDS) formulae developed by the Province.

Respecting Policies 2.3.1, 2.3.3.1 and 2.3.3.2, the Project integrates vertical expansion over the existing landfill footprint, as well as a boundary expansion to accommodate additional buffer areas and a Waste and Resource Material Drop-off Area. As detailed in the following Official Plan discussion, the expansion area is located within the defined boundary of the site-specific W12A Landfill policy area. In our opinion, the proposed boundary expansion would be accommodated on lands specifically designated for a waste management system. Accordingly, in the context of the PPS, the Project would not introduce a new non-agricultural use into a prime agricultural area. Further, in our opinion, the components of the Project would not specifically constrain, or compromise, existing agricultural uses and normal farm practices within the prime agricultural area proximate to the Site Area.

With regard to Policy 2.3.3, MDS setbacks are applied to separate uses to reduce incompatibility concerns relating to odour emissions from livestock facilities. Specific direction on the applicability of MDS formulae is provided in the Minimum Distance Separation (MDS) Document, prepared by OMAFRA (Publication 853). Guideline No. 3 of this Publication states that MDS I and II

setbacks are not required for landfills. Accordingly, consistent with Policy 2.3.1 of the PPS, the existing landfill area and the proposed buffer area should not constrain existing agricultural operations in proximity of this facility, including those within the Site-Vicinity Study Area.

Policy 2.6 of the PPS contains several policies related to the conservation of significant cultural heritage and archaeological features. A Heritage Impact Assessment, dated August 2020, was completed that details areas of potential cultural heritage within the vicinity of the W12A landfill site. Generally, it is concluded in Section 7 of this study report that cultural heritage resources would not be directly or indirectly impacted by the proposed expansion, and no further studies or monitoring is required.

Conclusion

In light of these considerations and our broader evaluation of this Project relative to the PPS, provided recommended monitoring and mitigation measures are implemented, it is our opinion that the Project satisfies, and is consistent with, the Provincial Policy Statement.

4.1.2.2 City of London Official Plan (1989)

The City of London Official Plan was adopted by Council in June 1989. A comprehensive five year update of the Official Plan was carried out during the period of 2006 to 2009. This review process concluded with the approval of Official Plan Amendment No. 438 by the Minister of Municipal Affairs and Housing, with modifications, on December 17, 2009. Certain policies incorporated into the update were referred to the Ontario Municipal Board; however, these appeals were subsequently resolved.

Section 1.2 of the 1989 Official Plan states that, “The Official Plan for the City of London contains City Council’s objectives and policies to guide the short-term and long-term physical development of all lands within the boundary of the municipality.” Policies defined within the Official Plan provide direction on a range of planning considerations, such as growth management, urban form, urban design and public consultation, in order to promote the physical development of a healthy, sustainable community.

Figure 3 of this Report illustrates that the Site Area and Site-Vicinity Study Area contain the following land use designations pursuant to Schedule ‘A’ (Land Use Plan) of the 1989 Official Plan:

- Agriculture;
- Open Space; and
- Environmental Review.

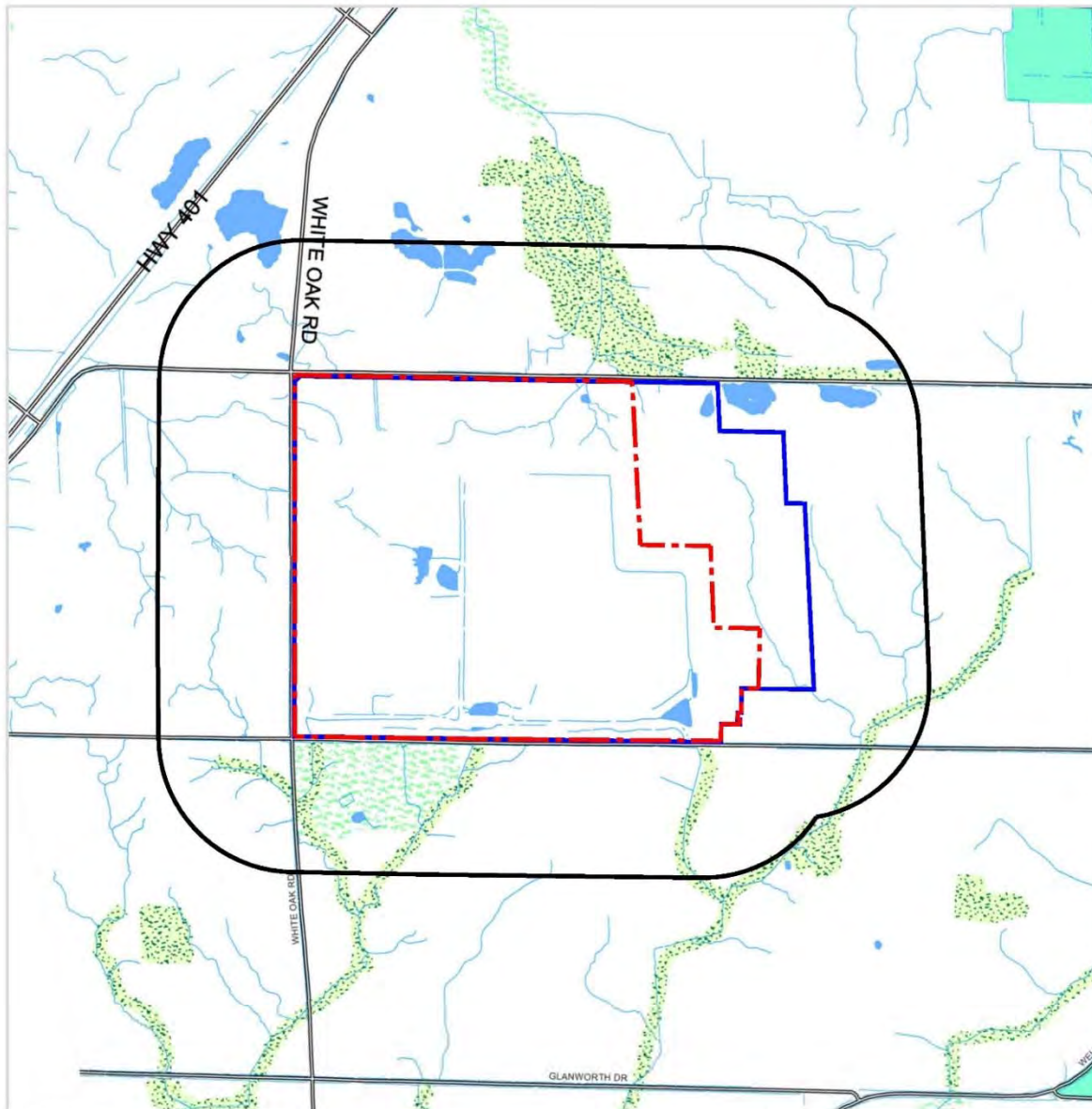


Figure 3
Schedule A - Land Use
 Map 11 & 14 - City of London Official Plan, 1989

Legend

- Site Area
- Site Study Area
- Site-Vicinity Study Area

- | | | |
|--|---|---|
| Regional Facility | Urban Reserve Community Growth | Environmental Review |
| Community Facility | Urban Reserve Industrial Growth | Agricultural |
| Open Space | Rural Settlement | Urban Growth Boundary |

DATE: Dec. 3, 2020

SCALE: 1:20,000

FILE: 08227L

DRN: JB



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W12A Landfill
 City of London

MHBC PLANNING
 URBAN DESIGN
 & LANDSCAPE
 ARCHITECTURE
 200-540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9
 P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

The following provides a summary of the identified land use designations:

Agriculture Designation

The preamble to Chapter 9 of this Official Plan outlines that the Agriculture designation is applied to lands outside of the urban community. As illustrated on Figure 3, this designation comprises the majority of the Site Area and Site-Vicinity Study Area including the W12A landfill site. Section 9.1.1 sets out a series of objectives for the Agriculture designation. In our opinion, the following objectives are particularly relevant to the Project:

- “i) Protect, maintain and improve the prime agriculture land base for future generations. Prime agricultural land consists of Classes 1, 2, and 3 soils according to the Canada Land Inventory Capability Classification for Agriculture mapping and specialty croplands.
- ii) Promote and support a healthy and productive agricultural industry as a key component of the City's economic base and heritage.
- iii) Promote farm practices which encourage the conservation of surface and ground water resources, aquatic habitat, woodlands, wetlands, wildlife habitat and other natural features, where such practices do not impose undue limitations on the farming community.
- ix) Mitigate impacts from any new non-agricultural uses on surrounding agricultural operations and lands to the extent feasible.”

In accordance with Section 9.2.1 of this Official Plan, the primary permitted use of land in the Agriculture designation is the cultivation of land and the raising of livestock. Further, a full range of farm-related activities are permitted in this designation including general farming, livestock farming, cash crop farming, market gardening, specialty crops, nurseries, forestry, aquaculture and agricultural research. Farm residences are also permitted in this designation, as are home occupations and secondary farm occupations subject to specific provisions set out in the Official Plan.

Open Space Designation

Pursuant to Section 8A of the 1989 Official Plan, the Open Space designation is applied to lands which are to be maintained as park space or in a natural state. Within the Site-Vicinity Study Area, the Open Space designation is only applied to the Islamic Cemetery of London lands located at the southeast corner of Manning Drive and White Oak Road (south of the W12A Landfill site). In accordance with Section 8A.2.2, private open space areas such as cemeteries are permitted in this designation.

The proposed expansion to the landfill boundary would not encroach into areas designated Open Space.

Environmental Review Designation

Schedule 'A' identifies that the Environmental Review designation has been applied to several lands in the Site-Vicinity Study Area, including lands adjacent to drainage corridors, and a large area in the northeast corner of the Site-Vicinity Study Area.

As set out in Section 8B of this Official Plan, areas designated Environment Review are identified through Subwatershed Planning Studies and are identified on Schedule 'A'. As stated in this Section, these lands are to be protected from activities that would diminish their functions pending the completion of a detailed environmental study. In accordance with Section 8B.3, pending further evaluation of these features, permitted uses in this designation include agriculture, woodlot management, horticulture, conservation, recreational uses, and essential public utilities and municipal services.

The proposed expansion to the landfill boundary would not encroach into areas designated Environmental Review.

Waste Management Area Policies

Notwithstanding the permissions set out for the Agricultural designation, specific policies for landfill sites are provided under Section 9.2.15 'Waste Management and Resource Recovery Area' and Section 17.4 'Operating and Closed Landfill Sites' of this Official Plan.

Section 9.2.15 specifically pertains to the Waste Management Resource Recovery Area which encompasses the W12A Landfill site and the lands generally located within the block bounded by Wellington Road South, Manning Drive, White Oak Road and Scotland Drive. In accordance with Section 9.2.15.1, properties addressed as 3137 and 3405 Scotland Drive and 5529, 5595, 5615, 5751 and 5879 Wellington Road South, which are located within this City block, do not form part of this specific policy area.

Section 9.2.15.2 addresses the planned function of the W12A Landfill and the adjacent MRF site:

"The City of London recognizes the importance of the existing W12A landfill and the suitability of the existing location to minimize environmental and social impact while providing the important economic function of waste management. The adjacent site is also a suitable location for landfill expansion and the development of an integrated Resource Recovery Centre for municipally managed waste reduction, waste disposal, waste diversion and waste processing, using principles of sustainability which are socially, environmentally and fiscally responsible."

Further, this Section identifies a set of objectives for the use of land within the Waste Management and Resource Recovery Area. In our opinion, the following objective is particularly relevant to the Project:

- “i To support the environment, public health and safety and the interests of residents by ensuring that all environmental, social and financial impacts of waste management / resource recovery activities are sufficiently controlled or mitigated in a timely manner.”

In our opinion, the Project supports the planned function of the Waste Management Resource Recovery Area. In this regard, the Project proposes to expand the existing landfill property to accommodate additional waste management facilities with consideration for sustainable design principles (as discussed in relation to associated PPS policies). It is also our opinion that the Project aligns with the referenced Waste Management Resource Recovery Area objective, as the facility expansion is being planned in a manner that considers the environment, public health and safety and the public interest.

In accordance with Section 9.2.15.3, a variety of waste management/resource recovery uses may be permitted within this defined area subject to site-specific zoning. Among the permitted uses in this defined area are municipal waste disposal facilities, as well as other waste disposal facilities such as material recovery facilities, yard waste composting facilities, and source separated organic composting facilities.

It is further noted in this Section that:

- Permitted uses are subject to the criteria listed in Section 9.2.15, 17.4 and 17.5 of the Official Plan;
- Farm dwellings and secondary farm dwellings are not permitted within this area; and
- Waste management and resource recovery uses should be planned to minimize disruption to existing agricultural uses and facilities.

In addition to the policy direction provided in Section 9.2.15, Sections 17.4 and 17.5 provide additional policies relating to operational landfills and other waste management facilities, respectively. In our opinion, Section 17.4.3 is of particular relevance to the Project. This policy sets out criteria for development in proximity of the existing landfill:

“Notwithstanding the land uses designated on Schedule "A" of this Plan and any associated policies, **future development will not be permitted on or in the vicinity of operating landfill sites**, closed landfill sites and other sites which produce gases similar to those found in landfill areas, **unless it is determined that the development satisfies the provisions of the Environmental Protection Act, and the development complies with any other provincial and municipal guidelines**, as applicable.” (emphasis added)

As discussed, the Project integrates a boundary expansion to the existing landfill property to accommodate additional lands for buffering and a Waste and Resource Material Drop-off Area. This expansion would be encompassed within the existing boundary of the defined Waste Management Resource Recovery Area. Further, with consideration for the intended use of the

expansion area, it is our opinion that the Project would (1) comply with existing permissions for the Waste Management Resource Recovery Area and (2) align with the identified objectives of the Agricultural designation. Additionally, as discussed in the aforementioned agricultural impact assessment, the Project should not adversely impact on existing agricultural uses and normal farm practices proximate to the Site Area.

Conclusion

Based on the foregoing and our broader evaluation of the proposed landfill expansion relative to the 1989 Official Plan, it is our opinion that the Project conforms with the planning direction and development permissions of this Official Plan.

4.1.2.3 The London Plan (2016)

The City of London Council adopted a new City of London Official Plan ('The London Plan') on June 23, 2016 and the Ministry of Municipal Affairs (MMA) issued its approval of the new Official Plan, with modifications, on December 28, 2016. Several parties subsequently appealed policies and schedules of the MMA-approved Official Plan to the Ontario Municipal Board, now the Local Planning Appeal Tribunal.

At this time, a number of policies and schedules applicable to the Site Area and Site-Vicinity Study Area remain under appeal and are not currently in effect. Notwithstanding, the following discussion describes how the Project aligns with the policy direction and development provisions of The London Plan as approved by the MMA.

Policy Context

Figure 4 of this Report illustrates that the Site Area and Site-Vicinity Study Area contain the following designations pursuant to Map 1 (Place Types) of The London Plan:

- Waste Management Resource Recovery Area;
- Farmland;
- Green Space; and
- Environmental Review.

An overview of the applied place types is provided below:

Waste Management Resource Recovery Area

The existing W12A Landfill site and adjacent lands are designated Waste Management Resource Recovery Area. As set out in Policy 1254 of The London Plan, this place type was developed specifically for the W12A Landfill to provide for the continued evolution of the landfill and surrounding area as an integrated waste management centre.

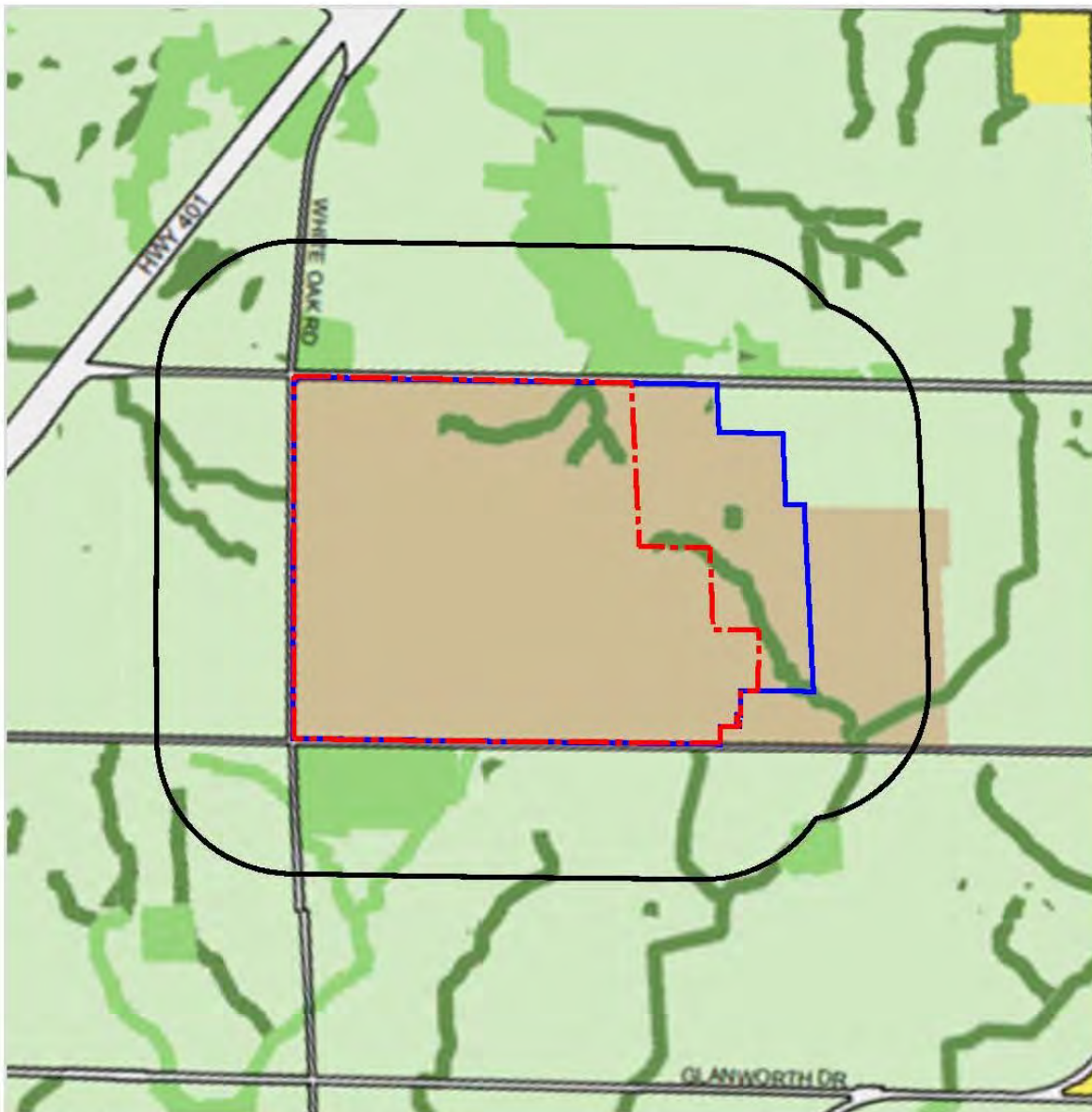


Figure 4
Place Types

Map 1 - The London Plan, 2016

Legend

- Site Area
- Site Study Area
- Site-Vicinity Study Area

PLACE TYPES

- | | |
|--|---|
| Urban Space | Heavy Industrial |
| Environmental Reserve | Light Industrial |
| Downtown | Commercial/Industrial |
| Transit Village | Future Community Growth |
| Rapid Transit Corridor | Future Industrial Growth |
| Urban Corridor | Farmland |
| Shopping Area | Rural Neighbourhoods |
| Main Street | Waste Management Resource Recovery Area |
| Neighbourhood | Urban Growth Boundary |
| Institutional | |

DATE: Dec. 3, 2020

SCALE: 1:20,000

FILE: 08227L

DRN: JB



1:08227L-0012A LANDFILL SITE THE LONDON PLAN, DEC 2020.DWG

MHBC PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE
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Policy 1254 also states that, “Landfills are important to the city’s future growth and development, provide a necessary public benefit and the ability to manage the city’s solid waste”. It is further prescribed in this Policy that landfills will be (1) designed to maximize utility and minimize negative impacts and (2) maintained in accordance with all relevant federal, provincial and municipal legislation and regulations.

Pursuant to Policy 1256 of this Official Plan, policies pertaining to the Waste Management Resource Recovery Area place type are intended to address several key objectives, including to:

- Apply to lands that are either currently being used as a landfill, are being considered for expansion, or a landfill in the process of remediation;
- Facilitate the transition into productive use as a landfill; and
- Promote best practices in site selection, site design, operation, and remediation.

In accordance with Policy 1258, the following uses are generally permitted on lands designated Waste Management Resource Recovery Area place type:

- Landfills;
- Related uses necessary to support waste reduction, re-use, recycling, resource recovery, treatment and waste disposal; and
- Eco-Industrial Parks where industries use materials available from the Waste Management Resource Recovery Area.

In addition to the above-noted uses, it is stated in Policy 1259 that a number of related uses are permitted in this place type through a site-specific Zoning By-law Amendment. These associated uses include a municipal waste disposal facility, community recycling drop-off depot, material recovery facility, and other similar waste uses.

The London Plan also contains a number of policies to guide land use and development in the vicinity of this place type. Most notably:

- Policy 1272 states that lot creation, either by consent or by plan of subdivision within the Waste Management Resource Recovery Area place type will not be permitted unless required to support approved landfill or resource recovery activities; and
- Policy 1273 provides the following policies for lands located within a 1,500 m radius of the Waste Management Resource Recovery Area place type boundary:
 - “1. The City will continue to work with property owners within a 1,500 metre radius of the Waste Management Resource Recovery Area to mitigate impacts related to odour, dust, litter and traffic.

2. Within the Farmland Place Type, the City will discourage new official plan and/or zoning by-law amendments to allow the development of new residential uses or other sensitive land uses within a 1,500 metre radius of the Waste Management Resource Recovery Area Place Type to provide appropriate separation distance to mitigate impacts.
3. The City will confine all municipal waste management and resource recovery uses and accessory uses to the Waste Management Resource Recovery Area Place Type."

Farmland Place Type

Figure 4 illustrates that the majority of lands within the Site-Vicinity Study Area surrounding the Waste Management Resource Recovery Area are designated Farmland place type. In accordance with Policy 1179, this place type is the prime agricultural area of London, and consists of prime agricultural land (Canada Land Inventory Classes 1, 2, and 3 soils) and associated Class 4 through 7 soils. This Policy also prescribes that the prime agricultural area, "...will be protected and maintained for the long term as the base to support a healthy, productive, and innovative agricultural industry as a key component of the city's economic base and cultural heritage."

Policy 1181 provides additional direction regarding the intent of the Farmland place type. In our opinion, the following objectives for this place type are of particular relevance to the Project:

- "9. Discourage uses which are not supportive of agriculture from locating in the Farmland Place Type. Limited non-agricultural uses may be permitted only where it can be demonstrated that the proposed use is consistent with the Provincial Policy Statement.
10. Minimize the potential for land use conflicts between residential uses and farm operations.
11. Mitigate impacts from any new or expanding non-agricultural uses on surrounding agricultural operations and lands."

As prescribed in Policy 1182, the Farmland place type permits a variety of agricultural and agricultural-related uses, and certain associated residential uses including principal farm residences, secondary farm dwelling units, and residential uses on existing lots of record.

With respect to sensitive land uses, pursuant to Policy 1186, the predominant type of development permitted in the Farmland place type is the farm unit. Pursuant to Policy 1186, the farm unit consists of the land base, the principal farm residence, secondary farm dwelling units that are required for the farm operation, and barns, silos, drive sheds, manure storage facilities and other farm buildings/ structures that support the farm operation.

Green Space

The Green Space place type is applied to the Islamic Cemetery of London (6100 White Oak Road) located south of the landfill facility. Within the Site-Vicinity Study Area, this place type is also applied to two woodlots on the north side of Scotland Drive, and a woodlot south of Manning Drive.

In accordance with Policy 758 of The London Plan, the Green Space place type is comprised of the following:

“... public and private lands; flood plain lands; lands susceptible to erosion and unstable slopes; natural heritage features and areas recognized by City Council as having city-wide, regional, or provincial significance; lands that contribute to important ecological functions; and lands containing other natural physical features which are desirable for green space use or preservation in a natural state.”

In accordance with Policy 762, uses permitted within this place type vary depending on the natural heritage features and areas contained on a site, the hazards present, and the presence of natural resources.

Environmental Review

The Environmental Review place type is applied to stream and drainage corridors throughout the Site-Vicinity Study Area. In accordance with Policy 779 of The London Plan, the Environmental Review place type is applied to lands that may contain natural heritage features and areas that have not been adequately assessed to determine their environmental significance.

In accordance with Policy 784, existing uses are permitted in this place type. Pending evaluation through environmental studies, permitted uses in the Environmental Review place type also include agriculture, woodlot management, horticulture, conservation, and recreational uses.

Conclusion

The Project integrates a proposed vertical expansion to the existing landfill footprint, as well as an expansion to the existing landfill boundary for additional buffering and a Waste and Resource Material Drop-off Area. As discussed, the boundary expansion would be encompassed within the existing boundary of the defined Waste Management Resource Recovery Area.

Given the intended use of the proposed expansion area, it is our opinion that the Project would comply with the policy objectives and existing permissions of the Waste Management Resource Recovery Area place type. In this respect, the Project was selected as the preferred alternative for the EA, in part, to maximize utility and minimize negative impacts associated with the landfill

expansion. Further, activities associated with the expanded landfill would be maintained in accordance with applicable legislation and regulations.

Additionally, it is our opinion that the Project would align with the function and objectives of the Farmland designation. In particular, as discussed in relation to the PPS, the components of the Project should not conflict with, or compromise, existing agricultural operations and normal farm practices proximate to the Site Area.

In light of these considerations, and our broader evaluation of the proposal relative to the policies of The London Plan, it is our opinion that the Project conforms with the planning direction and development permissions of this Official Plan.

4.1.2.4 City of London Zoning By-law

Figure 5 of this Report illustrates the zoning applied to the Site Area and Site-Vicinity Study Area pursuant to City of London Zoning By-law No. Z-1 (Zoning By-law). As illustrated, the W12A Landfill is zoned Waste and Resource Management (WRM1). Lands surrounding the landfill site within the Site-Vicinity Study Area are primarily zoned:

- Agricultural (AG2) Zone;
- Environment Review (ER) Zone;
- Open Space (OS3(1)) Zone; and
- Resource Extraction (EX) Zone.

A brief description of each zone is provided below.

Waste and Resource Management (WRM) Zone

Section 51.1 of the Zoning By-law states that the WRM Zone is applied to lands within the rural area of the City planned for waste management resource recovery areas. It is further stated in this Section that this Zone regulates a range of waste management and resource recovery uses, which are to be permitted by site-specific zoning.

In accordance with Section 51.2, the following uses are permitted in the WRM1 Zone variation applied to the Site Area and the MRF property:

- Agricultural uses;
- Municipal waste disposal facility;

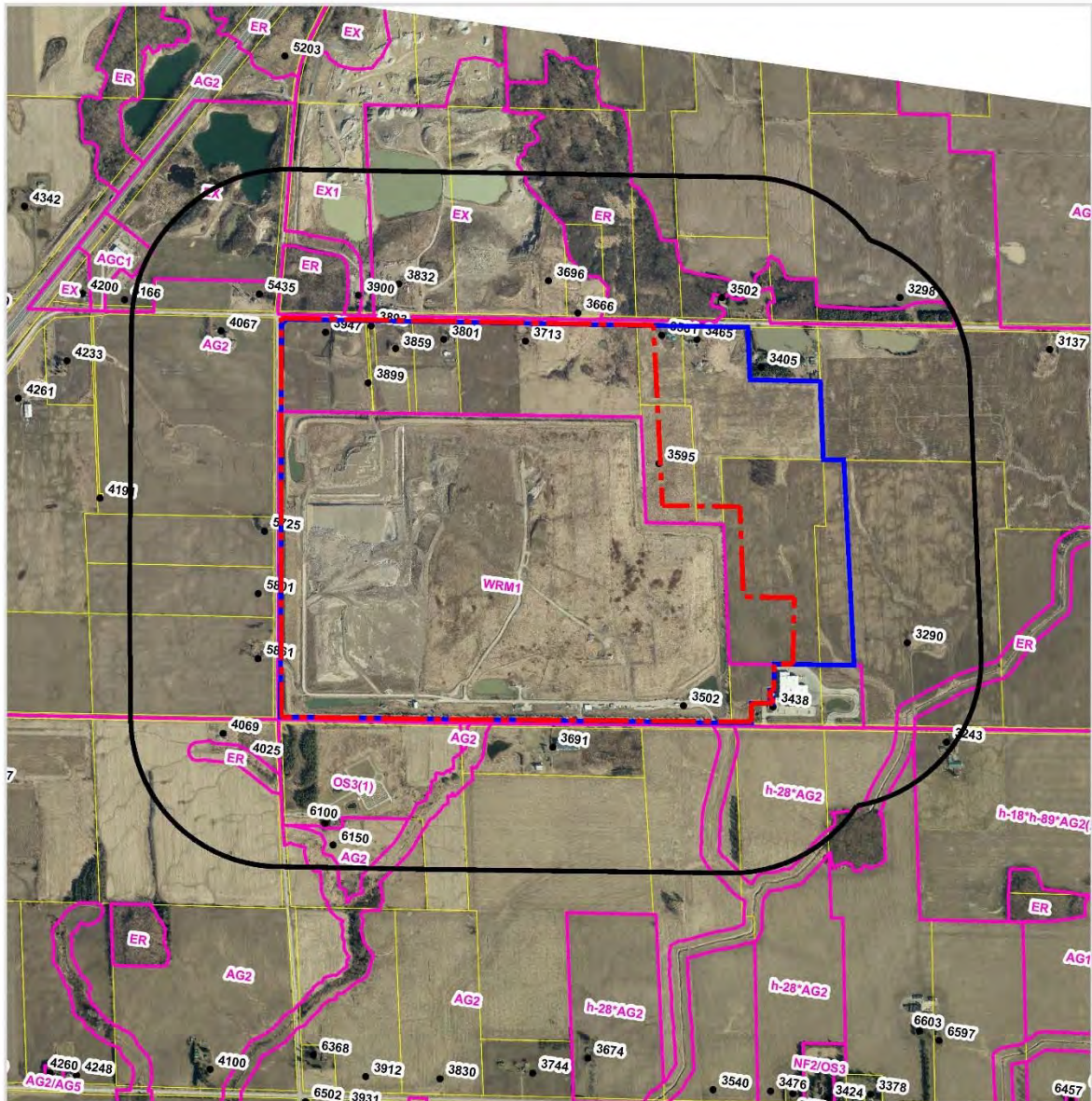


Figure 5
Zoning
City of London

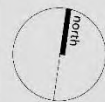
- Legend**
- Site Area
 - Site Study Area
 - Site-Vicinity Study Area
 - Parcel Fabric
 - Zoning

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W12A Landfill
City of London

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- Leachate pre-treatment/hauling liquid waste facility;
- Public drop-off for municipal hazardous and special waste;
- Community recycling and drop-off depot;
- Yard waste composting facility; and
- Material recovery facility.

Municipal waste disposal facility and material recovery facility are defined in Section 2 of the Zoning By-law as follows:

“MUNICIPAL WASTE DISPOSAL FACILITY” A Municipal Waste Disposal Facility is a facility for final disposal and includes landfills, solid waste incinerator and waste to energy facilities, including the flaring of landfill gas.”

Agricultural (AG) Zone

The Agricultural Zone is applied to the majority of the area surrounding the W12A Landfill, including those lands intended for the landfill boundary expansion. In accordance with Section 45.1 of the Zoning By-law, this Zone is intended to be applied to lands which are designated Agriculture in the Official Plan. As identified below, the AG1 Zone variation permits a wide range of non-intensive agricultural uses whereas the AG2 Zone variation permits intensive and non-intensive agricultural uses. AG2 zoned lands are located within the Site-Vicinity Study Area.

In accordance with Section 45.2 of the Zoning By-law, the following uses are permitted in the AG2 Zone.

AG1:

- Agricultural uses;
- Livestock facilities provided that such facilities are located at least 300 m from the City's Urban Growth boundary; or in accordance with the minimum distance separation regulations, whichever is greater;
- Farm dwelling;
- Forestry uses;
- Kennels;
- Conservation lands;
- Wayside pits;
- Nursery;
- Passive recreation use;
- Farm market;
- Small Wind Energy Conversion System; and
- Greenhouse Farm.

AG2:

- Any use permitted in the AG1 Zone variation;
- Livestock facilities;
- Compost facility;
- Aquaculture;
- Agricultural research station;
- Manure storage facility; and
- Mushroom Farm.

The lands associated with the proposed buffer expansion are zoned AG2. In light of the intended use of these lands as fallow field, it is anticipated that the proposed buffer would be permitted in accordance with the agricultural use permissions of the AG2 Zone. However, if the buffer areas are required for additional waste management uses, it is anticipated that these lands would need to be rezoned to WRM1.

Environmental Review (ER) Zone

Section 37.1 of the Zoning By-law states that the ER Zone applies to areas designated Environmental Review on Schedule 'A' of the 1989 Official Plan. It is further stated that lands in this zone are intended to remain in a natural condition until their significance is determined through detailed environmental studies. In keeping with the local application of the Environmental Review designation, the ER Zone is primarily applied to drainage and stream corridors and to the woodlot near the northeastern corner of the Site-Vicinity Study Area.

Pursuant to Section 37.2, the following uses are permitted in the ER Zone:

- Conservation lands;
- Conservation works;
- Passive recreational uses;
- Managed woodlot; and
- Agricultural uses.

Open Space (OS3(1)) Zone

The Open Space (OS3) Zone is applied within the Site-Vicinity Study Area to the Islamic Cemetery of London. Pursuant to Section 36.1 of the Zoning By-law, the OS3 Zone variation is applied to cemeteries that have no alternative uses.

Further, a site-specific OS3(1) Zone variation is applied to the cemetery lands. As prescribed in Section 36.3 of the Zoning By-law, structures related to assembly, mausoleum or crematorium are not permitted within the OS3(1) Zone boundary.

Resource Extraction (EX) Zone

Within the Site-Vicinity Study Area, lands zoned EX and EX1 are located on the north side of Scotland Drive. Section 43.1 of the Zoning By-law states that this zone regulates resource extraction operations.

Section 43.2 prescribes that the following uses are permitted in these zones:

EX Zone:

- Resource extraction operations, including accessory aggregate reprocessing;
- Farms;
- Wayside pits; and
- Forestry uses.

EX1 Zone:

- Resource extraction operations, including accessory aggregate reprocessing, asphalt batching plants, and concrete batching plants;
- Farms, except for livestock facilities;
- Wayside pits; and
- Forestry uses.

Conclusion

In summary, it is anticipated that the proposed vertical expansion of the landfill and the proposed Waste and Resource Material Drop-off Area would be permitted uses in the WRM1 Zone. It is also anticipated that the proposed buffer would be permitted in accordance with the agricultural use permissions of the AG2 Zone. However, if the buffer areas are required for additional waste management uses, these lands may need to be rezoned to WRM1. Further review will be needed during the design phase of the Project to confirm if the uses intended for the boundary expansion comply with existing Zoning By-law permissions. As discussed, in our opinion, the proposed Waste and Resource Material Drop-off Area and expanded on-site buffer area would be consistent with existing Official Plan permissions.

With respect to the other zones within the Site-Vicinity Study Area, the existing zoning structure limits development permissions in the vicinity of the Site Area. Further, in light of the existing zoning structure and the associated Official Plan policy framework, in our opinion, it is unlikely that new sensitive land uses would be introduced in close proximity to the Site Area.

4.2 Assessment of Effects on Current Land Uses

As identified in Section 4.1.2 of this Report, Guideline D-4 itemizes sensitive land uses for operating landfills:

- A permanent structure used in animal husbandry;
- Agricultural land used for pasturing livestock;
- A permanent structure where: a person sleeps, or a person is present on a full time basis (but not including food or motor vehicle service facilities adjacent to a highway, utility operations, scrap yards, heavy industrial uses, gravel pits, quarries, mining or forestry activities); and
- Cemeteries.

As an outcome of our land use evaluation, the following sensitive uses were identified within the Site-Vicinity Study Area in proximity to the existing landfill facility. Figure 2 of this Report illustrates the general location of the identified uses.

North:	Seven residential dwellings; aggregate extraction operation;
West:	Agricultural land;
East:	City of London MRF; agricultural land; and
South:	Cemetery; agricultural land; farm and associated dwelling; cattle farm.

As identified in Section 4.1.2 of this Report, several studies have been completed to assess potential impacts of the Project on existing land uses within the Site-Vicinity Study Area including identified sensitive land uses. Of particular relevance to this assessment are the noise, odour and air assessments. Generally, it is concluded in these associated reports that the proposed landfill expansion (1) is expected to meet all Provincial criteria with respect to noise, odour and air quality and (2) is not expected to result in impacts in excess of these criteria. Mitigation and monitoring programs are recommended in these reports to help minimize potential impacts associated with landfill operations following implementation of the Project.

Additionally, as outlined in Section 3.1 of this Report, the proposed landfill expansion does not result in the limits of waste being extended towards any of the sensitive land uses identified above. A residential dwelling is currently located to the north of the existing landfill on lands addressed as 3801 Scotland Drive. This residence is situated within the area intended for the landfill boundary expansion. In conjunction with the landfill expansion process, this dwelling will be removed to facilitate additional on-site buffering.

Given these considerations, provided the recommended impact mitigation is implemented, in our opinion the Project should not generate adverse impacts on these existing land uses. Further, in light of the intended use of the proposed expansion area, it is our opinion that the Project would be compatible with the existing land uses within the Site-Vicinity Study Area.

4.3 Assessment of Effects on Planned Future Land Use

No current development applications have been identified within the Site-Vicinity Study Area. Additionally, given the policy framework described under Section 2 of this Report it is not anticipated that sensitive land uses would be constructed in the Site-Vicinity Study Area within the 2035 planning horizon defined for the London Plan (pursuant to Policies 24 and 67). Our opinion on future land use in proximity to the landfill site is based, in part, on the following considerations:

- Pursuant to Section 17.4.3 of the 1989 Official Plan, future development is not permitted on or in the vicinity of operating landfill sites, unless it is determined that the development satisfies the provisions of the Environmental Protection Act, and the development complies with any other applicable provincial/municipal guidelines; and
- Policy 1273 of The London Plan prescribes that within the Farmland place type, the City will discourage new official plan and/or zoning by-law amendments to allow the development of new residential uses or other sensitive land uses within a 1,500 m radius of the Waste Management Resource Recovery Area place type (to provide appropriate separation distance to mitigate impacts).

In addition, the City owns a majority of the parcels within the Site-Vicinity Study Area to the east of the Site Area, as well as a number of parcels to the west and north of the Site Area. As outlined in this Report, the City has implemented measures to reduce the potential impacts of the existing W12A Landfill on sensitive land uses in the vicinity of the site (i.e., dwelling removal).

In light of these considerations, in our opinion it is anticipated that any future development in the Site-Vicinity Study Area within the 2035 planning horizon would be compatible with the uses planned for the Site Area. In this respect, given the planning framework applicable to Site-Vicinity Study Area, it is unlikely that new sensitive uses would be established in close proximity to the W12A Landfill site.

Based on the forgoing, it is our opinion that the Project should not adversely impact on future land uses within the Site-Vicinity Study Area.

5.0 Mitigation and Monitoring

As discussed in this Report, in our opinion measures recommended in conjunction with this Environmental Assessment should be implemented to mitigate any potential impacts to land uses proximate to the existing landfill facility. In this respect, project planning should have regard for (1) any mitigation required to protect surrounding land uses from noise, odour and dust impacts and (2) mitigation measures recommended to protect natural heritage features and functions.

6.0 Other Approvals

Section 4.1.2 of this Report identifies that the existing W12A Landfill and the Site Area limits are located within the Waste Management Resource Recovery Area of the City of London Official Plan (1989) and are designated Waste Management Resource Recovery Area pursuant to The London Plan. In our opinion, the core components of the Project (i.e., vertical landfill expansion, expanded on-site buffer area, Waste and Resource Material Drop-off Area) would be consistent with the existing land use permissions of both Official Plans.

Additionally, as identified in Section 4.1.2 of this Report, it is anticipated that the proposed vertical expansion of the landfill and the proposed Waste and Resource Material Drop-off Area would be permitted uses in the WRM1 Zone. It is also anticipated that the proposed buffer would be permitted in accordance with the agricultural use permissions of the AG2 Zone. However, if these buffer areas are required for additional waste management uses, these lands may need to be rezoned to WRM1. Further review will be needed during the design phase of the Project to confirm if the intended uses of the Site Area comply with existing Zoning By-law permissions.

7.0 Conclusion

The City of London is proposing an expansion of the existing W12A Landfill site (the Project) located at 3502 Manning Drive, London. Generally, this property is located in a predominately agricultural area of London, south of the City's Urban Growth Boundary.

The proposed landfill expansion incorporates a vertical expansion over 106.3 ha of the existing landfill footprint. Additionally, the existing landfill property boundary is proposed to be extended to accommodate (1) additional on-site buffering north and east of the existing landfill facility and (2) a new small vehicle Waste and Resource Material Drop-off Area. Collectively, these site modifications would increase the landfill boundary from approximately 140.0 ha to approximately 192.4 ha.

This Report evaluates the compatibility of the Project with surrounding land uses with consideration for (1) the proposed operational practices and (2) predictive assessments related to potential nuisance effects. The assessment of current and future land uses in the defined Site Area and Site-Vicinity Study Area was predicated on a study methodology designed at the outset of the evaluation. Generally, this methodology integrated: a review of the regulatory context and planning policy framework applicable to these areas; data collected during a field survey, an analysis of aerial photography; and information obtained through interviews with City of London (City) staff. The evaluation process was carried out between September 2019 and August 2020. Through this review, land uses that may be sensitive to the potential impacts of landfilling activities were identified.

In effect, the core elements of the Project would not result in an expansion to the existing landfill footprint; however approximately 52.4 ha of adjacent lands would be integrated into the facility for site buffering and additional waste management activities. These lands are currently within City of London ownership and are encompassed with the Waste Management Resource Recovery Area permissions of the City's 1989 Official Plan and The London Plan. Based on our planning analysis of the Project and the applicable planning policy framework, it is our opinion that the Project would (1) comply with existing permissions for this special policy area and (2) align with the identified objectives of these Official Plans.

As identified in this Report, several studies have been completed to assess potential impacts of the Project on existing land uses within the Site-Vicinity Study Area including identified sensitive land uses. Of particular relevance to this assessment are the noise, odour and air assessments. Generally, it is concluded in these associated reports that the proposed landfill expansion is expected to meet all Provincial criteria with respect to noise, odour and air quality and is not expected to result in impacts in excess of these criteria. Further, as outlined in this Report:

- The proposed landfill expansion does not result in the limits of waste being extended towards any of the identified sensitive land uses; and
- Given the intended use of the proposed expansion area, it is our opinion that the Project would be compatible with existing land uses in the Site-Vicinity Study Area.

Additionally, in our opinion it is anticipated that any future development in the Site-Vicinity Study Area within the 2035 planning horizon of The London Plan would be compatible with the uses planned for the Site Area. In this respect, given the planning framework applicable to Site-Vicinity Study Area, it is unlikely that new sensitive uses would be established in close proximity to the W12A Landfill site.

In light of these findings, provided recommended impact mitigation is implemented, in our opinion the Project should not generate adverse impacts on current or future land uses in the Site-Vicinity Study Area. It is also our opinion that the Project would be compatible with current and future land uses within this defined study area.

Respectfully submitted,

MHBC
Planning, Urban Design & Landscape Architecture



Scott Allen, MA, RPP
Partner



Eric Miles, MPL, RPP
Planner

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D.07 Agricultural Resources Existing Conditions and
Impact Assessment Report; completed by
MHBC

AGRICULTURAL EXISTING CONDITIONS AND IMPACT ASSESSMENT

W12A Landfill Expansion Environmental Assessment

DRAFT

3502 Manning Drive
London

Date:

December 2020

Prepared for:

City of London

Prepared by:

MacNaughton Hermesen Britton Clarkson Planning Limited (MHBC)

630 Colborne Street, Suite 202

London ON N6B 2V2

T: 519 858 2797 x223

F: 519 858 2920

MHBC File: 08227'A'

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Appendix A: Soil Mapping

Abbreviations

ToR	Terms of Reference
EA	Environment Assessment
EASR	Environmental Assessment Study Report
PPS	Provincial Policy Statement
OMAFRA	Ontario Ministry of Agriculture, Food, and Rural Affairs
CLI	Canada Land Inventory
MDS	Minimum Distance Separation
ha	Hectares
m	Metre
m³	Cubic Metres
masl	Metres Above Sea Level
MRF	Material Recovery Facility

1.0 Introduction

The City of London is proposing an expansion of the existing W12A Landfill site (the Project) located at 3502 Manning Drive, London. The existing landfill lands are described as part of Lots 18, 19 and 20, Concession 6 in the former Township of Westminster. Generally, these lands are located in a predominately agricultural area of London, south of the City's Urban Growth Boundary.

The environment is considered in broad terms to include the natural, social, cultural, and economic aspects of the environment. This Report presents the existing conditions and impact assessment for the agricultural component of the Environment Assessment (EA) being carried out for the proposed W12A Landfill expansion. This assessment has been conducted in accordance with the requirements set out in the approved Terms of Reference (ToR) for the EA, dated February 2019.

This Report is a supporting document to the Environmental Assessment Study Report (EASR). As discussed in Section 3.0 of this Report, the preferred expansion alternative identified through the EA process is the vertical expansion above the existing landfill footprint.

2.0 Existing Conditions

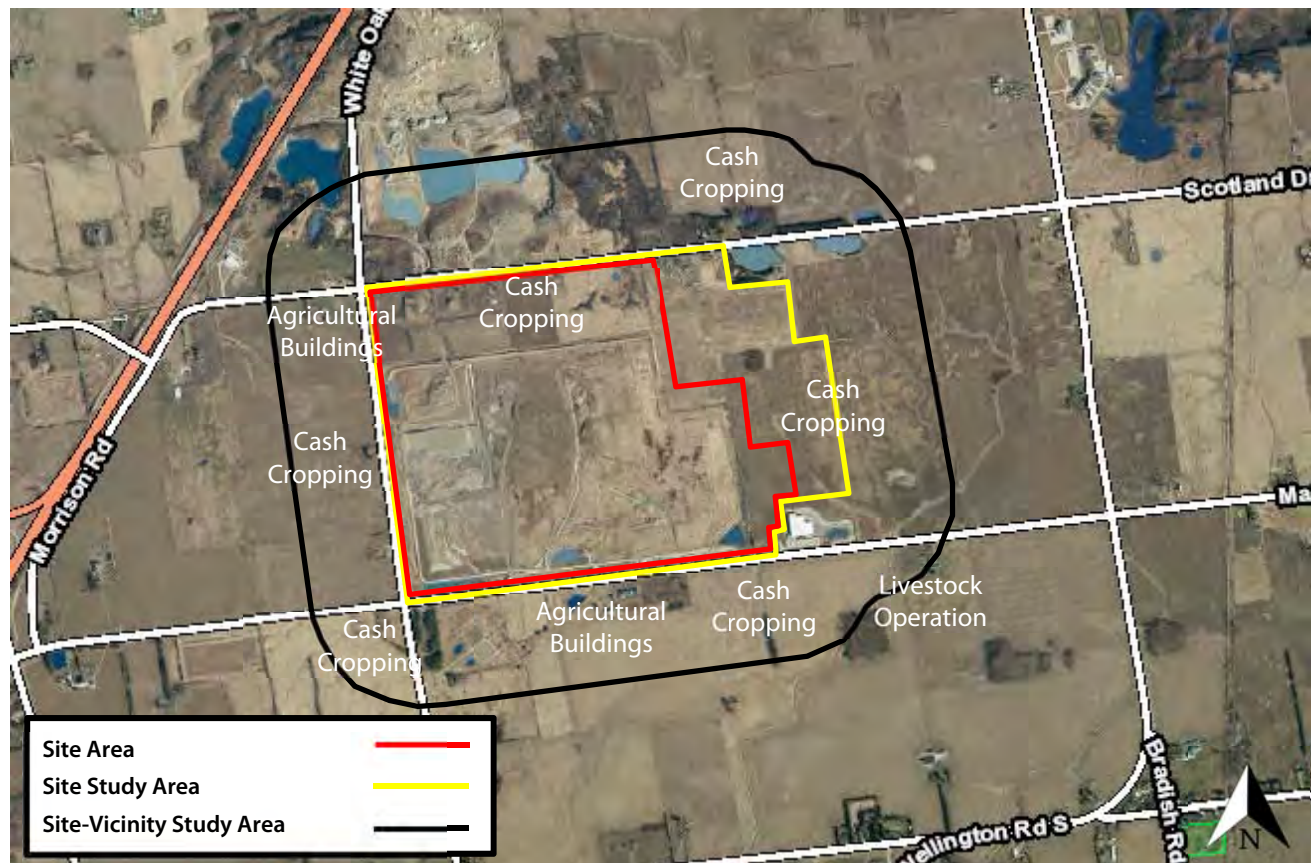
2.1 Agricultural Characteristics in Site Area and Site-Vicinity Study Area

The following provides an overview of agricultural and non-agricultural uses surrounding the W12A Landfill within the Site Area, Site Study Area and Site-Vicinity Study Area, as defined through the EA process. The boundaries of each of these study areas are described below and illustrated on Figure 1 of this Report:

- The Site Area encompasses the existing W12A Landfill site and adjacent lands required for the proposed landfill expansion;
- The Site Study Area represents the limit of property considered in conjunction with the evaluation of EA study alternatives; and
- The Site-Vicinity Study Area includes an area with a radius of 500 m around the Site Study Area.

Figure 1 also illustrates the general agricultural land uses in the vicinity of the existing landfill site.

Figure 1: Location and Context Map



Source: City of London Maps, 2020

Land uses within the Site-Vicinity Study Area are summarized in the following discussion. The characterization of land use activities in the Site-Vicinity Study Area was based primarily on a field survey undertaken by vehicle (i.e., 'windshield survey') on October 8, 2019, an examination of aerial imagery, and discussions with the City of London.

Existing Land Uses (Site-Vicinity Study Area):

North: A portion of the land base between the existing landfill berm and Scotland Drive is actively cultivated for cash crop production (soybeans). The remaining lands are considered fallow with hilly topography observed between the berm and Scotland Drive. These lands do not appear to have been used for agricultural production. Westcliff Pit, operated by AAROC Aggregates, and the Bre-Ex Gravel Pit, operated by Brekemens Holdings, are located on the north side of Scotland Drive (gravel pit). Soybean and corn production were also observed on the north side of Scotland Drive. Further, storage for non-agricultural activities was visible at 3405 Scotland Drive, and rural residential dwellings are located at that property, as well as 3465, 3561, 3465 and 3801 Scotland

Drive. The property at 3405 Scotland Drive includes a large pond; the property at 3465 Scotland Drive includes a demolished barn.

East: Lands east of the proposed landfill expansion are under active cultivation for conventional cash crop production (corn, soybeans, wheat rotation). There is a vacant industrial storage building at the intersection of Scotland Drive and Wellington Road South. In terms of crops, typical cash crops (corn and soybeans) are found along Wellington Road South. A rural residential dwelling at 5751 Wellington Road South shows evidence of a previous farmstead (bank barn foundation and roofless silo). Rural residential dwellings are also located at 5595, 5615 and 5751 Wellington Road South.

South: A livestock operation (beef) is located at 3243 Manning Drive, approximately 400 m southeast of the Material Recovery Facility (MRF), which is situated at 3438 Manning Drive. The house on the property is vacant. Large agricultural parcels were in conventional cash crop production (corn). There is also an agricultural operation located at 3691 Manning Drive, which includes a large driving shed with solar panels, a bank barn, roofless silo and rural residential dwelling surrounded by cash crop production (corn). Livestock was not visible at this location. The Islamic Cemetery of London (6100 White Oak Road) is also located south of the existing landfill.

West: There is a dilapidated barn/storage building located at 4025 Manning Drive. Large agricultural parcels were in cash crop production (soybeans). There is evidence of a farmstead at 5861 White Oak Road (treeline, foundation of buildings). There is also an existing farmstead at 4067 Scotland Drive, which includes a small barn, Quonset hut, ancillary structures and a rural residential dwelling. This property appears to be used for storage rather than active agricultural production. A rural residential dwelling is located at 5435 White Oak Road with evidence of a previous farmstead (stand-alone silo, barn foundation).

In summary, the Site-Vicinity Study Area is largely comprised of conventional agricultural production (e.g., cash crop production, livestock operations). A review of census of agriculture data (2016) confirms that the characterization of the Site-Vicinity Study Area is consistent with regional and provincial agricultural production practices, as nearly half (47%) of recorded farms are oilseed and grain operations. The surrounding context is illustrated on Figure 1.

3.0 Project Description

3.1 General Description

The Project incorporates a vertical expansion over 106.3 ha of the existing landfill footprint, which has a total approved footprint area of 107 ha. In effect, implementation of this Project would

result in 13.8 million m³ of additional airspace for waste and daily cover, with a highest ridge elevation of waste of 318.43 masl (approximately 43 m above ground elevation).

Additionally, the boundary of the existing landfill site is proposed to be expanded to accommodate additional on-site buffering and additional waste management activities. In comparison to existing conditions, the following modifications are proposed within this expanded boundary (Site Area):

- The northern boundary of the landfill property would be extended approximately 310 m to the Scotland Drive corridor for buffering purposes, with the eastern buffer width extended approximately 60 m. At this time, with the exception of a boundary fence, no infrastructure is proposed for these buffer areas. These lands would be seeded and left fallow, unless there is a future need for contingency measures or other infrastructure within these areas; and
- An eastern expansion of the existing landfill adjacent along the Manning Drive frontage to interface with the adjacent MRF property (approximately extension width: 145 m). Lands in this expansion area would accommodate a new small vehicle Waste and Resource Material Drop-off Area. It is anticipated that this new facility would include a new scale and scalehouse, a grade-separated small vehicle drop-off for waste, a grade-separated small vehicle drop-off for recyclable materials, an area for drop-off of brush, tires and large items, and a new Household Special Waste depot.

Collectively, the proposed modifications would increase the landfill boundary from approximately 140.0 ha to approximately 192.4 ha.

4.0 Impact Assessment

4.1 Methodology

The assessment of Project-related impacts on agricultural land and operations within the Site-Vicinity Study Area was predicated on the Province's draft Agricultural Impact Assessment Guidelines (released March 2018).

Considerations applied in the assessment include: the degree of investment and agricultural infrastructure (e.g. tile drainage, fencing); soil capability; and potential impacts on agricultural land, surrounding uses and the wider agricultural system. These considerations were evaluated to assess the potential loss of agricultural lands and production, as well as the potential impact of the landfill expansion on the broader agricultural system.

Predicted impacts on agricultural lands were based on a site visit, which occurred on October 8, 2019, to identify and verify existing conditions, and analysis of the following data sources:

- Relevant provincial land use plans (Provincial Policy Statement, 2020);
- Municipal planning documents and land use maps (1989 Official Plan, The London Plan);
- OMAFRA constructed and agricultural artificial drainage mapping (OMAFRA Agricultural Information Atlas);
- Soil and Canada Land Inventory (CLI) Capability mapping (OMAFRA Agricultural Information Atlas);
- Aerial imagery (historic and recent);
- Agricultural crop statistics (Statistics Canada, 2016 Census of Agriculture); and
- Parcel mapping from City of London.

4.1.1 Policy Overview

MHBC completed a land use assessment for the Site Area and Site-Vicinity Study Area in conjunction with the EA process. The findings of this evaluation are detailed in the Land Use Existing Conditions and Impact Assessment: W12A Landfill Expansion Environmental Assessment, dated November 2020 (Land Use Assessment Report).

The following provides an overview of the agricultural policy framework applicable to the Site Area and Site-Vicinity Study Area, as presented in the aforementioned Land Use Assessment Report. Specifically, this overview addresses how, in our opinion, the Project is in keeping with the agricultural policies of the Provincial Policy Statement, the City of London's Official Plan (1989) and the City's new Official Plan (The London Plan).

4.1.1.1 Provincial Policy Statement, 2020

The 2020 Provincial Policy Statement (PPS) came into effect on May 1, 2020 under Section 3 of the *Planning Act*. The PPS provides overall policy direction on matters of provincial interest related to land use planning and development, and sets the policy foundation for regulating the development and use of land. In this respect, Section 3 of the Planning Act requires that all decisions affecting planning matters "shall be consistent with" policy statements issued under the Planning Act.

Policy Context

In the context of the 2020 PPS, in our opinion, the activities associated with the W12A Landfill and the Project would be considered a 'waste management system'. It is also our opinion that a landfill would be classified as a 'major facility' under the terms of the PPS. Section 6.0 of the PPS defines these relevant terms as follows:

“Waste management system: means sites and facilities to accommodate solid waste from one or more municipalities and includes recycling facilities, transfer stations, processing sites and disposal sites.

Major facilities: means facilities which may require separation from sensitive land uses, including but not limited to airports, manufacturing uses, transportation infrastructure and corridors, rail facilities, marine facilities, sewage treatment facilities, waste management systems, oil and gas pipelines, industries, energy generation facilities and transmission systems, and resource extraction activities.”

Additionally, in the context of the PPS, in our opinion, the Site-Vicinity Study Area would be classified as a prime agricultural area. Prime agricultural areas are defined as follows in Section 6:

“Prime agricultural area: means areas where prime agricultural lands predominate. This includes areas of prime agricultural lands in associated Canada Land Inventory Class 4 through 7 Lands, and additional areas where there is a local concentration of farms which exhibit characteristics of ongoing agriculture. Prime agricultural areas may be identified by the Ontario Ministry of Agriculture and Food using guidelines developed by the Province as amended from time to time. A prime agricultural area may also be identified through an alternative agricultural land evaluation system approved by the Province.”

Further, Section 6 defines prime agricultural land as:

“Prime agricultural land: means specialty crop areas and/or Canada Land Inventory Class 1, 2 and 3 lands, as amended from time to time, in this order of priority for protection.”

A review of the Site-Vicinity Study Area’s soil capability confirms that surrounding agricultural lands are identified as prime agricultural lands comprised predominantly of Class 2 and 3 soils. Class 5 and unclassified soils are also identified within the southern and northern portions of the Site-Vicinity Study Area, respectively (refer to Soil Mapping provided in **Appendix A**).

The PPS defines specialty crop areas as follows:

“Specialty crop area: means areas designated using guidelines developed by the province, as amended from time to time. In these areas, specialty crops are the predominantly grown, such as tender fruits (peaches, cherries, and plums), grapes, other fruit crops, vegetable crops, greenhouse crops, and crops from agriculturally developed organic soil, usually resulting from:

- a) Soils that have suitability to produce specialty crops, or lands that are subject to special climatic conditions, or a combination of both;
- b) Farmers skilled in the production of specialty crops; and
- c) A long-term investment of capital in areas such as crops, drainage, infrastructure and related facilities and services to produce, store, or process specialty crops.”

The Site Area and Site-Vicinity Study Area have not been identified or designated as a specialty crop area by the Province or the City of London and, in our opinion, these lands do not exhibit characteristics of a specialty crop production as defined by the PPS.

Policy Review (Agricultural Policies)

The Project has been evaluated with regard to the policy direction and provisions of the PPS. In our opinion, specific policies contained within Section 2.0 (Wise Use and Management of Resources) are particularly relevant to the evaluation of potential agricultural impacts associated with this Project. These policies form part of Policy 2.3 (Agriculture) and are identified below:

1. Policy 2.3.1 states that prime agricultural areas shall be protected for long-term use for agriculture.
2. Policy 2.3.3 addresses permitted land uses in prime agricultural areas:
 - Policy 2.3.3.1 states that, “In prime agricultural areas, permitted uses and activities are: agricultural uses, agriculture-related uses and on-farm diversified uses”;
 - Policy 2.3.3.2 prescribes that all types, sizes and intensities of agricultural uses and normal farm practices shall be promoted and protected in prime agricultural areas, in accordance with provincial standards; and
 - Policy 2.3.3 states that new land uses shall comply with the Minimum Distance Separation (MDS) formulae developed by the Province.

Respecting Policies 2.3.1, 2.3.3.1 and 2.3.3.2, the Project integrates vertical expansion over the existing landfill footprint, as well as a boundary expansion to accommodate additional buffer areas and a Waste and Resource Material Drop-off Area. As detailed in the following Official Plan discussion, the expansion area is located within the defined boundary of the site-specific W12A Landfill policy area. In our opinion, the proposed boundary expansion would be accommodated on lands specifically designated for a waste management system. Accordingly, in the context of the PPS, the Project would not introduce a new non-agricultural use into a prime agricultural area. Further, in our opinion, the components of the Project would not specifically constrain, or compromise, existing agricultural uses and normal farm practices within the prime agricultural area proximate to the Site Area.

With regard to Policy 2.3.3, MDS setbacks are applied to separate uses to reduce incompatibility concerns relating to odour emissions from livestock facilities. Specific direction on the applicability of MDS formulae is provided in the Minimum Distance Separation (MDS) Document, prepared by OMAFRA (Publication 853). Guideline No. 3 of this Publication states that MDS I and II setbacks are not required for landfills. Accordingly, consistent with Policy 2.3.1 of the PPS, the

existing landfill area and the proposed buffer area should not constrain existing agricultural operations in proximity of this facility, including those within the Site-Vicinity Study Area.

Additionally, noise, odour and air quality studies were conducted to assess the potential impacts of the proposed landfill expansion on adjacent sensitive land uses. Generally, it is concluded in these associated reports that the identified landfill expansion is expected to meet all Provincial criteria with respect to noise, odour and air quality.

In light of these considerations and our broader evaluation of the Project relative to the PPS documented in the associated Land Use Assessment Report, it is our opinion that the Project satisfies, and is consistent with, the Provincial Policy Statement.

4.1.1.2 City of London Official Plan (1989)

The City of London Official Plan was adopted pursuant to approval of Official Plan Amendment No. 438 by the Minister of Municipal Affairs and Housing, with modifications, on December 17, 2009. Certain policies incorporated into the update were referred to the Ontario Municipal Board; however, these appeals were subsequently resolved.

Policy Context

Figure 2 of this Report illustrates that the Site-Vicinity Study area contains the following land use designations pursuant to Schedule 'A' (Land Use Plan) of the 1989 Official Plan:

- Agriculture;
- Open Space; and
- Environmental Review.

For the purposes of this assessment, the policies of the Agricultural designation are referenced. As discussed, a more detailed evaluation of adjacent land uses is included in the Land Use Assessment Report.

Policy Review (Agriculture Designation)

The preamble to Chapter 9 of the 1989 Official Plan outlines that the Agriculture designation is applied to lands outside of the urban community. As illustrated on Figure 2, this designation comprises the majority of the Site-Vicinity Study Area including the W12A Landfill site.

Section 9.1.1 sets out a series of objectives for the Agriculture designation. In our opinion, the following objectives are particularly relevant to the Project:

- “i) Protect, maintain and improve the prime agriculture land base for future generations. Prime agricultural land consists of Classes 1, 2, and 3 soils according to the Canada Land Inventory Capability Classification for Agriculture mapping and specialty croplands.

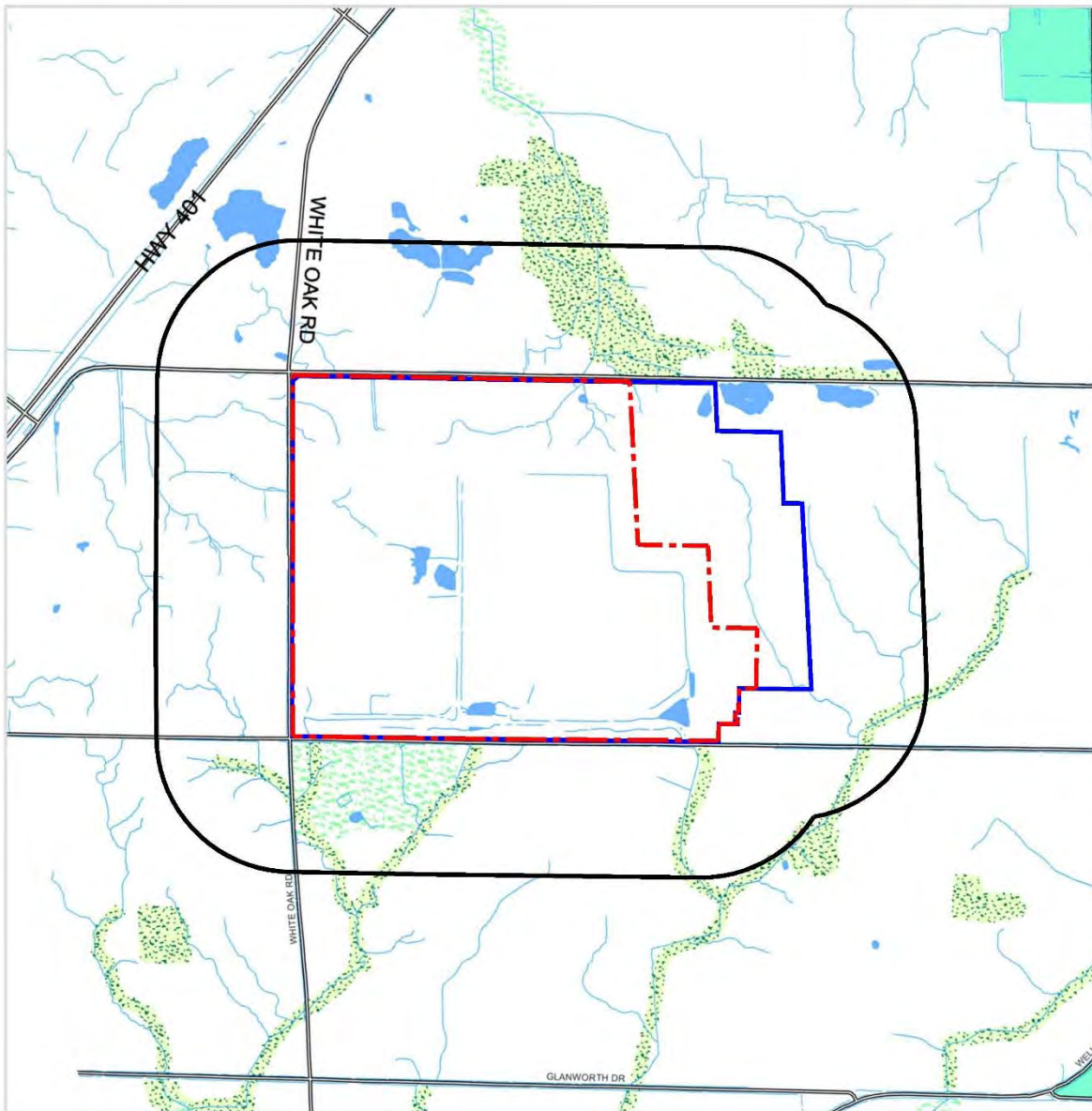


Figure 2
Schedule A - Land Use
 Map 11 & 14 - City of London Official Plan, 1989

Legend

- Site Area
- Site Study Area
- Site-Vicinity Study Area

 Regional Facility	 Urban Reserve: Community Growth	 Environmental Review
 Community Facility	 Urban Reserve: Industrial Growth	 Agricultural
 Open Space	 Rural Settlement	 Urban Growth Boundary

DATE: Dec. 3, 2020

SCALE: 1:20,000

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DRN: JB



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W12A Landfill
 City of London

MHBC PLANNING
 URBAN DESIGN
 & LANDSCAPE
 ARCHITECTURE
 200-540 BINGEMANS CENTRE DR. KITCHENER, ON, N2B 3X9
 P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

- ii) Promote and support a healthy and productive agricultural industry as a key component of the City's economic base and heritage.
- iii) Promote farm practices which encourage the conservation of surface and ground water resources, aquatic habitat, woodlands, wetlands, wildlife habitat and other natural features, where such practices do not impose undue limitations on the farming community.
- ix) Mitigate impacts from any new non-agricultural uses on surrounding agricultural operations and lands to the extent feasible."

In accordance with Section 9.2.1 of this Official Plan, the primary permitted use of land in the Agriculture designation is the cultivation of land and the raising of livestock. Further, a full range of farm-related activities are permitted in this designation including general farming, livestock farming, cash crop farming, market gardening, specialty crops, nurseries, forestry, aquaculture and agricultural research. Farm residences are also permitted in this designation, as are home occupations and secondary farm occupations subject to specific provisions set out in the Official Plan.

Notwithstanding the permissions set out for the Agricultural designation, specific policies for landfill sites are provided under Section 9.2.15 'Waste Management and Resource Recovery Area' and Section 17.4 'Operating and Closed Landfill Sites' of this Official Plan.

Section 9.2.15 specifically pertains to the Waste Management Resource Recovery Area which encompasses the W12A Landfill site and the lands generally located within the block bounded by Wellington Road South, Manning Drive, White Oak Road and Scotland Drive. In accordance with Section 9.2.15.1, properties addressed as 3137 and 3405 Scotland Drive and 5529, 5595, 5615, 5751 and 5879 Wellington Road South, which are located within this block, do not form part of this specific policy area.

Section 9.2.15.2 addresses the planned function of the W12A Landfill and the adjacent MRF site:

"The City of London recognizes the importance of the existing W12A landfill and the suitability of the existing location to minimize environmental and social impact while providing the important economic function of waste management. The adjacent site is also a suitable location for landfill expansion and the development of an integrated Resource Recovery Centre for municipally managed waste reduction, waste disposal, waste diversion and waste processing, using principles of sustainability which are socially, environmentally and fiscally responsible."

In accordance with Section 9.2.15.3, a variety of waste management/resource recovery uses may be permitted within this defined area subject to site-specific zoning. Among the permitted uses in this defined area are municipal waste disposal facilities, as well as other waste disposal facilities

such as material recovery facilities, yard waste composting facilities, and source separated organic composting facilities. It is further noted in this Section that waste management and resource recovery uses should be planned to minimize disruption to existing agricultural uses and facilities.

As discussed, the Project integrates a boundary expansion to accommodate additional lands for buffering and a Waste and Resource Material Drop-off Area. This expansion would be contained within the existing boundary of the defined Waste Management Resource Recovery Area. In our opinion, the Project supports the planned function of the Waste Management Resource Recovery Area to accommodate additional waste management facilities planned with consideration for sustainable design principles (as discussed in the Land Use Assessment Report). It is also our opinion that the Project would (1) comply with existing permissions for the Waste Management Resource Recovery Area and (2) align with the identified objectives of the Agricultural designation. In particular, as discussed in relation to the PPS, the Project should not adversely impact on existing agricultural uses and normal farm practices proximate to the Site Area.

Based on the foregoing and our broader evaluation of the proposed landfill expansion relative to the 1989 Official Plan as discussed in the Land Use Assessment Report, in our opinion the Project conforms with the policy direction and development permissions of this Official Plan.

4.1.1.3 City of London Official Plan (The London Plan)

The City of London Council adopted a new City of London Official Plan ('The London Plan') on June 23, 2016 and the Ministry of Municipal Affairs (MMA) issued its approval of the new Official Plan, with modifications, on December 28, 2016. Several parties subsequently appealed policies and schedules of the MMA-approved Official Plan to the Ontario Municipal Board, now the Local Planning Appeal Tribunal.

At this time, a number of policies and schedules applicable to the Site Area and Site-Vicinity Study Area remain under appeal and are not currently in effect. Notwithstanding, the following discussion describes how the Project aligns with the policy direction and development provisions of The London Plan as approved by the MMA.

Policy Context

Figure 3 of this Report illustrates that the Site Area and Site-Vicinity Study Area contain the following designations pursuant to Map 1 (Place Types) of The London Plan:

- Waste Management Resource Recovery Area;
- Farmland;
- Green Space; and
- Environmental Review.

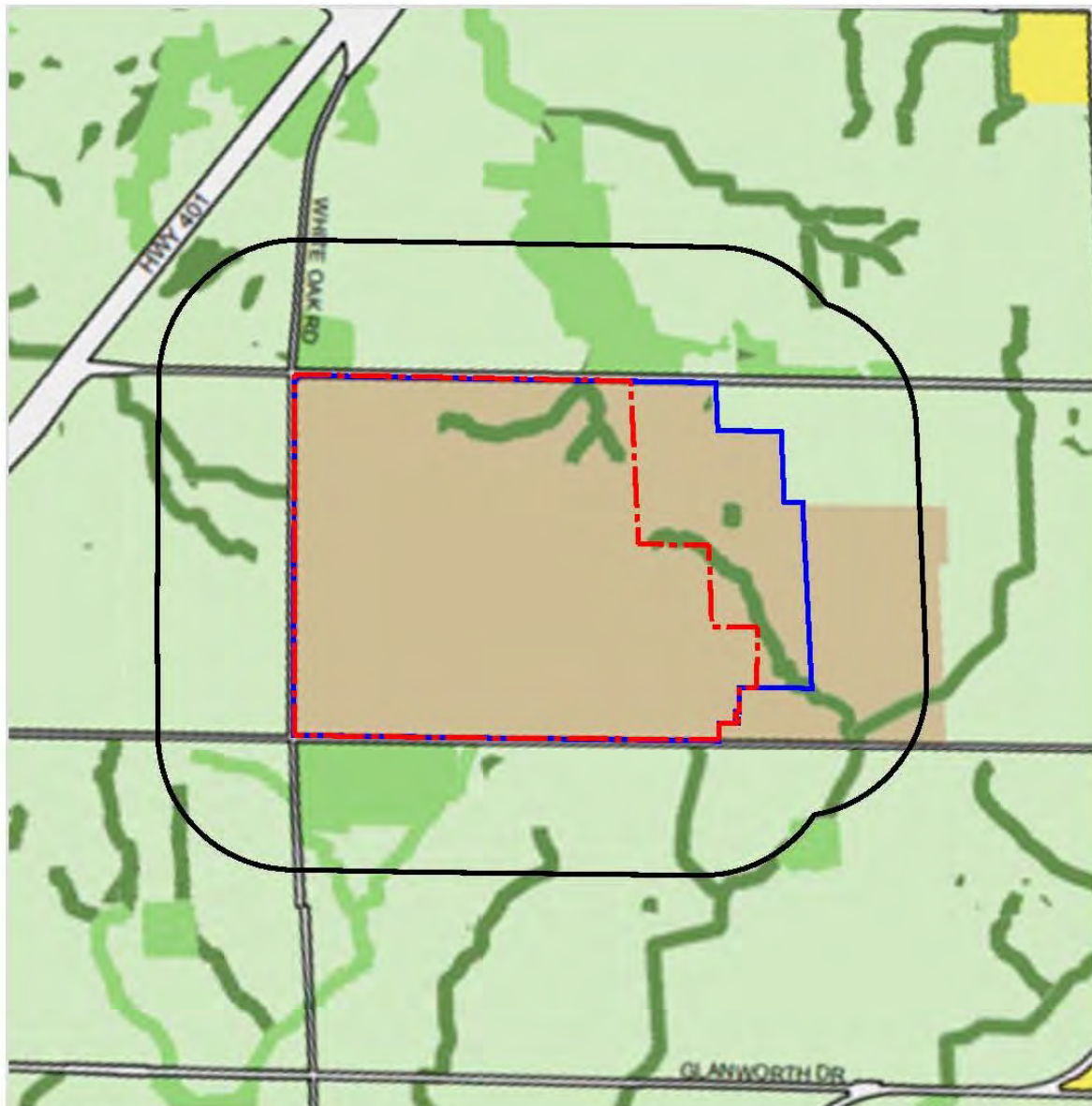


Figure 3
Place Types

Map 1 - The London Plan, 2016

W12A Landfill
City of London

Legend

- Site Area
- Site Study Area
- Site-Vicinity Study Area

PLACE TYPES

- | | |
|--|---|
| Green space | Heavy Industrial |
| Environmental Reserve | Light Industrial |
| Downtown | Commercial/Industrial |
| Transit Village | Future Community Growth |
| Rapid Transit Corridor | Future Industrial Growth |
| Urban Corridor | Farmland |
| Shopping Area | Rural Heritage/Scenic |
| Main Street | Waste Management Resource Recovery Area |
| Neighbourhood | Urban Growth Boundary |
| Institutional | |

DATE: Dec. 3, 2020

SCALE: 1:20,000

FILE: 08227L

DRN: JB



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& LANDSCAPE
ARCHITECTURE
200-540 BINGHAM'S CENTRE DR. KITCHENER, ON, N2B 3K9
P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

For the purposes of this assessment, the policies of the Waste Management Resource Recovery Area and Farmland place types are referenced. A more detailed evaluation of adjacent land uses is included in the Land Use Assessment Report.

Waste Management Resource Recovery Area Place Type

The existing W12A Landfill site and adjacent lands are designated Waste Management Resource Recovery Area place type. As set out in Policy 1254 of The London Plan, this place type was developed specifically for the W12A Landfill to provide for the continued evolution of the landfill and surrounding area as an integrated waste management centre.

Policy 1254 also states that, “Landfills are important to the city’s future growth and development, provide a necessary public benefit and the ability to manage the city’s solid waste”. It is further prescribed in this Policy that landfills will be (1) designed to maximize utility and minimize negative impacts and (2) maintained in accordance with all relevant federal, provincial and municipal legislation and regulations.

Pursuant to Policy 1256 of this Official Plan, policies pertaining to the Waste Management Resource Recovery Area place type are intended to address several key objectives, including to:

- Apply to lands that are either currently being used as a landfill, are being considered for expansion, or a landfill in the process of remediation;
- Facilitate the transition into productive use as a landfill; and
- Promote best practices in site selection, site design, operation, and remediation.

In accordance with Policy 1258, the following uses are generally permitted on lands designated Waste Management Resource Recovery Area:

- Landfills;
- Related uses necessary to support waste reduction, re-use, recycling, resource recovery, treatment and waste disposal; and
- Eco-Industrial Parks where industries use materials available from the Waste Management Resource Recovery Area.

In addition to the above-noted uses, it is stated in Policy 1259 that a number of related uses are permitted in this place type through a site-specific Zoning By-law Amendment. These associated uses include a municipal waste disposal facility, community recycling drop-off depot, material recovery facility, and other similar waste uses.

As illustrated in Figure 3, the proposed landfill boundary expansion would be contained within the existing boundary of the Waste Management Resource Recovery Area place type.

Farmland Place Type

Figure 3 identifies that the majority of lands within the Site-Vicinity Study Area surrounding the Waste Management Resource Recovery Area are designated Farmland place type. In accordance with Policy 1179, this place type is the prime agricultural area of London, and consists of prime agricultural land (Canada Land Inventory Classes 1, 2, and 3 soils) and associated Class 4 through 7 soils. This Policy also prescribes that the prime agricultural area, "...will be protected and maintained for the long term as the base to support a healthy, productive, and innovative agricultural industry as a key component of the city's economic base and cultural heritage."

Policy 1181 provides additional direction regarding the intent of the Farmland place type. In our opinion, the following objectives for this place type are of particular relevance to the Project:

- "9. Discourage uses which are not supportive of agriculture from locating in the Farmland Place Type. Limited non-agricultural uses may be permitted only where it can be demonstrated that the proposed use is consistent with the Provincial Policy Statement.
10. Minimize the potential for land use conflicts between residential uses and farm operations.
11. Mitigate impacts from any new or expanding non-agricultural uses on surrounding agricultural operations and lands."

As prescribed in Policy 1182, the Farmland place type permits a variety of agricultural and agricultural-related uses, and certain associated residential uses including principal farm residences, secondary farm dwelling units, and residential uses on existing lots of record.

Policy Review

The Project integrates a proposed vertical expansion to the existing landfill footprint, as well as an expansion to the existing landfill boundary for additional buffering and a Waste and Resource Material Drop-off Area. As discussed, the Site Area would be encompassed with the existing boundary of the defined Waste Management Resource Recovery Area.

Given the intended use of the proposed expansion area, it is our opinion that the Project would comply with the policy objectives and existing permissions of the Waste Management Resource Recovery Area place type. In this respect, the Project was selected as the preferred alternative for the EA, in part to maximize utility and minimize negative impacts associated with the landfill expansion. Further, activities associated with the expanded landfill would be maintained in accordance with applicable legislation and regulations.

Additionally, it is our opinion that the Project would align with the function and objectives of the Farmland designation. In particular, as discussed in relation to the PPS, the components of the

Project should not conflict with, or compromise, existing agricultural operations and normal farm practices proximate to the Site Area.

In light of these considerations, and our broader evaluation of the proposal relative to The London Plan as discussed in the Land Use Assessment Report, it is our opinion that the Project conforms with the planning direction and development permissions of this Official Plan.

4.2 Agricultural Lands and Operations

Section 2.1 of this Report provides an overview of agricultural and non-agricultural uses within the Site-Vicinity Study Area. Based on the findings of this review, agricultural uses within this defined area is characterized by conventional agricultural production that is in keeping with regional and provincial trends (e.g., cash crop production, livestock operations).

4.2.1 Assessment of Effects on Agricultural Lands and Operations

4.2.1.1 Degree of Investment/Infrastructure

The Project incorporates a vertical expansion over 106.3 ha of the existing landfill footprint with no expansion of the landfill area. The boundary of the existing landfill site is also proposed to be expanded to accommodate additional on-site buffering and a Waste and Resource Material Drop-off Area. Given the intent to implement vertical landfill expansion and the nature of the activities planned for the Site Area, with the exception of additional perimeter fencing, the Project is not anticipated to require a substantial increase in the existing level of investment and infrastructure servicing agricultural lands in the Site-Vicinity Study Area.

4.2.1.2 Soil Capability (CLI rating)

As discussed, the Project does not propose an expansion to the existing landfill footprint. Given that no additional lands are required for the landfill component of the Project, the proposed expansion to the landfill boundary is not expected to have an adverse impact on the soil capability within either the Site Area or the Site-Vicinity Study Area. Additionally, in our opinion, the activities planned for the expanded landfill (i.e., buffering, Waste and Resource Material Drop-off Area) should not adversely impact on the capability of Class 2 and 3 soils located within these delineated areas.

4.2.1.3 Potential Impacts on Agricultural Land within Site Area

Section 3.1 of the Report identifies that the landfill boundary would increase from approximately 140.0 ha to approximately 192.4 ha, with no expansion planned for the landfill footprint. As discussed in this Section:

- The expansion area would be predominantly used for buffering purposes, with limited infrastructure planned for the affected lands (i.e., boundary fencing); and

- A portion of the expansion area fronting Manning Road would be used for a new Waste and Resource Material Drop-off Area.

In light of the intended use of the lands contained within the proposed landfill boundary, the potential impacts of the Project on the agricultural land base within the boundary expansion are expected to be minor. Further, as discussed in Section 4.1.1 of this Report, this boundary expansion would occur on lands designated for waste management purposes pursuant to the City's 1989 Official Plan and The London Plan.

4.2.1.4 Potential Impacts on Agricultural Land within Site-Vicinity Study Area

The Land Use Assessment Report referenced in this Report evaluates the Project relative to applicable components of the Land Use Compatibility (D-Series) Guidelines administered by the Ministry of Environment, Conservation and Parks (Ministry). Based on our review of the published D-Series Guidelines, in our opinion, Guideline D-4 (Land Use On or Near Landfills and Dumps) relates most directly to the proposed landfill expansion project. This Guideline identifies restrictions and controls on land use in the vicinity of landfills and dumps, in order to protect the health, safety, convenience and welfare of residents near such facilities.

Pursuant to Section 5.1.1 of this Guideline, the following are considered sensitive land uses for operating landfills:

"Any existing or committed land use which includes:

- a. a permanent structure used in animal husbandry; or
- b. agricultural land used for pasturing livestock; or
- c. a permanent structure where:
 - i. a person sleeps, or
 - ii. a person is present on a full time basis;
 but not including food or motor vehicle service facilities adjacent to a highway, utility operations, scrap yards, heavy industrial uses, gravel pits, quarries, mining or forestry activities; or
- d. cemeteries"

As an outcome of our land use evaluation, the following sensitive uses were identified within the Site-Vicinity Study Area in proximity to the existing W12A Landfill, including several related to agricultural operations:

North:	Seven residential dwellings; aggregate extraction operation;
West:	Agricultural land;
East:	City of London MRF; agricultural land; and
South:	Islamic Cemetery of London; agricultural land; farm and associated dwelling; cattle farm.

The Project would expand the Site Area approximately 52.4 ha; however, the existing landfill footprint would be retained. The expanded area, which is partially under active cultivation, would be predominately used for buffering purposes.

As identified in the Land Use Assessment Report, several studies have been completed to assess potential impacts of the Project on existing land uses within the Site-Vicinity Study Area, including identified sensitive land uses. Of particular relevance to this assessment are the noise, odour and air assessments completed, as discussed previously in this Report. Mitigation and monitoring programs are recommended in these reports to minimize potential impacts associated with landfill operations following implementation of the Project.

Additionally, as outlined in Section 3.1 of this Report, the proposed landfill expansion does not result in the limits of waste being extended towards any of the sensitive land uses identified above. A residential dwelling is currently located to the north of the existing landfill on lands addressed as 3801 Scotland Drive. This residence is situated within the Site Area. In conjunction with the landfill expansion process, this dwelling will be removed to facilitate additional on-site buffering.

Given these considerations, provided the recommended impact mitigation is implemented, in our opinion the Project should have minimal impact on existing agricultural activities and other sensitive uses in the Site-Vicinity Study Area. Additionally, based on the applicable planning framework for the Site Area and the adjacent agricultural area, in our opinion, the Project would not constrain agricultural activities in the vicinity of this landfill facility.

4.2.1.5 Impact on Agricultural System

In effect, the expansion area associated with the Project would take a limited amount of agricultural land out of active production to accommodate additional on-site buffering and a proposed Waste and Resource Material Drop-off Area. These lands are currently within City of London ownership and are encompassed with the Waste Management Resource Recovery Area permissions of the 1989 Official Plan and The London Plan. Moreover, with the exception of boundary fencing, no additional investment or infrastructure is planned for those lands intended for buffering purposes.

Given these considerations, in our opinion the proposed expansion to the landfill boundary should not compromise, or constrain, agricultural operations within the Site-Vicinity Study Area and should not result in the further fragmentation of agricultural lands in this area. Accordingly, in our opinion, the Project is expected to have minimal impact on the wider agricultural system.

4.3 Conclusion

Based on the foregoing, in our opinion the Project (1) is expected to have minimal land use impacts on existing agricultural land and/or operations within the Site-Vicinity Study Area and (2) should not adversely impact on the wider agricultural system.

5.0 Mitigation and Monitoring

As an outcome of the agricultural impact assessment summarized in this Report, in our opinion the Project should have minimal land use impacts on agricultural land and/or operations in the Site-Vicinity Study Area. Notwithstanding, it is also our opinion that mitigation and monitoring programs associated with the expanded landfill operations recommended in conjunction with this Environmental Assessment should be implemented to minimize any potential impacts on local agricultural activities and the larger agricultural system.

6.0 Other Approvals

Based on our evaluation, implementation of the Project should not require any additional approvals related specifically to the agricultural sector.

7.0 Conclusion

The City of London is proposing an expansion of the existing W12A Landfill site (the Project) located at 3502 Manning Drive, London. Generally, this property is located in a predominately agricultural area of London, south of the City's Urban Growth Boundary.

The proposed landfill expansion incorporates a vertical expansion over 106.3 ha of the existing landfill footprint. Additionally, the facility boundary is proposed to be extended to accommodate (1) additional on-site buffering north and east of the existing landfill facility and (2) a new small vehicle Waste and Resource Material Drop-off Area. Collectively, these site modifications would increase the landfill boundary from approximately 140.0 ha to approximately 192.4 ha.

This Report addresses the existing conditions and impact assessment for the agricultural component of the EA being carried out for the proposed landfill expansion. Generally, the study area (Site-Vicinity Study Area) defined for this EA is largely comprised of conventional agricultural production consistent with regional and provincial agricultural production practices (e.g., oilseed/grain operations).

The assessment of impacts on agricultural land and operations within the Site-Vicinity Study Area was predicated on the Province's draft Agricultural Impact Assessment Guidelines.

Considerations applied in the assessment include: the degree of investment and agricultural infrastructure (e.g., tile drainage, fencing); soil capability; and potential impacts on agricultural land, surrounding uses and the wider agricultural system. These considerations were evaluated to assess the potential loss of agricultural lands and production, as well as the proposed landfill expansion's impact on the broader agricultural system.

In effect, the expansion area associated with the Project would take a limited amount out agricultural land (52.4 ha) out of active production to accommodate additional on-site buffering and a Waste and Resource Material Drop-off Area. These lands are currently within City of London ownership and are encompassed within the Waste Management Resource Recovery Area permissions of the City's 1989 Official Plan and The London Plan. Moreover, with the exception of boundary fencing, no additional investment or infrastructure is planned for those lands intended for buffering purposes.

In light of the intended use of the lands contained within the proposed expansion area, the potential impacts of the Project on local agricultural land and operations are expected to be minor. Further, in our opinion the proposed expansion to the landfill boundary should not compromise, or constrain, agricultural operations within the Site-Vicinity Study Area.

Based on the foregoing, in our opinion the Project (1) is expected to have minimal land use impacts on existing agricultural land and operations within the Site-Vicinity Study Area and (2) should not adversely impact on the wider agricultural system.

Respectfully submitted,

MHBC
Planning, Urban Design & Landscape Architecture



Scott Allen, MA, RPP
Partner



Eric Miles, MPL, RPP
Planner

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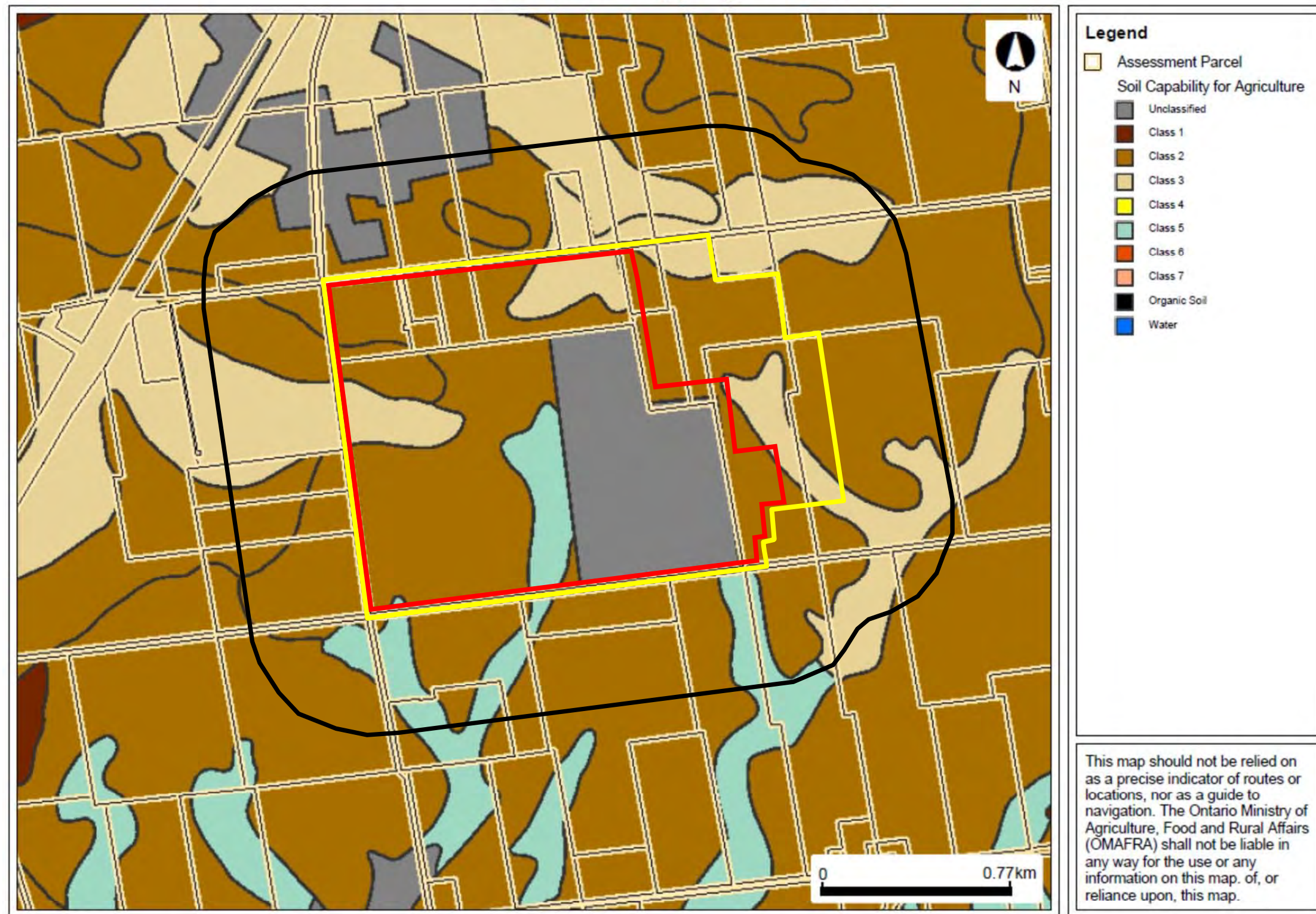
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APPENDIX A

SOIL MAPPING

CLI Soil Mapping - W12A



D.08 Archaeology Existing Conditions and
Impact Assessment Report; completed by
Golder Associates Ltd.

REPORT

Archaeology Existing Conditions and Impact Assessment

W12A Landfill Expansion EA, City of London, Ontario

Submitted to:

City of London
300 Dufferin Avenue
London, Ontario
PO BOX 5035
N6A 4L9

Attention: Mike Losee, Division Manager, Solid Waste Management

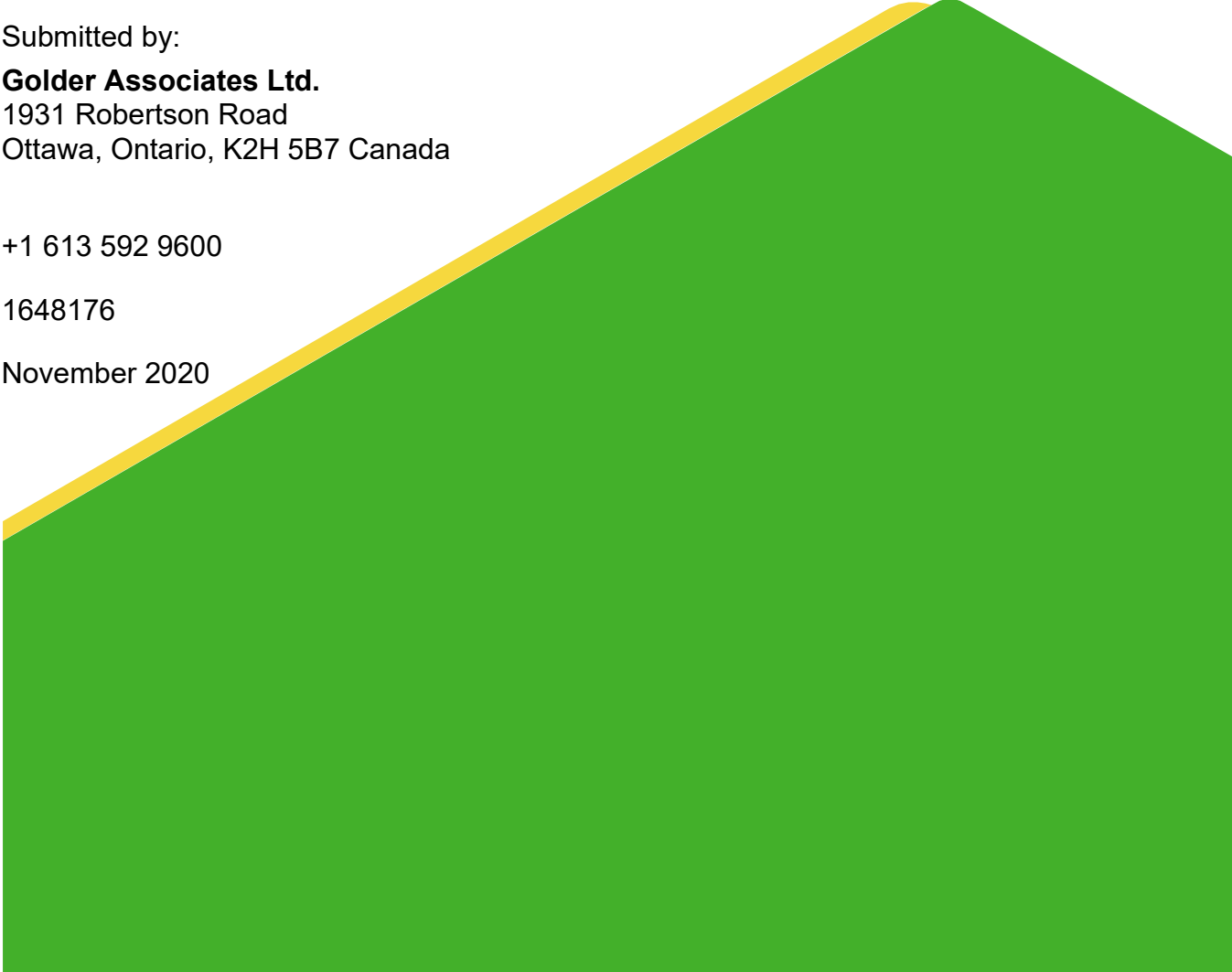
Submitted by:

Golder Associates Ltd.
1931 Robertson Road
Ottawa, Ontario, K2H 5B7 Canada

+1 613 592 9600

1648176

November 2020



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B.01 Stage 3 Archaeological Assessment

B.02 MHSTCI Review and Entry in Public Registry

Acronyms and Glossary of Terms

Term / Acronym	Definition
EA	Environmental Assessment
EASR	Environmental Assessment Study Report
ha	hectares
m	metre
m ³	cubic metres
masl	metres above sea level
MHSTCI	Ministry of Heritage, Sport, Tourism and Culture Industries
MRF	Material Recovery Facility
ToR	Terms of Reference

1.0 INTRODUCTION

The City of London is proposing an expansion of the existing W12A Landfill site (the Project) located at 3502 Manning Drive, part of Lots 18, 19 and 20 of Concession 6 in the former Township of Westminster, in the south end of the City of London Ontario.

The environment is considered in broad terms to include the natural, social, cultural, and economic aspects of the environment. This document presents the details of the existing conditions and impact assessment related to archaeology for the Environment Assessment (EA) of the proposed W12A Landfill expansion. This work has been completed in two parts; Golder Associates Ltd. (Golder) completed a Stage 2 Archaeological Assessment in Attachment A and, based on report recommendations for further investigation, one pre-contact Indigenous site (White Oak 1) was advanced to a Stage 3 Archaeological Assessment provided in Attachment B.

All work was conducted in accordance with the requirements set out in the approved Amended Terms of Reference (ToR) dated February 2019.

This report is a supporting document to the Environmental Assessment Study Report (EASR).

2.0 PROJECT DESCRIPTION

The following describes the Project components considered relevant for the purposes of this archaeological assessment.

The landfill expansion consists of a vertical expansion over the existing landfill footprint to provide 13.8 million cubic metres (m³) of airspace for waste and daily cover. To accommodate ancillary features and provide additional on-Site buffer width compared to the existing landfill, the northern boundary of the landfill property will be adjacent to Scotland Drive and a 100 metre (m) buffer width will be provided on the east side of the landfill footprint and some additional area in the southeast corner to tie into the adjacent Material Recovery Facility (MRF) property line. This results in a 106.3 hectare (ha) landfill footprint within a 192.4 ha landfill property, with a highest ridge elevation of waste of 318.43 metres above sea level (masl).

3.0 EXISTING CONDITIONS

The details and discussion of existing historical and archaeological conditions is provided in Section 1.0 of Attachments A and B.01. Background information on the pre- and post-Indigenous contact culture history of the former geographic Township of Westminster, Middlesex County, now City of London, Ontario was compiled and reviewed in advance of the 21 day Stage 2 Archaeological Assessment field program between August 2018 and November 2019. The Stage 2 Archaeological Assessment consisted of a combination of pedestrian and test pit surveys at 5 m intervals, as described in Attachment A Section 2.0. Six artifact producing locations were identified during the field program, of which one location was considered to have cultural heritage value or interest and recommended to be subject to a Stage 3 Archaeological Assessment.

4.0 IMPACT ASSESSMENT

The results of the Stage 3 Archaeological Assessments identified the presence of one site with archaeological potential in the Site Area (White Oak 1 site [AfHh-926]), located on the north side of the western portion of the existing landfill footprint. The site appears to represent an occupation dating to the Late Archaic Period (ca. 1500 – 500 B.C.). The limited quantity of the cultural material identified at the site suggests that it represents a small, briefly occupied, campsite. The lithic tools and debitage suggest latter stage tool production and maintenance were carried out at this site.

The presence of high artifact-yielding test units (e.g., ≥ 10 artifacts) indicates that the White Oak 1 site (AfHh-926) has further cultural heritage value or interest and will require Stage 4 mitigation prior to development. This conclusion is consistent with Section 3.4.1, Standard 1a of the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI)'s *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011).

The Stage 4 mitigation for the White Oak 1 site will be an avoidance and protection strategy. As per Section 4.1.1 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011a) the avoidance and protection strategy for the White Oak 1 site (AfHh-926) will involve the establishment of a “no-go” zone consisting of a 10 m protective buffer around the extent of the site as defined by the results of the Stage 3 assessment. The area of the White Oak 1 site (AfHh-926) does not interfere with the proposed landfill expansion construction but care will be required when using proposed buffer land to the north of the landfill expansion to ensure soil stockpiles or other ancillary uses avoid the “no-go” zone. Details regarding the plans for avoidance and long-term protection of the White Oak 1 site (AfHh-926) are provided in Attachment B.01.

There are no further concerns for impacts to archaeological sites in the remainder of the Site Area outside the 10 m buffer. No monitoring or mitigation measures in addition to those required for the protection of White Oak 1 site are identified.

5.0 OTHER APPROVALS

The Stage 2 Archaeological Assessment Report was submitted to MHSTCI in May 2020 and is pending review.

The MHSTCI has reviewed the results and recommendations presented in the Stage 3 Archaeological Assessment Report (Appendix B) and accepted the report into the Provincial Register of archaeological reports, and issued a standard letter of compliance with the Ministry's 2011 *Standards and Guidelines for Consultant Archaeologists* and the terms and conditions for archaeological licencing.

ATTACHMENT A

A.01 Stage 2 Archaeological Assessment



REPORT

Stage 2 Archaeological Assessment

*W12A Landfill Expansion Environmental Assessment
Part of Lots 17, 18, 19, and 20, Concession 6,
Former Geographic Township of Westminster,
Now City of London, Middlesex County, Ontario*

Submitted to:

Michael Losee

Solid Waste Management
City of London
300 Dufferin Avenue
N6A 4L9

Submitted by:

Golder Associates Ltd.

309 Exeter Road, Unit #1, London, Ontario, N6L 1C1, Canada

+1 519 652 0099

1648176-6000-6400-R01

May 7, 2020

Licensee: Michael Teal, M.A.

PIF #: P364-0126-2018

Distribution List

1 PDF Copy - The Corporation of the City of London

1 PDF Copy - Ministry of Heritage, Sport, Tourism and Culture Industries

1 PDF Copy - Golder Associates Ltd.

Project Personnel

Project Director	Paul Smolkin, P.Eng., Principal
Project Manager	Trish Edmond, M.E.Sc., P.Eng., Principal
Archaeological Licensee	Michael Teal, M.A. (P364), Associate, Senior Archaeologist
Field Directors	Rebecca Parry, M.A. (P1013), Lafe Meicenheimer, M.A. (P457), Connor Schmid (R1119), Sheryl Spigelski, M.A. (P1034)
Field Assistants	Justine Buchler, Justin Eagleson, Sophie Grant, Edin Gurdic, Robyn Lacy, Tanya Maroofzadeh, Yashaan Mavalvala, Teegan Muggeridge, Ian Petty, Daniel Ring, Connor Schmid, David Schmoll, Mary Simonds, Jocelynn Thomas
Report Production	Lafe Meicenheimer, M.A., Staff Archaeologist Liz Yildiz, Environmental Group Administrator
Senior Review	Michael Teal, M.A. (P364), Associate, Senior Archaeologist

Acknowledgements

Proponent Contacts	Michael Losee, City of London Wesley Abbott, City of London
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Executive Summary

The Executive Summary summarizes only the key points of the report. For a complete account of the results and conclusions, as well as the limitations of this study, the reader should examine the report in full.

Golder Associates Ltd. ("Golder") was contracted by the Corporation of the City of London ("the City") to conduct a combined Stage 2 Archaeological Assessment of several land parcels as part of an Environmental Assessment (EA) for the proposed expansion of the City of London's W12A landfill site located at 3502 Manning Drive. The land parcels, hereafter referred to as the 'Study Area', are approximately 78.25 hectares (ha) combined and located on part of Lots 17, 18, 19, and 20, Concession 6 in the former geographic Township of Westminster, Middlesex County, now City of London, Ontario (Map 1). This Stage 1-2 Archaeological Assessment was conducted to meet the standard requirements of the *Environmental Assessment Act*, R.S.O. 1990, c.E.18 (Government of Ontario 1990a), as required by the City of London prior to land disturbance.

A Stage 1 Archaeological Assessment and built heritage assessment of a 397 ha study area from Scotland Drive to Manning Drive between White Oak Road and Wellington Road in 2005 by Archaeologix Inc. This Stage 1 assessment, which included the current Study Area, determined that portions of the Study Area had archaeological potential, and as such, would require Stage 2 Archaeological Assessment to identify archaeological sites that may be present. The Stage 2 assessment, which involved a combination of pedestrian survey at 5 m intervals and shovel test pit survey at 5 m intervals, resulted in the identification of six artifact-producing locations.

Location 1 consisted of one biface fragment, while Location 2 consisted of two pieces of lithic debitage, and Locations 3 and 6 each consisted of a single piece of lithic debitage. Despite intensified survey at each location, no additional archaeological material was recovered. All of the artifacts from Locations 1, 2, 3, and 6 were collected and retained for laboratory analysis. Biface fragments and lithic debitage are not typically diagnostic, therefore the age or cultural affiliation of Locations 1, 2, 3, and 6 could not be determined. The isolated nature of these artifacts suggests they are related to transient use of the area by Indigenous peoples that occurred during an undetermined time period. Given the isolated and non-diagnostic nature of the finds, Locations 1, 2, 3, and 6 are concluded to have no further cultural heritage value or interest as the sites do not meet the criteria identified in Section 2.2, Standard 1a of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) for determining the need for Stage 3 Archaeological Assessment.

Location 4 (AfHh-945) was identified through the recovery of 488 Euro-Canadian artifacts and 23 faunal elements from a total of 21 positive test pits and four 1 m² test units across an area measuring approximately 65 m north-south by 25 m east-west. The site is located near the southwest corner of a former house at 3173 Scotland Drive that was demolished in 2017. The artifact assemblage contains artifacts that date from the mid- to late 19th century into the 20th century, with the majority of the artifacts dating from the mid- to the late 19th century. According to a previous completed archaeological and built heritage report for the W12A landfill area, the former house was a one-and-a-half storey frame house, likely built around 1895 (Archaeologix 2005). The original house on the property was likely a two-storey brick house built in the 1870s and occupied by John Shore Jr., who was likely the son of one of the area's earliest settlers, John Shore (Archaeologix 2005). The 1878 map corroborates John Shore Jr.'s ownership and residence on the property, indicating a house and orchard where Location 4 (AfHh-945) is located (Map 6). Although the original two-storey brick house was replaced in 1895, a significant portion of the

artifact assemblage dates from the mid- to late 19th century and is likely related to the earlier occupation of the property. The 20th century material mixed in with the mid- to late 19th century material is likely related to the fact that the property has been continuously occupied until recently.

Given that there are at least 20 artifacts that date Location 4 (AfHh-945) to before 1900, as well as the fact that the location of the site has been occupied since the mid- to late 19th century and is likely associated with a structure depicted on historical mapping and potentially to the family of John Shore, an early settler of the area, the site meets the criteria identified in Section 2.2, Standard 1c and Table 3.2 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) for having CHVI and is therefore required to undergo Stage 3 Archaeological Assessment prior to any intrusive activity that may disturb or destruct the site.

Location 5 (AfHh-946) was identified through the recovery of 47 Euro-Canadian artifacts from a total of 11 positive test pits across an area measuring approximately 45 m north-south by 15 m east-west. It is adjacent to the east side of the house at 3465 Scotland Drive. Although the artifact assemblage contains artifacts that date from the mid- to late 19th century into the 20th century, the majority (75%) of the artifacts dating from the 19th century are VWE and wire-drawn nails, which were invented and used in the late 19th century, but continue to be used today. As well, no structures appear on any maps at the location of the current house and site until the 20th century. Finally, the house located at 3465 Scotland Drive is not listed in the City of London's *Register of Cultural Heritage Resources* (City of London 2019), indicating that it is of no historical significance. Due to these factors, Location 5 (AfHh-946) was determined to not meet the criteria identified in Section 2.2, Standard 1c and Table 3.2 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) for having sufficient CHVI to require Stage 3 Archaeological Assessment.

Based on the results of the Stage 2 Archaeological Assessment, Location 4 (AfHh-945) is considered to have cultural heritage value or interest, while Locations 1, 2, 3, 5 (AfHh-946), and 6 are not considered to have cultural heritage value or interest. These conclusions provide the basis for the following recommendations:

- 1) Location 4 (AfHh-945) should be subject to Stage 3 Archaeological Assessment prior to any impacts following Standards 1 and 2 of Table 3.1 in the MHSTCI's 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011:51).
 - a. As Location 4 (AfHh-945) was discovered during test pit survey, no CSP is required prior to hand excavation of test units.
 - b. Test units should be excavated at 5 m intervals across the site, focusing on the mid- to late 19th century concentration as defined by the positive test pits and test units (see Map 10). Additional test units amounting to 20% of the initial grid unit should be excavated focusing on areas of interest within the site extent. All test units should be excavated into the first 5 cm of subsoil, or until a cultural feature is uncovered.
 - c. Any features identified during the Stage 3 assessment should be recorded through photographs and plan drawings and then be covered with geotextile fabric prior to backfilling.
 - d. All soil excavated from the test units should be screened through 6 mm hardware cloth to facilitate the recovery of artifacts that may be present. The recovered artifacts should be tagged in the field by their provenience unit prior to subsequent washing, cataloguing and analysis.

- 2) Locations 1, 2, 3, 5 (AfHh-946), and 6 have been sufficiently assessed and documented, and no further archaeological assessment is required for these locations.

The Ontario Ministry of Heritage, Sport, Tourism and Culture Industries is asked to review the results and recommendations presented herein, accept this report into the Provincial Register of archaeological reports and issue a standard letter of compliance with the Ministry's 2011 *Standards and Guidelines for Consultant Archaeologists* and the terms and conditions for archaeological licencing.

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APPENDICES

APPENDIX A

Glossary of Pre-Contact Indigenous Terms

APPENDIX B

Complete Artifact Catalogues

1.0 PROJECT CONTEXT

1.1 Development Context

Golder Associates Ltd. ("Golder") was contracted by the Corporation of the City of London ("the City") to conduct a combined Stage 2 Archaeological Assessment of several land parcels as part of an Environmental Assessment (EA) for the proposed expansion of the City of London's W12A landfill site located at 3502 Manning Drive. The land parcels, hereafter referred to as the 'Study Area', are approximately 78.25 hectares (ha) combined and located on part of Lots 17, 18, 19, and 20, Concession 6 in the former geographic Township of Westminster, Middlesex County, now City of London, Ontario (Map 1). This Stage 2 Archaeological Assessment was conducted to meet the standard requirements of the *Environmental Assessment Act*, R.S.O 1990, c.E.18 (Government of Ontario 1990a), as required by the City of London prior to land disturbance.

The Stage 2 assessment was conducted under professional archaeological licence P364, issued to Michael Teal of Golder by the MHSTCI (PIF# P364-0126-2018). Permission to enter the property to conduct all required archaeological fieldwork activities, including the recovery of artifacts, was granted by Wesley Abbott of the City of London.

1.2 Historical Context

Table 1 provides a general outline of the pre- and post-contact culture history for Middlesex County, drawn from Ellis and Ferris (1990), while Map 2 displays the pre-contact Indigenous culture history of Middlesex County.

Table 1: Cultural Chronology for Middlesex County.

Period		Time Range (circa)	Characteristics
Paleo	Early	9000 - 8400 BC	Gainey, Barnes and Crowfield traditions; Small bands; Mobile hunters and gatherers; Utilization of seasonal resources and large territories; Fluted projectiles
	Late	8400 - 8000 BC	Holcombe, Hi-Lo and Lanceolate biface traditions; Continuing mobility; Campsite/Way-Station sites; Smaller territories are utilized; Non-fluted projectiles
Archaic	Early	8000 - 6000 BC	Side-notched, Corner-notched (Nettling, Thebes) and Bifurcate Base traditions; Growing diversity of stone tool types; Heavy woodworking tools appear (e.g., ground stone axes and chisels)
	Middle	6000 - 2500 BC	Stemmed (Kirk, Stanly/Neville), Brewerton side- and corner-notched traditions; Reliance on local resources; Populations increasing; More ritual activities; Fully ground and polished tools; Net-sinkers common; Earliest copper tools

Period		Time Range (circa)	Characteristics
	Late	2000 - 950 BC	Narrow Point (Lamoka), Broad Point (Genesee) and Small Point (Crawford Knoll) traditions; Less mobility; Use of fish-weirs; True cemeteries appear; Stone pipes emerge; Long-distance trade (marine shells and galena)
Woodland	Early	950 - 400 BC	Meadowood tradition; Crude cord-roughened ceramics emerge; Meadowood cache blades and side-notched points; Bands of up to 35 people
	Middle	400 BC - AD 500	Saugeen tradition; Stamped ceramics appear; Saugeen projectile points; Cobble spall scrapers; Seasonal settlements and resource utilization; Post holes, hearths, middens, cemeteries and rectangular structures identified
	Transitional	AD 550 - 900	Princess Point tradition; Cord roughening, impressed lines and punctate designs on pottery; Adoption of maize horticulture at the western end of Lake Ontario; Oval houses and 'incipient' longhouses; First palisades; Villages with 75 people
	Late (Ontario Iroquois Tradition)	AD 900 - 1300	Early - Glen Meyer tradition; Settled village-life based on agriculture; Small villages (0.4 ha) with 75–200 people and 4–5 longhouses; Semi-permanent settlements
		AD 1300 - 1400	Middle - Uren and Middleport traditions; Classic longhouses emerge; Larger villages (1.2 ha) with up to 600 people; More permanent settlements (30 years)
		AD 1400 - 1600	Late - Larger villages (1.7 ha); Examples up to 5 ha with 2,500 people; Extensive croplands; Also, hamlets, cabins, camps and cemeteries; Potential tribal units; Fur trade begins ca. 1580; European trade goods appear
	Late (Western Basin Tradition)	AD 500 - 900	Riviere au Vase - introduction of corn
		AD 900 - 1200	Young Phase - dense storage pits, proto-settlements
		AD 1200 - 1400	Springwell Phase - emergence of agricultural villages
		AD 1400 - 1550	Wolf Phase - palisaded villages, warfare and displacement

1.2.1 Paleo Period

The first human occupation of the London area, known as the Paleo Period, begins just after the end of the Wisconsin Glacial Period. Although there was a complex series of ice retreats and advances which played a large role in shaping the local topography, southwestern Ontario was finally ice free by 12,500 years ago. The first human settlement can be traced back 11,000 years, when this area was inhabited by Indigenous groups that had been living south of the Great Lakes.

Our current understanding of Early Paleo settlement patterns suggests that small bands consisting of up to 25 to 35 individuals followed a pattern of seasonal mobility extending over large territories (Ellis and Deller 1990:54). Sites from this time are exceedingly rare, in part because population densities are thought to have been very low, with all of southwestern Ontario being occupied by perhaps only 100 to 200 people (Ellis and Deller 1990:54).

Many Early Paleo sites are located in elevated locations on well-drained loamy soils, and many have been found on former beach ridges associated with post-glacial Lake Algonquin that had previously occupied the Lake Huron/Georgian Bay basin. Given their placement in elevated locations, which were likely conducive to the interception of migratory mammals such as caribou, it has been suggested that these sites may represent communal hunting camps. Although most Early Paleo sites are relatively small, there are a few large sites, such as one located close to Parkhill, Ontario, which covered as much as 6 ha (Ellis and Deller 1990:51). However, it appears that these larger sites were formed when the same general locations were occupied for short periods of time over the course of many years.

There are also smaller Early Paleo camps scattered throughout the interior of southwestern Ontario, usually situated adjacent to wetlands.

Within the limits of London there are at least four known Early Paleo sites, of which three are isolated find spots of the distinctive fluted points or channel flakes. One site, located near Dingman Creek, appears to represent a possible occupation area with the potential for contributing to our knowledge of this period (Keron 1979 and 2016; Golder 2017). To date, all of the known Early Paleo sites in Middlesex are located south of the Main and South branches of the Thames River.

The Late Paleo Period (8400 - 8000 BC) has been less well researched than the Early Paleo, and as a result it is poorly understood. By this time the environment of southwestern Ontario was coming to be dominated by closed coniferous forests with some minor deciduous elements. It seems that many of the large game species that had been hunted in the early part of the Paleo Period had either moved further north or became extinct.

During the Late Paleo Period people continued to cover large territories as they moved about in response to seasonal resource fluctuations. On a province wide basis Late Paleo projectile points are far more common than Early Paleo materials, suggesting a relative increase in population.

The end of the Paleo Period was heralded by numerous technological and cultural innovations that appeared throughout the Archaic Period. These innovations may be best explained in relation to the dynamic nature of the post-glacial environment and region-wide population increases.

1.2.2 Archaic Period

During the Early Archaic Period (8000-6000 BC), the jack and red pine forests that characterized the Late Paleo environment were replaced by forests dominated by white pine with some associated deciduous trees (Ellis, Kenyon and Spence 1990:68-69). Notable technological changes during this period include the appearance of

side- and corner-notched projectile points not found during the previous Paleo times, and the introduction of ground stone tools such as celts and axes, which suggest woodworking was increasing in importance. In addition to the introduction of new tools, there may have been some reduction in the degree of seasonal movement of groups, although it is still suspected that population densities were quite low, and band territories large.

During the Middle Archaic Period (6000-2500 BC) the trend towards more diverse toolkits continued, as the presence of net-sinkers and fishing weirs suggest that fishing was becoming an important aspect of the subsistence economy. It was also at this time that "bannerstones" were first manufactured. Bannerstones are carefully crafted ground stone devices that may have served as a counterbalance for "atlatls" or spear-throwers.

Another characteristic of the Middle Archaic is an increased reliance on local, often poor-quality chert resources for the manufacturing of projectile points. It seems that during earlier periods, when groups occupied large territories, it was possible for them to visit a primary outcrop of high-quality chert at least once during their seasonal round.

However, during the Middle Archaic, groups inhabited smaller territories that often did not encompass a source of high-quality raw material. In these instances, it appears that lower quality materials which had been deposited by the glaciers in the local till and river gravels were utilized more regularly.

The apparent reduction in territory size may be linked to gradual region-wide population growth which led to the infilling of the landscape and a reorganization of Indigenous subsistence practices as more people became more reliant on resources from smaller areas. During the latter part of the Middle Archaic, technological innovations such as fish weirs have been documented as well as stone tools especially designed for the preparation of wild plant foods.

It is also during the latter part of the Middle Archaic Period that long-distance trade routes began to develop, spanning the northeastern part of the continent. In particular, native copper tools manufactured from a source located northwest of Lake Superior were being widely traded across the northeast (Ellis, Kenyon and Spence 1990:66).

During the Late Archaic (2500-950 BC) the trend towards decreased territory size and a broadening subsistence base continued. Late Archaic sites are far more numerous than either Early or Middle Archaic sites, and it seems that the local population had expanded. It is during the Late Archaic that the first true cemeteries appear. Before this time individuals were interred close to the location where they died. During the Late Archaic, if an individual died while his or her group happened to be at some distance from their group cemetery, the bones would be kept until they could be placed in the cemetery. Consequently, it is not unusual to find disarticulated skeletons, or even skeletons lacking minor elements such as fingers, toes or ribs, in Late Archaic burial pits.

The appearance of cemeteries during the Late Archaic has been interpreted as a response to increased population densities and competition between local groups for access to resources. It is argued that cemeteries would have provided strong symbolic claims over a local territory and its resources. These cemeteries are often located on heights of well-drained sandy/gravel soils adjacent to major watercourses such as the Thames River.

This suggestion of increased territoriality is also consistent with the regionalized variation present in Late Archaic projectile point styles. It was during the Late Archaic that distinct local styles of projectile points appear. Also, during the Late Archaic the trade networks which had been established during the Middle Archaic continued to flourish. Native copper from northern Ontario and marine shell artifacts from as far away as the Mid-Atlantic coast are frequently encountered as grave goods. Other artifacts such as polished stone pipes and banded slate

gorgets also appear on Late Archaic sites. One of the more unusual and interesting of the Late Archaic artifacts is the "birdstone". Birdstones are small, bird-like effigies usually manufactured from green banded slate. While the function of these artifacts is presently poorly understood, they are especially common in the London area.

1.2.3 Woodland Period

The Early Woodland Period (950-400 BC) is distinguished from the Late Archaic Period primarily by the addition of ceramic technology. While the introduction of pottery provides a useful demarcation point for archaeologists, it may have made less difference in the lives of the Early Woodland peoples. The first pots were very crudely constructed, thick walled, and friable. It has been suggested that they were used in the processing of nut oils by boiling crushed nut fragments in water and skimming off the oil (Spence, Pihl and Murphy 1990:137). These vessels were not easily portable, and individual pots must not have sustained a long use life. There have also been numerous Early Woodland sites located at which no pottery was found, suggesting that these poorly constructed, undecorated vessels had yet to assume a central position in the day-to-day lives of Early Woodland peoples.

Other than the introduction of this rather limited ceramic technology, the life ways of Early Woodland peoples show a great deal of continuity with the preceding Late Archaic Period. For instance, birdstones continue to be manufactured, although the Early Woodland varieties have "pop-eyes" which protrude from the sides of their heads. Likewise, the thin, well-made projectile points which were produced during the terminal part of the Archaic Period continue in use. However, the Early Woodland variants were side-notched rather than corner-notched, giving them a slightly altered and distinctive appearance.

The trade networks which were established in the Middle and Late Archaic also continued to function, although there does not appear to have been as much traffic in marine shell during the Early Woodland Period. During the last 200 years of the Early Woodland Period, projectile points manufactured from high quality raw materials from the American Midwest begin to appear on sites in the London area.

In terms of settlement and subsistence patterns, the Middle Woodland (400 BC- AD 900) provides a major point of departure from the Archaic and Early Woodland Periods. While Middle Woodland peoples still relied on hunting and gathering to meet their subsistence requirements, fish became an even more important part of their diet. This is especially true in the nearby London area, where some Middle Woodland sites have produced literally thousands of bones from spring spawning species such as walleye and sucker. In addition, Middle Woodland peoples relied much more extensively on ceramic technology. Middle Woodland vessels are often garishly decorated with hastily impressed designs covering the entire exterior surface and upper portion of the vessel interior. Consequently, even very small fragments of Middle Woodland vessels are easily identifiable.

It is also at the beginning of the Middle Woodland Period that rich, densely occupied sites appear on the valley floor of major rivers. While the valley floors of floodplains had been utilized by earlier peoples, Middle Woodland sites are significantly different in that the same location was repeatedly occupied over several hundred years. Because this is the case, rich deposits of artifacts often accumulated. Unlike earlier seasonally utilized locations, these Middle Woodland sites appear to have functioned as base camps, occupied off and on over the course of the year. There are also numerous small upland Middle Woodland sites, many of which can be interpreted as special purpose camps from which localized resource patches were exploited. This shift towards a greater degree of sedentism continues the trend witnessed from at least Middle Archaic times and provides a prelude to the developments that follow during the Late Woodland Period.

In the portion of southwestern Ontario east of London, the Late Woodland Period began with a shift in settlement and subsistence patterns involving an increasing reliance on corn horticulture (Fox 1990:185; Smith 1990; Williamson 1990:312). Corn may have been introduced into southwestern Ontario from the American Midwest as early as AD 600. However, it did not become a dietary staple until at least three to four hundred years later.

The first agricultural villages in southwestern Ontario date to the 10th century AD. Unlike the riverine base camps of the Middle Woodland Period, these sites are located in the uplands, on well-drained sandy soils. Categorized as "Early Ontario Iroquoian" (AD 900-1300), many archaeologists believe that it is possible to trace a direct line from the Iroquoian groups which inhabited southwestern Ontario at the time of first European contact, to these early villagers.

Village sites dating between AD 900 and 1300, share many attributes with the historically reported Iroquoian sites, including the presence of longhouses and sometimes palisades. However, these early longhouses were actually not all that large, averaging only 12.4 m in length (Dodd et al 1990:349; Williamson 1990:304-305). It is also quite common to find the outlines of overlapping house structures, suggesting that these villages were occupied long enough to necessitate re-building. The Jesuits reported that the Huron moved their villages once every 10-15 years, when the nearby soils had been depleted by farming and conveniently collected firewood grew scarce (Pearce 2010). It seems likely that Early Ontario Iroquoians occupied their villages for considerably longer, as they relied less heavily on corn than did later groups, and their villages were much smaller, placing less demand on nearby resources.

Judging by the presence of carbonized corn kernels and cob fragments recovered from sub-floor storage pits, agriculture was becoming a vital part of the Early Ontario Iroquoian economy. However, it had not reached the level of importance it would in the Middle and Late Ontario Iroquoian Periods. There is ample evidence to suggest that more traditional resources continued to be exploited and comprised a large part of the subsistence economy. Seasonally occupied special purpose sites relating to deer procurement, nut collection, and fishing activities, have all been identified. While beans are known to have been cultivated later in the Late Woodland Period, they have yet to be identified on Early Ontario Iroquoian sites.

The Middle Ontario Iroquoian Period (AD 1300-1400) witnessed several interesting developments in terms of settlement patterns and artifact assemblages. Changes in ceramic styles have been carefully documented, allowing the placement of sites in the first or second half of this 100-year period. Moreover, villages, which averaged approximately 0.6 ha in extent during the Early Ontario Iroquoian Period, now consistently range between one and two hectares.

House lengths also change dramatically, more than doubling to an average of 30 m, while houses of up to 45 m have been documented. This radical increase in longhouse length has been variously interpreted. The simplest possibility is that increased house length is the result of a gradual, natural increase in population (Dodd et al 1990:323, 350, 357; Smith 1990). However, this does not account for the sudden shift in longhouse lengths around AD 1300. Other possible explanations involve changes in economic and socio-political organization (Dodd et al 1990:357). One suggestion is that during the Middle Ontario Iroquoian Period small villages were amalgamating to form larger communities for mutual defense (Dodd et al 1990:357). If this was the case, the more successful leaders may have been able to absorb some of the smaller family groups into their households, thereby requiring longer structures. This hypothesis draws support from the fact that some sites had up to seven rows of palisades, indicating at least an occasional need for strong defensive measures. There are, however, other Middle Ontario Iroquoian villages which had no palisades present (Dodd et al 1990). Overall, the general consensus among archaeologists is that more research is required to evaluate these competing interpretations.

The lay-out of houses within villages also changes dramatically by AD 1300. During the Early Ontario Iroquoian Period villages were haphazardly planned at best, with houses oriented in various directions. During the Middle Ontario Iroquoian Period villages are organized into two or more discrete groups of tightly spaced, parallel aligned, longhouses.

It has been suggested that this change in village organization may indicate the initial development of the clans which were a characteristic of the historically known Iroquoian peoples (Dodd et al 1990:358).

Initially at least, the Late Ontario Iroquoian Period (AD 1400-1650) continues many of the trends which have been documented for the proceeding century. For instance, between AD 1400 and 1450, house lengths continued to grow, reaching an average length of 62 m. One longhouse excavated on a site southwest of Kitchener stretched an incredible 123 m (Lennox and Fitzgerald 1990:444-445). After AD 1450, house lengths begin to decrease, with houses dating between AD 1500-1580, averaging only 30 m in length.

Why house lengths decrease after AD 1450 is poorly understood, although it is believed that the even shorter houses witnessed on historical period sites can be at least partially attributed to the population reductions associated with the introduction of European diseases such as smallpox (Lennox and Fitzgerald 1990:405, 410).

Village size also continued to expand throughout the Late Ontario Iroquoian Period, with many of the larger villages showing signs of periodic expansions. The Late Middle Ontario Iroquoian Period and the first century of the Late Ontario Iroquoian Period was a time of village amalgamation. One large village situated just north of Toronto has been shown to have expanded on no fewer than five occasions. These large villages were often heavily defended with numerous rows of wooden palisades, suggesting that defence may have been one of the rationales for smaller groups banding together.

Late Ontario Iroquoian village expansion has been clearly documented in the London area. The ongoing excavations at the Lawson site, a large Late Iroquoian village located on the grounds of the Museum of Ontario Archaeology, has shown that the original village had expanded by at least twenty percent to accommodate the construction of nine additional longhouses (Anderson 2009).

The Ontario Iroquoian and Western Basin are two archaeological traditions that characterize pre-contact Indigenous communities living in the Middlesex County area of southwestern Ontario from about AD 500 to 1650. Peoples of the Western Basin Tradition lived throughout the southwestern-most portion of the province, from the present-day Sarnia/Windsor area to about London. Iroquoian peoples, on the other hand, appear to have lived from the present-day Chatham area east to Toronto. Each of these traditions are divided into distinct temporal phases (see Table 1) defined by material cultural attributes, and settlement and subsistence patterns that exhibit a shift towards larger and more permanent villages due to an increasing reliance on cultivated plants such as corn, beans, squash, sunflower, and tobacco (Dodd et al. 1990; Foreman 2011; Fox 1990; Lennox and Fitzgerald 1990; Murphy and Ferris 1990).

After AD 1525, communities of pre-contact Indigenous peoples of the Late Ontario Iroquoian Period who had formerly lived throughout southwestern Ontario as far west as the Chatham area moved further east to the Hamilton area. During the late 1600s and early 1700s, the French explorers and missionaries reported a large population of Iroquoian peoples clustered around the western end of Lake Ontario. They called these people the "Neutral", because they were not involved in the ongoing wars between the Huron and the League Iroquois located in upper New York State.

It has been satisfactorily demonstrated that the Late Ontario Iroquoian communities which were located in southwestern Ontario as far west as the Chatham area were ancestral to at least some of the Neutral Nation groups (Lennox and Fitzgerald 1990; Smith 1990:283). For this reason, the Late Ontario Iroquoian groups which occupied southwestern Ontario prior to the arrival of the French are often identified as "Prehistorical Neutral". They occupied a large area extending along the Grand River and throughout the Niagara Peninsula as far east as Fort Erie and Niagara Falls (Lennox and Fitzgerald 1990:448).

1.2.4 Post-Contact Indigenous Period

The post-contact Indigenous occupation of southern Ontario was heavily influenced by the dispersal of various Iroquoian-speaking peoples, such as the Huron and closely related Petun, by the New York State Iroquois and the subsequent arrival of Algonkian-speaking groups from northern Ontario at the end of the 17th century and beginning of the 18th century (Schmalz 1991).

The nature of their settlement size, population distribution, and material culture shifted as European settlers encroached upon their territory. However, despite this shift, "written accounts of material life and livelihood, the correlation of historically recorded villages to their archaeological manifestations, and the similarities of those sites to more ancient sites have revealed an antiquity to documented cultural expressions that confirms a deep historical continuity to Iroquoian systems of ideology and thought" (Ferris 2009:114). First Nation peoples of Southern Ontario have left behind archaeologically significant resources throughout Southern Ontario which show continuity with past peoples, even if they have not been recorded in historical Euro-Canadian documentation.

Portions of southwestern Ontario were also occupied by Algonkian-speaking groups both before and after European contact. Generally, the pre-contact Indigenous presence in much of southern Ontario reflects occupation by northern Iroquoian speakers. During and following the Iroquois Wars of the mid-17th century and the dispersal of the Iroquoian-speaking Huron-Petun and Neutral, a considerable reduction in the extent of territory occupied by Algonkian speakers occurred in southern Ontario. Beginning about 1690, northern Algonkian speakers from northern Ontario began to move southwards and southern Iroquoian speakers began to push southern Algonkian-speakers further west (Ferris 2009; Schmalz 1991).

1.2.5 Historical Euro-Canadian Period

Following the Toronto Purchase of 1787, today's southern Ontario was within the old Province of Quebec and divided into four political districts: Lunenburg, Mechlenburg, Nassau, and Hesse. These became part of the Province of Upper Canada in 1791, and renamed the Eastern, Midland, Home, and Western Districts, respectively. The Study Area is within the former Hesse District, then later the Western District, which originally included all lands lying to the west of a line running north from Long Point on Lake Erie to Georgian Bay. Each district was further subdivided into counties and townships, with the Study Area falling within Middlesex County and Westminster Township.

The Study Area is located in an area that first entered the Euro-Canadian historical record as part of Treaty No. 2, which:

... was made with the O[dawa], Chippew[a], Pottawatom[i] and Huro[n] May 19th, 1790, portions of which nations had established themselves on the Detroit River all of whom had been driven by the Iroquois from the northern and eastern parts of the Province, from the Detroit River easterly to Catfish Creek and south of the river La Tranche [Thames River] and Chenail Ecarte, and contains Essex County except Anderdon Township and Part of West Sandwich; Kent County except Zone

Township, and Gores of Camden and Chatham; Elgin County except Bayham Township and parts of South Dorchester and Malahide. In Middlesex County, Del[a]ware and Westminster Townships and part of North Dorchester [are included].

Morris 1943:17

Both the surveys and settlement would be disrupted by the War of 1812, which came to the London area in 1813. After advancing up the Thames, American forces faced a combined British regular, militia, and First Nation force at Moraviantown. In the ensuing Battle of the Thames, the widely respected First Nation leader Tecumseh was killed, and the British force was routed (Troughton & Quinlan 2009:43-44). During the 1814 campaign season, the American again met the British on the Thames, and the latter were again defeated at a skirmish on the Longwoods Road, also known as 'Battle Hill' (Troughton & Quinlan 2009:44).

After the war, settlers began arriving in Middlesex County in numbers, concentrating first in the Township of Delaware, near the Thames River, then spreading to Westminster Township and London Township.

1.2.5.1 Westminster Township

In 1791, Colonel John Graves Simcoe became the first Lieutenant-Governor of the newly formed Province of Upper Canada. Simcoe was particularly concerned about the threat of American expansion northward and their ability to cross at Detroit into the area known as the Western District (DWTH 2006:32).

It was believed that the best way to defend the land was to populate the area; therefore, in 1793, Simcoe ordered the lands of the Thames River basin to be surveyed for habitation. Surveying and settlement of the Middlesex County area was arranged by Col. Thomas Talbot, who had been granted a 618,000-acre tract of land along the north shore of Lake Erie. He arranged for his settlement to be surveyed into various townships with networks of roads and concessions that were divided into 200-acre lots.

Westminster Township, in particular, was surveyed in three different segments (DWTH 2006:33-34). The first segment along the North Branch of the Talbot Road (NBTR) was surveyed according to the single front survey system by Deputy Provincial Surveyor Simon T. Z. Watson in 1809. The second segment, which included Concessions A, B, 1 and 2, was also surveyed according to the single front survey system by Deputy Provincial Surveyor Watson and Deputy Surveyor John Bostwick in 1810. The remainder of the township (Concessions 3 to 9 and the Gore Concession between the NBTR and Delaware Township) was surveyed according to the double front survey system by Colonel Mahlon Burwell and John Bostwick in 1820.

The first land patents for Westminster Township, on the south bank of the Thames near the Forks of the Thames, were issued as early as 1812, shortly after the initial surveys in 1809 and 1810 (Brock and Moon 1972). Settlement began in the southwest corner of the Township along North Branch of the Talbot Road and followed by later settlements along Commissioners Road, with the southeast portion of the Township being settled last (Wilson and Horne 1995). The Township by 1817 had 107 houses and 428 people, including two schoolhouses, one grist mill and one sawmill (Brock and Moon 1972: 566). In 1842, the Township now contained four grist and two sawmills while the population had grown to 3,376 (Smith 1846), while at mid-century the population was 4,525 residents with three grist mills, two carding machines, and a fulling mill (Brock and Moon 1972:566).

The London and Port Stanley Railway line, which runs north-south through the Township, was fully operational by 1856 (Brock and Moon 1972: 566). Several small hamlets also developed within the township, including Byron, Lambeth, Hall Mills, Pond Mills, and Glanworth; these communities were settled over the course of the 19th century (Brock and Moon 1972: 577-581).

In 1961, a portion of the Township was annexed by the City, and in 1988, the Town of Westminster was established in an attempt to remain autonomous from London; however, it too was annexed in 1993 (Tourism London 2019; Meligrana 2000).

1.2.6 Study Area Historical Context

Prior to its annexation by the City of London in 1993, the Study Area fell within portions of Lots 17, 18, 19, and 20, Concession 6 in the former geographic Township of Westminster, Middlesex County, Ontario. Although there are historical maps of Westminster Township dating back to the early surveys of 1812, the first map that shows the Study Area is John Bostwick's 1821 survey map of the Township, which indicates that the clergy owned Lot 17 and the Crown owned Lots 18 and 20 (Map 3).

A patent plan of Westminster Township based on Mahlon Burwell's 1857 survey map (Map 4) indicates that the patent for the southwestern quarter of Lot 17 was issued to Frederick Watson Ersington. The patent holder for Lot 18 is illegible due to a damaged seam of the map. The patent for the northern half of Lot 19 was issued to Alex R. Scott, and the Canada Company is listed as the patent holder for Lot 20.

Tremaine's 1862 *Map of Middlesex County* (Map 5) indicates that J.D. Wright owned the portion of Lot 17 encompassed by the Study Area. This map also shows that the southern half of Lot 18 was owned by Alex McDonald, while the northern half was owned by William Scott. Finally, the northern half of Lot 19 is indicated as being owned by Jane Scott, and Ezekiel Burley is listed as the owner for the northern half of Lot 20. No structures are depicted in the Study Area.

The map of Westminster Township in the *Illustrated Historical Atlas of Middlesex County* (Map 6) indicates that in 1878, J. Crowley owned the portion of Lot 17 encompassed by the Study Area; no structures are shown on the property. The southern half of Lot 18 is shown as owned by the heirs of Alex McDonald. A house and orchard are shown on the map but are along present-day Manning Drive in the southern portion of the property outside of the Study Area. The northern half of Lot 18 is shown as divided into two parcels, with R. Jackson owning the eastern parcel and William Scott still owning the western parcel. William Scott's parcel has a house and orchard shown in the northeast corner within the Study Area, located on what is today 3465 Scotland Drive, although its location on the map is approximately 160 m east of where the current house stands. The portion of Lot 19 encompassed by the Study Area is shown as owned by John Shore, with a house and orchard depicted on the northern edge of the property within the Study Area, located on what is today 3713 Scotland Drive, roughly corresponding to where a house was demolished recently (see Map 7). The northern half of Lot 20 is shown as divided into two parcels, with W&D Johnston owning the eastern parcel and George Johnston owning the western parcel. A house and orchard are shown on the map but are along present-day White Oak Road on the western edge of the parcel outside of the Study Area.

1.3 Archaeological Context

1.3.1 Study Area Overview

The Study Area is situated within the Mount Elgin Ridges (Chapman and Putnam 1984:144-146).

"Between the Thames Valley and the Norfolk sand plain lies a succession of ridges and vales which are called the Mount Elgin Ridges....South of the Westminster and St. Thomas Moraines the country drains to Lake Erie by means of the tributaries of Kettle, Catfish and Otter Creeks....The two major landform components of this region provide obviously contrasting soils.

The ridges are well drained while imperfect and even poor drainage characterize the hollows. The ridges are formed from clay till similar to that of the Wyoming Moraine and the Stratford plain.”

Chapman and Putnam 1984:145

The localized topography is relatively flat, ranging between 280 m above sea level. The soils of the Study Area are comprised of the Muriel Association, which include silty clay loams, silty clays, and clay loams. Muriel soils are moderately well to imperfectly drained and are used today for common field crops (Haggerty and Kingston 1992:46). The bedrock deposits in the vicinity date to the Middle Devonian Period and consist of the Hamilton Group and Dundee Formations (Hewitt 1972).

The Study Area lies within the Mixedwood Plains ecozone of Ontario (The Canadian Atlas Online 2016). Although largely altered by recent human activity, this ecozone once supported a wide variety of deciduous trees, such as various species of ash, birch, chestnut, hickory, oak, and walnut, as well as a variety of birds and small to large land mammals, such as raccoon, red fox, white-tailed deer, and black bear.

The closest potable water sources include an unnamed tributary of Dingman Creek, which originates in the northern portion of the Study Area, and an unnamed tributary of Dodd Creek, which originates in the southeastern portion of the Study Area.

At the time of the Stage 2 assessment, the Study Area consisted of ploughed agricultural fields, residential properties, including various residential and farm structures and their associated driveways, overgrown fields, and one small woodlot area.

1.3.2 Previous Archaeological Work

A search of the Ontario Archaeological Sites Database (OASD), indicated that there are nine previously registered archaeological sites located within a 1 km radius of the Study Area (MHSTCI 2018). Three of these sites, AfHh-926, AfHh-928, and AfHh-929, are within 300 m of the Study Area and are discussed below. Data concerning these sites may be found in Table 2.

Table 2: Registered Archaeological Sites located within 1 km of the Study Area.

Borden Number	Site Name	Cultural Affiliation	Site Type
AfHh-48		Pre-Contact Indigenous; Archaic	Camp/Campsite
AfHh-389		Pre-Contact Indigenous; Early Archaic	Unknown
AfHh-897		Euro-Canadian	Homestead
AfHh-898		Pre-Contact Indigenous; Late Archaic	Findspot
AfHh-899		Pre-Contact Indigenous; Late Archaic	Findspot
AfHh-909	Location 15	Post-Contact	Dump
AfHh-910	Location 16	Post-Contact	Dump
AfHh-911	Location 17	Post-Contact	Dump

Borden Number	Site Name	Cultural Affiliation	Site Type
AfHh-912	Location 19	Post-Contact	Dump
AfHh-926*	White Oak 1	Pre-Contact Indigenous; Late Archaic	Camp/Campsite
AfHh-928*	Location 1	Pre-Contact Indigenous; Late Archaic	Findspot
AfHh-929*	Location A	Euro-Canadian	Scatter

*Site located within 300 m of the Study Area.

Several archaeological assessments have taken place within 50 m of the Study Area.

In 2005, Archaeologix Inc. conducted a Stage 1 Archaeological Assessment and built heritage assessment of a 397 ha study area from Scotland Drive to Manning Drive between White Oak Road and Wellington Road. This Stage 1 assessment, which included the current Study Area, determined areas within the study area to have archaeological potential and recommended that those areas be subject to Stage 2 archaeological assessment should they be developed. (Archaeologix 2005). One of the properties examined from a built heritage perspective, 3713 Scotland Drive, falls within the current Study Area. This was a one-and-a-half storey frame house built around 1895. It was determined in the Stage 1 to have lost most of its historical detail through renovations and lacks significant historical associations (Archaeologix 2005). Based on aerial imagery, this house was demolished in 2017.

In 2010, Golder conducted a Stage 1 and 2 Archaeological Assessment for a 12-acre property located at 3438 and 3290 Manning Drive for a proposed regional materials recovery facility. This stage 2 assessment consisted of pedestrian survey and did not identify any archaeological sites (Golder 2010).

In 2018, Golder conducted a Stage 1 and 2 Archaeological Assessment for a 30-ha portion of the City's W12A Landfill site located at 3502 Manning Drive, within part of Lot 20, Concession 6. The study area for this Stage 1-2 assessment included two proposed cells (Cells 9 and 10) in the northeast corner of the landfill for future waste disposal, as well as a proposed laydown area to be used to temporarily stockpile soil during cell construction immediately north of the W12A Landfill, which overlaps with the current Study Area (Map 8) The Stage 1 background study determined that the portions of the Study Area had archaeological potential, and as such, would require Stage 2 Archaeological Assessment to identify archaeological sites that may be present. The Stage 2 assessment involved a combination of pedestrian survey at 5 m intervals and shovel test pit survey at 5 m intervals, resulted in the identification of seven archaeological locations, six of which, Locations 1-6, lie in the current Study Area (Golder 2018).

Location A (AfHh-929) consisted of 716 Euro-Canadian artifacts and 81 faunal elements from 42 positive test pits and two test units in an area measuring approximately 30 m east-west by 50 m north-south. Though the assemblage dates from the mid-19th century to the 20th century, its location in close proximity to berms created by the demolition of the farm complex in that area indicates that the artifacts here come from disturbed contexts. Thus, Location A (AfHh-929) was concluded to have no further cultural heritage value or interest (CHVI) and has been sufficiently documented. No further archaeological assessment was recommended (Golder 2018).

Location 1 (AfHh-928) consisted of one Late Archaic Innes projectile point and one piece of lithic debitage. The isolated nature of these artifacts suggests they are related to transient use of the area by Indigenous peoples that

occurred during the Late Archaic Period. Given the isolated and non-diagnostic nature of the finds, Location 1 (AfHh-928) was concluded to have no further CHVI and has been sufficiently documented. No further archaeological assessment was recommended (Golder 2018).

Location 2 consisted of four pieces of lithic debitage, while Locations 3, 5, and 6 are each represented by a single chert flake. The isolated nature of these artifacts suggests they are related to transient use of the area by Indigenous peoples that occurred during an unknown time period. Given the isolated and non-diagnostic nature of the finds, Locations 2, 3, 5, and 6 were concluded to have no further CHVI and have been sufficiently documented. No further archaeological assessment was recommended (Golder 2018).

Location 4 (AfHh-926) consisted of six pre-contact Indigenous artifacts in an area measuring approximately 23 m east-west by 20 m north-south, including one projectile point, one scraper, and four pieces of lithic debitage. The quantity of the cultural material identified at Location 4 (AfHh-926) suggests that it may represent a campsite that was occupied during the Late Archaic Period and that lithic tool production and maintenance were carried out at this site. Based on the size and nature of the assembly, Location 4 (AfHh-926) was concluded to have further CHVI and further archaeological assessment was recommended (Golder 2018).

In the summer of 2018, Location 4 (AfHh-926), renamed the White Oak 1 site, was subject to Stage 3 by Golder. The Stage 3 consisted of the hand excavation of 28 1 m² test units across an area measuring approximately 30 m east-west by 25 m north-south and resulted in the recovery of 126 pre-contact Indigenous artifacts and 62 Euro-Canadian artifacts. Based on the results of the Stage 3 Archaeological Assessment, the White Oak 1 site (AfHh-926) was interpreted as a small Late Archaic campsite that meets provincial criteria for have sufficient CHVI to require Stage 4 mitigation prior to development impacts. Through discussions with the proponent and engagement with Indigenous communities, it was determined that the White Oak 1 site (AfHh-926) could be avoided.

Plans for the avoidance and long-term protection of the White Oak 1 site (AfHh-926), including a commitment that any ground alterations will avoid the archaeological site and its protective buffer, were provided to the City of London as the proponent and approval authority of this project. As well, if the City of London or any other future landowner determines at a later date that the White Oak 1 site (AfHh-926) will be altered in any way, either temporarily or permanently, including minor forms of soil disturbance such as tree removal, minor landscaping, and utilities installation, then Stage 4 mitigation will be required (Golder 2019).

To the best of our knowledge, no additional archaeological assessments have been conducted within 50 m of the current Study Area.

Information concerning specific site locations is protected by provincial policy and is not fully subject to the *Freedom of Information Act*. The release of such information in the past has led to looting or various forms of illegally conducted site destruction. Confidentiality extends to all media capable of conveying location, including maps, drawings, or textual descriptions of a site location. For this reason, maps and data that provide information on archaeological site locations are provided as supplementary documentation and do not form part of this public report.

2.0 FIELD METHODS

2.1 Stage 2 Archaeological Assessment

The Stage 2 Archaeological Assessment of the Study Area was conducted over 21 days between August 2018 and November 2019 under archaeological consulting licence P364, issued to Michael Teal of Golder Associates, by the Ministry of Heritage, Sport, Tourism and Culture Industries (PIF# P364-0126-2018). Lafe Meicenheimer (P457), Rebecca Parry (P1013), and Sheryl Spigelski (P1034) assumed partial responsibility of undertaking the archaeological fieldwork as per Section 12 of the MHSTCI's 2013 *Terms and Conditions for Archaeological Licences*, issued in accordance with clause 48(4)(d) of the *Ontario Heritage Act* (Government of Ontario 1990b). Lafe Meicenheimer supervised June 19, 24, 25, 27, and July 19, 2019, while Rebecca Parry supervised August 20, September 11, 12, 13, 14, 17, and 18, 2018, as well as November 6, 2019, and Sheryl Spigelski supervised August 2, 3, September 18, 19, and 21, 2018, as well as August 1, 2, 15, and 16, 2019.

The weather during the assessment was variable (see Table 3). At no time were the conditions detrimental to the observation or recovery of archaeological material.

Table 3: Weather during the Stage 2 Assessment.

Date	Temperature	Comments
August 2, 2018	22°C - 27°C	Mostly sunny
August 3, 2018	17°C - 26°C	Overcast
August 20, 2018	17°C - 26°C	Overcast
September 11, 2018	12°C - 22°C	Overcast
September 12, 2018	13°C - 23°C	Overcast
September 13, 2018	17°C - 26°C	Overcast
September 14, 2018	18°C - 27°C	Partly cloudy
September 17, 2018	17°C - 27°C	Mostly sunny
September 18, 2018	17°C - 24°C	Overcast
September 19, 2018	16°C	Sunny
September 21, 2018	28°C	Mostly sunny
June 19, 2019	14°C - 25°C	Sunny
June 24, 2019	18°C - 26°C	Overcast - mostly sunny
June 25, 2019	20°C - 26°C	Mostly sunny
June 27, 2019	20°C - 31°C	Overcast

Date	Temperature	Comments
July 19, 2019	38°C	Sunny
August 1, 2019	16°C - 26°C	Sunny
August 2, 2019	18°C - 27°C	Sunny
August 15, 2019	16°C - 26°C	Partly cloudy
August 16, 2019	17°C - 25°C	Partly cloudy
November 6, 2019	-3°C - 4°C	Overcast, light flurries in afternoon

Photo locations are illustrated on Map 9 through Map 9C. All activities undertaken during the assessment were in compliance with the *Ontario Heritage Act* (Government of Ontario 1990b) and the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011).

The Study Area is comprised of cultivated agricultural fields, overgrown fields, woodlot, and residential properties. Given the nature of the Study Area, it was assessed using a combination of pedestrian survey and shovel test pit survey.

2.1.1 Pedestrian Survey

The approximately 51.45 ha of the Study Area consisted of ploughed agricultural fields (Image 1 and Image 2). These areas were assessed using the standard pedestrian survey method at 5 m intervals (Image 3 and Image 4). The Study Area was recently ploughed and weathered, and surface visibility was excellent (Image 1 to Image 4). When an artifact was encountered, the initial artifact was marked, and survey intervals intensified to 1 m within at least a 20 m radius of the find. Any additional artifacts identified while conducting the intensified survey were also marked. This process continued until the full extent of the surface scatter was defined. A controlled surface pick-up (CSP) that met all requirements outlined in Section 3.2.1 of the MHSTCI's *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) was conducted at all locations as part of the Stage 2 assessment (Image 5). Once the full extent of a location was defined, all of the artifacts identified in the scatter were retained for laboratory analysis and their positions documented with a Trimble Nomad GPS unit using its internal receiver, achieving a minimal accuracy of 3 m.

2.1.2 Test Pit Survey

The remaining 26.8 ha of the Study Area included overgrown fields, woodlot, and residential properties consisting of manicured lawns, residential structures and their associated driveways and outbuildings (Image 6 to Image 8). These areas could not be ploughed and as such were assessed using the standard shovel test method. Test pits were dug by hand and spaced at 5 m intervals (Image 9 and Image 10). Each test pit was at least 30 cm in diameter and was excavated to a minimum of 5 cm into subsoil. All soil was screened through 6 mm hardware cloth to facilitate the recovery of any cultural material present. Each test pit was examined for stratigraphy, cultural features and fill. Test pits were excavated to within 1 m of built structures or until test pits showed evidence of recent ground disturbance or poor drainage. All test pits were back filled upon completion.

When an artifact-yielding test pit was encountered, test pit excavations continued on the survey grid to determine the extent of additional positive test pits in the area. If this process yielded insufficient archaeological resources to meet the criteria for recommending a Stage 3 Archaeological Assessment, intensified survey coverage around the initial positive test pits was performed as appropriate for each site. Locations 3 and 6 were small pre-contact Indigenous locations and as such were intensified with eight test pits excavated around the positive test pit and a 1 m² test unit excavated over the positive test pit as per Standards 1 and 2a, Section 2.1.3 of the *Standards and Guidelines for Consultant Archaeologists* (Image 11) (Government of Ontario 2011). Location 4 was a Euro-Canadian site, and after consultation with the MHSTCI, four 1 m² test units were excavated in the vicinity of the test pits yielding the highest number of pre-20th century artifacts (Image 12), as per *The Archaeology of Rural Historical Farmsteads* technical bulletin (Government of Ontario 2014). Correspondence with the MHSTCI is presented in the Supplementary Documentation, separate from this report.

Relevant UTM coordinates for all locations are presented in the Supplementary Documentation, separate from this report. The Supplementary Documentation also contains Tiles showing the specific site locations.

2.1.2.1 Stratigraphy and Disturbances

The stratigraphy found across the Study Area was consistent with minor exceptions. Typical soils found in test pits across the Study Area consisted of medium grey-brown silty clay loam topsoil over red-brown or yellow brown clay loam subsoil (Image 13 to Image 16). Test pits ranged from 15 to 40 cm deep. All 1 m² test units excavated at all locations except Location 4 (AfHh-945) displayed soils as described above (Image 17).

Test units at Location 4 (AfHh-945) in the northern-central portion of the Study Area displayed three soil layers (lots); two topsoil lots (Lots 1 and 2) and one subsoil lot (Lot 3) (Image 18). Lot 1 consisted of up to 26 cm of dark brown silty clay loam, while Lot 2 consisted of 5 to 10 cm of slightly mottled dark yellow-brown silty clay loam, and Lot 3 consisted of yellow-brown clay loam. Both topsoil lots were artifact-bearing, with Lot 2 being interpreted as the interface between the topsoil and the subsoil.

Areas that were found to be subject to prior disturbance included residential properties, including houses, barns, and other outbuildings and their associated driveways and parking areas, and areas where former buildings were removed (Image 19 to Image 23). Residential properties included 3801, 3561, and 3465 Scotland Drive, while the house and farm complex buildings were removed from 3713 Scotland Drive in 2017 (Map 7).

3.0 RECORD OF FINDS

The Stage 2 Archaeological Assessment was conducted employing the methods described in Section 2.0. Map 9 through Map 9C show the areas assessed and techniques employed, while Image 1 to Image 18 illustrate the Stage 2 survey conditions.

Numerous areas of previous disturbance, slope, and permanently wet areas were found throughout the Study Area (Image 19 to Image 27; see Map 9 through Map 9C). Previously disturbed areas have been discussed above (see Section 2.1.2.1 and Image 19 to Image 23). The Stage 2 Archaeological Assessment resulted in the identification of six locations producing archaeological material, each of which is discussed below.

For a list of terms and definitions regarding the pre-contact Indigenous cultural material discussed in this report, see Appendix A.

Artifacts recovered from the Stage 2 Archaeological Assessment are contained in one banker's box stored at Golder's London office at 309 Exeter Road, London, Ontario.

Table 4 provides an inventory of the documentary record generated in the field, while all artifact catalogues may be found in Appendix B.

Table 4: Inventory of Documentary Record.

Document Type	Current Location of Document	Additional Comments
Field Notes	Golder Office in London	66 pages from original field book stored in project folder and digitally in project file.
Hand Drawn Maps	Golder Office in London	27 maps stored in project folder and digitally in project file.
Maps provided by Client	Golder Office in London	One map stored in project folder and stored digitally in project file.
Digital Photographs	Golder Office in London	608 digital photos stored digitally in project file.

3.1 Location 1

Location 1 was identified during pedestrian survey in the northwest corner of the Study Area. The CSP of Location 1 resulted in the recovery of one biface fragment manufactured from Onondaga chert (Image 28). The biface fragment measures 4.62* mm long (*incomplete), 19.73 mm wide, and is 5.27 mm thick.

3.2 Location 2

Location 2 was identified during pedestrian survey in the northwest corner of the Study Area, approximately 65 m northeast of Location 1. The CSP of Location 2 resulted in the recovery of two biface thinning flakes of Onondaga chert (Image 29).

3.3 Location 3

Location 3 was identified during test pit survey in the north-central portion of the Study Area, on higher ground overlooking a natural drainage approximately 50 m west of a farm laneway. The test pit intensification, including excavation of eight cardinal test pits and one test unit (see Section 2.1.2 above) resulted in the recovery of one flake fragment of Selkirk chert (Image 30).

3.4 Location 4 (AfHh-945)

Location 4 (AfHh-945) was identified during test pit survey in the northern central portion of the Study Area, adjacent to the west and south of the footprint of the house that was demolished in 2017 at 3713 Scotland Drive. The test pit survey and intensification resulted in the recovery of 488 Euro-Canadian artifacts and 23 faunal elements from 21 positive test pits and four 1 m² test units across an area measuring approximately 65 m north-south by 25 m east-west (Image 31 to Image 44). Test units were excavated in the vicinity of the test units yielding the highest numbers of mid-19th century artifacts, such as machine-cut nails, RWE, and yellowware, in order to obtain as much additional information about the nature of the site as possible, as per advice from the MHSTCI and *The Archaeology of Rural Historical Farmsteads* (Government of Ontario 2014). Correspondence from the MHSTCI is presented in the Supplementary Documentation separate from this report.

3.4.1 Euro-Canadian Material

The Euro-Canadian artifact assemblage from Location 4 (AfHh-945) includes 186 structural-related artifacts (36.40% of total assemblage), 107 artifacts with a food and beverage function (20.94% of total assemblage), 103 artifacts with an indeterminate function (20.16% of total assemblage), 45 artifacts with miscellaneous functions (8.81% of total assemblage), 42 tools and equipment-related artifacts (8.22% of total assemblage), four personal/societal related artifacts (0.78% of total assemblage), and one artifact relating to arms and ammunition (0.20% of total assemblage). Each class of artifact along with dateable artifacts are discussed in detail below in Section 4.2.

3.4.2 Faunal Material

A total of 23 faunal elements (4.50% of total assemblage) were recovered from Location 4 (AfHh-945), including 22 mammal bones and one cow (*Bos taurus*) tooth. The mammal bones include one metapodial condyle from a cow (*Bos taurus*) and nine calcined bones (Image 45).

3.5 Location 5 (AfHh-946)

Location 5 (AfHh-946) was identified during test pit survey in the northeast corner of the Study Area, adjacent to the east of the house at 3465 Scotland Drive. The test pit survey of Location 5 (AfHh-946) resulted in the recovery of 47 Euro-Canadian artifacts from eleven positive test pits across an area measuring approximately 45 m north-south by 15 m east-west (Image 46 to Image 49).

3.5.1 Euro Canadian Material

The Euro Canadian artifact assemblage from Location 5 (AfHh-946) includes 23 artifacts with a food and beverage function (48.94% of total assemblage), ten structural-related artifacts (21.28% of total assemblage), nine artifacts with an indeterminate function (19.15% of total assemblage), and five artifacts with miscellaneous functions (10.64% of total assemblage). Each class of artifact along with dateable artifacts are discussed in detail below in Section 4.3.

3.5.2 Faunal Material

Three faunal elements were recovered from Location 5 (AfHh-946), all of which are mammal bones that show signs of butchering, including one cow (*Bos taurus*) bone (Image 49).

3.6 Location 6

Location 6 was identified during test pit survey in the northeastern corner of the Study Area, on higher ground overlooking a natural depression in the topography. The test pit survey and intensification, including excavation of eight cardinal test pits and one test unit (see Section 2.1.2 above) resulted in the recovery of one biface thinning flake of Onondaga chert (Image 50).

4.0 ANALYSIS AND CONCLUSIONS

A previously-completed Stage 1 assessment indicated that the Study Area had archaeological potential and would require Stage 2 Archaeological Assessment (Archaeologix 2005). As such a Stage 2 Archaeological Assessment of the Study Area, consisting of pedestrian and test pit survey at 5 m intervals was completed and resulted in the identification of six artifact-producing locations, each of which is discussed below.

4.1 Locations 1, 2, 3, and 6

Location 1 consisted of one biface fragment, while Location 2 consisted of two pieces of lithic debitage, and Locations 3 and 6 each consisted of a single piece of lithic debitage. Despite intensified survey at each location, no additional archaeological material was recovered. All of the artifacts from Locations 1, 2, 3, and 6 were collected and retained for laboratory analysis (see Section 2.1 above).

The biface fragment from Location 1 and the lithic debitage from Locations 2 and 6 are manufactured from Onondaga chert. Onondaga chert is a high-quality raw material found within the Onondaga Formation that outcrops along the north shore of Lake Erie west of the mouth of the Grand River as far west as Nanticoke, east of the mouth of the Grand River as far east as Fort Erie, and along the Onondaga Escarpment between Cayuga and Hagersville (Telford and Tarrant 1975). This material can also be recovered from secondary, glacial deposits across much of southwestern Ontario, east of Chatham (Eley and von Bitter 1989; Fox 2009:361-362).

The single piece of lithic debitage from Location 3 is manufactured from Selkirk chert. Selkirk chert is a moderate to relatively high-quality raw material that occurs within the Dundee Formation; it outcrops along Sandusk Creek and its tributaries just west of the village of Selkirk (Telford and Tarrant 1975). Its distribution as a secondary source material is similar to Onondaga chert and it is frequently encountered as far west as the Chatham area (Eley and von Bitter 1989; Fox 2009:362).

Although the biface fragment from Location 1 is non-diagnostic, it was defined according to Fisher's (1997) typology. In this, she separates bifaces into four stages based on number and size of flakes removed, length and depth of flakes scars, cross-section, length to width ratio, and edge configuration. According to Fisher's typology, the biface from Location 1 is considered a Stage 4 biface. Stage 4 bifaces are nearly completed projectile points with a shaped base, relatively even edges, a relatively high width to thickness ratio, and some retouch. Some bifaces classed as Stage 4 bifaces may have been finished projectile points, though they are not as finely crafted as the definitive finished projectile points (Fisher 1997).

Biface fragments and lithic debitage are not typically diagnostic, therefore the age or cultural affiliation of Locations 1, 2, 3, and 6 could not be determined. The isolated nature of these artifacts suggests they are related to transient use of the area by Indigenous peoples that occurred during an unknown time period.

Given the isolated and non-diagnostic nature of the finds, Locations 1, 2, 3, and 6 are concluded to have no further cultural heritage value or interest (CHVI) as the sites do not meet the criteria identified in Section 2.2, Standard 1a of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) for determining the need for Stage 3 Archaeological Assessment.

4.2 Location 4 (AfHh-945)

As described in Section 3.4, the artifact assemblage from Location 4 (AfHh-945) includes 488 Euro-Canadian artifacts and 23 faunal elements (Image 31 to Image 45). The assemblage is predominately structural-related items, food and beverage-related items, and artifacts with an indeterminate function, followed by lesser amounts

of artifacts with miscellaneous functions, tools and equipment-related artifacts, personal/societal-related artifacts, and one artifact related to arms and ammunitions. The faunal assemblage from Location 4 (AfHh-945) includes 22 mammal bones and one cow (*Bos taurus*) tooth. Artifacts that provide relative dates from each functional category will be discussed in detail below.

4.2.1 Euro-Canadian Component

4.2.1.1 Structural

A total of 186 structural-related artifacts were recovered from Location 4 (AfHh-945), including 130 nails, 31 shards of windowpane glass, 17 pieces of brick, two ceramic artifacts, two asphalt shingle fragments, one asbestos tile fragment, one piece of mortar, one piece of concrete, and one piece of electrical wire.

Nails included 26 machine-cut nails and 104 wire-drawn nails, while ceramic artifacts included one dust-pressed tile and one electrical insulator.

Dateable structural artifacts from Location 4 (AfHh-945) include wire-drawn nails (n=104), machine-cut nails (n=26), asphalt shingles (n=2), electrical artifacts (n=2), dust-pressed tile (n=1), and structural concrete (n=1) (Image 31 and Image 32).

Wire drawn nails are identical to the type of nails in current use today, with a flat, round head and a wire shaft. They were developed in the 1850s but did not become popular until the 1890s (Adams et al. 1994). Cut nails were machine cut from flat sheets of iron creating a nail that is of even thickness when viewed from the side, not tapered on all sides like hand-made nails, with a square and flat head. Invented about 1790, cut nails were in common use from the 1830s until the 1890s (Adams et al. 1994: 94).

Asphalt shingles consists of asphalt-impregnated material covered in finely-ground aggregate granules. The modern asphalt shingle was invented in 1903 by Henry Reynolds in Grand Rapids, Michigan, who began cutting the rolls of asphalt-impregnated materials into individual shingles. The first shingles were cut by hand, but by the 1920s, machinery had been perfected to quickly and efficiently cut shingles, making them widely available. Asphalt shingles are still in use today (Anderson, 2012).

Electric lighting was invented in the early 1880s, bringing about the age of electricity. Electricity, however, did not come into widespread use until the 1890s and early 1900s, with porcelain insulators being used until the 1930s (Tod 1977).

Ceramic tiles such as the one fragment recovered from Location 4 (AfHh-945) are manufactured using a process called “dust pressing.” Materials such as quartz, sand, and feldspar are mixed with water and clay and heated to dry the mixture out to approximately 6% moisture content to produce a powder. This powder is then pressed with a force up to 100,000 pounds per square inch into the desired shape. Finally, the tiles are glazed and fired in a kiln (Edmonds 2008). This process was invented in the mid-19th century and originates in button manufacturing. The dust pressing process for tiles is similar to the process of manufacturing Prosser buttons, in which the clay and flint used to make porcelain is dried to a powder, put into moulds, and subjected to strong pressure. This process was invented and patented by Richard Prosser of Birmingham, England in 1840 and revolutionized button production. During the early 1840s, a Stoke-On-Trent ceramic manufacturer named Herbert Minton acquired a share in Prosser’s patent and applied the process to tile manufacture. Much like the button industry, Minton’s application of the dust pressing process revolutionized tile manufacturing. This in turn made them widely available, fueling a large demand for decorative tile in the late 19th century (Darby 2017).

Portland cement, the most critical ingredient of modern concrete, was invented in 1824. It is a mixture of lime and clay that is fired and pulverized, then mixed with aggregate and water to make concrete. Despite its invention date, it was not used as a building material until the 20th century due to there being no standard recipe nor technique for production (Simpson 1989, Strenchock 2009).

4.2.1.2 Food and Beverage

A total of 107 food and beverage-related artifacts were recovered from Location 4 (AfHh-945), included 106 ceramic sherds and one piece of butchered cow (*Bos taurus*) bone. Dateable artifacts relating to food and beverage from Location 4 (AfHh-945) include refined white earthenware (RWE), vitrified white earthenware (VWE), stoneware, porcelain, Rockingham ware, and yellowware.

4.2.1.2.1 Ceramics

Table 5 provides a breakdown of the ceramic assemblage by ware type, while Table 6 provides a summary of decorative styles present on the tableware portion of the assemblage.

Table 5: Location 4 (AfHh-945) Ceramic Assemblage by Ware Type.

Ware Type	Freq.	% of Total
Refined White Earthenware	55	51.89%
Vitrified White Earthenware	18	16.98%
Coarse Earthenware	16	15.09%
Stoneware	10	9.43%
Porcelain	3	2.83%
Rockingham ware	3	2.83%
Yellowware	1	0.94%
Total	106	100.00%

Table 6: Location 4 (AfHh-945) Tableware Assemblage by Decorative Style.

Ceramic Artifact	Freq.	% of Total
RWE, Plain/Undecorated	24	30.00%
RWE, Transfer-Printed	16	20.00%
RWE, Banded	6	7.50%
RWE, Hand-Painted	5	6.25%
RWE, Edged	2	2.50%

Ceramic Artifact	Freq.	% of Total
RWE, Flow Transfer-Printed	2	2.50%
VWE, Plain/Undecorated	10	12.50%
VWE, Flow Transfer-Printed	3	3.75%
VWE, Transfer-Printed	2	2.50%
VWE, Moulded	2	2.50%
VWE, Lithographed	1	1.25%
Porcelain, Plain/Undecorated	3	3.75%
Rockingham Ware	3	3.75%
Yellowware, Plain/Undecorated	1	1.25%
Total	80	100.00%

White Earthenwares

Refined white earthenware is slightly porous, white-pasted earthenware with a near colourless glaze first developed in 1805 and began to replace earlier near-white ceramics, such as creamware and pearlware, by the early 1830s. Its use continued throughout the 19th century, and is still used today, but its popularity began to decline by the 1840s with the introduction of vitrified white earthenware (Adams et al 1994; Miller 2000:10, 13). A total of 55 RWE sherds were recovered from Location 4 (AfHh-945), including 24 plain/undecorated sherds, 16 transfer-printed sherds, six industrial slipped sherds, five hand-painted sherds, two edged sherds, and two flow transfer-printed sherds.

Vitrified white earthenware (VWE), also known as white granite, graniteware, white stone ironstone, or simply ironstone is a variety of white bodied earthenware with a white to greyish-white fabric that is usually thick and heavy beneath a thick, hard clear glaze with a white, greyish or bluish tint. Vitrified white earthenware was first developed in the 1840s but did not become popular until the second half of the 19th century. Its popularity continued into the 20th century and it is still in use to some extent today (MACL 2015a). A total of 18 VWE sherds were recovered from Location 4 (AfHh-945) including 10 plain/undecorated sherds, three flow transfer-printed sherds, two transfer-printed sherds, two moulded sherds, and one lithographed sherd.

Dateable decorative techniques represented on VWE and RWE sherds from Location 4 (AfHh-945) include transfer-printing, industrial slip (banded), hand-painting, flow transfer-printing, edged sherds, moulding, and lithographing.

During the 19th century, the technique of transfer-printing designs to the underglaze surface of clay ceramics revolutionized the British ceramic industry. Manufacturers were now able to apply intricate patterns quickly and rather inexpensively, allowing for more uniformity between vessels (Samford 1997). Prior to 1829, most transfer

printed wares were blue, but after 1830, colours such as light blue, brown, black, sepia, green, red and mulberry became more common (Collard 1967; Coysh and Henrywood 1982:10). From about 1850 to 1890 only the colours blue, black, and brown are common, while in the 1890s and later a wide variety of colours were in use (Adams *et al.* 1994:101). Transfer-printed wares recovered from Location 4 (AfHh-945) include both RWE and VWE. Colours represented in the Location 4 (AfHh-945) RWE assemblage include blue (n=12), black (n=3), and brown (n=1). while colours from the VWE assemblage include blue (n=2) (Image 33).

Banded wares were decorated with horizontal bands of coloured slip applied in varying widths. These wares are a type of industrial slip wares, produced by mechanized slip decorating introduced in the 18th century. Industrial slip is known by a number of other names, many referring to a specific type of decoration, rather than the decoration group as a whole. Banding colours are predominantly muted earth tones including, black, green, brown, orange, yellow, grey, and pale blue. Banded patterns can be found on white earthenwares from about 1830 through the 20th century and occurred both as a primary decorative element and in conjunction with other design elements such as cabling or 'finger trailing' found on mocha ware after 1836 (Sussman 1997). Examples from the first half of the century are fairly elaborate with multiple colours, while most banded wares from the last half of the century tend to be plainer, often consisting of nothing but bands of blue slip (Adams *et al.* 1994:101). A total of five banded RWE sherds from Location 4 (AfHh-945) have blue and green banding, while one has blue banding (Image 34).

Hand-painted RWE sherds from the assemblage include one sherd painted with early palette brown, as well as five sherds painted with late palette green and red (Image 35). Early palette paints for white-bodied ceramics, including blue, brown, yellow, and green were in use from approximately 1795 until the 1820s, while late palette paints including brighter shades of yellow and green, as well as red, became popular after the 1830s (Miller 1991).

Flow transfer-printing involved adding a mixture of volatilizing chemicals to the kiln during the firing process, which cause the printed design to diffuse into the glaze, blurring the image. This type of decoration became popular in North America during the 1840s (Collard 1967). Flow transfer-printing occurs on both RWE (n=2) and VWE (n=3) at Location 4 (AfHh-945) (Image 36).

White earthenware plates and other tableware were often decorated with moulded rim motifs that were usually painted under the glaze in blue or green, and occasionally red (Miller 1991). This method of decoration, simply referred to as 'edged' by 19th century potters, was first introduced in the 1770s. By the 1840s, green edged wares became rare, while blue edged wares remained popular into the 1860s and continued to be available for purchase well into the 1890s and possibly later (Miller 1991). The moulded motifs present on edged wares changed through time with scalloped or undulating rims occurring prior to 1840 and unscalloped rims occurring after 1840. Unscalloped edged wares remained popular until the 1870s (Adams *et al.* 1994:102; Miller 1987). The RWE sherds include one scalloped sherd and one unscalloped sherd (Image 37).

Both moulded VWE sherds are wheat or Ceres patterned sherds (Image 38). The first raised grain pattern was patented in 1848 by Minton and Company and gained popularity after that, made in large quantities by many manufacturers (Sussman 1985).

The lithographic decorative process for ceramics entails applying a design in the form of a paper-backed sheet to the surface of a vessel that has first been covered in a layer of tacky varnish. The backing paper is then sponged off. There were endless assortments of lithographic patterns, which were generally many different colours and

often included much shading. This type of decoration became popular during the 1890s and early 20th century and is in common use still today (Savage and Newman 1974) (Image 39).

Porcelain, Rockingham Ware, and Yellowware

A total of three porcelain sherds, three sherds of Rockinghamware, and two sherds of yellowware were recovered from Location 4 (AfHh-945) (Image 40).

Porcelain is made from a mixture of china clay (kaolin) and china stone (petuntse). Porcelaneous ware was first made in China, hence its common name *china*. Chinese porcelain is less vitrified (and therefore softer) than its modern European counterpart, which was developed in Germany in the early 18th century. Porcelain is a highly vitrified pottery with a white, fine-grained body that is usually translucent, as distinguished from earthenware, which is porous, opaque, and coarser (MACL 2016). A total of three plain/undecorated porcelain sherds were recovered from Location 4 (AfHh-945). Though there was a large amount of porcelain produced in England and Europe as early as the 18th century, on North American archaeological sites, it is most often found in post-1850 contexts (MACL 2016).

Rockingham glaze is an uneven brown glaze that was often combined with moulded decoration on cooking vessels, teapots, pitchers, and spittoons manufactured from coarse earthenware and stoneware (MACL 2015a). It was first produced by English potters after 1788, however it was not widespread in North America until potters began producing it here in the mid-19th century (Spargo 1926; Collard 1967). Rockingham-glazed vessels were manufactured from the mid-19th century into the early 20th century, with peak popularity during the 1890s (Burke 1991). A total of three Rockinghamware sherds were recovered from Location 4 (AfHh-945).

Yellowware is earthenware made from naturally coloured buff/yellow clay, covered with a clear glaze dating from 1830 to 1940 (Miller 2000), with its peak popularity after 1850 (Burke 1991). Glazed wares vary from brownish mustard to light yellow (Sussman 1997). This ware type was primarily used for food preparation and storage (Miller 2000). A total of two plain/undecorated yellowware sherds were recovered from Location 4 (AfHh-945).

Coarse Earthenware and Stoneware

Coarse earthenware is generally somewhat porous and hard with orange to red or yellow coloured paste and has been manufactured since the late 18th century and continues to be produced today. It was the most common utilitarian ware during the first half of the 19th century (Adams *et al.* 1994). As it is quite porous, glaze is needed for the vessel to hold liquid contents. A total of 16 coarse earthenware sherds were recovered from Location 4 (AfHh-945), all of which have slip and/or glaze.

Stoneware is a hard, heavy, grey to light brown ceramic that was commonly used for utilitarian purposes (i.e., crocks and jugs). It is fired at a higher temperature than earthenware and has a less porous body. A total of ten stoneware sherds were recovered from Location 4 (AfHh-945), including seven sherds with salt glaze and Albany slip, two sherds with a clear glaze, and one sherd with a yellow glaze (Image 41). Salt glaze is a high-temperature glaze formed by the addition of salt into the kiln when it is at its highest temperature. The vaporized sodium combines with the silica on the surface of the ceramics to create a glossy, hard glaze with a characteristic 'orange peel' texture. Salt glazing has been around for hundreds of years and is therefore not a viable indicator of date on its own (MACL 2015b). Albany slip is a varying brown slip originally created from alluvial clays in New York. It has since come to refer to any dark brown or black slip. Albany slip was invented in the early 19th century, however it did not become widespread and popular until the mid- to late 19th century. Albany slip paired with salt glaze indicates a post-1860 date (MACL 2015b).

4.2.1.3 Indeterminate

A total of 102 artifacts recovered from Location 4 (AfHh-945) have an indeterminate function, including 60 shards of glass, 22 pieces of metal, 14 pieces of plastic, five sherds of coarse earthenware, and one cement-based asbestos tile. Glass artifacts are all fragments of indeterminate containers, jars, and bottles, including five external thread jar finishes and one mineral-type bottle finish. Metal artifacts include 19 pieces of indeterminate metal, two can lids, and one metal plate fragment.

Artifacts from this group that provide relative dates for Location 4 (AfHh-945) include glass bottle finishes and some colours of glass (Image 42). Plastics are diagnostic to the 20th century.

The mineral finish is a two-part finish with a moderately tall portion on top of a short portion. This bottle finish was most frequently used from the 1840s into the 1880s on a wide variety of bottles (Lindsey 2014). External thread finishes came into being in the late 19th century, however they did not become widely used until the early 20th century, when machines came to dominate bottle production, as well as new industry-wide standards for external thread finishes and screw closures (Lindsey 2014).

Varying colours are represented in this assemblage, including clear/colourless (n=42), aqua (n=5), manganese-tinted (n=5), dark olive (n=4), brown (n=2), and white (n=1). Typically, the colour of bottle glass has limitations in providing dates of manufacture (Lindsey 2014; Jones and Sullivan 1989); however, some colours are useful. One study suggests that most manganese-tinted, or purple-coloured, glass typically dates between 1875 and 1920 (Lockhart 2006). During this time, manganese was often added during the manufacturing process to produce colourless glass. However, due to the presence of the manganese, the glass would turn light purple in colour over time when exposed to sunlight (Lindsay 2014). White glass, also called milk glass, was used for a wide variety of containers, but most commonly for cosmetic and toiletry containers. Though its dateable utility is limited, it has been used from the late-19th century on (Lindsey 2014).

4.2.1.4 Other Functional Categories

Functional categories represented to lesser degrees at Location 4 (AfHh-945) include miscellaneous, tools and equipment, personal/societal, and arms and ammunition.

A total of 47 artifacts recovered from Location 4 (AfHh-945) have miscellaneous functions, including 30 pieces of metal, eleven pieces of coal, and five pieces of clinker. Metal artifacts include various pieces of hardware, such as bolts, brackets, wires, pipes, hinges, and spikes.

Tools and equipment-related artifacts include 37 fragments of drainage tile, two terra cotta flowerpot sherds, one metal clothespin spring, and a plastic syringe that is likely for administering antibiotics to livestock. The first clothespin design that utilized a spring was invented by David M. Smith in 1853 in Vermont (Greenbaum and Wilson 2012). His design was an improvement on the simple peg design that was in use before then, and variations of it are still in use today. Plastics are diagnostic to the 20th century (Image 43).

Four personal/societal-related artifacts were recovered from Location 4 (AfHh-945), including two white ball clay pipe fragments, one metal button, and one aluminum Kodak film canister (Image 44). White ball clay pipes were widely made throughout the 19th century, though without maker's marks or distinctive decoration, they are of little diagnostic use. The Eastman Kodak Company has been a photography company since 1888, however their aluminum film canisters date to the mid-20th century (Eastman Kodak Company 2019).

The single arms and ammunition-related artifact is a .22 calibre shell casing.

4.2.2 Conclusions

Overall, the artifact assemblage from Location 4 (AfHh-945) consists of material that is typically associated with domestic occupation, such as structural artifacts, food and beverage-related items, container glass, personal/societal-related artifacts, and bones of domestic animals such as cows (*Bos taurus*). A total of 252 artifacts from the assemblage were considered dateable (51.64% of the total assemblage). The artifact assemblage contains artifacts that date from the mid- to late 19th century into the 20th century, with the majority of the artifacts dating from the mid- to the late-19th century (Table 7; also see Section 4.2.1).

Table 7: Dateable Artifacts from Location 4 (AfHh-945).

Artifact	Freq.	% of Total Assemblage	% of Dateable Assemblage
Mid-19th Century Artifacts			
Machine-Cut Nails	26	5.33%	10.32%
RWE	55	11.27%	21.83%
Yellowware, Plain/Banded	1	0.20%	0.40%
Mineral Finish	1	0.20%	0.40%
Subtotal	83	17.01%	32.94%
Late 19th Century Artifacts			
Wire-Drawn Nails	104	21.31%	41.27%
VWE	18	3.69%	7.14%
Porcelain	3	0.61%	1.19%
Rockingham ware	3	0.61%	1.19%
Stoneware, Salt Glaze/Albany Slip	7	1.43%	2.78%
Manganese Tinted Glass	5	1.02%	1.98%
White Glass	1	0.20%	0.40%
Dust-Pressed Tile	1	0.20%	0.40%
Clothespin Spring	1	0.20%	0.40%
Subtotal	143	29.30%	56.75%
20th Century Artifacts			
Plastics	15	3.07%	5.95%

Artifact	Freq.	% of Total Assemblage	% of Dateable Assemblage
External Thread Finish	5	1.02%	1.98%
Asphalt Shingle	2	0.41%	0.79%
Electrical Artifacts	2	0.41%	0.79%
Concrete	1	0.20%	0.40%
Kodak Film Canister	1	0.20%	0.40%
Subtotal	26	5.33%	10.32%
GRAND TOTAL	252	51.64%	100.00%

The positive test pits that produced the artifacts from Location 4 (AfHh-945) focus around the southwest corner of the former footprint of the house at 3173 Scotland Drive that, as mention earlier, was torn down in 2017. According to the 2005 Archaeologix Stage 1 report, this house was a one-and-a-half storey frame house, likely built around 1895. It was likely built by John Heck, who acquired the property from John Shore Jr. in 1887 and is not the original house on the property (Archaeologix 2005). The patent for Lot 20, Concession 6 was issued in 1869 to Alexander Scott (Map 4) and the original house on the property was likely a two-storey brick house built in the 1870s (Archaeologix 2005). This is corroborated by historical mapping that does not appear to show a structure on the property until the 1878 *Illustrated Historical Atlas of Middlesex County* map of Westminster Township (Map 3 to Map 6) The property remained in the Scott family until 1878, when they sold it to Maxwell D. Fraser, who in turn sold it to John Shore Jr. shortly after he acquired it that same year. John Shore Jr. was likely the son of one of the area's earliest settlers, John Shore (Archaeologix 2005). The 1878 map corroborates John Shore Jr's ownership and residence on the property, indicating a house and orchard where Location 4 (AfHh-945) is located (Map 6).

Spatially, dateable material was concentrated around the southwest corner of the former house footprint, primarily in test pits TP3, TP4, TP5, TP7, TP8, TP9, TP16, TP17, TP18, and TP19. Excavation of four 1 m² test units was carried in the vicinity of test pits TP7, TP17, TP18, and TP19, which produced the highest number of mid-19th century material (see Section 4.3.1 and Map 10). Combined, these test units yielded a total of 204 artifacts dating to the mid- to late 19th century, as well as 19 artifacts dating to the 20th century, although material from all time periods appeared in all soil lots, presenting no distinct cultural strata (see Section 2.1.2.1 for discussion of stratigraphy).

Lot 20, Concession 6 has been continuously occupied since the 1870s (see Section 1.2.6), with the likely son of an early settler, John Shore Jr., being the first inhabitant of the property in the 1870s. Although the original two-storey brick house was replaced by a one-and-a-half storey frame house in 1895, a significant portion (46.31% of the total assemblage; 89.68% of the dateable assemblage) of the artifact assemblage dates from the mid- to late 19th century and is likely related to the earlier occupation of the property. The 20th century material mixed in with the mid- to late 19th century material is likely related the fact that the property has been continuously occupied until recently.

Given that there are at least 20 artifacts that date Location 4 (AfHh-945) to before 1900, as well as the fact that the location of the site has been occupied since the mid- to late 19th century and can be tied to a structure on historical mapping and potentially to the family of John Shore, an early settler of the area, the site meets the criteria identified in Section 2.2, Standard 1c and Table 3.2 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) for having CHVI and is therefore required to undergo Stage 3 Archaeological Assessment prior to any intrusive activity that may disturb or destruct the site. The purpose of the Stage 3 assessment will be to determine the extent of the site, to determine if it will require mitigation of proposed impacts, and to provide appropriate recommendations for Stage 4 mitigation, if needed.

Location 4 also meets criteria identified in Section 7.12 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) requiring it to be registered as an archaeological site. As such, it was registered with the MHSTCI and received the Borden number AfHh-945.

4.3 Location 5 (AfHh-946)

As described in Section 3.5, the artifact assemblage from Location 5 (AfHh-946) includes 47 Euro-Canadian artifacts (Image 45 to Image 49). The assemblage is predominately food and beverage-related items, with lesser amounts of structural-related items, artifacts with an indeterminate function, and artifacts with miscellaneous functions. Three faunal elements were recovered from Location 5 (AfHh-946), all of which are mammal bones that show signs of butchering, including one cow (*Bos taurus*) bone. Artifacts that provide relative dates from each functional category will be discussed in detail below.

4.3.1 Euro-Canadian Component

4.3.1.1 Food and Beverage

A total of 20 food and beverage-related artifacts were recovered from Location 5 (AfHh-946), including 13 ceramic sherds, seven shards of glass, and three pieces of butchered bone, including one cow (*Bos taurus*) bone. Ceramics include 12 sherds of VWE and one sherd of coarse earthenware, while glass artifacts include six shards of indeterminate container glass and one sherd of glass tableware. Dateable artifacts relating to food and beverage from Location 5 (AfHh-946) include 12 sherds of vitrified white earthenware (VWE). A total of six of these sherds are decorated with transfer-printing, while the other six are plain/undecorated (Image 46). Transfer-print colours include teal (n=5) and blue (n=1).

As discussed above, VWE was first developed in the 1840s but did not become popular until the second half of the 19th century and it is still in use today (MACL 2015a).

4.3.1.2 Structural

A total of ten structural-related artifacts were recovered from Location 5 (AfHh-946), including three wire-drawn nails, two machine-cut nails, four shards of windowpane glass, and one piece of brick.

Dateable structural artifacts from Location 5 (AfHh-946) include two machine-cut nails and three wire-drawn nails (Image 47). As discussed above, machine-cut nails were in common use from the 1830s until the 1890s, while wire-drawn nails were developed in the 1850s but did not become popular until the 1890s (Adams et al. 1994: 94).

4.3.1.3 Indeterminate

A total of nine artifacts with an indeterminate function were recovered from Location 5 (AfHh-946), including three shards of glass, three pieces of plastic, two pieces of metal, and one piece of rubber. Glass artifacts are all shards of container glass, while the metal artifacts include one piece of tinfoil and one indeterminate piece of metal, and

the plastic and rubber artifacts are all indeterminate objects. Plastics are diagnostic to the 20th century and are the only dateable artifacts in this category (Image 48).

4.3.1.4 **Miscellaneous**

A total of five artifacts with miscellaneous functions were recovered from Location 5 (AfHh-946), including two pieces of coal, one metal bracket, one metal staple, and one piece of metal wire. There are no dateable artifacts in this category.

4.3.2 **Conclusions**

Overall, the artifact assemblage from Location 5 (AfHh-946) consists of material of a variety of functional categories that is typically associated with domestic occupation, such as food and beverage-related items, structural artifacts, and artifacts with indeterminate and miscellaneous functions. A total of 20 artifacts from the assemblage were considered dateable (42.55% of the total assemblage). Although the artifact assemblage contains artifacts that date from the mid- to late-19th century into the 20th century, the majority (75%) of the artifacts dating from the 19th century are VWE and wire-drawn nails, which were invented and used in the 19th century, but continue to be used today (also see Section 4.3.1).

Location 5 (AfHh-946) was identified through the recovery of 47 Euro-Canadian artifacts from a total of 11 positive test pits across an area measuring approximately 45 m north-south by 15 m east-west. It is adjacent to the east side of the house at 3465 Scotland Drive. Although the artifact assemblage contains artifacts that date from the mid- to late 19th century into the 20th century, the majority (75%) of the artifacts dating from the 19th century are VWE and wire-drawn nails, which were invented and used in the late 19th century, but continue to be used today. As well, no structures appear on any maps at the location of the current house and site until the 20th century. Finally, the house located at 3465 Scotland Drive is not listed in the City of London's *Register of Cultural Heritage Resources* (City of London 2019), indicating that it is of no historical significance. Due to these factors, Location 5 (AfHh-946) was determined to not meet the criteria identified in Section 2.2, Standard 1c and Table 3.2 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) for having sufficient CHVI to require Stage 3 Archaeological Assessment.

Location 5 meets criteria identified in Section 7.12 of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011) requiring it to be registered as an archaeological site. As such, it was registered with the MHSTCI and received the Borden number AfHh-946.

5.0 RECOMMENDATIONS

Based on the results of the previous Stage 1 assessment (Archaeologix 2005) and the current Stage 2 Archaeological Assessment, Location 4 (AfHh-945) is considered to have cultural heritage value or interest, while Locations 1, 2, 3, 5 (AfHh-946), and 6 are not considered to have cultural heritage value or interest. These conclusions provide the basis for the following recommendations:

- 1) Location 4 (AfHh-945) should be subject to Stage 3 Archaeological Assessment prior to any impacts following Standards 1 and 2 of Table 3.1 in the MHSTCI's 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011:51).
 - a. As Location 4 (AfHh-945) was discovered during test pit survey, no CSP is required prior to hand excavation of test units.
 - b. Test units should be excavated at 5 m intervals across the site, focusing on the mid- to late-19th century concentration as defined by the positive test pits and test units (see Map 10). Additional test units amounting to 20% of the initial grid unit should be excavated focusing on areas of interest within the site extent. All test units should be excavated into the first 5 cm of subsoil, or until a cultural feature is uncovered.
 - c. Any features identified during the Stage 3 assessment should be recorded through photographs and plan drawings and then be covered with geotextile fabric prior to backfilling.
 - d. All soil excavated from the test units should be screened through 6 mm hardware cloth to facilitate the recovery of artifacts that may be present. The recovered artifacts should be tagged in the field by their provenience unit prior to subsequent washing, cataloguing and analysis.
- 2) Locations 1, 2, 3, 5 (AfHh-946), and 6 have been sufficiently assessed and documented, and no further archaeological assessment is required for these locations.

The Ontario Ministry of Heritage, Sport, Tourism and Culture Industries is asked to review the results and recommendations presented herein, accept this report into the Provincial Register of archaeological reports and issue a standard letter of compliance with the Ministry's 2011 *Standards and Guidelines for Consultant Archaeologists* and the terms and conditions for archaeological licencing.

6.0 ADVICE ON COMPLIANCE WITH LEGISLATION

This report is submitted to the Minister of Heritage, Sport, Tourism and Cultural Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18 (Government of Ontario 1990b). The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation 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 regards to alterations to archaeological sites by the proposed development.

It is an offence under Section 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alterations 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 fieldwork 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 Archaeological reports referred to in Section 65.1 of the *Ontario Heritage Act* (Government of Ontario 1990b).

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 Section 48(1) of the *Ontario Heritage Act* (Government of Ontario 1990b).

The *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33, requires that any person discovering or having knowledge of a burial site shall immediately notify the police or coroner (Government of Ontario 2002). It is recommended that the Registrar of Cemeteries at the Ministry of Consumer Services is also immediately notified.

Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48(1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological licence (Government of Ontario 1990b).

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