Updated Environmental Impact Study for 6160 Thunder Road & 5368 Boundary Road, Ottawa

2024-08-16

FINAL REPORT

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Project Number: AVE 1606.3

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List of Acronyms and Abbreviations

°C – degrees Celsius
AOO – Algonquins of Ontario
cm – centimetres
DBH – Diameter at Breast Height
DFO – Department of Fisheries and Oceans (Fisheries and Oceans Canada)
ECCC – Environment and Climate Change Canada
e.g. – *exempli gratia*
EIS – Environmental Impact Statement
ELC – Ecological Land Classification
ESA – *Endangered Species Act*
ESC – Erosion and Sediment Control
FWCA – *Fish and Wildlife Conservation Act*
i.e. – *id est*
GIS – Geographic Information System
ha – hectare
KAL – Kilgour & Associates Ltd.
km – kilometre
LIO – Land Information Ontario
m – metre
MBCA – *Migratory Birds Convention Act*
MECP – Ministry of Environment, Conservation and Parks
MNR – Ministry of Natural Resources
MNRF – Ministry of Natural Resources and Forestry
NHIC – Natural Heritage Information Centre
OBBA – Ontario Breeding Bird Atlas
OP – Official Plan
PPS – Provincial Policy Statement
PSW – Provincially Significant Wetland
SNCA – South Nation Conservation Authority
SAR – Species at risk
SARA – *Species at Risk Act*
SARO – Species at Risk in Ontario
SWH – Significant Wildlife Habitat

1.0 INTRODUCTION

This report is an Environmental Impact Study (EIS) prepared by Kilgour & Associates Ltd. (KAL; Appendix A) on behalf of Avenue 31 in support of a site plan application for the property located at 6160 Thunder Road & 5368 Boundary Road, Ottawa, Ontario (the "Site"; City of Ottawa File D07-12-21-0205). This EIS follows upon a previously completed EIS for the Site (addressed as 6150 Thunder Road at the time; KAL 2021, KAL 2020), which supported the Zoning By-law Amendment and the Site's rezoning from Rural Countryside (RU) to Rural General Industrial (RG) and Parks & Open Space (O1R). This EIS reviews existing site conditions and policy requirements as the relate to the proposed site plan.

2.0 ENVIRONMENTAL POLICY CONTEXT

Natural heritage policies and legislation relevant to this EIS are outlined below.

2.1 The Provincial Policy Statement, 2020

The Provincial Policy Statement (PPS) was issued under Section 3 of the Planning Act (Government of Ontario, 1990b). The current PPS came into effect May 1, 2020 (Government of Ontario, 2020). Natural features are afforded protections under Section 2.1 of the PPS. Protections may include maintenance, restoration, and improved function of diversity, connectivity, ecological function, and biodiversity of natural heritage systems. These protections restrict development and site alteration in significant natural areas (e.g., woodlands, wetlands, wildlife habitat) unless it can be demonstrated that there will be no negative effects on the features and ecological functions of those natural areas. Technical guidance for implementing the natural heritage policies of the PPS is found within the second edition of the Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 (NHRM: Ministry of Natural Resources & Forestry (MNR), 2010). This manual recommends the approach and technical criteria for protecting natural heritage features and areas in Ontario.

2.2 City of Ottawa Official Plan

The City of Ottawa Official Plan (2021) provides direction for future growth in the City and is a policy framework to guide physical development to 2031. The Official Plan was developed in accordance with the PPS (and relevant provincial legislation). The City of Ottawa reviews development applications within its boundaries, which must be in accordance with the Official Plan. The Site is located within Ottawa's rural area and is designated "Rural Industrial and Logistics" in Schedule B9 of the Official Plan. A portion of the Site has a natural heritage features overlay in Scheduled C11-C. Section 5.6.4.1 of the Official Plan requires that development or site alteration proposed in or adjacent to natural heritage features must be supported by an EIS prepared in accordance with the City's guidelines.

2.3 City of Ottawa Zoning By-law 2008-250

The majority of the Site is zoned as Rural General Industrial (RG(908r)-h) and the western and southern strip along the Site boundaries is zoned as Parks & Open Space (O1R subzone). Section 179 of the City of Ottawa Zoning By-law 2008-250 states that the purpose of the Parks and Open Space Zone is to:

(1) permit parks, open space and related and compatible uses to locate in areas designated as General Urban Area, General Rural Area, Major Open Space, Mixed Use Centre, Village, Greenbelt Rural and Central Area as well as in Major Recreational Pathway areas and along River Corridors as identified in the Official Plan, and

(2) ensure that the range of permitted uses and applicable regulations is in keeping with the low scale, low intensity open space nature of these lands.

Section 180 of the By-law states that:

(18) In the O1R Subzone, the following uses only are permitted:

environmental preserve and education area forestry operation.

Section 69, Setback from Watercourses and Waterbodies states:

(1) Subject to subsection (3), despite the provisions of the underlying zone, the minimum setbacks set forth in subsection (2) must be provided to provide a margin of safety from hazards associated with flooding and unstable slopes and to help protect the environmental quality of watercourses and waterbodies.

(2) Except for flood or erosion control works, or a public bridge or a marine facility, no building or structure, including any part of a sewage system, which does not require a plan of subdivision, or site plan control approval, shall be located closer than:
    a. 30 m to the normal highwater mark of any watercourse or waterbody, or
    b. 15 m to the top of the bank of any watercourse or waterbody, whichever is the greater.

(3) Development requiring a plan of subdivision or that is subject to site plan control must provide the watercourse or waterbody setbacks set forth in subsection (2) unless, as established through conditions of approval, a different setback is determined to be appropriate in accordance with the criteria set forth in the Official Plan.

2.4 Conservation Authorities Act, 1990

Conservation Authorities were created to address erosion, flooding, and drought concerns regionally by managing at the watershed level. Conservation Authorities were given the ability to regulate under Section 28 of the Conservation Authorities Act (Government of Ontario, 1990a). The Act provides mechanisms to regulate works and site alterations that have potential to affect erosion, flooding, and alterations to waterbodies within their jurisdiction. The Act obliges Conservation Authorities to implement Ontario Regulations 42/06 and 146/06 to 182/06 Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses under Section 28 of the Conservation Authorities Act for relevant works. The Site is located within the jurisdiction of South Nation Conservation (SNC), and is regulated under O. Reg. 170/06, and establishes Regulated Areas where development may be subject to flooding, erosion or dynamic beaches; or where interference with wetlands and alterations to shorelines and watercourses might have an adverse effect on those environmental features.

Bill 23, which was passed on November 28th, 2022, and received Royal Assent the same day, introduced a series of legislative and proposed regulatory changes affecting conservation authorities. It is now in effect. Among the changes under Bill 23, the definition of “watercourse” was updated from an identifiable depression to a defined channel having a bed, and banks or sides.

2.5 Species at Risk Act, 2002

The federal *Species at Risk Act* (Government of Canada, 2002) is administered by Environment and Climate Change Canada (ECCC) and provides direction to protect and ensure the survival of wildlife species in Canada. The purpose of the SARA is to prevent populations of wildlife from becoming Extirpated, Endangered, or Threatened, provide recovery for Endangered or Threatened species, and to manage other species to prevent them from becoming Endangered or Threatened.

All species listed on Schedule 1 of SARA are afforded protection on federal lands. Aquatic species and species of migratory birds protected by the *Migratory Birds Convention Act* (MBCA; 1994) and listed as Endangered, Threatened, or Extirpated under Schedule 1 of SARA are protected wherever they occur in Canada, regardless of land ownership. SARA protections for other species do not normally extend to privately owned land. However, the Federal Minister of ECCC can and has imposed SARA protections on private projects where habitat is deemed "…*necessary for the survival or recovery of the species…*" in the area of concern.

2.6 Endangered Species Act, 2007

The provincial *Endangered Species Act* (ESA; Government of Ontario, 2007) is administered by the Ministry of Environment, Conservation, and Parks (MECP) and provides protection for species at risk (SAR) and their habitat. The ESA states that it is illegal to harm the habitat of species listed as Extirpated, Endangered, and Threatened. It is also illegal to kill, harm, harass, possess, transport, buy or sell Extirpated, Endangered, and Threatened species, whether it is living or dead. Species listed as Endangered, Threatened, or Extirpated and their habitats (e.g., areas essential for breeding, rearing, feeding, hibernation, and migration) are automatically afforded legal protection under the ESA.

2.7 *Fisheries Act*, 1985

The federal *Fisheries Act*, (Government of Canada, 1985) is administered by Fisheries and Oceans Canada (DFO) and provides protections to fish, fish habitat, and fisheries. Specifically, the *Fisheries Act* provides:

- Protection for all fish and fish habitat;
- Prohibition against the "harmful alteration, disruption or destruction of fish habitat"; and
- Prohibition against causing "the death of fish by means other than fishing".

Projects with a scope that does not fall within DFO-defined standards and codes of practice require submission of a request for review to DFO.

2.8 Migratory Birds Convention Act, 1994

Nesting migratory birds are protected under the MBCA (Government of Canada, 1994). No work is permitted that would result in the destruction of active nests (nests with eggs or young birds) or the wounding or killing of bird species protected under the MBCA and/or associated regulations (e.g., SARA). The "incidental take" of migratory birds and the disturbance, destruction, or taking of the nest of a migratory bird is prohibited. "Incidental take" is the killing or harming of migratory birds due to actions that are not primarily focused on taking migratory birds (e.g., economic development) and no permits

exist for the incidental take of migratory birds or their nest/eggs as a result of activities that are not focused on taking migratory birds. These prohibitions apply throughout the year. The Government of Canada has compiled nesting calendars for regions across Canada that can be used to greatly reduce the risk of harming/destroying active nests by ensuring works that may impact nests are performed outside of the nesting period.

Effective July 30, 2022, a list of 18 species of migratory birds identified on Schedule 1 of the MBCA are provided year-round nest protection until they can be deemed abandoned. The Schedule includes this list for birds that re-use their own nest from one year to the next. If the nest of a Schedule 1 species has not been occupied by a migratory bird for the entirety of the waiting time indicated in the MBCA, it is considered to be abandoned, and to no longer have high conservation value for migratory birds.

2.9 Fish and Wildlife Conservation Act, 1997

The provincial *Fish and Wildlife Conservation Act* (FWCA; Government of Ontario, 1997) governs the hunting and trapping of a variety of wildlife including mammals, birds, reptiles, amphibians, and fish in Ontario, thereby facilitating the protection of wildlife and their habitat. The FWCA outlines the prohibition of hunting or trapping specially protected species and the requirement for provincially issued licenses for the hunting or trapping of "furbearing" or "game" animals. Examples of specifically protected animals include, for example, Southern Flying Squirrel (*Glaucomys volans*), Northern Harrier (*Circus cyaneus*), American Kestrel (*Falco sparverius*), Blue Jay (*Cyanocitta cristata*), Midland Painted Turtle (*Chrysemus picta marginata*), Northern Watersnake (*Nerodia sipedon*) and Gray Treefrog (*Hyla versicolor*). In particular, raptors that are not protected under the MBCA (including Peregrine Falcon) are protected under the FWCA.

3.0 PROPERTY IDENTIFICATION AND CONTEXT

The Site address is 6160 Thunder Road & 5368 Boundary Road, Ottawa, Ontario K0A 1K0, and is legally described as Part Lot 1, Concession 9 on Ottawa River (Roll #'s 0614.600.230.12208.00000 and 0614.600.230.12202.0000, respectively). It was included as part of 6150 Thunder Road prior to the rezoning; 6150 Thunder Road now applies to the remainder of that larger site located immediately to the north. The irregularly shaped parcel is bordered by Thunder Road, Boundary Road, industrial and commercial land uses to the east, Mitch Owens Road to the south, forested lands to the west, and rural residences to the north. Figure 1 shows the location of the Site.

The entire Site was under active agricultural production in 1976 according to the geoOttawa aerial imagery (City of Ottawa, 2024). Land to the south at that time was well forested and was similarly covered in 1965, indicating that forest cover adjacent to the Site is more mature (> 50 years old) than that of the Site (less than 45 years old). By 1991, most of the central portion of the Site had been re-ploughed and planted as a conifer plantation. A large portion of the south half of the Site was subject to excavation through the 1990s. Following the late 1990s and through the early 2000s, the excavated area showed some signs of tree re-growth and re-naturalization, with more-deeply excavated portions taking on apparent wetland characteristics (City of Ottawa, 2024). This portion of the Site was fully cleared and partially regraded in 2019. The north half of the site is currently forested with a mix of coniferous plantation and young, early successional forest.

Figure 1 Site Location

Legend

Property Boundary

N

0 100 m

Project File: AVE 1606 - 2023-11a.map
MTM Zone 9
(NAD 83)
Printed on: 2022-11-17

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4.0 METHODOLOGY

4.1 Desktop and Background Data Review

4.1.1 Agency Consultation

No request for information was submitted to Fisheries and Oceans Canada (DFO) for this specific project. Reviews with DFO require the submission of detailed site plans, which will only be completed during the detailed design phase. A "Request for Review" will be filed with DFO as part of subsequent project phases. A pre-consultation with the City and SNC was held in November 2019, with a follow-up meeting held on January 29, 2020, after the application was submitted but prior to it being deemed completed.

City staff were further consulted in 2023 and confirmed that data related to the Site and adjacent properties included in the 2020 EIS (KAL) are sufficient to support this EIS, and no further field studies are required, except where identified by KAL. City staff were further consulted in 2024 to ensure all natural heritage concerns for the Site are adequately addressed. Details of past and current field studies supporting this EIS are described in Section 4.2 below.

4.1.2 General Records Review

Background information was obtained from online databases and geographic information system mapping applications to review relevant information. Aerial imagery from Google Earth and geoOttawa (City of Ottawa, 2024) was used to identify existing features and confirm information found in the background review.

The descriptions of the existing natural environment on and adjacent to the Site are based on field investigations and desktop reviews of previously completed studies and information available on publicly accessible databases, including the City of Ottawa Urban Natural Areas Environmental Evaluation Study (Muncaster Environmental Planning Inc. & Brunton Consulting Services, 2005).

4.2 Species at Risk

The review of existing information for the previous EIS work (KAL, 2020, 2021) included a preliminary SAR screening for species listed under the federal SARA and provincial ESA having some record of occurrence within the broader vicinity of the Site. The screening was completed following the *Draft Client's Guide to Preliminary Screening for Species at Risk* (MECP, 2019) and was submitted to the MECP on November 11, 2020. The results of the screening process helped informed the list of species that were considered in the assessment of the potential for development impact(s) to SAR or SAR habitat.

The MECP response on January 5, 2021, requested the consideration of three species: Bald Eagle (*Haliaeetus leucocephalus*), Northern Long-eared Myotis (*Myotis septentrionalis*), and Tri-coloured Bat (*Perimyotis subflavus*). These three species, however, had already been considered regardless, as the full list of 71 SAR currently known to occur within the region of the City of Ottawa was reviewed to identify the potential for SAR presence on and adjacent to the Site (Appendix B).

4.3 Field Surveys

Field surveys conducted in 2018 and 2020 in support of the previous EIS completed for the Site (KAL, 2020, 2021) included vegetation (ELC and tree) surveys, anuran (frog & toad) surveys, breeding bird surveys (BBS), and a headwater drainage features assessment (HDFA).

Field surveys identified for update and completion in 2023 based on previous field study results and through consultation with City staff included one site visit to complete an updated tree survey and confirm current Site conditions. Updated breeding bird surveys and an assessment of forest gaps on the Site was completed at the request of City staff in June 2024.

Table 1 Summary of Field Studies

Date	Purpose	Conditions	Personnel
April 12, 2018	• HDFA #1	• 7°C • Light rain • Wind 14 km/h	Liza Hamilton Tyler Peat
April 23, 2018	• Anuran survey	• 10°C • Clear • Wind 4 km/h	Robert Hallett Liza Hamilton
May 30, 2018	• Anuran survey	• 21°C • Cloudy • Wind 11-14 km/h	Robert Hallett Liza Hamilton
June 1, 2018	• HDFA #2	• 27°C • Cloudy • Wind 9 km/h	Robert Hallett Tyler Peat
June 20, 2018	• BBS #1 • Initial tree inventory • ELC survey	• 12°C • Partly cloudy • No wind	Terry Hams
June 21, 2018	• Anuran survey	• 17°C • Clear • Wind 7-10 km/h	Robert Hallett Liza Hamilton
July 5, 2018	• BBS #2	• 22°C • Clear • No wind	Terry Hams
October 15, 2020	• Updated tree survey • Updated ELC survey • Soil cores	• 19°C • Light rain • Wind 22 km/h SW	Ed Malindzak
October 18, 2020	• Updated tree survey • Updated ELC survey • Soil cores	• 14°C • Overcast • Wind 17 km/h SE	Anthony Francis
November 2, 2023	• Updated tree survey to reflect 2023 conditions	• 8°C • Cloudy • Wind 16 km/h SW	Robert Hallett
June 13, 2024	• BBS #1 (updated) • Forest gap analysis	• 25°C • Partly sunny • Wind 7-10 km/h	Maren Nielsen
June 20, 2024	• BBS #2 (updated)	• 30°C • Overcast • Wind 7-10 km/h	Maren Nielsen

4.3.1 Vegetation

4.3.1.1 Ecological Land Classification

A desktop review of current and historical aerial imagery informed the initial vegetation, topography, and land cover conditions on the Site. Vegetation communities on the Site were confirmed in the field during a site visit using standard Ecological Land Classification (ELC) methods for Ontario (Lee et al., 1998). This method provides a consistent approach to identify, describe, and map vegetation communities or physiographic features on the landscape based on dominant plant species and soil composition. It results in a standardized description of each vegetation community to capture the natural diversity and variability of communities within a site, and to provide insight into available habitat and the type of species that may be present. More specifically, the classifications from ELC provide a basis for determining whether potential habitat for a given SAR or other ecological value may be present.

KAL Biologist Terry Hams completed a general ELC survey of the Site on June 20, 2018. That work was not used to support a development application at the time. The south half of the Site was cleared and partially regraded in 2019 in conformance in the rural area with the Urban Tree Conservation By-law and the Municipal Trees and Natural Areas Protection By-law in place at that time. The site alteration prior to the Zoning & OPA application is outside the scope of the current development application. The ELC for the Site was updated following brief sited visits by Ed Malindzak (October 15, 2020) and Anthony Francis (October 18, 2020) to note the cleared area, review species in the remaining tree stands, and collect soil cores. The ELC was further updated based on vegetation state and additional soil cores collected on June 7, 2021.

4.3.1.2 Tree Studies (TCR)

KAL Biologist Terry Hams completed an initial tree inventory on June 20, 2018. Tree surveys following 2019 site works were undertaken on October 15 & 18, 2020. An updated tree survey was completed on November 2, 2023, by KAL biologist Robert Hallett to gain an understanding of current site conditions, size, and species distributions within forested areas of the Site.

All tree surveys were performed following the TCR guidelines set forth by the City of Ottawa Forestry Staff (City of Ottawa, 2020b). As part of the survey process Butternut (*Juglans cinerea*) and Black Ash (*Fraxinus nigra*) trees (Endangered under the ESA) were reviewed and assessed as required. Detailed surveys of individual trees were not to be completed as part of this study, however included detailed measures of mature trees as they occur in forest groupings, and measures of notable trees within the forested areas on the Site. A TCR was prepared to support the site plan application (Kilgour & Associates Ltd., 2024).

4.3.2 Wildlife

4.3.2.1 Anurans

Site amphibian (anuran) surveys were conducted and lead by KAL biologists, Rob Hallett and Liza Hamilton, following protocols set forth by the Marsh Monitoring Program (Birds Canada, Environmental Canada, et al., 2009). Three surveys are completed to identify early, mid, and late-season breeding amphibian species generally in April, May, and June, respectfully, though survey dates are temperature dependent. Surveys are completed on nights of calm weather with temperatures above 5 degrees Celsius (°C), 10°C, and 17°C for each of the three respective survey periods. Surveys begin a half-hour after sunset and are finished by midnight with a five-minute recording period at each survey station. Amphibian species are recorded at

each point along with the estimated distance from observers, calling code, an estimate of the number of individuals, and estimated directions of calling anurans.

Amphibian surveys were performed on April 23, May 30, and June 21, 2018 (Table 2). Three stations were surveyed in wetland and aquatic habitats (F1 through F3; Figure 2). Station F3 was located at the north end of the Site with the observers facing south. Stations F1 and F2 were the same point located near the southwestern corner of the Site, but with one observer facing south (F1) and one facing north (F2).

Table 2 Summary of frog survey times and weather conditions

Survey Date	Temperature (°C)	Weather conditions	Wind speed (km/hour)
23-Apr-18	10*	Clear	4
30-May-18	21*	Mostly Cloudy	11-14
21-Jun-18	17**	Clear	7 - 10

* Temperatures on these nights were warmer than the preceding nights, with evening temperatures just above 5°C and 10°C, respectively, within a few days of the surveys. Frogs for the period would still be expected to be calling regardless.
** Temperatures on this night just reached the minimum required temperature but had been warmer the preceding nights, with evening temperatures above 17°C. Frogs for the period would still be expected to be calling regardless.

4.3.2.2 Breeding Bird Surveys

Two rounds of breeding bird surveys were completed on the Site in 2018 by Terry Hams, and updated in 2024 by KAL Biologist Maren Nielsen. All surveys followed point count guidelines by the Ontario Breeding Bird Atlas (Birds Canada, Canadian Wildlife Service (Environment and Climate Change Canada), et al., 2009). According to these guidelines, breeding bird surveys are to be completed from survey stations that, combined, provide suitable viewing of all habitats on-site on calm weather days with light wind (less than 19 km/hr) and no precipitation. Surveys must take place between sunrise and five hours after sunrise between May 24 and July 10. Surveys were conducted from four survey stations in 2018 (B1 to B4; Figure 3), and two stations in 2024 (BBS1, BBS2; Figure 2). The point counts were conducted for at least five minutes at each station on each survey date (Table 3).

Table 3 Summary of breeding bird survey times and weather conditions

Survey Date	Start Time	Temperature (°C)	Precipitation (mm)	% Cloud Cover	Wind speed (km/hour)
20-Jun-2018	06:59	12	0	30	0
05-Jul-2018	06:00	22	0	0	0
13-Jun-2024	09:00	25	0	0-25%	7-10 km/h
20-Jun-2024	08:34	30	0	50-75%	7-10 km/h

4.3.2.3 Bats

Bat monitoring was completed following acoustic surveys under the MNRF's *Survey Protocol for Species at Risk Bats within Treed Habitats* (2017). This is currently the recommended protocol for confirming the presence/absence of Little Brown Myotis, Northern Myotis, and Tri-coloured Bat, where it is determined that wooded areas providing potentially suitable habitat for the establishment of maternity roosts are present.

All species of bats in a given area are detectable under this protocol if ultrasonic acoustic monitors are used and the signal-to-noise ratio can be analyzed from sonogram displays to identify bat calls to the species level. Under the protocol, acoustic monitors are to be installed for 10 nights in June, with recordings commencing after dusk and continuing for five hours. We installed an acoustic monitor (Song Meter SM3, Wildlife Acoustics) at the center of the wooded area south of Channel R7 (Figure 2). Bats use echolocation more frequently in cluttered environments (Falk et al., 2014); installing the monitor along the edge of the wooded area, rather than in the middle of an open foraging area, is expected to increase

bat detectability. The existing woodland cut provided a suitable "edge" area within a central portion of the forest, i.e., just outside of the cluttered environment (forest) as the distinguishability of calls among species diminishes within such locations (National Park Service, 2016). The monitor was installed on June 22 and removed on July 6, 2021 (14 nights of data collection).

4.3.3 Aquatic Habitat

Headwater channels on the Site were investigated in 2018 following *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (Toronto and Region Conservation Authority & Credit Valley Conservation, 2013) to document their hydrological and riparian and terrestrial habitat (Appendix C). On April 12, 2018 (i.e. during the spring freshet), KAL biologists Liza Hamilton and Tyler Peat identified and described seven channelized features on the Site (reaches R1 through R8; Figure 2), noting the channel dimensions, substrate, form, and riparian vegetation. On June 1, 2018, KAL biologists Rob Hallett and Tyler Peat conducted an electrofishing survey of R1, R3, R4, and a portion of R2 north of R4. These channels were deemed at the time to be sufficiently wet to potentially support fish, whereas R2, R5, and R6 were dry at the time of electrofishing surveys and therefore not able to support fish. R7, a permanent stream, was not fished as the feature is protected with a 30 m setback (Section 5.3). As a permanently flowing channel connected to larger creeks downstream, R7 is considered to directly support fish regardless.

Channels R8 through R11 were either observed or created subsequent to the initial HDFA review (Appendix C). An updated inspection of headwater channels, including their water levels and general condition was completed by KAL Biologist Maren Nielsen on June 13, 2024.

5.0 EXISTING CONDITIONS

5.1 Landforms, Soils and Geology

Soil mapping shows the entire property is underlain by medium/fine sand deposits (Schut & Wilson, 1987). Soils in the north half of the cleared area are from the Manotick formation and are underlain by fine-textured marine clay. Soils on the remainder of the Site (i.e. the north half and the southernmost end) are part of the Uplands formation (Schut & Wilson, 1987). The sand layer here is deeper, with no apparent clay layer within 1.2 metres (m) of the surface based on soil cores dug for the ELC analysis. Soil mottles in the remaining forested areas were evident at depths of > 75 centimetres (cm), indicating fresh-moist but not wetland conditions.

Boreholes for soil sampling were excavated by Paterson Group (2020) in late June of 2020 around the southern half of the site (i.e. through the recently cleared area; Appendix D). In all but one instance, the first 1.5 m or more of the cores, showed loose sandy soils with low soil moisture and only trace organics. The low organic load and lack of stratification may be due to the history of agriculture and extraction across the Site.

The depth of the sandy soil in Borehole BH4-20 was only 60 cm before changing to firm silty clay, though soil moisture was still low above a 2 m depth. The location of BH4-20 corresponds with a previous excavation pit on the Site and may indicate added fill.

Soil cores were taken in each ELC ecosite to support the ELC mapping of the site (Figure 2; Table 4).

Table 4 Soil Core Descriptions

Soil Core	Date	Soil Profile	Terrestrial / Wetland
1	18-Oct-2020	Organic Layer: 0 to 5 cm A Horizon: 5 to 30 cm – fresh moist medium sandy soil B Horizon: 30 to >120 cm – fresh moist medium sandy parental soil Mottles begin at a depth of 65 cm, no gley	Terrestrial
2	7-Jun-2021	Organic Layer: 0 to 5 cm A Horizon: 5 to 25 cm – fresh moist medium sandy soil B Horizon: 25 to 110 cm – fresh moist medium sandy parental soil Mottles begin at a depth of 82 cm, no gley Heavy clay below 110 cm, no gley	Terrestrial
3	7-Jun-2021	Organic Layer: 0 to 5 cm A Horizon: 5 to 32 cm – fresh moist medium sandy soil B Horizon: 32 to 95 cm – fresh moist medium sandy parental soil Mottles begin at a depth of 60 cm, no gley Heavy clay below 95 cm, no gley	Terrestrial
4	18-Oct-2020	Organic Layer: 0 to 5 cm A Horizon: 5 to 20 cm – fresh moist medium sandy soil B Horizon: 20 to 105 cm – fresh moist medium sandy parental soil No mottles or gley Heavy clay below 105 cm	Terrestrial
5	7-Jun-2021	Organic Layer: 0 to 5 cm A Horizon: 5 to 40 cm – fresh moist medium sandy soil B Horizon: 20 to 105 cm fresh moist medium sandy parental soil Mottles begin at a depth of 70 cm, no gley Heavy clay below 110 cm	Terrestrial
6	18-Oct-2020	Medium sand with high organic loading and gley 0 to 40 cm. Characteristically wetland; no need to core further.	Wetland
7	18-Oct-2020	No organic layer. A Horizon: 0 to 40 cm - fresh moist medium sandy soil B Horizon: 40 to 110 cm fresh moist medium sandy parental soil Mottles begin at a depth of 85 cm, no gley Heavy clay below 110 cm	Terrestrial
8	7-Jun-2021	Organic Layer: 0 to 5 cm A Horizon: 5 to 25 cm - fresh moist medium sandy soil B Horizon: 25 to 90 cm fresh moist medium sandy parental soil Mottles begin at a depth of 50 cm, no gley Heavy clay below 90 cm	Terrestrial
9	7-Jun-2021	No organic layer. A Horizon: 0 to 47 cm - fresh moist medium sandy soil B Horizon: 40 to 110 cm fresh moist medium sandy parental soil Mottles begin at a depth of 90 cm, no gley Heavy clay below 110 cm	Terrestrial
10	7-Jun-2021	No organic layer. A Horizon: 0 to 27 cm - fresh moist medium sandy soil with high humic load B Horizon: 27 to 60 cm moist medium sandy parental soil Mottles and gley throughout the B Horizon. Heavy clay below 60 cm	Wetland

5.2 Vegetation Cover

An initial vegetation survey was conducted during the site visit on June 20, 2018, updated on October 15, 2020, and confirmed during the site visit on November 2, 2023, that delineated four distinct vegetation communities present on the Site. Vegetation communities observed include a Coniferous Plantation (TAGM1), a Naturalized Coniferous Plantation (FOCM6), a Willow Mineral Deciduous Thicket Swamp (SWT2), and a Fresh – Moist Lowland Deciduous Forest Ecosite (FOD7). The vegetation communities observed on the Site are described in detail below and are shown in Figure 2.

Figure 2 Existing conditions

Legend

- Property Boundary

ELC

- TAGM1
- FOCM6
- FOD7
- FOD8
- SWT2
- Residential

Cleared Areas

- Formerly Treed
- Formerly Wetland
- Sand-filled pit

- Interior Forest - current edge
- Interior Forest - post development
- Surface Water Feature
- Individual Roadside Trees
- BBS 2024

N

0 100 m

Project File: AVE 1606 - 2408a.map
MTM Zone 9
(NAD 83)
Printed on: 2021-07-15

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5.2.1 Coniferous Plantation (TAGM1)

The northern portion of the Site is characterized by a Coniferous Plantation (TAGM1) dominated by White Spruce (*Picea glauca*) with subordinate species of Jack Pine (*Pinus banksiana*) and Red Pine (*Pinus resinosa*) ranging from 20-35 DBH in size. This community is a disturbed, low-quality habitat with very little to no understory present. According to historic aerial imagery (City of Ottawa, 2024), the entire Site was cleared for agricultural purposes prior to 1991. Around 1991, the TAGM1 and FOCM6 communities were planted immediately north of the 2019 clearing area.

Figure 3 Coniferous Plantation (TAGM1)

5.2.2 Naturalized Coniferous Plantation (FOCM6)

Immediately south of the TAGM1 community, and part of the original ~1991 plantation, a Naturalized Coniferous Plantation (FOCM6) vegetation community is present. This community is similar to the TAGM1 community, but has re-naturalized to include deciduous tree species and understory species. Dominant species within this community include White Spruce (*Picea glauca*), Balsam Poplar (*Populus balsamifera*), Trembling Aspen (*Populus tremuloides*), and White Birch (*Betula papyrifera*), with smaller amounts of American Elm (*Ulmus americana*), Largetooth Aspen (*Populus grandidentata*), Manitoba Maple (*Acer negundo*), and Red Maple (*Acer rubrum*). Note that this community was previously identified as a Fresh –

Moist Lowland Deciduous Forest (FOD7) community, however, many of the deciduous trees have downed and the community has become White Spruce dominant with associations of deciduous species.

Figure 4 Naturalized Coniferous Plantation (FOCM6)

5.2.3 Willow Mineral Deciduous Thicket Swamp (SWT2)

In the centre of the Site, immediately adjacent to the cleared area, a small (0.7 ha) depression forms a Willow Mineral Deciduous Thicket Swamp (SWT2) ecosite, dominated by a mix of Bebb's Willow (*Salix bebbiana*) and Speckled Alder (*Alnus incana*) with some Buckthorn (*Rhamnus spp.*). Ground cover includes sedge (*Carex* sp.) and rush (*Juncus* sp.) species.

Figure 5 Willow Mineral Deciduous Thicket Swamp (SWT2)

5.2.4 Fresh – Moist Lowland Deciduous Forest Ecosite (FOD7)

In the southern portion of the Site along the property boundary and adjacent to the Site access point, a Fresh – Moist Lowland Deciduous Forest Ecosite (FOD7) vegetation community is present. This community is dominated by Trembling Aspen (*Populus tremuloides*) and Red Maple (*Acer rubrum*) with associations of White Ash (*Fraxinus americana*), Green Ash (*Fraxinus pennsylvanica*). The understory is dominated by Willow species (*Salix spp.*). A small pocket of SWT2 thicket swamp is located just off the southwest edge of the Site with the same species mix present in the SWT2 pocket in the center of the site.

Figure 6 Fresh – Moist Lowland Deciduous Forest Ecosite (FOD7)

Cleared area

Adjacent SWT2 ecosite off the SW corner of the Site

Plant regrowth within the cleared area adjacent to the SWT2 thicket in the southwest corner is dominated by Creeping Spike-rush (*Eleocharis palustris*), Awl-fruited Sedge (*Carex stipata*) and Pointed Broom Sedge (*Carex scoparia*), with abundant Hard-stem Bulrush (*Schoenoplectus acutus*) and Common Cattail (*Typha latifolia*). These species and Soil Core 11 (Table 4) indicate a swath of the SWT2 feature had previously crossed the corner of the Site in a narrow swath of (former) wetland.

New vegetation in through the remainder of the cleared area, however, is dominated by upland grasses – Orchard Grass (*Dactylis glomerata*) and Kentucky Bluegrass (*Poa pratensis*) – with forbs including Common Boneset (*Eupatorium perfoliatum*), Sheep Sorrel (*Rumex acetocella*) and Steeplebush (*Spiraea tomentosa*) and Sensitive Fern (*Onoclea sensibilis*). While the forb species indicate fresh moist soil conditions, they do not denote the remainder of the cleared area as "wetland", especially in the presence of the grass species.

A small central portion of the cleared area corresponding with the previous location of a quarry pit appears to have been refilled with sand. While sparse vegetation has begun regrowing across the surface of the cleared areas, this pocket is currently still devoid of vegetation.

Lands immediately north of the site (north of R7) are characterized by a Fresh-Moist Poplar Deciduous Forest (FOD8-2). The ecosite is co-dominated by Balsam Poplar (*Populus balsamifera*) and Trembling Aspen (*Populus tremuloides*). These trees have a diameter at breast height (DBH) that ranges from 10 to 35 cm. Other tree species present in small numbers include Red Maple (*Acer rubrum*), European Birch (*Betula pendula*), Eastern Cottonwood (*Populus deltoids*) and Green Ash (*Fraxinus pennsylvanica*). This is the oldest contiguously wooded area on the Site, though it is still no more than 45 years old (City of Ottawa, 2024).

5.3 Surface Water and Fish Habitat

Channel R1 is a roadside ditch along Thunder Road (Figure 2). Channel R7 is a permanent stream. R3, R4, and the north half of R2 all contained some water (< 15 cm) until mid-summer in 2018, but likely only did so because of the presence of beaver dams on R7, which had backed up water onto the Site. Beaver dams have been consistently removed from the Site and neighbouring properties since that time; those channels now dry shortly after the spring freshet.

Channels R5, R6 and the southern half of R2 are ephemeral and were found to dry very quickly after the freshet, even when the beaver dams were present. Fish were observed in features on the Site downstream of R4. Reaches above R4, being dry, did not have fish. With the beaver dams having been removed since mid-2018, only R7 and the lowermost section of R2 will likely have sufficient water post-freshet to provide fish habitat.

Channel R8 was first observed on October 8, 2020. It contained standing water at that time. Given its direct connection to R7, it is presumed to provide fish habitat. Channel R9 is a shallow ephemeral ditch along the western property line leading northward to R7. The feature is a linear, dirt swale, 1 - 1.5 m in width, with no obvious bank substructure. It likely conveys some runoff during the spring freshet but is unlikely to provide aquatic habitat beyond that.

Channel R10 was dug as an eastward-running, linear drainage channel sometime in either late fall 2020 or spring 2020. The 2 m wide swale was excavated in the bare sandy soil of the cleared portion at the south end of the site. City of Ottawa air photos from 2019 (City of Ottawa, 2024) suggest some natural surface drainage had previously occurred along that route, though no headwater features were evident there during site surveys through the 2018 field season. Channel R11 is a similarly sized and formed feature at the north end of the cleared area, dug within the same time frame. City of Ottawa air photos (City of Ottawa, 2024) do not suggest any channel had existed there previously. Both R10 and R11 were fully dry on June 8, 2021.

The review of headwater features on the Site reflects site conditions at the time of the development application. From the HDFA (Appendix C), channels R1, R5, R6, R10, R11 and the upper half of R2, receive management recommendations of "Mitigation"; channels R3, R4, R9 and R2 (lower end) receive management recommendations of "Conservation"; and channels R7 and R8 receive a management recommendation of "Protection".

Features recommended for mitigation are not required to be maintained, but their functionality must be replicated or enhanced through lot-level conveyance measures as part of the site stormwater management system. As the features convey runoff to more ecologically important reaches, replacement features/systems, should be vegetated to mimic online wet vegetation pockets to the extent possible, and should convey water to the same final receiver (i.e. R7). Lot-level conveyance features would form part of the Site's future stormwater management system. As such, the replacement features would not require either setbacks or a natural channel design, nor would they need to be comparable dimensions so long as they function to provide the required conveyance and opportunity for allochthonous input, compensating for the loss of features and fish habitat.

Channels recommended for conservation may be either maintained or relocated/realigned, though any channel alterations must follow natural channel design techniques to maintain or enhance the overall productivity of the reach. If realigned, the features may be relocated on or off the Site. In either case (i.e. maintained or realigned), the channel must be situated within a naturalized riparian corridor. City OP Policy 4.9.3(2) would require a corridor associated with natural channels to provide a setback equivalent to the greater of the following:

- Development limits as established by the regulatory flood line or geotechnical hazard limit;
- Development limits as established by the geotechnical limit of the hazard lands;
- 30 m from the normal high-water mark; and/or
- 15 m from the existing top of bank.

If catchment drainage will be removed due to the diversion of stormwater flows, lost functions should be restored through enhanced lot level controls (e.g. restore original catchment using clean roof drainage).

Channels recommended for protection may be maintained and/or enhanced but should not generally be relocated. Improvements, however, could be possible to its overall channel form and thus some minor realignment may be considered within that context. The riparian zone should be protected and enhanced where feasible and must allow for the same setbacks as indicated above per City OP Policy 4.9.3(2). The hydro-period must be maintained. Use natural channel design techniques or wetland design to restore and enhance existing habitat features if and where needed. Stormwater management systems must be designed to avoid impacts (i.e. sediment, temperature) to this headwater channel.

Channel loss, replacement, and compensation is discussed further in Sections 6.0, 7.1, and 8.1.

The closest currently listed provincially significant wetland (PSW) is Mer Bleue, located > 5 kilometres (km) to the northwest. Much of the outer edge of the neighbouring lands to the west appears to be a continuation of the fresh moist forest ecosites that occur (or previously occurred) on the Site, other than the small wetland pocket located at the southern end. These forested areas to the west, however, include wetland habitat beyond the first 20 m or so of forest observable from the property edge that was recently

evaluated by the City. These areas are anticipated to be listed as PSW. This EIS will proceed considering adjacent lands as PSW.

5.4 Wildlife

5.4.1 Anurans

From station F3 (i.e. covering the north half of the site), the only frog heard was a single Spring Peeper (*Pseudacris crucifer*) during the second anuran survey.

Choruses (i.e. Calling Code 3) from both Spring Peepers and Wood Frogs (*Lithobates sylvaticus*) were heard on the first survey date from station F1/F2 from the wooded areas beyond the western edge of the site. Seven American Toads calling from scattered points around the southern half of the property were the only anurans observed from station F1/F2 on the second visit. No anurans were heard anywhere on the property during the third round of surveys.

Based on the presence of large numbers of two different anuran species, wooded areas southwest of the Site may be considered Significant Wildlife Habitat (SWH; MNRF, 2015) for frog breeding. The Site itself does not directly support large numbers of any anuran species and so does not constitute SWH. The lack of any calling frogs from the wooded areas west of the Site after the first frog visit suggests the forest there may be too dry following the spring freshet to provide suitable wetland habitat.

5.4.2 Birds

Overall, 32 bird species were observed on or adjacent to the Site during the two rounds of surveys in 2018 (Table 4), and 19 species observed on or adjacent to the Site in 2024. All of the birds observed are common species in the Ottawa region. Song Sparrow (*Melospiza melodia*) was the most abundant species on site followed by Black-capped Chickadee (), Common Grackle (*Quiscalus quiscula*), White-throated Sparrow (*Zonotrichia albicollis*), and Cedar Waxwing (*Bombycilla cedrorum*).

None of the birds observed occurring directly on the Site are species protected under the ESA or SARA. Two observed species – Eastern Wood-Pewee (*Contopus virens*) and Wood Thrush (*Hylocichla mustelina*) – are listed as Special Concern. Only a single individual of each species was noted during bird surveys, both from station B3. Both birds were noted at the edge of audible detection during both surveys and were placed as occurring over 100 m to the southwest (Eastern Wood-Pewee) and to the southeast (Wood Thrush). These locations are situated within the mature forest areas to the south of the property. Those forested areas thus constitute SWH for Special Concern and Rare Wildlife Species. As neither species was noted to occur directly within the younger forest features on the Site, the SWH designation does not extend onto the Site.

Table 5 2018 Breeding Bird Survey Data

Common Name	Scientific Name	Breeding Potential	Common Name	Scientific Name	Breeding Potential
American Crow	*Corvus brachyrhynchos*	Likely	Least Flycatcher	*Empidonax minimus*	Likely
American Goldfinch	*Spinus tristis*	Likely	Mourning Dove	*Zenaida macroura*	Likely
American Redstart	*Setophaga ruticilla*	Likely	Northern Cardinal	*Cardinalis cardinalis*	Likely
American Robin	*Turdus migratorius*	Likely	Ovenbird	*Seiurus aurocapilla*	Likely
Black-and-white Warbler	*Mniotilta varia*	Likely	Purple Finch	*Haemorhous purpureus*	Likely
Black-capped Chickadee	*Poecile atricapillus*	Likely	Red-eyed Vireo	*Vireo olivaceus*	Likely

Blue Jay	*Cyanocitta cristata*	Likely	Red-winged Blackbird	*Agelaius phoeniceus*	Likely
Canada Goose	*Branta canadensis*	Probable	Song Sparrow	*Melospiza melodia*	Likely
Cedar Waxwing	*Bombycilla cedrorum*	Likely	Swamp Sparrow	*Melospiza georgiana*	Likely
Common Grackle	*Quiscalus quiscula*	Likely	Veery	*Catharus fuscescens*	Likely
Common Yellowthroat	*Geothlypis trichas*	Likely	Warbling Vireo	*Vireo gilvus*	Likely
Downy Woodpecker	*Picoides pubescens*	Likely	White-breasted Nuthatch	*Sitta carolinensis*	Likely
Eastern Wood-pewee *	*Contopus virens*	Likely	White-throated Sparrow	*Zonotrichia albicollis*	Likely
Gray Catbird	*Dumetella carolinensis*	Likely	Wood Thrush *	*Hylocichla mustelina*	Likely
Hairy Woodpecker	*Leuconotopicus villosus*	Likely	Yellow-bellied Sapsucker	*Sphyrapicus varius*	Likely
House Wren	*Troglodytes aedon*	Likely	Northern Flicker	*Colaptes auratus*	Likely

* = Special Concern under the ESA and SARA

Breeding Potential = Likely: Breeding behaviour was observed and preferred nesting habitat occurs on Site, Probable: potential breeding habitat occurs on Site.

Table 6 2024 Breeding Bird Survey Data

Species Observed	Station(s) Observed	Breeding Potential	Species Observed	Station(s) Observed	Breeding Potential
Alder Flycatcher (*Empidonax alnorum*)	BBS1	Possible	Eastern Wood-Pewee (*Contopus virens*)*	BBS1	Probable
American Goldfinch (*Spinus tristis*)	BBS1	Possible	Great Crested Flycatcher (*Myiarchus crinitus*)	BBS2	Possible
American Redstart (*Setophaga ruticilla*)	BBS1	Possible	Ovenbird (*Seiurus aurocapilla*)	BBS2	Probable
American Robin (*Turdus migratorius*)	BBS2	Possible	Red-eyed Vireo (*Vireo olivaceus*)	BBS1	Possible
Black-and-white Warbler (*Mniotilta varia*)	BBS1	Possible	Song Sparrow (*Melospiza melodia*)	BBS1	Possible
Black-capped Chickadee (*Poecile atricapillus*)	BBS1, BBS2	Probable	Veery (*Catharus fuscescens*)	BBS1	Possible
Chestnut-sided Warbler (*Setophaga pensylvanica*)	BBS1	Possible	White-throated Sparrow (*Zonotrichia albicollis*)	BBS1, BBS2	Probable
Common Grackle (*Quiscalus quiscula*)	BBS2	Probable	Yellow Warbler (*Setophaga petechia*)	BBS1	Possible
Common Yellowthroat (*Geothlypis trichas*)	BBS1	Probable	Yellow-rumped Warbler (*Setophaga coronata*)	BBS1	Possible
Downy Woodpecker (*Picoides pubescens*)	BBS1	Possible			

5.4.3 Bats

Throughout the bat monitoring period (June 10-23, 2021), a total of six species of bats were recorded on the acoustic monitors (Table 5). All survey nights were warm (temperature ≥7°C) with low wind. There were intermittent showers during the nights of June 14, 18, and 21, 2021; survey nights were otherwise calm and free of precipitation. Almost all of the recorded echolocations were made by Big Brown Bats (*Eptesicus fuscus*) and Hoary Bats (*Lasiurus cinereus*) with smaller numbers of Silver-haired Bats (*Lasionycteris noctivagans*). Eastern Red Bats (*Lasiurus borealis*) were also observed. A very small number of calls were attributed to two at-risk bat species, Little Brown Myotis (*Myotis lucifugus*; 9 calls) and Tri-coloured Bat (*Perimyotis subflavus*).

Table 7 Number of bat recordings by species from acoustic monitoring

Date	Big Brown Bat	Eastern Red bat	Hoary Bat	Silver-haired Bat	Little Brown Bat
22-Jun	1		5	1	
23-Jun	69		1	11	
24-Jun	30	1	4	24	

25-Jun	33		6	2	
26-Jun	20		4	1	
27-Jun	65	1	17	10	1
28-Jun	75	1	17	11	1
29-Jun	42	1	28	12	
30-Jun	84	6	16	21	1
1-Jul	14		14	17	
2-Jul	75		8	15	
3-Jul	76		3	8	
4-Jul	26	1	8	7	
5-Jul	45		11	12	
Total	**655**	**11**	**142**	**152**	**3**

* The single recording auto-ID'ed as Northern-Long-eared Bat had a low match ratio (<0.15).

Note that the number of call recordings obtained is not directly equivalent to the number of bats present in an area. A single bat may pass a monitor many times during an evening, triggering multiple recordings. Very generally, however, the number of recordings per species can be indicative of relative abundances.

Recordings for Little Brown Myotis were captured a single time on each of three nights, suggesting a single bat passing by but not actively using the area. The species is likely generally present within the broader vicinity but does not appear to use the wooded areas of the Site itself as significant habitat.

No recordings were captured of either Northern Long-eared Myotis or Tri-colored Bat suggesting those species are absent from the area.

5.5 Species at Risk

Based on our review of existing information records, our ELC delineations of the Site to characterize potential habitat areas, and our field surveys (Appendix B), seven (7) species were considered to have some probability of transient presence.

Two bird species, Eastern Wood-Pewee and Wood Thrush, were noted a single time each in the mature forest areas to the southwest of the Site. These birds, however, were not observed on the Site and the mix of young, scrubby forest and coniferous plantation present there provides only marginally suitable habitat by comparison. While it is possible both species could occur there transiently, the forested portions of the Site are not considered to be suitable habitat areas for these species.

Snapping Turtles (*Chelydra serpentina*) commonly occur in the general vicinity and tend to live and breed in close proximity to permanent watercourse features (MNRF, 2014). Watercourse feature R7 has some potential to support the species, though no individuals have previously been noted here. Areas of the Site beyond R7 or its immediate riparian corridor lack any permanent water features and are not considered as potential habitat. As the species is listed as Special Concern, its habitat is not specifically protected under the ESA regardless.

5.5.1 SAR Bats

The Committee on the Status of Species at Risk in Ontario (COSSARO) has updated the provincial status for the Hoary Bat, Silver-haired Bat, and Eastern Red Bat to Endangered. These species will receive general habitat protection on or prior to January 31, 2025. Although these species are not officially listed at the time of this EIS, it is anticipated that protections may apply throughout the development application timeline. As such, these species are considered and assessed as Endangered species in this EIS.

The Hoary Bat, Silver-haired Bat, and Eastern Red Bat were detected in moderate numbers at the monitoring station on the Site, and therefore likely forage and/or roost in proximity to the Site. The numbers of detections, however, were not high, suggesting only a limited transient presence over most of the Site, with little evidence of maternal roosting activity or habitat. The Little Brown Myotis was observed to have some potential to occur transiently on the property. The young forests of the Site include few large snags typical of roosting trees. As such, they are unlikely to provide significant nursery habitat. The sandy soils of the area do not include cave-supporting geology for potential hibernacula.

As Endangered species, the Hoary Bat, Silver-haired Bat, Eastern Red Bat, and Little Brown Myotis receive "general habitat protection" under the ESA. However, vegetation removal on the Site would not result in a loss of maternal roosting habitat.

5.6 Other Significant Natural Features

The Site includes areas identified by the City as part of the Natural Heritage System per Schedule C11-C of the City's Official Plan (City of Ottawa, 2021). Areas flagged under Schedule C11-C are considered to be, or to have some potential to be, significant natural heritage features per the OP (City of Ottawa, 2021) and/or the *Natural Heritage Reference Manual* (MNR, 2010).

5.6.1 Significant Woodlands and Interior Forest

Significant Woodlands

The forest ecosites of the Site are contiguous with an expansive forested area to the west, covering an extended area of > 120 ha. Based on the size alone, the extended wooded areas constitute Significant Woodland under the Natural Heritage Reference Manual (MNR, 2010). Since the forest cover directly on the Site is contiguous with these wooded areas, it is part of this Significant Woodland. However, the forest cover on the Site forms the youngest portion of the adjacent Significant Woodland, with the oldest parts on Site <40 years old and the youngest parts only ~20 years old.

Interior Forest

Forests on the Site maintain two large gaps, with an average width of ~32 m. Interior forest habitat includes forested areas >100 m from a forest edge. Given the existing condition of forest cover across the Site, no portion of the Site constitutes interior forest. The calculation of interior forest presence, shown in Figure 7, was completed following precise forest gap measurements made onsite on June 13,2024 to capture the most up to date condition of forest cover and condition on the Site. Forest gaps were measured using an accurate rangefinder in ~5 m transects across the entirety of the forest gap areas. These measurements were then used to calculate an average gap width for both forest clearings. The average gap width of the southern forest clearing is 31.5 m, and 33.12 m in the northern forest clearing (i.e. south of TAGM1). The forest gaps were then factored into the >100 m forest edge calculation in a GIS system and mapped accordingly (Figure 7). The assessment of forested areas directly on the Site as"not interior forest" is further supported by the lack of interior-dependent bird species observed (Section5.4.2)

6.0 DESCRIPTION OF THE PROPOSED PROJECT

The proposed development consists of warehouse and employment uses in the general ruralarea (Figure 7). Three stormwater ponds are proposed for the Site; one large SWM pond located in thenorthern portion of the Site, one located centrally along the western site boundary, and a small pond atthe southeastern site boundary adjacent to Boundary Road. The extent of development on the Site will feature permanent fencing as the final barrier between the buffer areas and future Site activity.

A 736 m naturalized watercourse and swale feature is proposed to be located in the western and southern portions of the Site centrally within the O1R zone (R9, R12). While some regrading along the development side of the buffer may be completed as part of the overall restoration/renaturalization (i.e. including but not necessarily limited to the swale habitat), Site works would not otherwise encroach on the O1R zone. Currently bare areas and the regraded edges will be fully planted with appropriate, native plant species to develop the O1R buffer zone as a naturalized terrestrial-to-wetland transition.

The watercourse/swale will be a low-intensity open feature primarily receiving flow backwatered from R7, input from southern forest drainage onto the Site, overland flow, and during large precipitation events and spring freshet. The swale will have a grade of 0.1% and is expected to retain back water into late summer and function as 300 m of fish habitat, connected to the R7 system. It is intended to serve as an important natural element within the O1R zone between the development and the adjacent aquatic, wetland, and forested areas supporting its overall form and functionality as a transitional habitat zone.

The large SWM pond in the northern portion of the Site will provide 50 m of fish habitat and connectivity with R7. An OGS and headwall with riprap will be located at the outlet of the SWM pond to R7. Between the OGS and headwall and R7, a 1 m wide, open, shaded, and naturalized trapezoidal channel to R7 will be established to meander through the TAGM1 vegetation community, with a minimum 2% slope and 3:1 side slopes. The large SWM pond will be setback greater than 30 m from the northern Site boundary and the top of bank of the channel R7. The retention of forest cover within the riparian buffer to channel R7 would provide a ~65 m wide natural corridor (i.e. two 30 m setbacks plus the width of the channel).

The Grading and Drainage Plan (LRL Engineering, 2024) detailing the proposed development and above noted features is included in Appendix E.

In consideration of the Ottawa Bird-Safe Design Guidelines (City of Ottawa, 2020a), the main building of the proposed development has an eave height of 4.863 m and features two small clear anodized aluminum windows along the southern building façade, six along the northern façade, three along the eastern façade, and none along the western façade. Therefore, the site building designs are anticipated to minimize the potential for impacts to birds and prevent bird strikes. Elevation drawings are included in Appendix F.

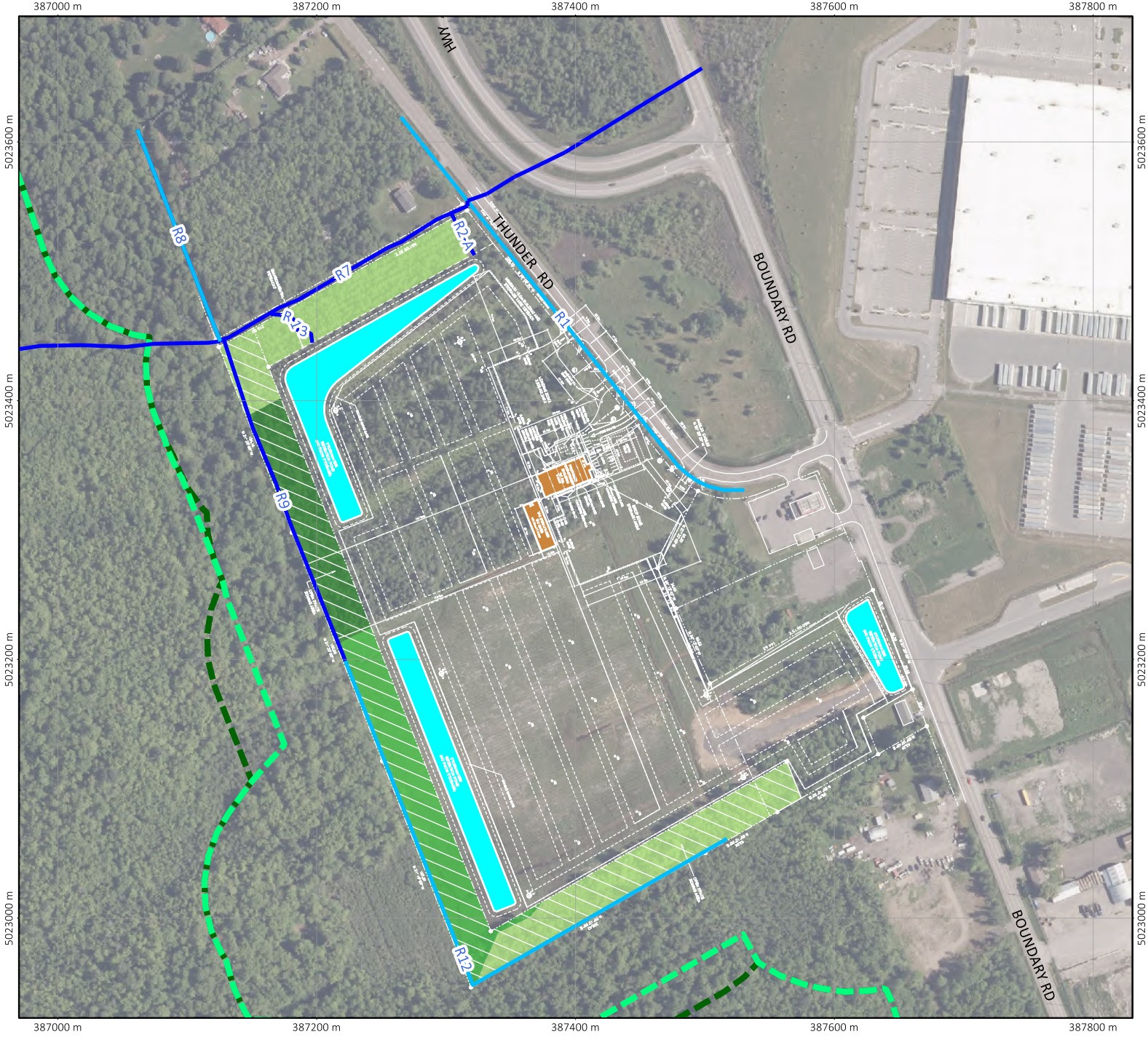

Figure 7 Proposed development

Legend

Forest Cover-
Post Development
- Enhanced
- Newly Established
- Retained

- Interior Forest - current edge
- Interior Forest - post development

Watercourses
Post Development
- Intermittent/ Ephemeral
- Permanent (direct fish habitat)

N

0 100 m

Project File: AVE 1606 - 2408a.map
MTM Zone 9
(NAD 83)
Printed on: 2021-07-15

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7.0 IMPACT ASSESSMENT

7.1 Aquatic Habitat

Channelized Water Features

Table 8 Channelized Water Feature Impacts & Compensation

Channel	Flow Condition	Fish Habitat Considerations	Length (m)
Channels Removed			
R2-B	Permanent (with backwater from R7)	Fish Habitat	52
R2-C	Initially wet through the season because of beaver dam at R2B. With the removal of the dams in 2018, water drains by mid spring.	Previously provided fish habitat when a beaver dam induced flooding through the area. Water now drains too early to provide fish habitat.	144
R3			144
R4			146
R10	Ephemeral	Not Fish Habitat	130
R11	Ephemeral	Not Fish Habitat	95
R2-D	Intermittent	Not Fish Habitat	251
R5	Ephemeral	Not Fish Habitat	54
R6	Ephemeral	Not Fish Habitat	55
Total length of channels removed			**1071**
(Total length of channels providing fish habitat removed)			**52**
Channels Added or Improved			
R9	Currently ephemeral, the channel will be deepened to match the existing invert of R7 and regraded to 0.1% grade around along its entire length, with 3:1 bank grading. This will allow for spring flows and the retention of backwater from R7 late into the summer.	The feature currently cannot provide fish habitat, but will support local fish species along its entire length post development.	300
R13	Permanent Surface water runoff from the site directly will be conveyed (after treatment in SWM systems) to R7 via R13.	With its direct connection to R7 and supply from the site SWM systems, R7 will support local fish species along its entire length post development.	50
R12	Intermittent Channels currently along the center of the site collect and convey surface water runoff to R7. The development area will be raised, thereby preventing the surface water runoff site from adjacent forest/wetland areas from accessing the Site directly. R12 conveys these flows instead around the site, to the improved R9, to re-establish a flow connection to R7.	With only intermittent (early spring) flows, this feature is unlikely to provide direct fish habitat.	436
Total length of new channels			**786**
(Total length of new channels providing fish habitat)			**350**
Channels Retained			
R7	Main creek through the site	Fish Habitat	218
R2-A	Permanent	Fish Habitat (Back water)	38
R8	Intermittent	Fish Habitat (Back water)	176
R1	Roadside Ditch	Not Fish Habitat	401
Total Length of Channels Post-Development			**1,619**

Construction of the proposed development would require the removal of channels R3, R4, R5, R6, R10, R11 and the lower portion of R2 (R2-B, R2-C, R2-D) — a total of 1071 m of drainage features, 52 m of which currently constitute fish habitat.

This is proposed be replaced with the 736 m long, 1-2 m wide naturalized watercourse/swale feature around the perimeter of the developed area, within the O1R zone (Figure 7). R9, forming the upper portion of the feature is currently ephemeral. The channel will be deepened to match the existing invert of R7 and regraded to 0.1% along its entire length (i.e., including R12), with 3:1 bank grading. Backwater and spring flows will allow R9 to hold water through late summer. Where the feature transitions to R12, the channel will hold water intermittently, and convey Site flows as well as flows from adjacent forested lands and wetlands around the Site to R7. R9 will provide 300 m of fish habitat. R12 will not function as fish habitat. Both R9 and R12 will be planted with native grass, forb, shrub, and treed vegetation to provide a naturalized buffer, shading, and allochthonous inputs.

Water from the northern SWM detention pond will outlet to R13; an OGS and headwall with riprap will be located at the outlet of the SWM pond to R7. Between the OGS and headwall and R7, a 1 m wide, open, shaded, and naturalized trapezoidal channel to R7 will be established to meander through the TAGM1 vegetation community, with a minimum 2% slope and 3:1 side slopes, and provide 50 m of fish habitat.

R9, R12, and R13 replace the functionality of all removed channels, providing a net gain in higher-quality aquatic habitat and resulting in 786 m of new channels and 350 m of fish habitat, as required under the HDFA management recommendations of either Mitigation or Conservation. Post-development, 1,619 m of channels will be present on the Site, 350 m of which will provide fish habitat, through a combination of retained and new channels. This results in a gain of 298 m of new fish habitat.

The O1R zone allows for compatible, low scale and low intensity open space natural areas. As such, the O1R zone does not specifically disallow watercourse feature development if such development is low scale, intensity and compatible with parks, open space and natural area land uses. The new 736 m long feature, with a 30 m wide, naturally-vegetated riparian buffer to the west will enhance habitat functionality on and adjacent to the Site. Many other properties within the City of Ottawa O1R zone exhibit similar characteristics (Appendix G).

Proposed changes to watercourse alignment on the Site must be supported by a Permit to Alter a Watercourse to be applied for to the SNCA. All realignment work must be completed in accordance with such permits as issued. Proposed impacts to fish-bearing waters must be reviewed by DFO. Given the limited extent of the fish community and low quality generally of the fish habitat observed on the Site, no requirement for a Fisheries Act Authorization is anticipated.

Reach 8, located offsite to the north was not assessed in detail as part of this current study. The proposed development, however, is located > 30 m from this feature, thus retaining an untouched, natural setback.

Wetland Areas

Lands to the west of the Site, currently owned by the AOO, include broad wetland features that the City of Ottawa has recently accessed as constituting PSW. To protect the SWT2 thicket areas off the southwest corner of the Site, the 30 m O1R zone will provide naturalize setback/buffer zone along the entire length of the western and southern Site boundaries. Renaturalization within this zone will establish a terrestrial-

to-wetland transition buffer across its width, retaining existing vegetation and/or be regrading and revegetating as required. The watercourse/swale system around the perimeter of the Site will allow for infiltration as of surface flows as they are otherwise generally conveyed northward towards R7 though a naturalized milieu, as comparable to pre-development flow patterns along the existing, linearized HDFs. Site surface water runoff will be directed through the Site SWM detention pond for quality control before its ultimate release to R7 and resumption of its westward flow.

Floodplain

SNC recently completed an update of floodplain mapping west of the Site, which is reflected in their revised regulatory limit (Appendix H). No regulatory floodplain extends onto the Site.

7.2 Vegetation, Trees and Significant Woodland

An area of 3.1 ha consisting of a mix of young deciduous forest and coniferous plantation, with a pocket of thicket swamp, would be removed under future site development. While these wooded areas are part of a Significant Woodland, they are part of a small area of regrowth on former farm fields extending out from the main, more mature forest block to the west. The forest area to be cleared represents 3.5% of the broader forested area. Natural areas within the buffers along the south and west sides of the Site, and within the riparian corridor for Channel R7 (~0.7 ha) would be retained and enhanced.

The TAGM1 vegetation community in the northern portion of the Site is retained as a 30 m wide setback from R7. This community is a disturbed, low-quality habitat with very little to no understory present, however, based on consultation with City of Ottawa forestry staff, little to no value exists in restoring this forest. One row of Pine trees and associated vegetation is located along the 30 m setback line, which is proposed to be removed (~5m wide area). This area will be planted with appropriate native trees and vegetation, with a spacing of 5 m to improve the forest edge and enhance the natural buffer between the development and environmental setback lands.

Revegetation within the currently cleared portion of the south and west side (O1R zone) setbacks would restore a further 1.6 ha of natural land cover and would establish/enhanced a 30 m naturalized buffer against the forest and wetlands to the west of the Site. Planting and revegetation details are provided in the landscape plan for the Site (Appendix I).

No portion of the Site contains interior forest. As such, no negative impacts to interior forest will occur as a result of the proposed development. Planting, enhancement and creation of additional forested lands within the O1R zone associated with the proposed watercourse will create a net positive benefit for the interior forest and significant woodland on the adjacent lands to the west and south, through the creation of a treed buffer with significant canopy cover. Interior forest in its existing condition compared to post development condition (net gain) is shown in Figure 7 above. The minor impacts anticipated to the broader Significant Woodland are considered to be sufficiently balanced by proposed improvements.

7.3 Species at Risk

A total of seven species subject to protections as SAR under the ESA and/or SARA were initially considered to have potential to interact with the project. Of those seven species, four were observed to occur on the Site, but are not considered likely to be negatively impacted by the project should mitigation measures

be implemented. The SAR Bat mitigations and general wildlife mitigations provided in Sections 8.3 and 8.4, respectively, are anticipated to protect the SAR that may occur on the Site.

7.4 Significant Wildlife Habitat

The wooded area to the southwest of the Site supports sufficient numbers and species of anurans in the early spring to qualify as SWH. This area will remain untouched by the proposed development and will be protected by a 30 m wide treed buffer along the naturalized watercourse and swale to be constructed around the periphery of the Site within the O1R zone. The Site itself does not constitute SWH. No negative impacts are anticipated to the ability of the adjacent forest area to support early-breeding frog species. No mid- or late-breeding-season frogs were noted there. The construction of the naturalized watercourse and swale within the O1R zone is expected to enhance and improve habitat on and adjacent to the Site, and the realigned R13 drain to R7 from the SWM detention pond is expected to provide enhanced aquatic and terrestrial habitat, supporting a wide range of wildlife. Wildlife habitat will be established through the planting of native vegetation species on the Site within setback buffer areas.

8.0 MITIGATION

8.1 Aquatic Habitat

The realignment of existing headwater channels on the Site to form the proposed perimeter watercourse and swale system and drain to R7 can only be completed under a permit to alter a waterway issued by SNC. No alteration of the existing channels will be completed prior to the issuance of a permit to alter a waterway; all such works must then be completed in accordance with the conditions of that permit. Any proposed works in fish-bearing waters must also be reviewed by DFO and may require a Fisheries Authorization. At a minimum, all construction works will require standard erosion and sediment control (ESC) mitigation measures to protect waters in the broader vicinity including:

- a multi-faceted approach to provide erosion and sediment control;
- retention of existing vegetation and stabilization of exposed soils with vegetation where possible;
- limiting the duration of soil exposure and phase construction;
- limiting the size of disturbed areas by minimizing nonessential clearing and grading;
- minimizing the total slope length and the gradient of disturbed areas;
- refuelling of machinery should occur >30 m from any watercourse;
- maintaining overland sheet flow and avoid concentrated flows; and
- storing/stockpiling all soil away (e.g. greater than 30 m) from watercourses, drainage features and tops of steep slopes.

8.2 Vegetation / Trees

Existing trees within retained natural areas adjacent to R7 must be maintained. Existing trees along the western and southern buffer will be retained to the extent possible to establish Site grading and the swale along the eastern extent of the O1R zone. Where applicable, the watercourse and swale corridor must be replanted with native tree species consistent with those present in the adjacent FOCM6 and FOD7 ecosites. The watercourse and swale itself is to be seeded with a wetland grass mix to improve natural filtration along the channel length.

To minimize impacts to trees adjacent to the Site, the following general protection measures are recommended as necessary during construction:

- Tree removal on Site should be limited to that which is necessary to accommodate construction;
- To minimize impact to trees adjacent to the Site during construction:
    - Erect a fence beyond the critical root zone (CRZ; i.e. 10x the DBH) of trees to be retained. The fence should be highly visible (orange construction fence) and paired with erosion and sediment control fencing.
        - The fencing shall not be moved and will be maintained until construction is complete;
        - Pruning of branches is recommended in areas of potential conflict with construction equipment;
        - Do not place any material or equipment within the CRZ of trees;
        - Do not attach any signs, notices, or posters to any trees;
        - Do not raise or lower the existing grade within the CRZ of trees without approval;
        - Tunnel or bore when digging within the CRZ of a tree;
        - Do not damage the root system, trunk, or branches of any remaining trees; and
        - Ensure that exhaust fumes from all equipment are not directed toward any tree's canopy.

This report does not constitute permission to remove any trees from the Site. Removal of trees can only be undertaken following appropriate consultation with City planning staff.

8.3 Species at Risk

Individuals of listed bat species may periodically roost diurnally in trees on the Site during the active season (April 1 to September 30 inclusive; MNRF, 2017), i.e., bats could briefly use any Site tree or structure as a rest stop, but only opportunistically (not as a required habitat element). Potential impacts to individual at-risk bats directly would be mitigated by clearing trees, removing structures (or

commencing construction works on them) outside of the roosting season. Following this tree-clearing window would also avoid potential interactions with birds and bird nests protected under the Migratory Birds Convention Act (MBCA; Government of Canada, 1994). As such, the Hoary Bat, Silver-haired Bat, Eastern Red Bat, Little Brown Myotis are generally considered unlikely to be impacted by future Site development.

8.4 General Wildlife Management

Common wildlife species may occur on the Site. The following mitigation measures shall be implemented during future construction phases of the project to generally protect wildlife:

- Areas shall not be altered or cleared during sensitive times of the year for wildlife (breeding season; early spring to early summer) unless mitigation measures are implemented and/or the habitat has been inspected by a qualified Biologist;
    - Clearing of trees or vegetation should not take place April 1 to September 31 inclusive unless a qualified Biologist has determined that no nesting is occurring within 5 days prior to the clearing:
        - The MBCA protects the nests and young of migratory breeding birds in Canada. As such, clearing of trees or vegetation should take place between April 1st and August 31st, unless a qualified Biologist has determined that no nesting is occurring within 5 days prior to the clearing (City of Ottawa, 2022b);
        - Bats day-roost in trees from May to September (MNRF, 2017);
- Do not harm, feed, or unnecessarily harass wildlife;
- Manage waste to prevent attracting wildlife to the Site. Effective mitigation measures include litter prevention, and keeping all trash secured in wildlife-proof containers and promptly removing it from the Site, especially during warm weather;
- Drive slowly and avoid hitting wildlife;
- Manage stockpiles and equipment on Site to prevent wildlife from being attracted to artificial habitat. Cover and contain any piles of soil, fill, brush, rocks and other loose materials and cap-ends of pipes where necessary to keep wildlife out. Ensure that trailers, bins, boxes, and vacant buildings are secured at the end of each workday to prevent access by wildlife;
- Check the entire work site for wildlife prior to beginning work each day;
- Inspect protective fencing and/or other installed wildlife exclusion measures daily and after each rain event to ensure their integrity and continued function;
- Monitor construction activities to ensure compliance with the project-specific protocol (where applicable) or any other requirements; and
- If SAR are encountered on the worksite, immediately stop all work in the vicinity of the observation and contact the MECP.

9.0 SUMMARY AND RECOMMENDATIONS

It is our professional opinion that future Site development consistent with the land use change being proposed for the Site could be constructed without imposing negative impacts on species-at-risk, Significant Wildlife Habitat, or aquatic habitat present in the broader vicinity under the proposed project, if all recommendations and mitigation measures provided within this EIS are followed. Mitigation measures include standard ESC measures, general wildlife management for construction sites (City of Ottawa, 2022a), and tree planting, the latter of which is detailed in the Site landscape plan. Impacts to the broader Significant Woodland under future development of the Site are anticipated to be minor; the impacted area represents the youngest portion of the extended feature, which includes no uncommon vegetation coverage and does not provide functionality as SWH. The maintenance of surface flows on the Site and the creation and enhancement of aquatic and terrestrial habitat with a range of native vegetation and supporting a variety of wildlife species creates no-net impact for the development on the Site.

10.0 CLOSURE

This report was prepared for exclusive use by Avenue 31 Inc. and may be distributed only by or in accordance with the express instructions of Avenue 31 Inc. Questions relating to the data and interpretation can be addressed to the undersigned.

Respectfully submitted,

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Appendix A Qualifications of Report Authors

Anthony Francis, PhD

Dr. Francis is a Senior Ecologist with 24 years consulting experience to both government agencies and private industry. He has worked on a diversity of projects relating to species at risk, invasive species, terrestrial and aquatic habitat, environmental effects monitoring and mitigation, and fate/effects of contaminants. Within each of these subject areas, Dr. Francis has completed projects addressing specific site concerns and broader policy initiatives. He has extensive experience in preparing Environmental Impact Statements, Integrated Environmental Reviews and Tree Conservation Reports in support of land development and property severances. He has carried out literature reviews for government agencies, performed complex geospatial analyses of plant and animal distributions, and completed numerous field programs in support of environmental impact statements and assessments.

Maren Nielsen, BES, EMA

Maren is a Biologist with a background in terrestrial ecology. She has over eight years of comprehensive field, laboratory and technical report writing experience through a combination of graduate and undergraduate studies and work experience. Maren completed a Bachelor of Environmental Studies with Honours at York University and a Graduate Certificate in Environmental Management and Assessment from Niagara College Canada. Maren has over three years of environmental and agricultural consulting experience, assisting clients to navigate the land development and site rehabilitation processes as well as obtaining permits and approvals from regulatory agencies. She has led numerous studies including Environmental Assessments (EA), Environmental Impact Studies (EIS), Opportunities & Constraints Analysis, Agricultural Impact Assessments (AIA), LEAR Studies and Minimum Distance Separation (MDS) I & II studies. Maren has carried out field programs for the collection of soils, water, sediment, fish and benthos as well as vegetation surveys, wildlife surveys, wind turbine avian and bat mortality monitoring, and land use surveys. Since joining Kilgour & Associates Ltd. in 2023, Maren has worked on a variety of land development projects and completed numerous Environmental Impact Studies (EIS), Headwater Drainage Feature Assessments (HDFA), Existing Conditions Reports, Opportunities and Constraints Analysis, and Species at Risk (SAR) monitoring. Maren is a certified wetland evaluator under the Ontario Wetland Evaluation System (OWES).

Appendix B SAR Screening Assessment

Species Name (*Taxonomic Name*)	Status under Ontario *Endangered Species Act* (ESA)	Status under federal *Species at Risk Act* (SARA) - Schedule 1	Habitat Description	Ottawa Regional Occurrence (*Observation records in the vicinity*)	Potential to Occur in the Project Area (Yes / No)	Probability of Interaction with the Project (None, Low, Moderate, High)
Birds						
Bald Eagle (*Haliaeetus leucocephalus*)	**Special Concern**	**No Status**	Nest in mature forests near open water. In large trees such as Pine and Poplar.	Confirmed nest at Shirley's Bay since 2012.	No	None. No suitable nesting or feeding areas and no observations of the species on or near subject site.
Bank Swallow (*Riparia riparia*)	**Threatened**	**Threatened**	Colonial nester; burrows in eroding silt or sand banks, sand pit walls, and human-made settings, which are often found on banks of rivers and lakes.	12 confirmed, 2 probable and 8 possible nests in recent OBBA. *(OBBA)*	No	None. No suitable nesting or feeding areas and no observations of the species on or near subject site. OBBA observations are only within 10 km.
Barn Swallow (*Hirundo rustica*)	**Special Concern**	**Threatened**	Nests on barns and other structures; forages in open areas for flying insects. Live in close association with humans and prefer to nest in structures such as open barns, under bridges, and in culverts.	33 confirmed, 2 probable and 3 possible nests during recent OBBA. (*OBBA*)	No	None. No suitable nesting areas and no observations of the species on or near subject site. OBBA observations are only within 10 km.
Black Tern (*Chlidonias niger*)	**Special Concern**	**No Status**	Build floating nests in loose colonies in shallow marshes, especially cattails.	Four confirmed nests in recent OBBA.	No	None. No suitable nesting or feeding areas on subject site and no observations of the species near by.
Bobolink (*Dolichonyx oryzivorus*)	**Threatened**	**Threatened**	Live in tall grass prairie and other open meadows. With major clearing of prairies, Bobolink are moving to hayfields. Build nests on the ground in dense grasses.	Widespread; confirmed or probable nests found in 39 out of 40 local atlas squares during recent OBBA. (*LIO, OBBA, NHIC*)	No	None. No suitable nesting or feeding areas and no observations of the species on subject site.
Canada Warbler (*Cardellina canadensis*)	**Special Concern**	**Threatened**	Prefers wet forests with dense shrub layers. Nests located on or near the ground on mossy logs or roots, along stream banks or on hummocks.	One confirmed nest, two probable and six possible reported in recent OBBA. No critical habitat identified.	No	None. Suitable habitat is present but there are no observations of the species on or near subject site.
Cerulean Warbler (*Setophaga cerulea*)	**Threatened**	**Endangered**	Prefers mature deciduous forests with an open under storey.	Unlikely but within range (found on Gatineau side)	No	None. No suitable habitat and outside of known range.
Chimney Swift (*Chaetura pelagica*)	**Threatened**	**Threatened**	Nests in traditional-style open brick chimneys (and rarely in hollow trees). Tend to stay close to water	Confirmed nests in 3 squares, 2 probable and 11 possible reported in recent OBBA. No critical habitat identified. (*OBBA*)	No	None. No suitable nesting areas on subject site.
Common Nighthawk (*Chordeiles minor*)	**Special Concern**	**Threatened**	Nests in wide variety of open sites, including beaches, fields and gravel rooftops with little to no ground vegetation. They also nest in cultivated fields, orchards, urban parks, mine tailings and along gravel roads/railways but tend to occupy more natural sites.	Six probable and five possible nests reported in recent OBBA. No critical habitat identified.	No	None. Habitat suitability is limited and no individuals have been observed in the immediate vicinity.

Eastern Meadowlark (*Sturnella magna*)	**Threatened**	**Threatened**	Typically nest in tall grasslands (pastures/hayfields) but also found in alfalfa fields, weedy borders of croplands, roadsides, orchards, airports, shrubby overgrown fields, or other open areas. Often use trees, shrubs, or fence posts to elevate song perches.	22 confirmed, 11 probable and 3 possible nests during recent OBBA. (*LIO, NHIC, OBBA*)	No	None. Habitat potential in cleared areas is limited and there are no observations of the species on the subject site.
Eastern Whip-poor-will (*Antrostomus vociferus*)	**Threatened**	**Threatened**	Nests on the ground in open deciduous or mixed woodlands with little underbrush.	Seven squares with probable nests and 10 with possible nests reported in recent OBBA. Critical habitat tentatively identified in 4 squares in western Ottawa.	No	None. Dense, young, scrubby forest cover provides low habitat suitability and the species is not identified as present in the vicinity.
Eastern Wood-pewee (*Contopus virens*)	**Special Concern**	**Special Concern**	Woodland species, often found in the mid-canopy layer near clearings and edges of deciduous and mixed forests.	4 possible, 15 probable and 19 confirmed nests in recent OBBA. (*NHIC, OBBA*)	Yes	Low. Presence is possible, but the young forest cover of the subject site provides low habitat suitability. The species was noted off site in more mature forest areas to the west, which provide greater habitat suitability.
Golden Eagle (*Aquila chrysaetos*)	**Endangered**	**No Status**	Nest in remote, undisturbed areas, usually building their nests on ledges on a steep cliff/riverbank or large trees if needed. Most hunting is done near open areas such as large bogs or tundra.	Migrant only; no reported nests.	No	None. Not identified in the vicinity.
Golden-winged Warbler (*Vermivora chrysoptera*)	**Special Concern**	**Threatened**	Ground nesting in areas of young shrubs surrounded by mature forest. Often areas that have recently been disturbed such as field edges, hydro or utility right-of-ways, or logged areas.	One confirmed nest, one probable nest reported during recent OBBA. Critical habitat identified in Québec (adjacent to northwestern Ottawa).	No	None. Not identified in the vicinity.
Grasshopper Sparrow (*Ammodramus savannarum*)	**Special Concern**	**Special Concern**	Lives in open grassland areas with well-drained sandy soil. Will also nest in hayfields and pastures, as well as alvars, prairies and occasionally grain crops such as barley. It prefers areas that are sparsely vegetated and its nests are well hidden in the field, woven from grasses in a small cup-like shape.	4 confirmed, 5 probable and 2 possible nests in recent OBBA.	No	None. No suitable nesting or feeding areas on subject site.
Evening Grosbeak (*Coccothraustes vespertinus*)	**Special Concern**	**Special Concern**	Nest in trees or large shrubs; prefer mature coniferous forests but will also use deciduous forests, parklands and orchards.	Five confirmed nests, six probable and eight possible during recent OBBA (mostly in west).	No	Low. Forest habitat of the site is not the preferred habitat and the replacement of the cottage with a house would not alter the overall suitability of the site regardless.
Henslow's Sparrow (*Ammodramus henslowii*)	**Endangered**	**Endangered**	Tends to avoid fields that have been grazed or are crowded with trees and shrubs. Prefers extensive, dense, tall	No nests reported during recent OBBA. (*LIO*)	No	None. No suitable habitat and not identified in the vicinity.

			grasslands where it can more easily conceal its small ground nest.			
Horned Grebe (*Podiceps auritus)*	**Special Concern**	**No Status**	Nest in small ponds, marshes and shallow bays that contain areas of open water and emergent vegetation.	Migrant only; no reported nests.	No	None. No suitable habitat and not identified in the vicinity.
Least Bittern (*Ixobrychus exilis*)	**Threatened**	**Threatened**	Found in a variety of wetland habitats, but strongly prefers cattail marshes with a mix of open pools and channels.	Confirmed nesting in 1 square, 3 probable and 4 possible reported during recent OBBA. (*OBBA*)	No	None. No suitable nesting or feeding areas on subject site.
Loggerhead Shrike (*Lanius ludovicianus*)	**Endangered**	**Endangered**	The Loggerhead prefers pasture or other grasslands with scattered low trees and shrubs. Lives in fields or alvars (areas of exposed bedrock) with short grass, which makes it easier to spot prey.	One possible nest reported in recent OBBA. Critical habitat identified in Montague Township. (*LIO*)	No	None. No suitable habitat and not identified in the vicinity.
Olive-sided Flycatcher (*Contopus cooperi*)	**Special Concern**	**Threatened**	Found along natural forest edges and openings. Will use forests that have been logged or burned, if there are ample tall snags and trees to use for foraging perches.	One probable and one possible nest reported in recent OBBA. No critical habitat identified.	No	None. Habitat is suitable, though not optimal, but the species has not been observed in the vicinity.
Peregrine Falcon (*Falco peregrinus*)	**Special Concern (as of January 2013)**	**Special Concern**	Nest on tall, steep cliff ledges close to large bodies of water. Urban peregrines raise their young on ledges of tall buildings, even in busy downtown areas.	One confirmed nest (101 Lyon) in recent OBBA. Second nest (875 Heron) established in 2011.	No	None. No suitable nesting or feeding areas on subject site.
Red Knot (*Calidris canutus rufa*)	**Endangered**	**Endangered**	Prefer open beaches, mudflats, and coastal lagoons, where they feast on molluscs, crustaceans, and other invertebrates.	Migrant only; Ottawa River shores, area lagoons, etc.	No	None. No suitable nesting or feeding areas on subject site.
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	**Special Concern**	**Threatened**	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 birds use for nesting and perching.	One confirmed nest, one probable and two possible during recent OBBA.	No	None. Habitat has only limited suitability and the species has not been observed in the vicinity.
Rusty Blackbird (*Euphagus carolinus*)	**Special Concern**	**Special Concern**	Prefers wet wooded or shrubby areas (nests at edges of boreal wetlands and coniferous forests). These areas include bogs, marshes and beaver ponds.	No nests reported during recent OBBA. Primarily occurs during migration.	No	None. Habitat is suitable but the species has not been observed in the vicinity.
Short-eared Owl (*Asio flammeus*)	**Special Concern**	**Special Concern**	Lives in open areas such as grasslands, marshes and tundra where it nests on the ground and hunts for small mammals.	One confirmed nest, two probable and two possible nests reported during recent OBBA.	No	None. No suitable nesting or feeding areas on subject site.
Wood Thrush (*Hylocichla mustelina*)	**Special Concern**	**Threatened**	Lives in mature deciduous and mixed (conifer-deciduous) forests. They seek moist stands of trees with well-developed undergrowth and tall trees for singing and perches. Usually build nests in sugar maple or American beech.	5 possible, 15 probable and 16 confirmed nests in recent OBBA. (*NHIC, OBBA*)	Yes	Low. Presence is possible, but the young forest cover of the subject site provides low habitat suitability. The species was noted off site in more mature forest areas, which provide greater habitat suitability.

Fish						
American Eel (*Anguilla rostrata*)	**Endangered**	**No Status**	Primarily nocturnal, hiding in soft substrate or submerged vegetation during the day.	Ottawa, Mississippi, Carp (including Poole Creek), South Nation and Rideau Rivers (including Rideau Canal)	No	None. No suitable habitat.
Bridle Shiner (*Notropis bifrenatus*)	**Special Concern**	**Special Concern**	Prefers clear water with abundant vegetation over silty or sandy substrate.	Rideau River	No	None. No suitable habitat.
Channel Darter (*Percina copelandi*)	**Special Concern**	**Threatened**	Prefers clean streams and lakes with moderate current over sandy or rocky substrate.	Ottawa River	No	None. No suitable habitat.
Lake Sturgeon (*Acipenser fulvescens*)	**Endangered**	**No Status**	Only found in large lakes and rivers. Forages in cool water, 4-9 m deep over soft substrate; spawns in shallower, fast-flowing areas over rocks or gravel.	Ottawa River	No	None. No suitable habitat.
Northern Brook Lamprey (*Ichthyomyzon fossor*)	**Special Concern**	**Special Concern**	Non-parasitic species; prefers shallow areas with warm water. Larvae live in burrows in soft substrate for up to 7 years.	Ottawa River	No	None. No suitable habitat.
Northern Sunfish (*Lepomis peltastes*)	**Special Concern**	**No Status**	Lives in shallow vegetated areas of quiet, slow flowing rivers and streams, as well as warm lakes and ponds, with sandy banks or rocky bottoms.	Ottawa River	No	None. No suitable habitat.
River Redhorse (*Moxostoma carinatum*)	**Special Concern**	**Special Concern**	Prefers fast-flowing, clear rivers over rocky substrate.	Ottawa and Mississippi Rivers; unconfirmed reports from Rideau River	No	None. No suitable habitat.
Silver Lamprey (*Ichthyomyzon unicuspis*)	**Special Concern**	**Special Concern**	Require clear water for they can find fish hosts, relatively clean stream beds of sand and organic debris for larvae to live in, and unrestricted migration routes for spawning. Larvae live 4-7 years in burrows (prefer soft substrates); filter-feed on plankton.	Ottawa River and mouths of tributaries from Rideau Canal east (downstream)	No	None. No suitable habitat.
Molluscs						
Hickorynut (*Obovaria olivaria*)	**Endangered**	**Endangered**	Live on sandy beds in large, wide, deep rivers. Usually more than two or three metres deep. Larval host believed to be Lake Sturgeon.	Ottawa River	No	None. No suitable habitat.
Mammals						
Algonquin Wolf (*Canis sp.*)	**Threatened**	**Special Concern**	Not restricted to any specific habitat type but typically occurs in deciduous and mixed forest landscapes.	Occasional reports	No	None. Presence is unlikely.
Eastern Cougar (*Puma concolor*)	**Endangered**	**No Status**	Live in large, undisturbed forests or other natural areas where there is little human activity	Occasional reports	No	None. No suitable habitat.

Eastern Small-footed Myotis (*Myotis leibii*)	**Endangered**	**No Status**	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. Overwinters in caves and abandoned mines.	Historical record in downtown Ottawa	No	None. No suitable habitat and the species is not known to occur in the vicinity.
Gray Fox (*Urocyon cinereoargenteus*)	**Threatened**	**Threatened**	Live in deciduous forests and marshes. Their dens are usually found in dense shrubs close to a water source but they will also use rocky areas, hollow trees, and underground burrows dug by other animals.	Recent reports to south and west of Ottawa (2016 COSEWIC status report).	No	None. Habitat is suitable but the species is not known to occur in the vicinity.
Little Brown Myotis (*Myotis lucifugus*)	**Endangered**	**Endangered**	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. They can squeeze through very tiny spaces (as small as six millimetres across) allowing them access to many different roosting areas.	Various sites in central and western parts of City; no critical habitat (hibernacula) identified in Ottawa to date.	Yes	Low. Young forest areas provide only marginal habitat suitability and the species is not generally known to occur in the east end of Ottawa. Site is very unlikely to provide important habitat
Northern Myotis / Northern Long-eared Bat (*Myotis septentrionalis*)	**Endangered**	**Endangered**	Associated with boreal forests, choosing to roost under loose bark and in the cavities of trees.	Historical record in downtown Ottawa, more recent sites to east (Orleans, Clarence- Rockland); no critical habitat (hibernacula) identified in Ottawa to date.	Yes	Low. Limited suitable habitat. Coniferous trees within the plantation areas are too small and healthy to replicate boreal forest conditions or provide suitable nesting snags. Site is very unlikely to provide important habitat.
Tri-coloured Bat / Eastern Pipistrelle (*Perimyotis subflavus*)	**Endangered**	**Endangered**	Roosts mainly in trees during summer; overwinters in caves and mines along with other species, but often uses deeper parts of the hibernaculum.	Unknown; historical records from sites in urban Ottawa, Lanark County. No critical habitat (hibernacula) identified in Ottawa to date.	Yes	Low. Young forest areas with few large snags provide limited habitat suitability. Transient presence on the Site is possible if roosting in mature forest to the west, but the Site is very unlikely to provide important habitat.
Amphbians						
Western Chorus Frog (*Pseudacris triseriata*)	**No Status**	**Threatened**	Inhabits forest openings around woodland ponds but can also be found in or near damp meadows, marshes, bottomland swamps and temporary ponds in open country, or even urban areas.	Scattered throughout, with numerous sites in western half of City. Critical habitat identified in several atlas squares in western Ottawa. (*Ontario Nature*)	No	None. No individuals observed during frog surveys.
Reptiles						
Blanding's Turtle (*Emydoidea blandingii*)	**Threatened**	**Threatened**	Quiet lakes, streams and wetlands with abundant emergent vegetation; also frequently occurs in adjacent upland forests.	Scattered throughout, with numerous sites in western half of City.	No	None. Limited suitable aquatic channels (most are too small and dry (R7 lacks an organic substrate) and no observations of the species on or near

				Critical habitat present in Ottawa. (*Ontario Nature*)		subject site. Ontario Nature observations are within 10 km.
Eastern Musk Turtle / Stinkpot (*Sternotherus odoratus*)	**Special Concern**	**Special Concern**	Found in ponds, lakes, marshes, and rivers that are generally slow-moving have abundant emergent vegetation and muddy bottoms that they burrow into for winter hibernation.	Scattered	No	None. No suitable habitat.
Eastern Ribbonsnake (*Thamnophis sauritus*)	**Special Concern**	**Special Concern**	Found in marshy edges of wetlands and watercourses. Livebearer (does not lay eggs).	Few reported; mostly from northwestern Ottawa	No	None. No suitable habitat.
Milksnake (*Lampropeltis triangulum*)	**No Status**	**Special Concern**	Found in variety of open, scrubby or edge habitats, including pastures.	Scattered throughout the northern half of the City	No	Not applicable as this species is not protected on private lands.
Northern Map Turtle (*Graptemys geographica*)	**Special Concern**	**Special Concern**	Lives in rivers and lakeshores where it basks on emergent rocks and fallen trees throughout the spring and summer. In winter, they hibernate on the bottom of deep, slow-moving sections of river.	Ottawa River, Rideau River (Burritt's Rapids area), South Nation River (LIO, NHIC, Ontario Nature)	No	None. No suitable habitat.
Snapping Turtle (*Chelydra serpentina*)	**Special Concern**	**Special Concern**	Spend most of their lives in the water. Prefer shallow waters so they can hide under the soft mud and leaf litter with only their noses exposed to the surface to breathe.	Widespread and abundant *(LIO, NHIC, Ontario Nature)*	No	None. No suitable habitat.
Spiny Softshell (*Apalone spinifera*)	**Endangered**	**Threatened**	Found primarily in rivers and lakes but also in creeks, ditches and ponds near rivers. Habitat requirements are open sand or gravel nesting areas, shallow muddy or sandy areas to bury in, deep pools for hibernation, areas for basking, and suitable habitat for crayfish and other food species.	Few historical records along Ottawa River, outside of Ottawa. No critical habitat identified in Ottawa.	No	None. No suitable habitat.
Spotted Turtle (*Clemmys guttata*)	**Endangered**	**Endangered**	Semi-aquatic and prefers ponds, marshes, bogs, and even ditches with slow-moving, unpolluted water and an abundant supply of aquatic vegetation.	Few reported (locations confidential). Critical habitat present in Ottawa	No	None. No suitable habitat.
Wood Turtle (Glyptemys insculpta)	**Endangered**	**Threatened**	The wood turtle prefers clear rivers, streams, or creeks with a slight current and sandy or gravelly bottom. Wooded areas are essential habitat for the Wood Turtle, but they are found in other habitats, such as wet meadows, swamps, and fields.	Few historical records in NHIC, NESS7 (may have been extirpated locally). No regulated habitat identified in Ottawa. Critical habitat may be present to northwest.	No	None. No suitable habitat.
Plants						
American Chestnut (*Castanea dentata*)	**Endangered**	**Endangered**	Typical habitat is upland deciduous forests on sandy acidic soils, occuring	One population reported along Dolman	No	None. Does not occur in the vicinity.

			with red oak, black cherry, sugar maple and beech.	Ridge Road (federal property); may have been extirpated.		
American Ginseng (*Panax quinquefolius*)	**Endangered**	**Endangered**	Grows in rich, moist, but well-drained, and relatively mature, deciduous woods dominated by Sugar Maple, White Ash, and American Basswood.	Various (locations confidential) Critical habitat broadly identified in Ottawa area.	No	None. No suitable habitat.
Butternut (*Juglans cinerea*)	**Endangered**	**Endangered**	Commonly found in riparian habitats, but is also found on rich, moist, well-drained loams, and well-drained gravels, especially those of limestone origin.	Widespread	No	None. While the area may generally be suitable, no individuals were observed on or adjacent to the site.
Eastern Prairie Fringed-orchid (Platanthera leucophaea)	**Endangered**	**Endangered**	Populations are found in three main habitat types: fens (peat-forming wetlands fed by groundwater), tallgrass prairie, and moist old fields	Richmond Fen (2 locations)	No	None. No suitable habitat.
Lichens						
Flooded Jellyskin (*Leptogium rivulare*)	**No Status**	**Threatened**	It grows in seasonally flooded habitats, typically on the bark of deciduous trees and rocks along the margins of seasonal ponds and on rocks along shorelines and stream/riverbeds.	Stony Swamp, Marlborough Forest	No	None. No suitable habitat.
Pale-bellied Frost Lichen (*Physconia subpallida*)	**Endangered**	**Endangered**	Typically grows on the bark of hardwood trees such as White ash, Black walnut, and American elm. Could also be found growing on fence posts and boulders.	Historical records in downtown area (extirpated locally). No critical or regulated habitat identified in Ottawa.	No	None. No longer known to occur in Ottawa.
Insects						
Bogbean Buckmoth (Hemileuca sp. 1)	**Endangered**	**Endangered**	Restricted to open, chalky, low shrub fens containing large amounts of bogbean, an emergent wetland flowering plant.	Richmond Fen (2 locations)	No	None. No suitable habitat.
Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*)	**Endangered**	**Endangered**	Live in diverse habitats including open meadows, mixed farmlands, urban areas, boreal forest and montane meadows. Host nests occur in abandoned underground rodent burrows and rotten logs.	Historic occurrences only; no known recent occurrences.	No	None. No suitable habitat.
Monarch butterfly (*Danaus plexippus*)	**Special Concern**	**Special Concern**	Milkweeds are the sole food plant for Monarch caterpillars. These plants predominantly grow in open and periodically disturbed habitats such as roadsides, fields, wetlands, prairies, and open forests.	Widespread	No	None. No suitable habitat.
Mottled Duskywing (*Erynnis martialis*)	**Endangered**	**No Status**	Requires host plants such as the New Jersey Tea and the Prairie Redroot. These plants grow in dry, well-drained soils or alvar habitat within oak woodland,	Constance Bay area, Burnt Lands Alvar	No	None. No suitable habitat.

			pine woodland, roadsides, riverbanks, shady hillsides and tall grass prairies.			
Nine-spotted Lady Beetle (*Coccinella novemnotata*)	**Endangered**	**No Status**	Occur within agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, riparian areas and isolated natural areas.	Unknown – historically present, but COSSARO reports no Ontario records since mid-1990s	No	Low. Habitat is suitable, presence is possible, but as a habitat generalist, no portion of the Site provides necessary habitat.
Rapids Clubtail (*Gomphus quadricolor*)	**Endangered**	**Endangered**	Inhabit a wide variety of riverine habitats ranging in size from the St. Lawrence River to small creeks Larvae are typically found in microhabitats with slow to moderate flow and fine sand or silt substrates where they burrow into the stream bed. Adults disperse from the river after emerging and feed in the forest canopy and other riparian vegetation.	None known. No regulated habitat identified in Ottawa.	No	None. No suitable habitat.
Rusty-patched Bumble Bee (*Bombus affinis*)	**Endangered**	**Endangered**	Can be found in open habitat such as mixed farmland, urban settings, savannah, open woods, and sand dunes.	Historic records only from scattered sites in Ottawa and Gatineau.	No	None. No suitable habitat.
Transverse Lady Beetle (*Coccinella transversoguttata*)	**Endangered**	**Special Concern**	Able to live in a wide range of habitats, including agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows and riparian areas.	Unknown – historically present, but COSSARO reports no southern Ontario records since 1985.	No	None. Not identified in the vicinity.
West Virginia White butterfly (*Pieris virginiensis*)	**Special Concern**	**No Status**	Lives in moist, deciduous woodlots. Requires a supply of toothwort, a small, spring-blooming plant that is a member of the mustard family, since if it the only food source for larvae.	Unknown; no records in NESS or NHIC	No	None. Not identified in the vicinity.
Yellow-banded Bumble Bee (*Bombus terricola*)	**Special Concern**	**Special Concern**	Forage and habitat generalist, able to use a variety of nectaring plants and environmental conditions.	Sporadic sightings submitted throughout	No	None. No suitable habitat.

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Appendix C Headwater Drainage Features Assessment

Headwater Drainage Feature Assessment
6150 Thunder Road, Ottawa

Updated Report

July 15, 2021

Submitted To:

Michel Pilon
Avenue31 Capital Inc.

222 Somerset St., Ste. 402,
Ottawa, Ontario,
K2P 2G3

KILGOUR & ASSOCIATES LTD.
www.kilgourassociates.com

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1.0 INTRODUCTION

This report is an updated Headwater Drainage Feature Assessment written by Kilgour & Associates Ltd. (KAL) on behalf of Avenue 31 in support of potential future development at 6150 Thunder Road in Ottawa, Ontario (the "Site").

2.0 HEADWATER DRAINAGE FEATURES

2.1 Overview

Seven headwater drainage features (HDFs) on the Site were initially reviewed in 2018 using field methodologies identified with the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (CVC & TCRA, 2013) (the "HDF Guidelines"). Six HDFs (R1 through R6) all drain to a permanent watercourse identified within this report as channel R7. The features were studied during the spring and summer of 2018 as part of a due-diligence review of the site prior to the commencement of planning for the site, though the formal HDFA report was not completed at the time.

Much of the southern half of the Site was cleared of vegetation in 2019. The site was briefly revisited on October 8, 2020, to note where portions of the Site landcover had been cleared. As vegetation clearing was permissible on the site at the time under City bylaws, the descriptions and management recommendations provided in this report reflect current site conditions.

Two additional existing channels have been noted since that time along the western boundary of the Site (R8 and R9), which was not part of the initial review in 2018. Two further temporary drainage channels (R10 and R11) were added to the Site in 2021.

This updated report describes current site conditions.

2.2 Assessment Methodology

2.2.1 Channel Form and Fish

Headwater channels R1 through R7 on the Site were investigated three times in 2018 following *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (Toronto and Region Conservation Authority and Credit Valley Conservation, 2014) to document their hydrological and riparian and terrestrial habitat. On April 12, 2018 (i.e. during the spring freshet), KAL biologists Liza Hamilton and Tyler Peat identified and described seven channelized features on the Site (reaches R1 through R7; Figure 2), noting the channel dimensions, substrate, form, and riparian vegetation.

Channel R1 is the roadside ditch along Thunder Road. This feature is unlikely to be altered (realigned) in any meaningful way under future development plans. All other channels on site had been (i.e. in 2018) located within young, early successional wooded areas and coniferous plantation covering former agricultural fields. A single small wetland pocket was observed at the upstream end of Channel R4. Natural landcover along Channels R6, R5 and most of R2 was completely removed in 2019.

Channel R7, the permanent watercourse crossing the north end of the Site is highly linearized, U-shaped drainage channel, though it does not have status as a municipal or ward drain. All other channels are small, shallow, linear, U-shaped agricultural ditches or swales that ultimately connect to Channel R7.

Channels R3 and R4, and the north half of Channel R2 were all wet until mid-summer in 2017, but only so because of the presence of beaver dams along Channel R7, which prevented the site from draining normally. With the dams having been removed, Channels other than R7, can be expected to run dry shortly after the spring freshet. Channels R5, R6 and the upper half of Channel R2 are ephemeral and ran dry very quickly after the freshet, even when beaver dams were present. Small numbers of fish were observed in all areas below Channel R 7 is considered as a potential fish habitat.

On June 21, 2018, KAL biologists Rob Hallett and Tyler Peat conducted an electrofishing survey of R1, R3, R4, and a portion of R2 north of R4. These channels were deemed at the time to be sufficiently wet to potentially support fish, whereas R2, R5, and R6 were dry at the time of electrofishing surveys and therefore not able to support fish. R7, a permanent stream, was not fished as the project does not propose to alter or build within 30 m of that feature. As a permanently flowing channel connected to larger creeks downstream, R7 is considered to directly support fish regardless.

Several beaver dams were removed from R7 just west of the Site in late June 2018. The effect on Site water levels was observed on July 5, 2018, by KAL biologist Terry Hams while completing bird surveys, with flows R7 noted as being greatly reduced and all other channels having dried. On June 8, 2021, KAL biologist Anthony Francis noted channel R7 was hydrated but had no perceptible flow. Channels R1 through R6 were fully dry, except for the bottom ~25 m of R2, which held shallow (<10 cm) of backwater from R7.

Channel R8 was initially noted during the field visit of October 8, 2020, by KAL biologist Ed Malindzak. The channel was observed to wet at the time. Given its direct connection to R7, it is presumed to provide fish habitat. Given its location at the rear of the Site, however, the feature will not be subject to alteration and no development is proposed within 30 m of its top-of-bank. No further study is deemed to be required at this time.

Channel R9 was first noted on June 8, 2021, as a dry shallow ditch along the western property line leading northward to R7. KAL biologist Nick Moore returned the feature on June 22, 2021, to take measurements and photos. The feature is a shallow, linear, dirt swale, 1 - 1.5 m in width, with no obvious bank substructure. It was fully dry along its entire length. It likely conveys some runoff during the spring freshet but is unlikely to provide aquatic habitat beyond that.

Channel R10 was dug as an eastward-running, linear drainage channel sometime in either late fall 2020 or spring 2020. The 2 m wide swale was excavated in the bare sandy soil of the cleared portion at the south end of the site. City of Ottawa air photos from 2019 (Ottawa, 2021) suggest some natural surface drainage may have previously occurred along that route, though no headwater features were evident there during site surveys through the 2018 field season. Channel R11 is a similarly sized and formed feature at the north end of the cleared area, dug within the same time frame. City of Ottawa air photos (Ottawa, 2021) do not suggest any channel had existed there previously. Both R10 and R11 were fully dry on June 8, 2021.

Figure 1 HDF Reaches

Legend

Property Boundary

ELC

- Residential
- FOD7
- FOD8
- TAG
- SWT

Cleared Areas

- Formerly Treed
- Formerly Wetland
- Sand-filled pit

N

0 100 m

Project File: Thunder 5.map
MTM Zone 9
(NAD 83)
Printed on: 2021-07-14

KILGOUR & Associates

2.2.2 Vegetation

KAL Biologist, Terry Hams, completed an initial tree inventory and an ecological land classification (ELC) of the Site on June 20, 2018. Vegetation cover on the Site was described following standard ELC methods, including the collection of soil samples (Lee *et al*., 1998).

As the south half of the Site was cleared and partially regraded in 2019, the ELC for the Site and the tree information for the remaining stands were updated by Ed Malindzak (October 15, 2020) and Anthony Francis (on October 18, 2020). The updated tree survey identified the size and species distributions of trees within forested areas of the Site.

2.2.3 Anurans

Site amphibian (anuran) surveys were conducted and lead by KAL biologists, Rob Hallett and Liza Hamilton, following protocols set forth by the Marsh Monitoring Program (Bird Studies Canada *et al.*, 2008). Three surveys are completed to identify early, mid, and, late-season breeding amphibian species generally in April, May, and June, respectfully, though survey dates are temperature dependent. Surveys are completed on nights of calm weather with temperatures above 5 degrees Celsius (°C), 10°C, and 17°C for each of the three respective survey periods. Surveys begin a half-hour after sunset and are finished by midnight with a five-minute recording period at each survey station. Amphibian species are recorded at each point along with the estimated distance from observers, calling code, an estimate of the number of individuals, and estimated directions of calling anurans.

Amphibian surveys were performed on April 23, May 30, and June 21, 2018 (Table 2). Three stations were surveyed in wetland and aquatic habitats (F1 through F3; Figure 2). Station F3 was located at the north end of the Site with the observers facing south. Stations F1 and F2 were the same point located near the southwestern corner of the Site, but with one observer facing south (F1) and one facing north (F2).

Table 1 Summary of frog survey times and weather conditions

Survey Date	Temperature (°C)	Weather conditions	Wind speed (km/hour)
23-Apr-18	10*	Clear	4
30-May-18	21*	Mostly Cloudy	11-14
21-Jun-18	17**	Clear	7 - 10

* Temperatures on these nights were warmer than the preceding nights, with evening temperatures just above 5°C and 10°C, respectively, within a few days of the surveys. Frogs for the period would still be expected to be calling regardless.
** Temperatures on this night just reached the minimum required temperature but had been were warmer the preceding nights, with evening temperatures above 17°C. Frogs for the period would still be expected to be calling regardless.

2.3 Component Classifications

The following tables summarize the functions provided by the Site channels.

Table 2. Hydrology Classification

Drainage Feature	Hydrology Classification					
	Assessment Period	Flow Conditions		Flow Classification	Modifiers	Hydrological Function
		Description	(OSAP Code)			
R1	April 12, 2018 June 21, 2018 July 5, 2018	Standing water Standing water Dry	4	Ephemeral	Road sided ditch. Water remained in this reach for a longer period of time than usual due to beaver dams in R7.	**Contributing**
R2	April 12, 2018 June 21, 2018 July 5, 2018	Standing water Upper channel: Dry Lower channel: standing water Dry	3	Intermittent (lower half) Ephemeral (upper half)	Water remained in lower portion of this reach for a longer period of time than usual due to beaver dams in R7.	**Valued (lower half)** **Contributing (upper half)**
R3	April 12, 2018 June 21, 2018 July 5, 2018	Standing water Standing water Dry	4	Intermittent	Water remained in this reach for a longer period of time than usual due to beaver dams in R7.	**Valued**
R4	April 12, 2018 June 21, 2018 July 5, 2018	Standing water Standing water Dry	4	Intermittent	Water remained in this reach for a longer period of time than usual due to beaver dams in R7.	**Valued**
R5	April 12, 2018 June 21, 2018 July 5, 2018	Standing water Dry Dry	1	Ephemeral		**Contributing**
R6	April 12, 2018 June 21, 2018 July 5, 2018	Standing water Dry Dry	3	Ephemeral		**Contributing**
R7	April 12, 2018 June 21, 2018 July 5, 2018	Surface flow Surface flow Surface flow	1	Perennial	Conducts flows from the east across the Site and on to neighbouring properties to the west. As a permanent perennial feature, this channel is not considered an HDF.	**Important**
R8	October 8, 2020 June 22, 2021	Standing Water Standing Water, bottom end, otherwise dry	1	Potentailly perennial	May contain water late into the season.	**Important**
R9	June 22, 2021	Dry	3	Ephemeral		**Contributing**
R10	June 8, 2021	Dry	3	Ephemeral		**Contributing**
R11	June 8, 2021	Dry	3	Ephemeral		**Contributing**

Table 3. Riparian Classification (Updated 2020)

Drainage Feature	Riparian Classification			
	OSAP Descriptions	**OSAP Riparian Codes**	**ELC Codes**	**Riparian Conditions**
R1	RUB – Cleared LUB – Road shoulder	RUB – 1 LUB – 1	- -	**Limited Functions**
R2	RUB – Cleared/Forest LUB – Cleared	RUB – 2 LUB – 4	- -	**Limited Functions (Upper half)** **Important Functions (Lower half)**
R3	RUB – Forest LUB – Forest	RUB – 6/2 LUB – 6/2	CUF CUF	**Important Functions**
R4	RUB – Forest LUB – Forest	RUB – 6/2 LUB – 6/2	CUW CUW	**Important Functions**
R5	RUB – Cleared LUB – Cleared	RUB – 6 LUB – 6	- -	**Limited Functions**
R6	RUB - Cleared LUB - Cleared	RUB – 2 LUB – 6	- -	**Limited Functions**
R7	RUB - Forest LUB – Meadow	RUB – 6 LUB – 4/6	CUW FOD	**Important Functions***
R8	RUB – Forest LUB – Forest	RUB – 6/2 LUB – 6/2	CUF CUF	**Important Functions**
R9	RUB – Forest LUB – Forest	RUB – 6/2 LUB – 6/2	CUF CUF	**Important Functions**
R10	RUB – Cleared LUB – Cleared	RUB – 6 LUB – 6	- -	**Limited Functions**
R11	RUB – Cleared LUB – Cleared	RUB – 6 LUB – 6	- -	**Limited Functions**

RUB – right upstream bank
LUB – left upstream bank
* "Important Function" level is discussed further in Section 3.1

Table 4. Fish and Fish Habitat Classification, June 21, 2018

Drainage Feature	Riparian Classification		
	Fish Observation • **Fishing effort**	**Fish & Fish Habitat Designation***	**Modifiers/Notes**
R1	Incidental fish present, no SAR present. • 630 SS = ~5.3s/m^2	Contributing Functions	20 fish (13 Central Mudminnows, 3 Brassy Minnows, 1 Brook Stickleback, and 3 Northern Redbelly Dace. These species are very common and highly tolerant. Only present as beaver dam backed up water into to this feature. Feature dried as soon as the dam was removed. Shallow feature is considered unlikely to support fish without the dams being present.
R2	Fish present lower half only, no SAR present. • 721 SS = 2.7 s/m2	Valued Functions (lower half) Contributing Functions (upper half)	155 fish (60 Central Mudminnows, 52 Brook Stickleback, 15 Northern Redbelly Dace, 8 Pumpkinseeds, 1 Fathead Minnow, and 1 Creek Chub). These species are very common and highly tolerant. Only present as beaver dam backed up water into to this feature. Feature dried as soon as the dam was removed. Bottom most end may provide some habitat in wet years regardless.
R3	Incidental fish, no SAR present. • 339 SS = 4.8 s/m2	Contributing Functions	130 fish (73 Central Mudminnows, 52 Brook Stickleback, and 3 Fathead Minnows, and 2 Pumpkinseeds). These species are very common and highly tolerant. Only present as beaver dam backed up water into to this feature. Feature dried as soon as the dam was removed. Shallow feature is considered unlikely to support fish without the dams being present.
R4	Incidental fish, no SAR present. • 327 SS = 2.7 s/m^2	Contributing Functions	32 Brook Stickleback were observed. This species is very common and highly tolerant. Only present as beaver dam backed up water into to this feature. Feature dried as soon as the dam was removed. Shallow feature is considered unlikely to support fish without the dams being present.
R5	No fish present, no SAR present. • Dry	Contributing Functions	
R6	No fish present, no SAR present. • Dry	Contributing Functions	
R7	Fish assumed present.	Valued Functions	Permanent channel assumed to have fish at all times of the year.
R8	Fish assumed present.	Valued Functions	Permanent channel assumed to have fish at all times of the year.
R9	No fish present, no SAR present. • Dry	Contributing Functions	
R10	No fish present, no SAR present. • Dry	Contributing Functions	
R11	No fish present, no SAR present. • Dry	Contributing Functions	

*Fish and Fish Habitat Designation is constrained by the HDF Guidelines definitions. “Modifiers” provides significant caveats to those designations.
SS = shocking seconds

Table 5. Terrestrial Habitat Classification (Updated 2020)

Drainage Feature	Description	Amphibians	Terrestrial Classification
R1	Roadside ditch.	No frogs were observed in the feature.	**Limited Functions**
R2	Lower half includes some portions within plantation forest. Upper half was located within moist forest/plantation (no adjacent wetland evident during surveys), but surrounding area has now been fully cleared.	No frogs were observed in the feature.	**Contributing Functions (lower half)** **Limited Functions (upper half)**
R3	Flows through plantation forest.	No frogs were observed in the feature.	**Contributing Functions**
R4	Upstream end is a small wetland pocket. Flows through plantation forest very near the clearing edge.	No frogs were observed in the feature.	**Valued Functions**
R5	All surrounding vegetation has been cleared.	No frogs were observed in the feature.	**Limited Functions**
R6	All surrounding vegetation has been cleared.	No frogs were observed in the feature.	**Limited Functions**
R7	Permanent stream within a forested area.	No frogs were observed in the feature.	**Valued Functions**
R8	Permanent stream within a forested area.	As no frogs were observed in R7, frog presence here is considered unlikely.	**Valued Functions**
R9	Ephemeral channel within a forested area with no adjacent wetlands features.	Frog presence here is considered unlikely.	**Contributing Functions**
R10	Newly dug ephemeral channel within a cleared area.	Frog presence here is considered unlikely.	**Limited Functions**
R11	Newly dug ephemeral channel within a cleared area.	Frog presence here is considered unlikely.	**Limited Functions**

2.4 Reach Summary

Dimensions of the HDF reaches are summarized in Table 5.

Table 6. Reach Dimensions During Spring Freshet (April 12, 2018)

Drainage Feature	Length (m)	Mean Bankfull Width (m)	Mean Wetted Width (m)	Mean Depth (m)
R1	401 (along the Site edge)	4.0	1.6	0.19
R2	485	3.0	90	0.90
R3	144	2.0	2.0	0.18
R4	145	3.0	3.0	-
R5	54	2.0	1.4	0.26
R6	55	2.5	1.2	0.32
R7	218 (on the Site)	5.1	3.2	-
R8	175	2		
R9	265	1.5		
R10	242	2.5		
R11	95	2.5		

3.0 MANAGEMENT RECOMMENDATIONS

The classification categories identified in Section 2 provide the basis of the management recommendations provided here. The following flow chart (Figure 2) combines and translates the classification results to management recommendations.

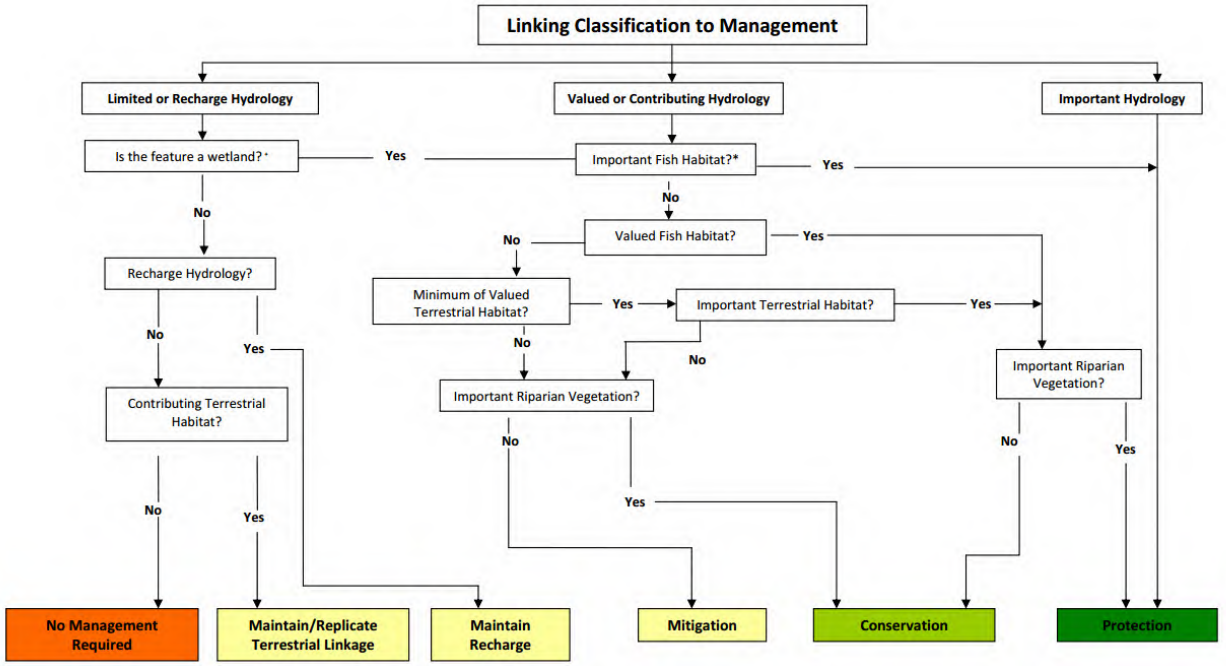


Figure 2. Headwater Drainage Feature Assessment (HDFA) flow chart providing direction on management options

3.1 Management Recommendations for Reaches

Channels R1, R5, R6, R10, R11 and the upper half of R2

These features are fully within the cleared area. They are ephemeral channels that do not provide fish habitat. Following the HDFA Guide flow chart linking component classification to management directives (Figure 2), these reaches:

1. Provide Contributing Hydrology.
2. Do not provide Important Fish Habitat;
3. Do not provide Valued Fish Habitat;
4. Do not provide Valued Terrestrial Habitat;
5. Do not provide Important Riparian Vegetation.

This chain of classification descriptors leads to a management directive of **Mitigation**. These features are not required to be maintained per se, but their functionality must be replicated or enhanced through lot level conveyance measures as part of the site stormwater management system. As the features convey runoff to more ecologically important reaches, replacement features/systems, should be vegetated to mimic online wet vegetation pockets to the extent possible, and should convey water to the same final receiver (i.e. R7). Lot level conveyance features would form part of the Site's future stormwater management system. As such, the replacement features would not require either setbacks or a natural channel design, nor would they need to be comparable dimensions so long as they function to provide the required conveyance and opportunity for allochthonous input.

Channels R3, R4 and R9

These reaches are small, ephemeral to intermittent drainage features located entirely within a treed area. While some fish were observed when beaver dams backed up water into them (R2 and R4), they are not considered valued fish habitat as the features now dry too quickly in the spring to support fish. The HDFA Guide flow chart linking component classification to management directives (Figure 2) progresses as follows:

1. Provides Contributing/Valued Hydrology;
2. Does not provide Important Fish Habitat;
3. Does provide Valued Fish Habitat;
4. Does not provide Valued Terrestrial Habitat; and
4. Provides Important Riparian Vegetation.

This chain of classification descriptors leads to a management directive of **Conservation** for this reach. The feature may be maintained or be realigned using natural channel design techniques to enhance their overall productivity. If realigned, the features may be relocated on or off the Site. In either case, the riparian corridors must be maintained or enhanced. If catchment drainage will be removed due to diversion of stormwater flows, lost functions should be restored through enhanced lot level controls (e.g. restore original catchment using clean roof drainage).

Channels R2 (lower half)

This reach, with its direct connection to R7 likely retains some water well into summer providing some potential fish habitat for tolerant forage fish. The HDFA Guide flow chart linking component classification to management directives (Figure 2) progresses as follows:

1. Provides Contributing/Valued Hydrology;
2. Does not provide Important Fish Habitat;
3. Provides Valued Fish Habitat;
4. Provides Important Riparian Vegetation.

This chain of classification descriptors would typically lead to a management directive of **Protection** for this reach, based in part on the assessment of "Important Riparian Vegetation". Under a management directive of **Protection,** the feature should not generally be relocated. For this feature, however, the

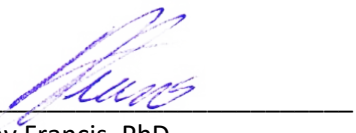
assessment of “Important Riparian Vegetation” comes from only the west side. The east side of the channel has limited vegetation and is generally located within <30 m of the Thunder Road (it connects with R7 within 3 m of the roadway), thus preventing options for an undisturbed, naturalized buffer on that side. The management recommendation for this feature is thus **Conservation** to allow its relocation. The feature should be realigned westward to allow for an improved, naturalized setback with an enhancement of the riparian corridors. Drainage must still be conveyed to R7 and stormwater management systems on the site must be designed to avoid impacts (i.e. sediment, temperature) to this headwater channel.

Channel R7 and R8

This perennial channel conveys off-site flows across the property. As a permanent stream, it does not qualify as headwater feature. As feature with important hydrology, it automatically receives a management directive of **Protection**. As such, this reach may be maintained and/or enhanced, but should not generally be relocated. Improvements, however, could be possible to its overall channel form and thus some minor realignment may be considered within that context. The riparian zone should be protected and enhanced where feasible. The hydro-period must be maintained. Use natural channel design techniques or wetland design to restore and enhance existing habitat features if and where needed. Stormwater management systems must be designed to avoid impacts (i.e. sediment, temperature) to this headwater channel.

4.0 CLOSURE

This report provides detailed descriptions of the HDFs on the Thunder Road site, as well as management recommendations to direct future development near those features. Points of clarification can be addressed to the undersigned.



Anthony Francis, PhD
KILGOUR & ASSOCIATES LTD.

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Appendix A: Site Photos

Note: Reach numbers located within the comment lines directly on photos indicate the order in which they were originally photographed and do not necessarily reflect the final assigned reach numbers used throughout this report.

Reach 1

Upstream view

Downstream view

Reach 2

Upstream view

Downstream view

Reach 3

Upstream view

Downstream view

Reach 4

Upstream view

Downstream view

Reach 5

Upstream view

Downstream view

Reach 6

Upstream view

Downstream view

Reach 7

Upstream view

Downstream view

Appendix B: Field Notes

KILGOUR & Associates

Daily Work Plan for Field Work

Client/Project #: SIMP 773

Date: 2018/04/12

Personnel Data: LH, TP

Staff Name	Date of Birth YYYY/MM/DD	Emergency contact and number	Staff hazard review initials@
L. Hamilton	1983/05/02	M. Vegiard 613-993-5683	LH.
T. Peat.	1988/07/19	Miranda Miller 613-985-6611	TP

If there are more than four crew, use a second sheet; *indicates person responsible for check in / check out; @ initial if staff has had the opportunity to review the hazard assessment and mitigations for this project, is aware of risks, and agrees the work can be done safely.

Vehicle (circle those that apply)	Owner	Licence
KAL Truck (Chev Silverado), Grey	Bruce Kilgour	685 7JZ (Ontario)
QUAD	Bruce Kilgour	2CK47 (Ontario)
QUAD Trailer	2317833 Ontario	M7807M (Ontario)
Tracker	2317833 Ontario	C23182ON (Transport Canada)
Tracker Trailer	2317833 Ontario	J3161S (Ontario)
Red Inflatable	2317833 Ontario	C23183ON (Transport Canada)
Inflatable Trailer	Bruce Kilgour	J7553K (Ontario)
White inflatable	Kilgour & Associates Ltd.	unmarked
LIZA'S HONDA FIT	L. HAMILTON.	NE9 H2W

Describe Anticipated Daily Activities Including Location(s), Route(s) and Access Points and approx. schedule

HJFA visit #1 @ 9150 Thunder Rd., Chelsea, QC.

Map is attached? Y☒ N☐

Check in / Check out Procedure

KAL Contact Person and cell number:	Charles Hatsy
Hotel Details	N/A
Client Contact Person and cell number:	N/A.
Check in method and frequency:	upon arrival / departure.

Both injured, out of reach of cell phones.

Anticipated Worst Outcome/ Catastrophic Failure (describe):

If CH hasn't heard from us in over 4 hrs, he calls both. If no one answers, he calls 911

Emergency Response Procedure (describe):

FINAL FIELD PACKAGE: P ____ OF ____

Home Base:	Field Location:
Time leaving 8:30	Time arriving 8:50
Time returning 11:15	Time Leaving 11:00

Person	Pre-Field Condition	Post-Field Condition
LIZA	GOOD	GOOD
TYLER	Good.	GOOD
Vehicle	**Pre-Field Condition**	**Post-Field Condition**
LIZA'S HONDA FIT	GOOD. Start km: 82125	Good. End km: 82155

Calibration										
Unit	Serial No.	Pre / Post	pH			Cond.	Turbidity			DO
			4	7	10	1413	0			100% Sat.
pH pen		Pre								
		Post								
YSI Pro Plus		Pre								
		Post								
HI Turb. Meter		Pre								
		Post								
Lamotte Turb. Meter		Pre								
		Post								
		Pre								
		Post								

Rules of thumb (when to flag your result):

- DO (mg/L): < 5 mg/L, check that YSI is calibrated to 100% saturation, if yes, then use HACH kit to confirm low DO
- pH: If < 6.5 or > 9, check pH meter vs buffer solutions
- If unit cannot calibrate, it must be serviced, so notify Bruce Kilgour

Issues with field equipment

Do not forget to mention all equipment issues to Rob Hallett as soon as possible

Datasheet Log

KILGOUR & Associates

Field Map

Client/Project #: SIMP773
Crew: LH, TP

Date: 2018/04/12
Location: 6150 Thunder Rd.

HDFA Visit #1

Notes

CREW INITIALS:

FINAL FIELD PACKAGE: P___ OF ___

KILGOUR & Associates

General Notes Sheet

Client/Project #: SIMPTT3

Crew: CH, TP

Date: 2018/04/12

Location: 1650 Thunder Rd.

Time (hh:mm)	Map Pin	Easting	Northing	Description/Note
9:30	3			- defined channel
	start	465083	5021498	- freeze over
	end	464905	5021419	- depth 18cm
				- substrate frozen.
				~ 9.0 m approx. wetted & estimated since cent measure.
				- forest on either side of channel
				- Moderate birch forest on (B), moderate to dense mixed birch and coniferous on (U)
				- 2°C water temp.
				- 2°C air temp.
9:50	4			
	start	465056	5021398	- defined channel
	end	464980	5021348	- freeze over
				- wetted ~ 3m (best guess)
				- coniferous forest on either side (dense)
				- air temp 2°C
				- beaver dam on channel 2 (D) Confluence w channel 4.
				- deep
				- very dense forest on either side of length of channel
				- scrubby brush then planted coniferous forest
				- ends in wetland area w/ lots of trees and scrubby brush
				- difficult to see perimeter.

CREW INITIALS:

FINAL FIELD PACKAGE: P ____ OF ____

Headwater Drainage Features - Up- and Down- Stream

Stream Code	Site Code	Zone	Easting	Northing	Date (YYYY)	(MM)	(DD)	Time (24hr)
	1	18N	465007	5621564	2018	04	12	0900

Stream Name: Roadside Ditch

Discharge Approximates Baseflow? ○ Baseflow ⊗ Freshet ○ Spate

Upstream Site Length (m):

Access Route: Thunder Rd.

Site Description: Roadside Ditch along Thunder Rd.

Optional Features

Water Temp (C)	Air Temp (C)	pH	Conductivity (Ns)	Turbidity (NTV)	Dissolved O_2 (ppm)
2	2				

Number of upstream features:

Upstream Roughness:

Photo #	Photo Name

Upstream Feature(s)

Feature Number	Distance (m)	Bearing	Type	Flow	Sediment Transport: Adjacent Feature	Sediment Deposition	Width MT	~~Wetted~~ Feature Width (m)	Wetted ~~BF~~ Depth (mm)	Bankfull ~~Entrenchment~~ Width (m)	Feat Veg	Riparian Vegetation 0-1.5 m Left	0-1.5 m Right	1.5-10 m Left	1.5-10 m Right	10-30 m Left	10-30 m Right
1			3	2		2		1.57	190	4.0	6	4	4	5	1	7	4
2																	
3																	
4																	

Upstream Longitudinal Gradient

Method Used	Distance (m)	Elevation Rise (m)

Upstream Flow Measure(s) — Record EITHER Hydraulic Head OR Volume OR Distance

Feature Number	Wetted Width (m)	Depth (mm) 1	2	3	Hydraulic Head (mm) 1	2	3	Volume (lt) 1	2	3	Distance (m) 1	2	3	Time (sec) 1	2	3

Comments

- C2 tails in ditch (80% cover)
- Substrate is mud, silt, organic matter.
- SIMP773

Unconstrained Headwater Drainage Feature Assessment

Date: _____ Project #: _____ Recorder/Crew: _____

Stream Name: _____ Stream Code: _____ Site Code: _____

Site Limits: Upstream WP# _____ Field Assessment: ☐ Sample 1 Unconnected HDF:

Downstream WP# _____ ☐ Sample 2 ☐ Not connected

Direction of Assessment: ☐ Upstream ☐ Downstream ☐ Sample 3 to downstream network

Flow Influence ☐ Freshet (1) ☐ Spate (2) ☐ Baseflow (3)

Flow Condition ☐ Dry (1) ☐ Interstitial Flow (3) ☐ Substantial Flow (5)
☐ Standing Water (2) ☐ Minimal Flow (4)

Feature Type ☐ Defined Natural Channel (1) ☐ No Defined Feature (4) ☐ Swale (7)
☐ Channelized or Constrained (2) ☐ Tiled Feature (5) ☐ Roadside Ditch (8)
☐ Multi-thread (3) ☐ Wetland (6) ☐ Pond (9)

Feature Vegetation ☐ None (1) ☐ Lawn (2) ☐ Cropped (3) ☐ Meadow (4) ☐ Scrubland (5) ☐ Wetland(6) ☐ Forest (7)

Riparian Vegetation

0 - 1.5 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
1.5 - 10 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
10 - 30 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)

Channel Gradient (S4.M7) ☐ Visual (1) ☐ Clinometer (2) ☐ Laser Level (3) ☐ Survey Level (4) ☐ Other (5) ☐ LiDAR (6)

Distance (m): _____ _____ _____ Elevation (cm) : _____ _____ _____ Gradient (°): _____

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐
Sub-Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐

Feature Roughness ☐ < 10% Minimal (1) ☐ 10 - 40% Moderate (2) ☐ 40 - 60% High (3) ☐ > 60% Extreme (4)

Width Measurement ☐ Can't Measure (1) ☐ Bankfull (2) ☐ Mean Width (3) ☐ Estimated (4) ☐ GIS (5) ☐ Measure/GIS (6)

Channel Dimensions Feature Width (m): _____ Bankfull Depth (mm) _____

Entrenchment Total: ☐ > 40 m ☐ < 40 m Left Bank _____ m Right Bank _____ m Total width _____ m

Surface Flow Method ☐ Perched Culvert (1) ☐ Hydraulic Head (2) ☐ Distance by Time (3) ☐ Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
_____	_____			_____			_____			_____			_____		

Sediment Transport

Adjacent ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Feature ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Sediment Deposition Measures (mm): _____ _____ _____ _____ _____

☐ None (1) ☐ Minimal: < 5 mm (2) ☐ Moderate: 5-30 mm (3) ☐ Substantial: 31-80 mm (4) ☐ Extensive: > 80 mm (5)

Headwater Drainage Features - Up- and Down- Stream

Stream Code: | Site Code: 2 | Zone: 19V | Easting: 464999 | Northing: 5021573 | Date (YYYY): 2018 - (MM): 04 - (DD): 12 | Time (24hr): 09:15

Stream Name: Ditch #1

Discharge Approximates Baseflow? ○ Baseflow ● Freshet ○ Spate

Upstream Site Length (m):

Access Route: Thurber Rd.

Site Description: Ditch running along length of property parallel to Thurber Rd.

Optional Features: Water Temp (C): 2 | Air Temp (C): 2 | pH: | Conductivity (Ms): | Turbidity (NTV): | Dissolved O_2 (ppm):

Number of upstream features:

Upstream Roughness:

Photo #: | Photo Name:

Upstream Feature(s)

Feature Number	Distance (m)	Bearing	Type	Flow	Sediment Transport: Adjacent	Sediment Transport: Feature	Sediment Deposition	Width MT	~~Feature~~ Wetted Width (m)	~~BF~~ Wetted Depth (mm)	~~Entrenchment~~ Bankfull Width (m)	Feat. Veg	Riparian Vegetation 0-1.5 m Left	0-1.5 m Right	1.5-10 m Left	1.5-10 m Right	10-30 m Left	10-30 m Right
1			1	2			3		0.90	90	3.0	1	4	4	4	4	7	4
2																		
3																		
4																		

Upstream Longitudinal Gradient: Method Used: | Distance (m): | Elevation Rise (cm):

Upstream Flow Measure(s)

Record EITHER Hydraulic Head OR Volume OR Distance

Feature Number	Wetted Width (m)	Depth (mm) 1	Depth (mm) 2	Depth (mm) 3	Hydraulic Head (mm) 1	Hydraulic Head (mm) 2	Hydraulic Head (mm) 3	Volume (lt) 1	Volume (lt) 2	Volume (lt) 3	Distance (m) 1	Distance (m) 2	Distance (m) 3	Time (sec) 1	Time (sec) 2	Time (sec) 3

Comments:

Substrate - muddy, silt

SIMP773

Unconstrained Headwater Drainage Feature Assessment

Date: _____ Project #: _____ Recorder/Crew: _____

Stream Name: _____ Stream Code: _____ Site Code: _____

Site Limits: Upstream WP# _____ Field Assessment: ☐ Sample 1 Unconnected HDF:

Downstream WP# _____ ☐ Sample 2 ☐ Not connected

Direction of Assessment: ☐ Upstream ☐ Downstream ☐ Sample 3 to downstream network

Flow Influence ☐ Freshet (1) ☐ Spate (2) ☐ Baseflow (3)

Flow Condition ☐ Dry (1) ☐ Interstitial Flow (3) ☐ Substantial Flow (5)
☐ Standing Water (2) ☐ Minimal Flow (4)

Feature Type ☐ Defined Natural Channel (1) ☐ No Defined Feature (4) ☐ Swale (7)
☐ Channelized or Constrained (2) ☐ Tiled Feature (5) ☐ Roadside Ditch (8)
☐ Multi-thread (3) ☐ Wetland (6) ☐ Pond (9)

Feature Vegetation ☐ None (1) ☐ Lawn (2) ☐ Cropped (3) ☐ Meadow (4) ☐ Scrubland (5) ☐ Wetland(6) ☐ Forest (7)

Riparian Vegetation

0 - 1.5 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
1.5 - 10 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
10 - 30 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)

Channel Gradient (S4.M7) ☐ Visual (1) ☐ Clinometer (2) ☐ Laser Level (3) ☐ Survey Level (4) ☐ Other (5) ☐ LiDAR (6)

Distance (m): _____ _____ _____ Elevation (cm) : _____ _____ _____ Gradient (°): _____

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐
Sub-Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐

Feature Roughness ☐ < 10% Minimal (1) ☐ 10 - 40% Moderate (2) ☐ 40 - 60% High (3) ☐ > 60% Extreme (4)

Width Measurement ☐ Can't Measure (1) ☐ Bankfull (2) ☐ Mean Width (3) ☐ Estimated (4) ☐ GIS (5) ☐ Measure/GIS (6)

Channel Dimensions Feature Width (m): _____ Bankfull Depth (mm) _____

Entrenchment Total: ☐ > 40 m ☐ < 40 m Left Bank _____ m Right Bank _____ m Total width _____ m

Surface Flow Method ☐ Perched Culvert (1) ☐ Hydraulic Head (2) ☐ Distance by Time (3) ☐ Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Sediment Transport

Adjacent ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Feature ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Sediment Deposition Measures (mm): _____ _____ _____ _____ _____

☐ None (1) ☐ Minimal: < 5 mm (2) ☐ Moderate: 5-30 mm (3) ☐ Substantial: 31-80 mm (4) ☐ Extensive: > 80 mm (5)

Headwater Drainage Features - Up- and Down- Stream

Stream Code	Site Code	Zone	Easting	Northing	Date (YYYY)	(MM)	(DD)	Time (24hr)
	5	16	465102	5021327	2018	06	12	10:15

Stream Name: ditch

Discharge Approximates Baseflow? ○ Baseflow ⊗ Freshet ○ Spate

Upstream Site Length (m):

Access Route:
Start - 465094 5021327.
end - 465102 5021327

Site Description:
- perpendicular to main ditch
- behind petro-Can.

Optional Features

Water Temp (C)	Air Temp (C)	pH	Conductivity (Ns)	Turbidity (NTV)	Dissolved O_2 (ppm)
2	2				

Number of upstream features:

Upstream Roughness:

Photo #	Photo Name

Upstream Feature(s)

Feature Number	Distance (m)	Bearing	Type	Flow	Sediment Transport: Adjacent	Sediment Transport: Feature	Sediment Deposition	Width MT	~~Feature~~ Wetted Width (m)	~~BF~~ Wetted Depth (mm)	~~Entrenchment~~ Bankfull Width (m)	Feat Veg	Riparian Vegetation 0-1.5 m Left	Riparian Vegetation 0-1.5 m Right	Riparian Vegetation 1.5-10 m Left	Riparian Vegetation 1.5-10 m Right	Riparian Vegetation 10-30 m Left	Riparian Vegetation 10-30 m Right
1			1	2			3		1.4	260	2.0M	1	5	5	5	5	5	5
2																		
3																		
4																		

Upstream Longitudinal Gradient

Method Used	Distance (m)	Elevation Rise (cm)

Upstream Flow Measure(s)

Record EITHER Hydraulic Head OR Volume OR Distance

Feature Number	Wetted Width (m)	Depth (mm) 1	Depth (mm) 2	Depth (mm) 3	Hydraulic Head (mm) 1	Hydraulic Head (mm) 2	Hydraulic Head (mm) 3	Volume (lt) 1	Volume (lt) 2	Volume (lt) 3	Distance (m) 1	Distance (m) 2	Distance (m) 3	Time (sec) 1	Time (sec) 2	Time (sec) 3

Comments

- Substrate - mud, sand.
- SIMP773

Unconstrained Headwater Drainage Feature Assessment

Date: _____ Project #: _____ Recorder/Crew: _____

Stream Name: _____ Stream Code: _____ Site Code: _____

Site Limits: Upstream WP# _____ Field Assessment: ☐ Sample 1 Unconnected HDF:

Downstream WP# _____ ☐ Sample 2 ☐ Not connected

Direction of Assessment: ☐ Upstream ☐ Downstream ☐ Sample 3 to downstream network

Flow Influence ☐ Freshet (1) ☐ Spate (2) ☐ Baseflow (3)

Flow Condition ☐ Dry (1) ☐ Interstitial Flow (3) ☐ Substantial Flow (5)
☐ Standing Water (2) ☐ Minimal Flow (4)

Feature Type ☐ Defined Natural Channel (1) ☐ No Defined Feature (4) ☐ Swale (7)
☐ Channelized or Constrained (2) ☐ Tiled Feature (5) ☐ Roadside Ditch (8)
☐ Multi-thread (3) ☐ Wetland (6) ☐ Pond (9)

Feature Vegetation ☐ None (1) ☐ Lawn (2) ☐ Cropped (3) ☐ Meadow (4) ☐ Scrubland (5) ☐ Wetland(6) ☐ Forest (7)

Riparian Vegetation

0 - 1.5 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
1.5 - 10 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
10 - 30 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)

Channel Gradient (S4.M7) ☐ Visual (1) ☐ Clinometer (2) ☐ Laser Level (3) ☐ Survey Level (4) ☐ Other (5) ☐ LiDAR (6)

Distance (m): _____ _____ _____ Elevation (cm) : _____ _____ _____ Gradient (°): _____

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐
Sub-Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐

Feature Roughness ☐ < 10% Minimal (1) ☐ 10 - 40% Moderate (2) ☐ 40 - 60% High (3) ☐ > 60% Extreme (4)

Width Measurement ☐ Can't Measure (1) ☐ Bankfull (2) ☐ Mean Width (3) ☐ Estimated (4) ☐ GIS (5) ☐ Measure/GIS (6)

Channel Dimensions Feature Width (m): _____ Bankfull Depth (mm) _____

Entrenchment Total: ☐ > 40 m ☐ < 40 m Left Bank _____ m Right Bank _____ m Total width _____ m

Surface Flow Method ☐ Perched Culvert (1) ☐ Hydraulic Head (2) ☐ Distance by Time (3) ☐ Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Sediment Transport

Adjacent ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Feature ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Sediment Deposition Measures (mm): _____ _____ _____ _____ _____

☐ None (1) ☐ Minimal: < 5 mm (2) ☐ Moderate: 5-30 mm (3) ☐ Substantial: 31-80 mm (4) ☐ Extensive: > 80 mm (5)

Headwater Drainage Features - Up- and Down- Stream

Stream Code	Site Code	Zone	Easting	Northing	Date (YYYY)	(MM)	(DD)	Time (24hr)
	6	18	465135	5021245	2018	04	12	

Stream Name

Discharge Approximates Baseflow? ○ Baseflow ⊗ Freshet ○ Spate

Upstream Site Length (m)

Access Route

Site Description

ditch runs perpendicular to MDN ditch runs along property.

Optional Features

Water Temp (C)	Air Temp (C)	pH	Conductivity (Ns)	Turbidity (NTV)	Dissolved O_2 (ppm)
1	2°C				

Number of upstream features

Upstream Roughness

Photo #

Photo Name

Upstream Feature(s)

Feature Number	Distance (m)	Bearing	Type	Flow	Sediment Transport Adjacent	Sediment Transport Feature	Sediment Deposition	Width MT	~~Feature~~ Wetted Width (m)	~~BF~~ Wetted Depth (mm)	BFull Entrenchment Width (m)	Feat Veg	Riparian Vegetation 0-1.5 m Left	0-1.5 m Right	1.5-10 m Left	1.5-10 m Right	10-30 m Left	10-30 m Right	Upstream Longitudinal Gradient Method Used	Distance (m)	Elevation Rise (cm)
1			1	2			2		1.15	320	2.50	1	5	5	5	5	5	5			
2																					
3																					
4																					

Upstream Flow Measure(s)

Record EITHER Hydraulic Head OR Volume OR Distance

Feature Number	Wetted Width (m)	Depth (mm) 1	Depth (mm) 2	Depth (mm) 3	Hydraulic Head (mm) 1	Hydraulic Head (mm) 2	Hydraulic Head (mm) 3	Volume (lt) 1	Volume (lt) 2	Volume (lt) 3	Distance (m) 1	Distance (m) 2	Distance (m) 3	Time (sec) 1	Time (sec) 2	Time (sec) 3

Comments

substrate - mud, silt, partially frozen still.
SIMP773

Unconstrained Headwater Drainage Feature Assessment

Date: _____ Project #: _____ Recorder/Crew: _____

Stream Name: _____ Stream Code: _____ Site Code: _____

Site Limits: Upstream WP# _____ Field Assessment: ☐ Sample 1 Unconnected HDF:

Downstream WP# _____ ☐ Sample 2 ☐ Not connected

Direction of Assessment: ☐ Upstream ☐ Downstream ☐ Sample 3 to downstream network

Flow Influence ☐ Freshet (1) ☐ Spate (2) ☐ Baseflow (3)

Flow Condition ☐ Dry (1) ☐ Interstitial Flow (3) ☐ Substantial Flow (5)
☐ Standing Water (2) ☐ Minimal Flow (4)

Feature Type ☐ Defined Natural Channel (1) ☐ No Defined Feature (4) ☐ Swale (7)
☐ Channelized or Constrained (2) ☐ Tiled Feature (5) ☐ Roadside Ditch (8)
☐ Multi-thread (3) ☐ Wetland (6) ☐ Pond (9)

Feature Vegetation ☐ None (1) ☐ Lawn (2) ☐ Cropped (3) ☐ Meadow (4) ☐ Scrubland (5) ☐ Wetland(6) ☐ Forest (7)

Riparian Vegetation

0 - 1.5 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
1.5 - 10 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
10 - 30 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)

Channel Gradient (S4.M7) ☐ Visual (1) ☐ Clinometer (2) ☐ Laser Level (3) ☐ Survey Level (4) ☐ Other (5) ☐ LiDAR (6)

Distance (m): _____ _____ _____ Elevation (cm) : _____ _____ _____ Gradient (°): _____

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐
Sub-Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐

Feature Roughness ☐ < 10% Minimal (1) ☐ 10 - 40% Moderate (2) ☐ 40 - 60% High (3) ☐ > 60% Extreme (4)

Width Measurement ☐ Can't Measure (1) ☐ Bankfull (2) ☐ Mean Width (3) ☐ Estimated (4) ☐ GIS (5) ☐ Measure/GIS (6)

Channel Dimensions Feature Width (m): _____ Bankfull Depth (mm) _____

Entrenchment Total: ☐ > 40 m ☐ < 40 m Left Bank _____ m Right Bank _____ m Total width _____ m

Surface Flow Method ☐ Perched Culvert (1) ☐ Hydraulic Head (2) ☐ Distance by Time (3) ☐ Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
_____	_____			_____			_____			_____			_____		

Sediment Transport

Adjacent ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Feature ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Sediment Deposition Measures (mm): _____ _____ _____ _____ _____

☐ None (1) ☐ Minimal: < 5 mm (2) ☐ Moderate: 5-30 mm (3) ☐ Substantial: 31-80 mm (4) ☐ Extensive: > 80 mm (5)

Headwater Drainage Features - Up- and Down- Stream

Stream Code | Site Code: 7 | Zone: 18 | Easting: 469981 | Northing: 5921600 | Date (YYYY): 2018 - (MM): 04 - (DD): 12 | Time (24hr): 1040

Stream Name

Discharge Approximates Baseflow? ○ Baseflow ⊗ Freshet ○ Spate

Upstream Site Length (m)

Access Route

Site Description: Main channel runs perpendicular to Thunder Rd.

Optional Features: Water Temp (C): 2 | Air Temp (C): 2°C | pH: / | Conductivity (Ns): / | Turbidity (NTV): / | Dissolved O_2 (ppm): /

Number of upstream features

Upstream Roughness | Photo # | Photo Name

Upstream Feature(s)

Feature Number	Distance (m)	Bearing	Type	Flow	Sediment Transport: Adjacent	Feature	Sediment Deposition	Width MT	~~Wetted~~ Feature Width (m)	~~Wetted~~ BF Depth (mm)	~~B-Full~~ Entrenchment Width (m)	Feat. Veg	Riparian Vegetation 0-1.5 m Left	0-1.5 m Right	1.5-10 m Left	1.5-10 m Right	10-30 m Left	10-30 m Right	Upstream Longitudinal Gradient: Method Used	Distance (m)	Elevation Rise (cm)
1			1	4			3		3.20	150	5.1	6	5	2	5	2	7	2			
2																					
3																					
4																					

Upstream Flow Measure(s)

Record EITHER Hydraulic Head OR Volume OR Distance

Feature Number	Wetted Width (m)	Depth (mm) 1	2	3	Hydraulic Head (mm) 1	2	3	Volume (lt) 1	2	3	Distance (m) 1	2	3	Time (sec) 1	2	3

Comments

Flow = 0.13 M/S. pockets of sediment > 40cm.
Substrate - Muck
- channel choked in wetland very close to road, thin patchy as you go downstream.

- SIMP773

Unconstrained Headwater Drainage Feature Assessment

Date: _____ Project #: _____ Recorder/Crew: _____

Stream Name: _____ Stream Code: _____ Site Code: _____

Site Limits: Upstream WP# _____ Field Assessment: ☐ Sample 1 Unconnected HDF:

Downstream WP# _____ ☐ Sample 2 ☐ Not connected

Direction of Assessment: ☐ Upstream ☐ Downstream ☐ Sample 3 to downstream network

Flow Influence ☐ Freshet (1) ☐ Spate (2) ☐ Baseflow (3)

Flow Condition ☐ Dry (1) ☐ Interstitial Flow (3) ☐ Substantial Flow (5)
☐ Standing Water (2) ☐ Minimal Flow (4)

Feature Type ☐ Defined Natural Channel (1) ☐ No Defined Feature (4) ☐ Swale (7)
☐ Channelized or Constrained (2) ☐ Tiled Feature (5) ☐ Roadside Ditch (8)
☐ Multi-thread (3) ☐ Wetland (6) ☐ Pond (9)

Feature Vegetation ☐ None (1) ☐ Lawn (2) ☐ Cropped (3) ☐ Meadow (4) ☐ Scrubland (5) ☐ Wetland(6) ☐ Forest (7)

Riparian Vegetation

0 - 1.5 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
1.5 - 10 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
10 - 30 m	Left Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)
	Right Bank	☐ None (1)	☐ Lawn (2)	☐ Cropped (3)	☐ Meadow (4)	☐ Scrubland (5)	☐ Wetland (6)	☐ Forest (7)

Channel Gradient (S4.M7) ☐ Visual (1) ☐ Clinometer (2) ☐ Laser Level (3) ☐ Survey Level (4) ☐ Other (5) ☐ LiDAR (6)

Distance (m): _____ _____ _____ Elevation (cm) : _____ _____ _____ Gradient (°): _____

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐
Sub-Dominant Substrate (S2.M3)	☐	☐	☐	☐	☐	☐	☐

Feature Roughness ☐ < 10% Minimal (1) ☐ 10 - 40% Moderate (2) ☐ 40 - 60% High (3) ☐ > 60% Extreme (4)

Width Measurement ☐ Can't Measure (1) ☐ Bankfull (2) ☐ Mean Width (3) ☐ Estimated (4) ☐ GIS (5) ☐ Measure/GIS (6)

Channel Dimensions Feature Width (m): _____ Bankfull Depth (mm) _____

Entrenchment Total: ☐ > 40 m ☐ < 40 m Left Bank _____ m Right Bank _____ m Total width _____ m

Surface Flow Method ☐ Perched Culvert (1) ☐ Hydraulic Head (2) ☐ Distance by Time (3) ☐ Estimated (4)

Wetted Width (m)	**Wetted Depth (mm)**			**Hydraulic head (mm)**			**Volume (L)**			**Distance (m)**			**Time (s)**		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3

Sediment Transport

Adjacent ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Feature ☐ None (1) ☐ Rill (2) ☐ Rill and Gully (3) ☐ Gully (4) ☐ Outlet Scour (5)
☐ Sheet Erosion (6) ☐ Instream Bank Erosion (7) ☐ Other (8)

Sediment Deposition Measures (mm): _____ _____ _____ _____ _____

☐ None (1) ☐ Minimal: < 5 mm (2) ☐ Moderate: 5-30 mm (3) ☐ Substantial: 31-80 mm (4) ☐ Extensive: > 80 mm (5)

KILGOUR & Associates

Daily Work Plan for Field Work

Client/Project #: 773

Date: 2018/06/12

Personnel Data:

Staff Name	Date of Birth YYYY/MM/DD	Emergency contact and number	Staff hazard review initials@
R. HACKETT	1990/11/25	KATIE 613 851 5951	RH
T. POAT	1988/07/19	MICHELLE 613 438 6611	TP

If there are more than four crew, use a second sheet; *indicates person responsible for check in / check out; @ initial if staff has had the opportunity to review the hazard assessment and mitigations for this project, is aware of risks, and agrees the work can be done safely.

~~Vehicle (circle those that apply)~~	Owner	Licence
KAL Truck (Chev Silverado), Grey	Bruce Kilgour	685 7JZ (Ontario)
QUAD	Bruce Kilgour	2CK47 (Ontario)
QUAD Trailer	2317833 Ontario	M7807M (Ontario)
Tracker	2317833 Ontario	C23182ON (Transport Canada)
Tracker Trailer	2317833 Ontario	J3161S (Ontario)
Red Inflatable	2317833 Ontario	C23183ON (Transport Canada)
Inflatable Trailer	Bruce Kilgour	J7553K (Ontario)
White inflatable	Kilgour & Associates Ltd.	unmarked

Describe Anticipated Daily Activities Including Location(s), Route(s) and Access Points and approx. schedule

complete HOFA Fishing @ Thrasher Pond

Map is attached? Y☑ N☐

Check in / Check out Procedure

KAL Contact Person and cell number:	A Francis
Hotel Details	
Client Contact Person and cell number:	
Check in method and frequency:	

Traffic encounter

Anticipated Worst Outcome/ Catastrophic Failure (describe):

911

Emergency Response Procedure (describe):

FINAL FIELD PACKAGE: P ____ OF ____

Home Base: KAC Time leaving 1200 Time returning 1730	**Field Location:** Thunder road Time arriving 1245 Time Leaving 1700

Person	Pre-Field Condition	Post-Field Condition
AM TP C	good	good
Vehicle	**Pre-Field Condition**	**Post-Field Condition**
	Start km:	End km:

Calibration									
Unit	Serial No.	Pre / Post	pH			Cond.	Turbidity			DO
			4	7	10	1413	0			100% Sat.
pH pen		Pre								
		Post								
YSI Pro Plus	unit 2	Pre	4.00	7.03	—	1410	—	—	—	—
		Post	4.03	7.00	—	1396	—	—	—	—
HI Turb. Meter		Pre								
		Post								
Lamotte Turb. Meter		Pre								
		Post								
		Pre								
		Post								

Rules of thumb (when to flag your result):

- DO (mg/L): < 5 mg/L, check that YSI is calibrated to 100% saturation, if yes, then use HACH kit to confirm low DO
- pH: If < 6.5 or > 9, check pH meter vs buffer solutions
- If unit cannot calibrate, it must be serviced, so notify Bruce Kilgour

Issues with field equipment

Do not forget to mention all equipment issues to Rob Hallett as soon as possible

none

Datasheet Log

DWP, map, fish x 4, notes

KILGOUR & Associates

Field Map

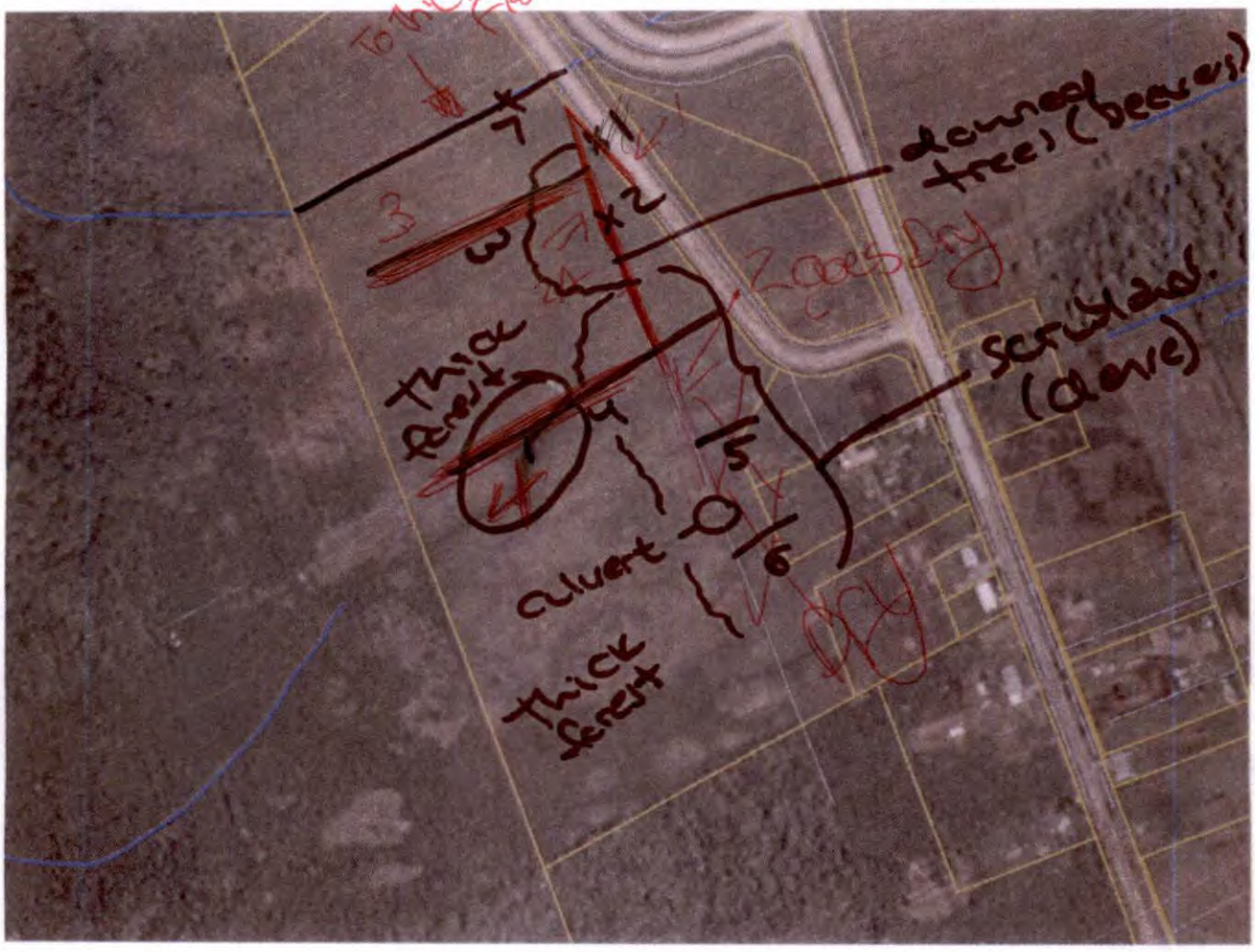
Client/Project #: SIMP773

Crew: ~~[illegible]~~

Date: 2018/06/21

Location: 6150 Thunder Rd.

HDFA Visit #1



Notes

New notes are in red.

CREW INITIALS:

FINAL FIELD PACKAGE: P___ OF ___

KILGOUR & Associates

Fish Collection Record

Client/Project #:

Date: 2018/06/21 Start Time: ~~—~~

Location: Thurcler Road	**Stream type:** Citch	**Crew:** RH TP
(UTM NAD 83): 18	**Reach Classification:** unk	**Task:** I-I DFA
Watercourse: unk	**Temperature:** 26.0°C	**Gear type:** E-
Reach/Station: Reach 1	**Conductivity:** 365 2uS/cm	**Seconds/ Set + Pull Time:** 630
W-Depth: 0.45m	**pH:** 6.49	**Length fished:** 260m
W-Width: 3.0m	**DO:** 1.65mg/L / 20.8%	

Fishing Details/Other Comments:

START : 465078 502 1483

END : 465032 502 1542 Fish were barely being shocked. no major issues

Species	Number	Total	Notes/Stage + Health Observations
CNMD	⊠ ∴	13	
BRMN	∴	3	
BRST	•	1	
NRDC	∴	3	

FINAL FIELD PACKAGE: P ____ OF ____

KILGOUR & Associates

Fish Collection Record

Client/Project #:

Date: 2018/06/21 Start Time:

Location: Thunder Road	**Stream type:** ~~perm~~	**Crew:** RA
(UTM NAD 83): 18	**Reach Classification:** Unk	**Task:** TD
Watercourse: Unk	**Temperature:** 22.5°C	**Gear type:**
Reach/Station: 2A	**Conductivity:** 4836	**Seconds/ Set + Pull Time:** 721
W-Depth: ~~3~~ 0.40m	**pH:** 7.61	**Length fished:**
W-Width: 3.5m	**DO:** 51.9% 4.4 mg/L	

Fishing Details/Other Comments:
Start: 465001 5021575
End: 465028 5011494
very high spCond, not much fish response.
Catch was netted not shocked

Species	Number	Total	Notes/Stage + Health Observations
CLMB	⊠ ⊠ ⊠ ⊠ ⊠ ⊠	60	
BRST	⊠ ⊠ ⊠ ⊠ ⊠ ··	52	
NRDC	⊠ ··	15	
PMSD	⊡	8	
FTMN	·	1.	
CRCH	·	1	

FINAL FIELD PACKAGE: P ____ OF ____

KILGOUR & Associates

Fish Collection Record

Client/Project #:

Date: 2018/06 / Start Time:

Location: Thunder Road	**Stream type:** perm.	**Crew:**
(UTM NAD 83): 18	**Reach Classification:** cnk	**Task:** HOFA
Watercourse: cnk	**Temperature:** 25°C	**Gear type:** /
Reach/Station: Reach 3	**Conductivity:** 3083	**Seconds/ Set + Pull Time:** 338.7
W-Depth: 30cm	**pH:** 7.62	**Length fished:** 70m
W-Width: 1m	**DO:** <8% 4.75mg/L	

Fishing Details/Other Comments:

START 465028 5021496

END 464977 5021475

Species	Number	Total	Notes/Stage + Health Observations
CHMP	⊠⊠⊠⊠⊠⊠⊠ ∴	73	
BRST	⊠⊠⊠⊠ ⊠ ∴	52	
FTHN	∴	3	
PNSD	∴	2	

FINAL FIELD PACKAGE: P ____ OF ____

KILGOUR & Associates

Fish Collection Record

Client/Project #:

Date: 2018/06/21 Start Time:

Location: Thunder Road	**Stream type:** Perm.	**Crew:** RH - TD
(UTM NAD 83): 18	**Reach Classification:** —	**Task:** HDFA
Watercourse: unk	**Temperature:** 17.8	**Gear type:** Back Pack
Reach/Station: Reach 4	**Conductivity:** 123.9	**Seconds/ Set + Pull Time:** 327
W-Depth: 40-45cm	**pH:** 6.98	**Length fished:** 66m
W-Width: 3m	**DO:** 13.6% 1.28mg/L	

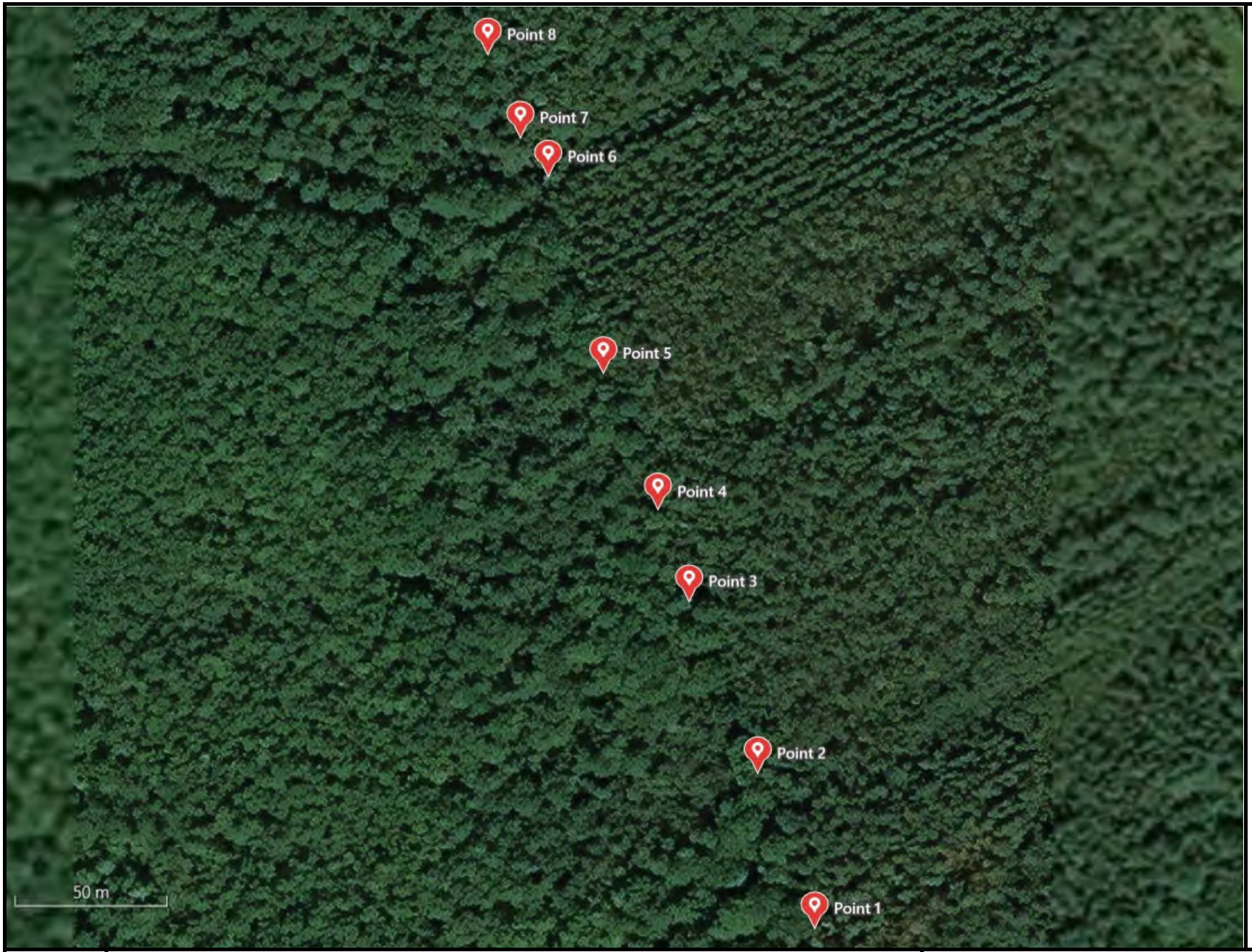
Fishing Details/Other Comments:

START 465065 5021389

END 465039 5021373

Species	Number	Total	Notes/Stage + Health Observations
BRST	⊠ ⊠ ∴	23	

FINAL FIELD PACKAGE: P ____ OF ____



Legend

Point

N

AVE1227 pdf

Date 2021-06-22

Point

Name	Description	Attachment	Latitude	Longitude	Altitude (m)	Date/Time
Point 8	North point	WIN_20210622_12_57_33_Pr WIN_20210622_12_57_39_Pr	45.34647400	-75.44961367	77.40	2021-06-22 12:57
Point 7	norh end	WIN_20210622_12_56_17_Pr WIN_20210622_12_56_22_Pr	45.34622833	-75.44947617	79.90	2021-06-22 12:56
Point 6	water starts at confluence	WIN_20210622_12_51_55_Pr WIN_20210622_12_52_12_Pr	45.34611350	-75.44935950	83.50	2021-06-22 12:51
Point 5	North of confluence		45.34553250	-75.44912767	86.90	2021-06-22 12:48
Point 4	cross of swLE going east	WIN_20210622_12_46_38_Pr WIN_20210622_12_46_45_Pr WIN_20210622_12_46_51_Pr	45.34513000	-75.44889800	84.30	2021-06-22 12:46
Point 3	North mid point	WIN_20210622_12_44_18_Pr WIN_20210622_12_44_24_Pr	45.34485850	-75.44876683	76.90	2021-06-22 12:43
Point 2	South mid swale	WIN_20210622_12_41_50_Pr WIN_20210622_12_41_56_Pr	45.34435100	-75.44847867	78.80	2021-06-22 12:41
Point 1	Start of swale	WIN_20210622_12_39_18_Pr WIN_20210622_12_39_37_Pr	45.34389283	-75.44823917	79.10	2021-06-22 12:38

Point 8 images (2)

WIN_20210622_12_57_39_Pro.jpg

WIN_20210622_12_57_33_Pro.jpg

Point 7 images (2)

WIN_20210622_12_56_22_Pro.jpg

WIN_20210622_12_56_17_Pro.jpg

Point 6 images (2)

WIN_20210622_12_52_12_Pro.jpg

WIN_20210622_12_51_55_Pro.jpg

Point 4 images (3)

WIN_20210622_12_46_51_Pro.jpg

WIN_20210622_12_46_45_Pro.jpg

WIN_20210622_12_46_38_Pro.jpg

Point 3 images (2)

WIN_20210622_12_44_24_Pro.jpg

WIN_20210622_12_44_18_Pro.jpg

Point 2 images (2)

WIN_20210622_12_41_56_Pro.jpg

WIN_20210622_12_41_50_Pro.jpg

Point 1 images (2)

WIN_20210622_12_39_37_Pro.jpg

WIN_20210622_12_39_18_Pro.jpg

Appendix D Geotech Report

PATERSON GROUP

Geotechnical Investigation

Proposed Warehouse Development

Boundary Road at Thunder Road
Ottawa, Ontario

Prepared for Avenue 31

Report PG5161-1 Revision 4 dated August 9, 2024

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Avenue 31 to conduct a geotechnical investigation for the proposed warehouse building, to be located at Boundary Road and Thunder Road in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report for the general site location).

The objectives of the geotechnical investigation were to:

- Determine the subsoil and groundwater conditions at this site by means of boreholes.
- Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

2.0 Proposed Development

Based on the available plans, it is understood that the proposed development will consist of a one-storey commercial building occupying a footprint of 745 m^2, located within the central portion of the site. The proposed building will be of slab-on-grade construction. A proposed shed structure will be located southwest of the building. A proposed stormwater retention pond is to be located within the western portion of the site. Paved and granular parking areas, loading docks, storage areas and associated driveways connecting to both Thunder Road and Boundary Road are expected. Truck traffic will be a large component of the vehicle loading on the pavement structure.

The site will be serviced by private sewer system and municipal water.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

Prior to undertaking this new assignment, existing geotechnical information was available from a previous environmental investigation carried out by Paterson for the subject site on December 19, 2018. At that time, a total of 3 boreholes were drilled to a maximum depth of 4.2 m to assess the subsurface soil conditions.

An investigation was carried out on June 30 and July 2, 2020. At that time a total of 7 boreholes were drilled to a maximum depth of 7.5 m to assess the subsurface soil conditions.

A supplemental investigation was carried out on April 15, 2021, along the existing residential area on the north portion of the site and on July 14, 2021 along the central treed portion of the site. At the time a total of 6 boreholes were drilled to a maximum depth of 5.8 m.

The test hole locations are shown on the enclosed drawing PG5161-1 - Test Hole Location Plan.

The boreholes were completed with a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer. The borehole procedure consisted of augering, or advancing a casing by rotary drilling, to the required depths at the selected locations, and sampling and testing the overburden soils.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags, and transported to our laboratory for further examination and classification. The depths at which the auger and split spoon samples were recovered from the boreholes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets.

The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was carried out in cohesive soils using a field vane apparatus.

The overburden thickness was evaluated by a dynamic cone penetration test (DCPT) at 2 borehole locations. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data Sheets in Appendix 1 of this report.

Groundwater

Boreholes of the previous investigation were outfitted with 51 mm water monitoring well. Flexible standpipe piezometers were installed in all other boreholes upon the completion of the drilling and sampling, in order to permit monitoring of the groundwater levels. Groundwater level observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data Sheets in Appendix 1.

3.2 Field Survey

The test hole locations were selected by Paterson personnel in a manner to provide general coverage of the proposed development, taking into consideration site features.

The borehole locations and ground surface elevations completed for our previous environmental investigation were surveyed by Annis, O'Sullivan, Vollebekk Ltd. The current investigation for borehole locations and ground surface elevations were surveyed by Paterson personnel and are referenced to a geodetic datum (NAD83). Both are presented on Drawing PG5161-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Review

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. All samples will be stored in the laboratory for 1 month after this report is completed. They will then be discarded unless we are otherwise directed.

3.4 Analytical Testing

One soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is undeveloped, and trees have been recently cleared on the south portion of the site. The northwestern portion of the site consists of a mature treed area. The site is bordered by Thunder Road to the northeast, residential dwellings and wooden area to the northwest, Boundary Road and commercial properties to the east, and treed land to the south and west. The existing ground surface is relatively flat and ranges across from an elevation of approximately 76 to 78 m. Excavated drainage ditches were also encountered at the subject site. Wet ground and surface water was encountered along the south and southwestern property borders.

The north portion of the site is separated by a creek. At the time of the investigation the creek was noted to be blocked by a beaver dam. The water was backflowing through a series of ditches located on the south portion of the site and towards the treed area. The ditches were noted to be full with approximately 0.6 to 1.2 m of water.

4.2 Subsurface Profile

Overburden

The subsurface profile encountered at the test hole locations generally consists of topsoil and/or organic material extending to approximate depths of 100 to 250 mm below the existing ground surface. A brown silty sand, trace clay was generally encountered underlying the topsoil, extending to depths of 0.7 to 1.3 m below ground surface. A firm, brown to grey silty clay deposit with sand seams was observed underlying the silty sand to sand layer. Practical refusal to the DCPT was encountered at a depth of 16 to 21.1 m.

It should be noted that a fill layer varying in thickness from 0.6 to 0.75 m was encountered around the existing residential dwelling on the north portion of the site.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

In reviewing available geological mapping, the bedrock in the subject area consists of grey shale, sandy shale and some dolomite layers of the Carlsbad Formation, with an overburden drift thickness varying between 25 to 35 m.

4.3 Groundwater

Groundwater levels were measured in the piezometers at the boreholes BH 1-20 through BH 7-20, as well as in the monitoring wells from the previous investigation (BH 1 and BH 2) on January July 22, 2020. The measured groundwater level (GWL) readings are presented in Table 1 below. Based on our field observations, experience with the local area, moisture levels and the colouring of the recovered samples, it is expected that the groundwater level is between 0.5 to 2 m below the existing grade. It should be noted that groundwater levels are subject to seasonal fluctuations and therefore groundwater levels could differ at the time of construction.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1-21	76.96	1.25	75.71	April 28, 2021
BH 2-21	76.76	0.05	76.71	April 28, 2021
BH 3-21	76.33	0.91	75.42	July 21, 2021
BH 4-21	76.53	Blocked	Blocked	July 21, 2021
BH 5-21	76.34	0.73	75.61	July 21, 2021
BH 6-21	76.3	0.78	75.52	July 21, 2021
BH 1-20	76.32	5.87	70.45	July 22, 2020
BH 2-20	76.62	0.70	75.92	July 22, 2020
BH 3-20	76.9	0.98	75.92	July 22, 2020
BH 4-20	76.46	3.12	73.34	July 22, 2020
BH 5-20	77.03	2.23	74.80	July 22, 2020
BH 6-20	76.93	3.09	73.84	July 22, 2020
BH 7-20	76.9	1.15	75.75	July 22, 2020
BH 1	77.1	1.49	75.61	July 22, 2020
BH 2	76.82	0.92	75.90	July 22, 2020

Note: Ground surface elevations at borehole locations were surveyed by Paterson and are referenced to a geodetic datum.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered satisfactory for the proposed warehouse development. Conventional shallow foundations are expected for the proposed buildings provided that the design loads can be achieved based on the bearing resistance values provided. For buildings where design loads exceed the bearing resistance values, then end bearing piles will be required to handle the design building loads. End bearing pile capacities and uplift resistance values have been provided in Subsection 5.3. Also, bearing capacities for conventional shallow footings have been provided in Subsection 5.3 for any lightweight structures to be constructed at the subject site.

Due to the presence of the deep silty clay deposit, a permissible grade raise restriction will be applied for the subject site.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic or other deleterious materials, should be stripped from under any buildings and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the proposed building footprint, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be tested and approved prior to delivery to the site. It should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building area should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern, in accordance with the permissible grade raise recommendations provided in Subsection 5.4. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite drainage membrane.

5.3 Foundation Design

Shallow Foundations

Pad footings and strip footings up to 1 m wide, placed on a bearing surface consisting of undisturbed, stiff to firm silty clay, can be designed using a bearing resistance value at serviceability limit states (SLS) of **60kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **90kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Pad footings and strip footings up to 1 m wide placed over 300 mm engineered fill such as OPSS crushed stone Granular A or Granular B type II, placed over an undisturbed stiff to firm silty clay, and compacted to minimum 98.0% of its SPMDD, can be can be designed using a bearing resistance value at serviceability limit states (SLS) of **80kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **110kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS. However, it should be noted that due to the maximum allowable grade raise restrictions, no additional grade raises should be made upon placing this engineered fill base below the footings.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in-situ soil of the same or higher capacity as the bearing medium soil.

Settlement

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when buildings are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

End Bearing Piled Foundation

For deep foundations, concrete-filled steel pipe piles are generally utilized in the Ottawa area. Applicable pile resistance values at ultimate limit states (ULS) are given in Table 2. A resistance factor of 0.4 has been incorporated into the factored at ULS values. Note that these are all geotechnical axial resistance values.

The geotechnical pile resistance values were estimated using the Hiley dynamic formula, to be confirmed during pile installation with a program of dynamic monitoring. Re-striking of all piles at least once will also be required after at least 48 hours have elapsed since initial driving.

Table 2 - Pile Foundation Design Data

Pile Outside Diameter (mm)	Pile Wall Thickness (mm)	Geotechnical Axial Resistance Factored at ULS (kN)	Final Set (blows/ 12 mm)	Transferred Hammer Energy (kJ)
245	9	1495	25	40
245	11	1750	24	48.5
245	13	2000	25	56

The minimum centre-to-centre pile spacing is 2.5 times the pile diameter. The closer the piles are spaced, however, the more potential that the driving of subsequent piles in a group could have influence on piles in the group that have already been driven. These effects, primarily consisting of uplift of previously driven piles, are checked as part of the field review of the pile driving operations.

Prior to the commencement of production pile driving, a limited number of indicator piles should be installed across the site. It is recommended that each indicator pile be dynamically load tested to evaluate pile stresses, hammer efficiency, pile load transfer, and end-of-driving criteria for end-bearing in the bedrock.

Due to the proposed grade raises at the site, downdrag loads should be considered on the piles. Based on the available subsurface information, it is expected that the piles will be driven through stiff to soft silty clay.

The silty clay generally has a cohesion of 20 to 40 kPa. Assigning an adhesion factor of 1.0 to 0.5, the silty clay can be taken to have an ultimate adhesion of 20 kPa against the sides of the piles.

The downdrag load is effectively applied to each pile at the location of the "neutral plane," where negative (i.e. downdrag) skin friction becomes positive shaft resistance. In the case of the end-bearing piles at this site, the neutral plane will be located near the bedrock surface.

The downdrag load is a structural pile capacity criterion and does not affect the geotechnical capacity of the piles. The structural axial capacity of the pile is governed by its structural strength at the neutral plane when subjected to the permanent load plus the downdrag load. Transient live load is not to be included. At or below the pile cap, the structural strength of the embedded pile is determined as a short column subjected to the permanent load plus the transient live load, but downdrag load is to be excluded.

At the depth of the neutral plane where the downdrag load is applied, the pile structure is well confined. The 4th edition of the Canadian Foundation Engineering Manual recommends that the allowable structural axial capacity of piles at the neutral plane, for resisting permanent load plus the downdrag load, can be determined by applying a factor of safety of 1.5 to the pile material strength (steel yield and concrete 28 day compressive strength).

Lateral Load Resistance

Lateral loads on the foundations can be resisted using passive resistance on the sides of the foundations. For Limit States Design, the resistance factor to be applied to the ultimate lateral resistance, including passive pressure, is 0.50. The total lateral resistance will be comprised of the individual contributions from up to several material layers, as follows.

Geotechnical parameters for the native sand and for typical backfill materials compacted to 98% of SPMDD in 300 mm lift thicknesses are provided in Table 3, below, along with the associated earth pressure coefficients for horizontal resistance calculations for footings under lateral loads or deadman anchors. Friction factors between concrete and the various subgrade materials are also provided in Table 3, where normal loads allow them to be used.

Where granular soils and/or granular backfill materials are present, the passive pressure can be calculated using a triangular distribution equal to $K_P \cdot \gamma \cdot H$ where:

K_P = factored passive earth pressure coefficient of the applicable retained soil, 1.5
γ = unit weight of the fill of the applicable retained soil (kN/m^3)
H = height of the equivalent wall or footing side (m)

Note that for cases where the depth to the top of the structure (i.e. footing) pushing against the soil does not exceed 50% of the depth to the base of the structure, the effective value of H in the above noted relationship will be the overall depth to the base of the structure. There will also be "edge effects" where the effective width of soil providing the resistance can be increased by 50% of the effective depth on each side of the pushing structural component.

Note that where the foundation extends below the groundwater level, the effective unit weight should be utilized for the saturated portion of the soil or fill.

Where a component of lateral resistance is to be provided by the EPS foam lightweight fill (LWF) layer, the ultimate passive or lateral resistance will be the compressive strength of the LWF at 5% deformation. A geotechnical resistance factor of 0.5 also applies to this resistance component. In Subsection 5.6 below, the LWF under the slab is recommended to consist of EPS Blocks Type 12, which has a compressive strength at 5% deformation of 35 kPa.

Should additional passive resistance be require, the horizontal component of the axial resistance of battered piles (up to 1H:3V inclination), or anchors can be used in the building foundation design.

Foundation Uplift Resistance

Uplift forces on the proposed foundations can be resisted using the dead weight of the concrete foundations, the weight of the materials overlying the foundations, and the submerged weight of the piles. Unit weights of materials are provided in Table 3.

For soil above the groundwater level, calculate using the "drained" unit weight and below groundwater level use the "effective" unit weight. Backfilled excavations in low permeability soils can be expected to fill with water and the use of the effective unit weights would be prudent if drainage of the anchor footings is not provided.

As noted, the piles will generally be located below the groundwater level, so the submerged, or effective, weight of the pile will be available to contribute to the uplift resistance, if required. Considering that this is a reliable uplift resistance, and is really counteracting a dead load, it is our opinion that a resistance factor of 0.9 is applicable for the ULS weight component.

A sieve analysis and standard Proctor test should be completed on each of the fill materials proposed to obtain an accurate soil density to be expected, so the applicable unit weights can be estimated.

Table 3 - Geotechnical Parameters for Uplift and Lateral Resistance Design

Material Description	Unit Weight (kN/m³)		Internal Friction Angle () φ'	Friction Factor, tan δ	Earth Pressure Coefficients		
	Drained γ_{dr}	Effective γ'			Active K_A	At-Rest K_O	Passive K_P
OPSS Granular A Fill (Crushed Stone)	22.0	13.7	38	0.60	0.22	0.36	8.8
OPSS Granular B Type I Fill (Well-Graded Sand-Gravel)	21.5	13.4	36	0.55	0.26	0.41	7.5
OPSS Granular B Type II Fill (Crushed Stone)	22.5	14.0	40	0.62	0.20	0.33	10.3
Silty Clay	17.0	9.0	30	0.30	0.33	0.50	3.0
In Situ Silty Sand or Site Excavated Silty Sand Fill	18.0	11.2	32	0.48	0.30	0.46	5.6

Notes:
- Properties for fill materials are for condition of 98% of standard Proctor maximum dry density.
- The earth pressure coefficients provided are for horizontal backfill profile.
- Passive pressure coefficients incorporate wall friction of 0.5 φ'.

Loading Dock

The foundation wall at the loading dock, if the loading dock grade is depressed, will act as a retaining wall. Therefore, it should be designed to resist the lateral earth pressure of the fill material on the inside of the foundation wall. The wall should be designed using a triangular earth pressure distribution with a maximum stress value at the base of the wall equal to Ka γ H where:

K_a = 0.35 - active earth pressure coefficient if some movement can be tolerated and 0.5 if no movement can be tolerated
γ = 22 kN/m3, unit weight of the fill
H = height of the retaining wall, m

It should be noted that the fill on the inside of the wall should consist of free draining material such as OPSS Granular Type I or II.

The excavation side slope of the footing/foundation wall excavation should be tapered at 3H:1V or flatter on the pavement side of the loading dock and backfilled with OPSS Granular B Type I or II to minimize frost heaving. The fill material should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's standard Proctor dry density. The depressed area should be properly drained to minimize total and differential frost heaving.

Permissible Grade Raise Recommendation

Permissible grade raise recommendations have been determined for the proposed development based on the consolidation testing results of samples of the silty clay obtained during the geotechnical investigation. Based on our findings, a permissible grade raise of 0.9 m is recommended for grading within 6 m of the proposed buildings' footprints and a 1.5 m permissible grade raise recommendation for the access lanes, car and truck parking areas.

For design purposes, the total and differential settlements associated with the combination of grade raises and slab loading conditions are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.
To reduce potential long-term liabilities, consideration should be given to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the structures, etc).

If required, LWF should consist of EPS (expanded polystyrene) Type 19 blocks for placement below the building footprint, which allow for raising the grade without adding a significant load to the underlying soils. However, these materials are expensive and, in the case of the EPS, are more difficult to use under the groundwater level, as they are buoyant, and must be protected against potential hydrocarbon spills. Use lightweight fill within the interior of the building to reduce the fill-related loads.

LWF should be covered by a 8 mil polyethylene liner followed by a non-woven geotextile, such as Terrafix 270 R or equivalent, and a biaxial geogrid, such as Geosynthetics Systems TBX2500 or equivalent for areas within the building footprint and under pavement structures, where required.

Surcharge and pre-loading can be an economical solution if time permits to induce initial settlement and reduce the requirements for LWF. Paterson should complete a detailed grading plan review and provide recommendations as required across the site.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D**. The soils underlying the proposed building foundations are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill within the footprint of the proposed building, the existing fill subgrade will be considered an acceptable subgrade on which to commence backfilling for floor slab construction.

A vibratory drum roller should complete several passes over the slab-on-grade subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill, such as OPSS Granular B Type II.

It is recommended that the upper 200 mm of sub-floor fill consist of OPSS Granular A crushed stone. All backfill materials required to raise grade within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

Modulus of Subgrade Reaction

A modulus of subgrade reaction of **15 MPa/m** can be provided for subfloor cross-section above.

5.6 Pavement Design

Car only parking areas, access lanes and heavy truck parking/loading areas are anticipated at this site. For the proposed surface parking areas, the pavement structures provided in Tables 4 and 5 are recommended.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil (compact-able and free draining), or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 5 - Recommended Pavement Structure Access Lanes and Heavy Truck Parking Areas	
Thickness (mm)	**Material Description**
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil (compact-able and free draining), or OPSS Granular B Type I or II material placed over in situ soil or fill	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable vibratory equipment.

LWF (EPS Type 19) blocks, where required below the flexible pavement structure, should be covered by a 8 mil polyethylene liner, a non-woven geotextile layer, such as Terrafix 270R or equivalent, and a biaxial geogrid, such as Geosynthetics TBX 2500 or equivalent, should be used to separate the granular material from the LWF. The LWF blocks should be placed at least 1 m below the finished grade.

Granular Pavement Design

The pavement structures presented in Tables 6 and 7 are recommended for the design of the heavy-duty granular driveways and light duty granular storage areas.

Table 6 – Granular Pavement Structure – Heavy Duty Granular Drive Lanes	
Thickness (mm)	**Material Description**
150	**BASE –** OPSS Granular A Crushed Stone
450	**SUBBASE –** OPSS Granular B Type II
Subgrade – Either fill, in-situ soil (compact-able and free draining), or OPSS Granular B Type material placed over in-situ soil.	

Table 7 – Granular Pavement Structure – Light Duty Vehicle Storage Areas	
Thickness (mm)	**Material Description**
150	**BASE –** OPSS Granular A Crushed Stone
300	**SUBBASE –** OPSS Granular B Type II
Subgrade – Either fill, in-situ soil (compact-able and free draining), or OPSS Granular B Type material placed over in-situ soil.	

The SSM used for the grade raise below the granular pavement structures should be comprised of a well-drained sandy material with lesser fine particles (silt or clay), with no significant organic materials and other deleterious materials. Furthermore, boulders greater than 300 mm in dimension should be avoided while placing the backfill. If the SSM used for the grade raise below the pavement structure has a higher composition of fine particles, it could lead to higher water retention of subgrade resulting in poor drainage conditions. Therefore, it is recommended to sample and test the SSM for sieve and proctor prior to usage below the pavement structures. If the SSM exhibits a higher composition of fine particles, it is recommended to place the granular subbase over a bi-axial geogrid such as Terrafix TBX2500 or equivalent in conjunction with a nonwoven geotextile such as Terrafix 360R or equivalent.

All the SSM and engineered fill materials should be placed in a maximum of 300 mm lifts and compacted to minimum 98.0% of the materials Standard Proctor Maximum Dry Density (SPMDD). Geotextile and geogrid provisional items should be carried if soft spots are encountered on site.

Maintenance of Granular Pavement

It should be noted that gravel access roads and parking areas generally have a lower design life and will require regarding the roads every one to two years and re-gravelling every two to three years. With increased truck traffic the frequency of these required maintenance may increase. To decrease the maintenance periods and extend the design life of the granular roads, biaxial geogrids such as Terrafix TBX1500 or equivalent can be placed between the Granular B type II subbase and the Granular A base. Installation of subdrains within the pavement structure can improve the drainage conditions below the roads, which will further help in improving the design life of the granular pavement structures. Additionally, the granular pavements will require annual maintenance for dust control.

As an alternative, surface treatment options such as granular sealing with hot asphalt or ground glue, etc., can be preferred, which will extend the design life of the granular pavement structures and reduce the maintenance required.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing load carrying capacity.

Consideration should also be given to installing subdrains during the pavement construction as per City of Ottawa standards. These drains should extend in four orthogonal directions or longitudinally when placed along a curb. The clear crushed stone surrounding the drainage lines, or the pipe should be wrapped with suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines. Discharge of the subdrains should be directed by gravity to storm sewers or deeper drainage ditches.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed building. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 19 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free draining non frost susceptible granular materials, such as clean sand or OPSS Granular B Type I granular material. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation, should be provided in this regard.

Exterior unheated footings, such as isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e., unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. Excavations below the groundwater level should be cut back at a maximum slope of 1.5H:1V, although, it is expected that all the excavations will be above the long-term groundwater table.

The subsurface soil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by "cut and cover" methods and excavations should not remain open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, should be placed from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 98% of the SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 98% of the material's SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

For areas where rigid insulation will be used to provide frost protection. It is recommended that the rigid insulation be placed at the pipe obvert to allow for the maximum amount of granular cover over the pipe. Having the insulation at the obvert will provide a more effective insulation detail.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Persons as stipulated under O.Reg. 63/16.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures using straw, propane heaters and tarpaulins or other suitable means.

In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a moderate to very aggressive corrosive environment.

6.8 Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. A shrinkage limit test and sieve analysis testing was also completed on selected soil samples. The shrinkage limit testing indicates a shrinkage limit of 14% with a shrinkage ratio of 1.92. The results of our atterberg limit and sieve testing are presented in Appendix 1.

Based on the results of our testing, the silty clay on site is a low to medium plasticity silty clay (Plasticity index < 40%). In accordance with the city of Ottawa guidelines, the tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided all the following conditions are met:

- The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.

- A small tree must be provided with a minimum of 25 m3 of available soil volume while a medium tree must be provided with a minimum of 30 m3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect. The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

7.0 Recommendations

It is a requirement for the foundation data provided herein to be applicable that the following material testing, and observation program be performed by the geotechnical consultant.

- Review of the as built grading plan, from a geotechnical perspective.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

All excess soils, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management*.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by Paterson.

8.0 Statement of Limitations

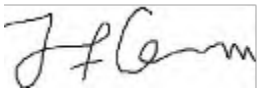
The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

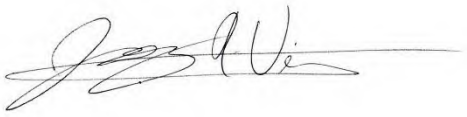
A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Avenue 31, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.





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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ATTERBERG LIMITS TESTING RESULTS

SIEVE/HYDROMETER ANALYSIS RESULT

ANALYTICAL TESTING RESULTS

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ATTERBERG LIMITS TESTING RESULTS

SIEVE/HYDROMETER ANALYSIS RESULT

ANALYTICAL TESTING RESULTS

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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Proposed Warehouse Development - Thunder Road
Ottawa, Ontario

DATUM Geodetic

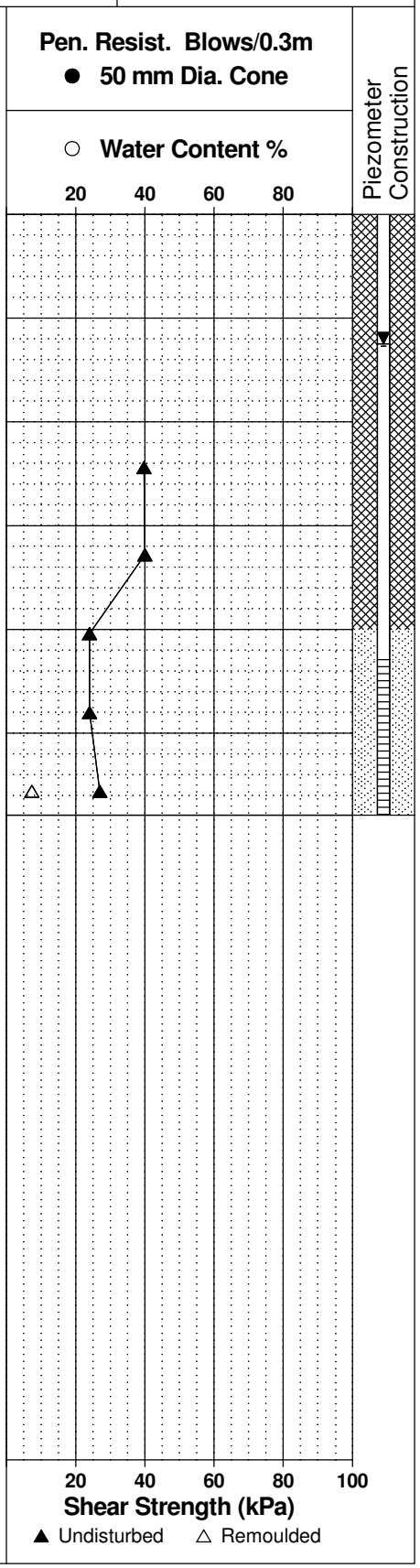
FILE NO. PG5161

REMARKS

HOLE NO. BH 1-21

BORINGS BY Track-Mount Power Auger **DATE** April 15, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.96
TOPSOIL 0.08							
FILL: Brown silty sand, trace topsoil 0.60		AU	1				
Compact, brown **SILTY SAND**		SS	2	33	12	1	75.96
1.68							
Stiff, brown **SILTY CLAY** 2.00		SS	3	25	2	2	74.96
Firm, grey **SILTY CLAY**						3	73.96
						4	72.96
						5	71.96
5.79							
End of Borehole							
(GWL @ 1.25m - July 21, 2021)							



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Ottawa, Ontario

DATUM Geodetic

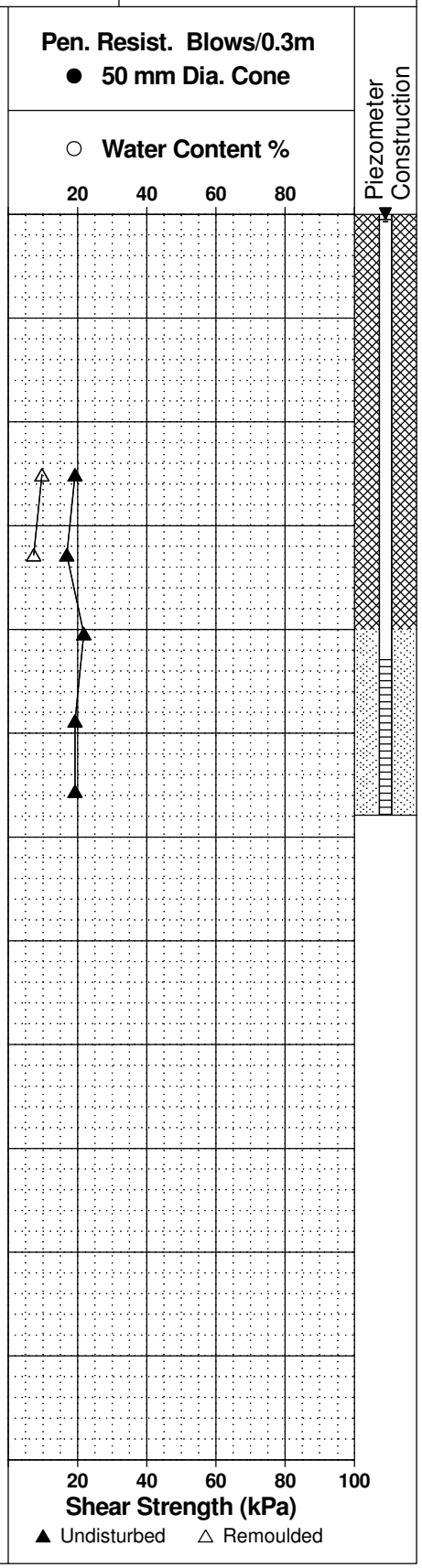
FILE NO. PG5161

REMARKS

HOLE NO. BH 2-21

BORINGS BY Track-Mount Power Auger **DATE** April 15, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.76
TOPSOIL 0.08							
FILL: Brown silty sand with topsoil		AU	1				
0.76							
Loose, brown **SILTY SAND**		SS	2	33	9	1	75.76
1.37							
Stiff, brown **SILTY CLAY**		SS	3	50	1	2	74.76
2.10							
		SS	4	100	P	3	73.76
		SS	5	100	P		
Soft, grey **SILTY CLAY**						4	72.76
						5	71.76
5.79							
Dynamic Cone Penetration Test commenced at 5.79m depth. Cone pushed to 19.2m depth.						6	70.76
						7	69.76
						8	68.76
						9	67.76
						10	66.76
						11	65.76
						12	64.76



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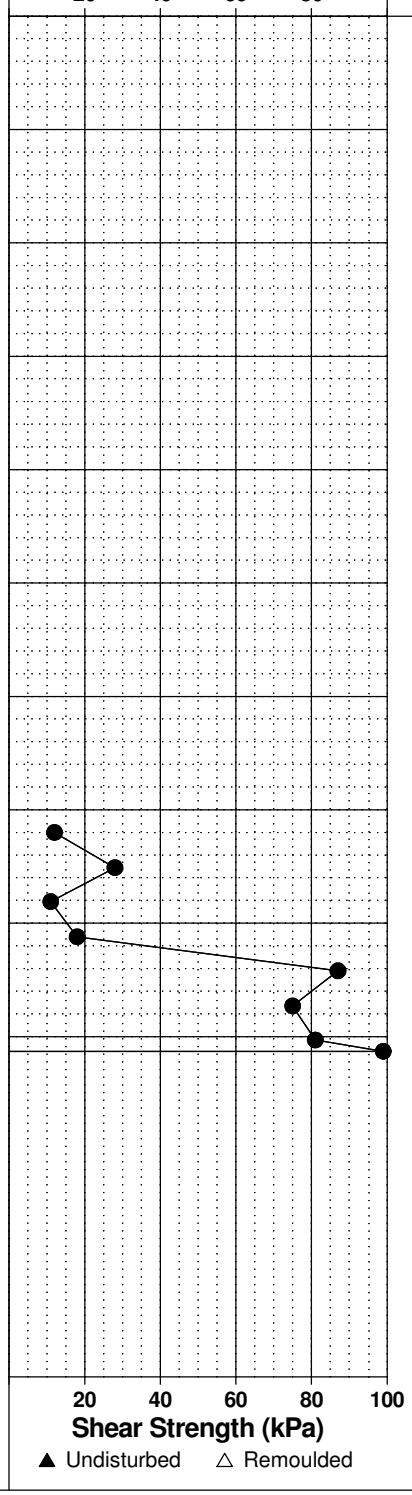
REMARKS

HOLE NO. BH 2-21

BORINGS BY Track-Mount Power Auger **DATE** April 15, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						12	64.76		
						13	63.76		
						14	62.76		
						15	61.76		
						16	60.76		
						17	59.76		
						18	58.76		
						19	57.76		
						20	56.76		
21.13						21	55.76		
End of Borehole									
Practical DCPT refusal at 21.13m depth									
(GWL @ 0.05m - July 21, 2021)									



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SOIL PROFILE AND TEST DATA

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Proposed Warehouse Development - Thunder Road
Ottawa, Ontario

DATUM Geodetic

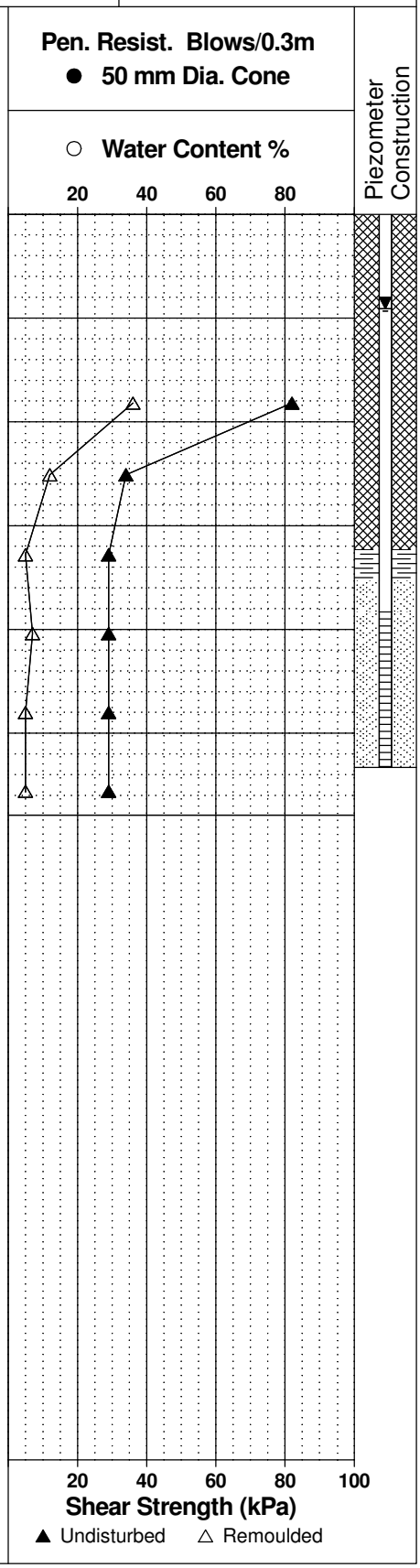
FILE NO. PG5161

REMARKS

HOLE NO. BH 3-21

BORINGS BY Track-Mount Power Auger **DATE** July 14, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.33
TOPSOIL 0.25		AU	1				
Compact, brown **SILTY SAND,** trace clay 0.46		AU	2				
Very stiff to stiff, brown **SILTY CLAY** with sand		SS	3	79	4	1	75.33
1.50		SS	4	75	P	2	74.33
Firm, grey **SILTY CLAY**						3	73.33
						4	72.33
						5	71.33
5.79							
End of Borehole							
(GWL @ 0.91m - July 21, 2021)							



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Proposed Warehouse Development - Thunder Road
Ottawa, Ontario

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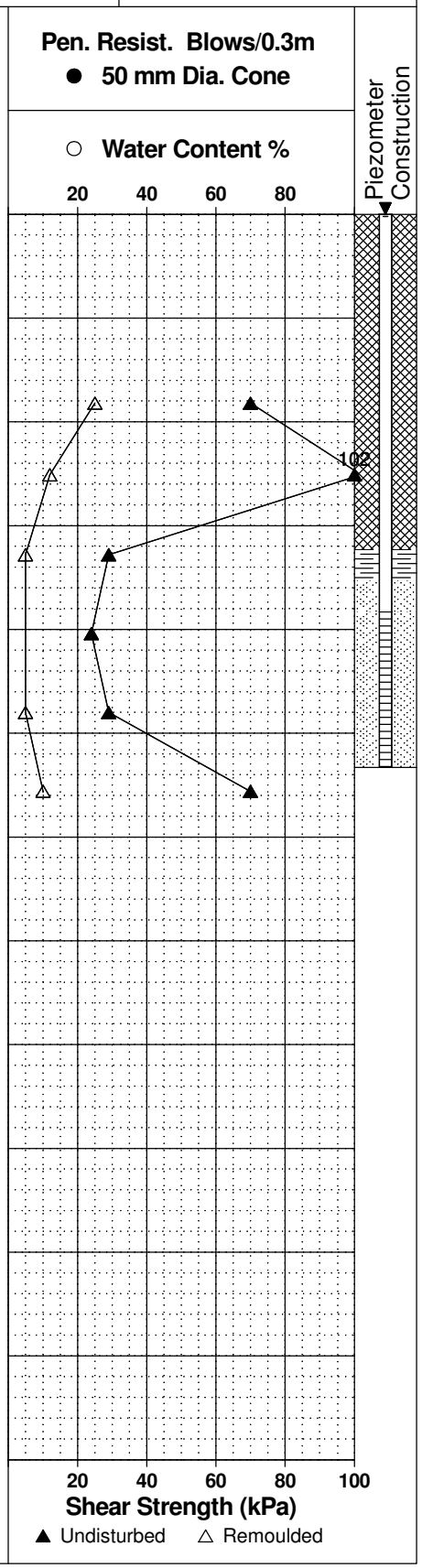
REMARKS

HOLE NO. BH 4-21

BORINGS BY Track-Mount Power Auger **DATE** July 13, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.53
TOPSOIL 0.28		AU	1				
Compact, brown **SILTY SAND** 0.76		AU	2				
		SS	3	83	4	1	75.53
Stiff to very stiff, brown **SILTY CLAY,** trace sand		SS	4	83	P	2	74.53
3.00						3	73.53
Firm to stiff, grey **SILTY CLAY**						4	72.53
						5	71.53
5.79						6	70.53
Dynamic Cone Penetration Test commenced at 5.79m depth. Cone pushed to 18.0m depth.						7	69.53
						8	68.53
						9	67.53
						10	66.53
						11	65.53
						12	64.53



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Proposed Warehouse Development - Thunder Road
Ottawa, Ontario

DATUM Geodetic

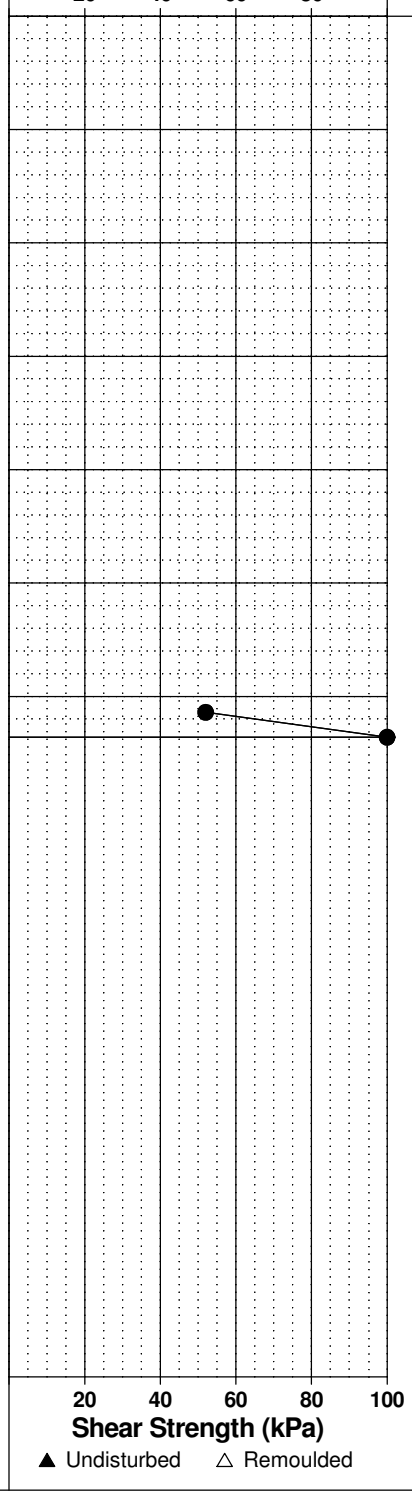
FILE NO. PG5161

REMARKS

HOLE NO. BH 4-21

BORINGS BY Track-Mount Power Auger **DATE** July 13, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						12	64.53		
						13	63.53		
						14	62.53		
						15	61.53		
						16	60.53		
						17	59.53		
						18	58.53		
18.36									
End of Borehole									
Practical DCPT refusal at 18.36m depth									



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Supplemental Geotechnical Investigation
Proposed Warehouse Development - Thunder Road
Ottawa, Ontario

DATUM Geodetic

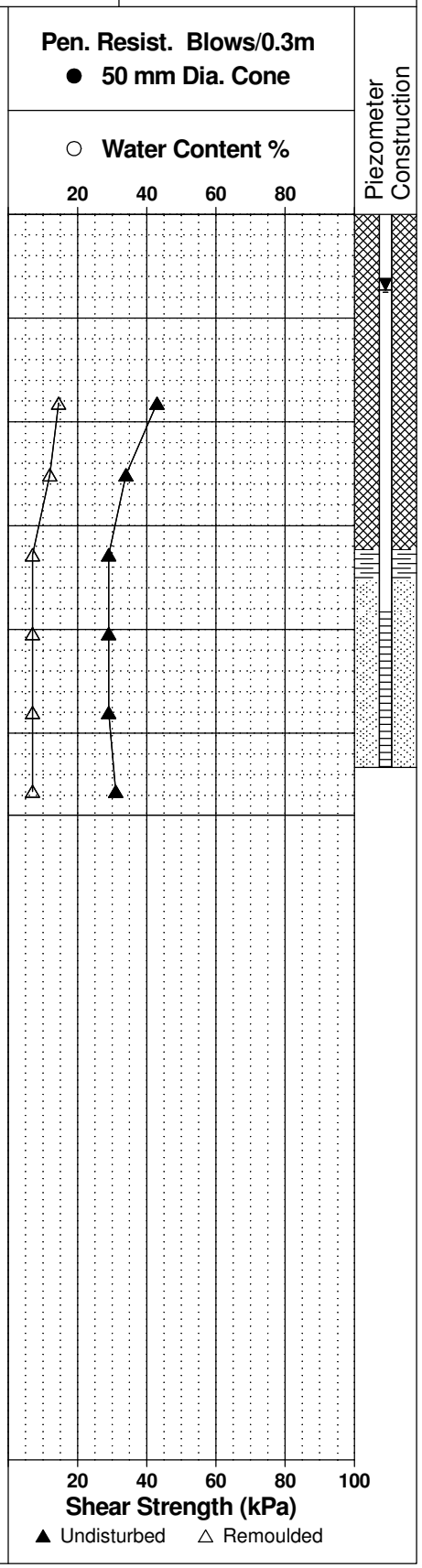
FILE NO. PG5161

REMARKS

HOLE NO. BH 5-21

BORINGS BY Track-Mount Power Auger **DATE** July 14, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.34
TOPSOIL 0.25		AU	1				
Compact, brown **SILTY SAND,** trace clay 0.41		AU	2				
		AU	3				
Very stiff to stiff, brown **SILTY CLAY** with sand		SS	4	67	3	1	75.34
1.50		SS	5	58	P	2	74.34
Firm, grey **SILTY CLAY,** trace sand						3	73.34
						4	72.34
						5	71.34
5.79							
End of Borehole							
(GWL @ 0.73m - July 21, 2021)							



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SOIL PROFILE AND TEST DATA

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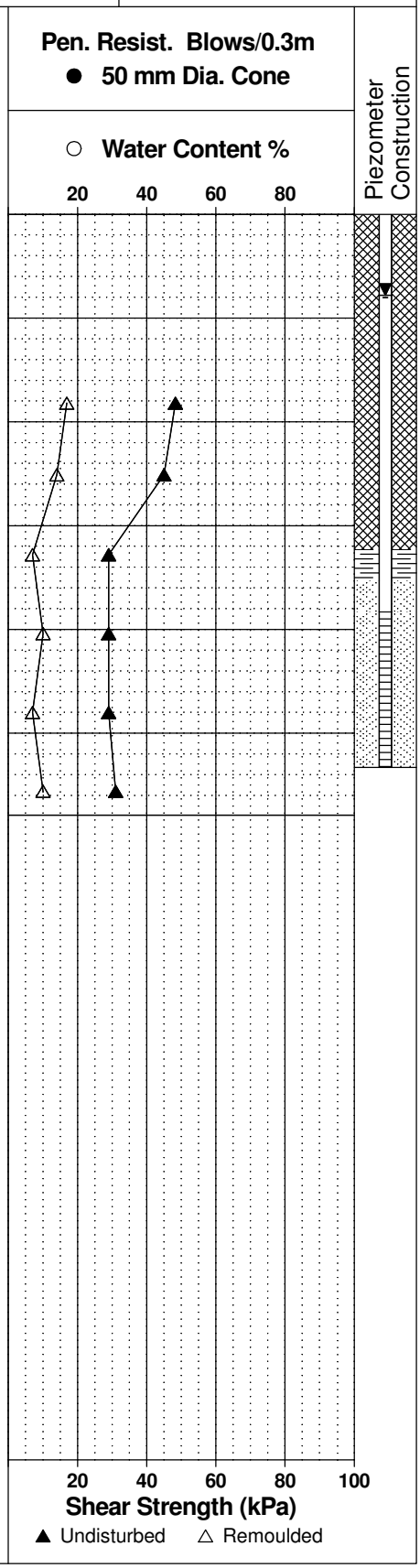
REMARKS

HOLE NO. BH 6-21

BORINGS BY Track-Mount Power Auger **DATE** July 14, 2021

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							0	76.30
TOPSOIL	0.25		AU	1				
Comapct, brown **SILTY SAND** with topsoil	0.46		AU	2				
			AU	3				
Very stiff to stiff, brown **SILTY CLAY** with sand			SS	4	58	6	1	75.30
	1.50		SS	5	71	P	2	74.30
Firm, grey **SILTY CLAY,** trace sand							3	73.30
							4	72.30
							5	71.30
	5.79							
End of Borehole								
(GWL @ 0.78m - July 21, 2021)								



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Ottawa, Ontario

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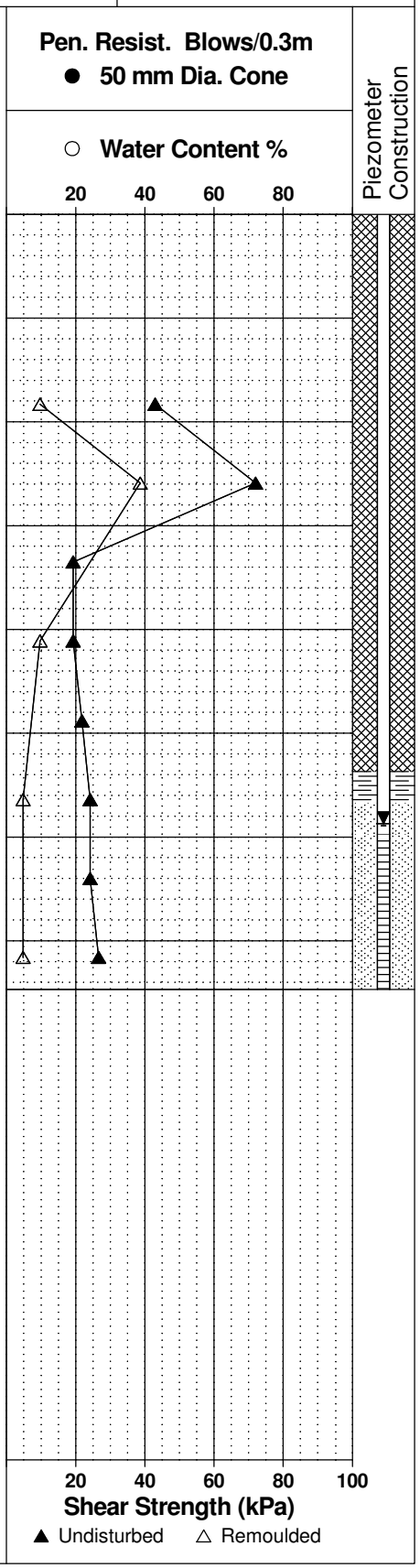
FILE NO. PG5161

REMARKS

HOLE NO. BH 1-20

BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.32
TOPSOIL 0.25		AU	1				
Brown **SILTY SAND** 0.38		SS	2	83	3	1	75.32
Firm, brown **SILTY SAND**						2	74.32
- soft to firm and grey by 3.0m depth						3	73.32
						4	72.32
						5	71.32
						6	70.32
7.47						7	69.32
End of Borehole							
(GWL @ 5.87m - July 22, 2020)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Warehouse Development - Thunder Road
Ottawa, Ontario

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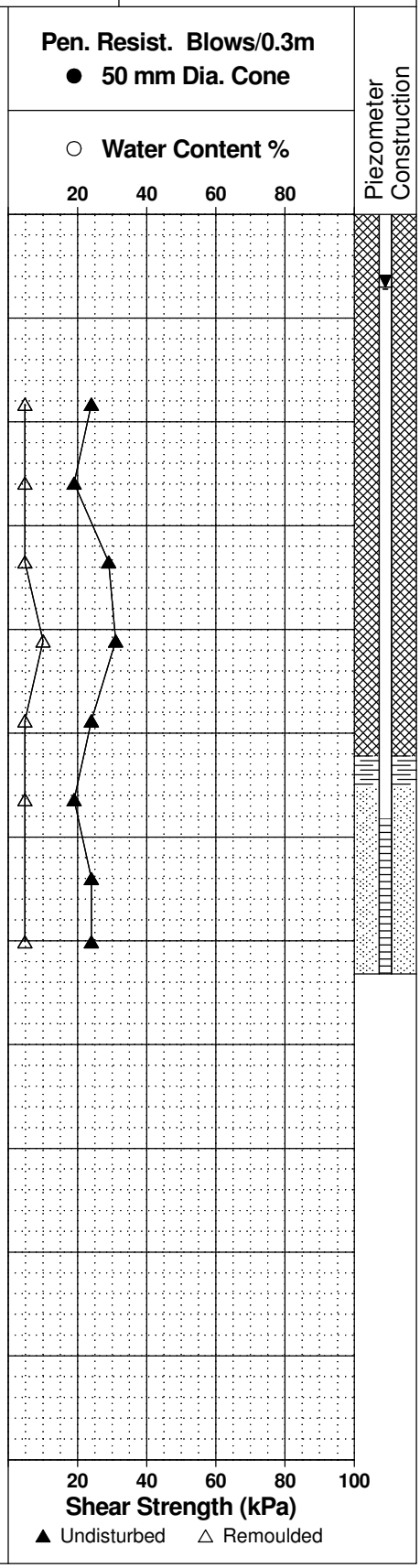
FILE NO. PG5161

REMARKS

HOLE NO. BH 2-20

BORINGS BY Track-Mount Power Auger **DATE** July 1, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.62
Very loose, brown **SILTY SAND,** some organics		AU	1				
0.56							
Brown **SILTY SAND** with sand seams		SS	2	79	3	1	75.62
1.52						2	74.62
						3	73.62
Firm to soft, grey **SILTY CLAY**						4	72.62
						5	71.62
						6	70.62
7.32						7	69.62
Dynamic Cone Penetration Test commenced at 7.32m depth. Cone pushed to 19.5m depth.						8	68.62
						9	67.62
						10	66.62
						11	65.62
						12	64.62



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SOIL PROFILE AND TEST DATA

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Prop. Warehouse Development - Thunder Road
Ottawa, Ontario

DATUM Geodetic

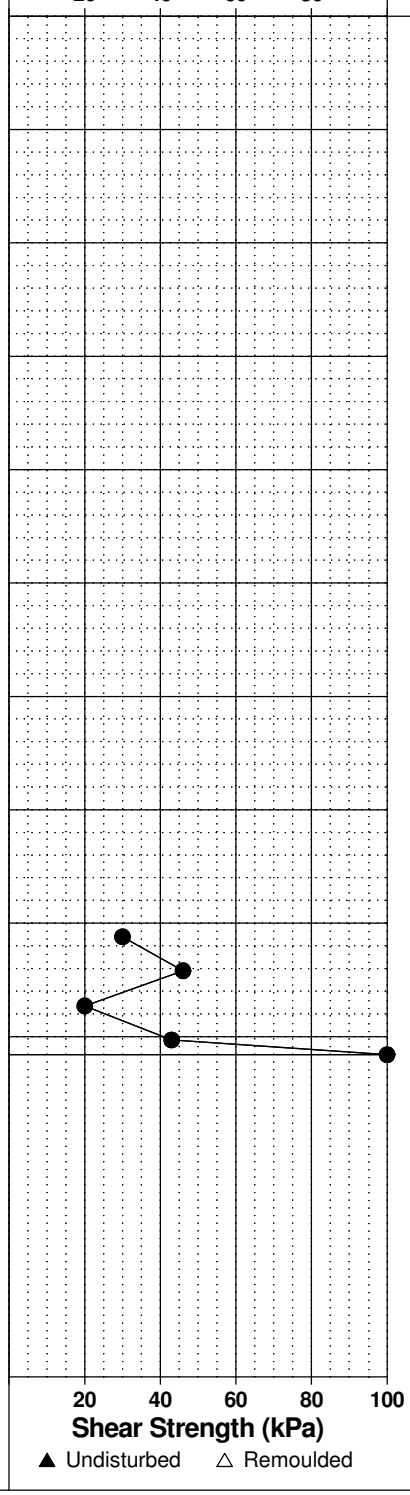
FILE NO. PG5161

REMARKS

HOLE NO. BH 2-20

BORINGS BY Track-Mount Power Auger **DATE** July 1, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						12	64.62		
						13	63.62		
						14	62.62		
						15	61.62		
						16	60.62		
						17	59.62		
						18	58.62		
						19	57.62		
						20	56.62		
21.16						21	55.62		
End of Borehole									
Practical DCPT refusal at 21.16m depth									
(GWL @ 0.70m - July 22, 2020)									



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Geotechnical Investigation
Prop. Warehouse Development - Thunder Road
Ottawa, Ontario

DATUM Geodetic

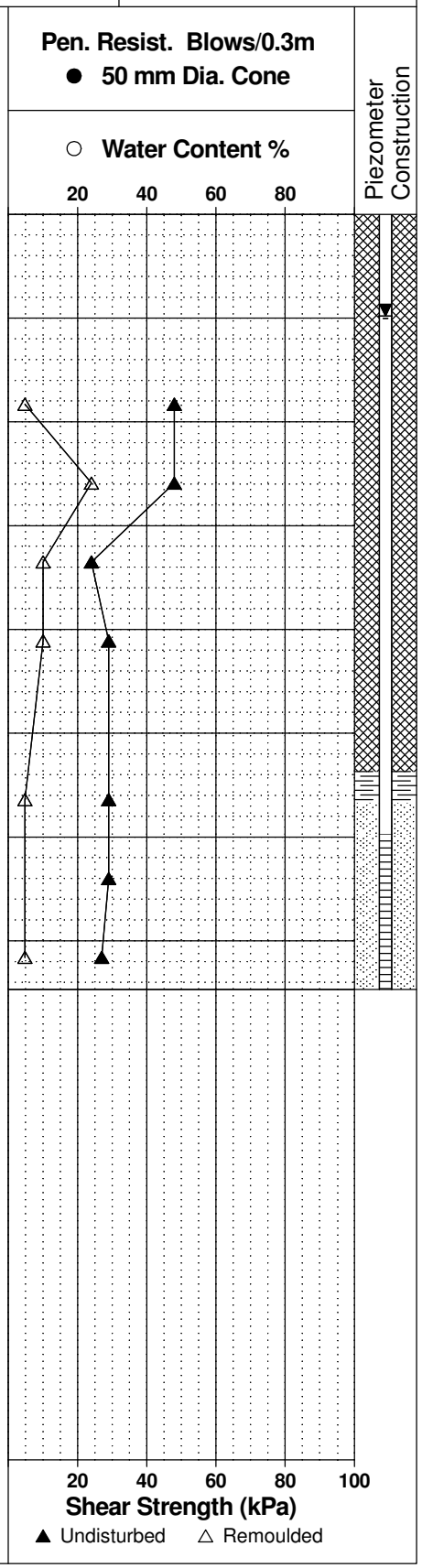
FILE NO. PG5161

REMARKS

HOLE NO. BH 3-20

BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.90
Loose, brown **SILTY SAND,** some organics, trace clay		AU	1				
		SS	2	58	8	1	75.90
1.27							
Firm, brow **SILTY CLAY**						2	74.90
- grey by 3.0m depth						3	73.90
						4	72.90
		SS	3	100	1	5	71.90
						6	70.90
						7	69.90
7.47							
End of Borehole							
(GWL @ 0.98m - July 22, 2020)							



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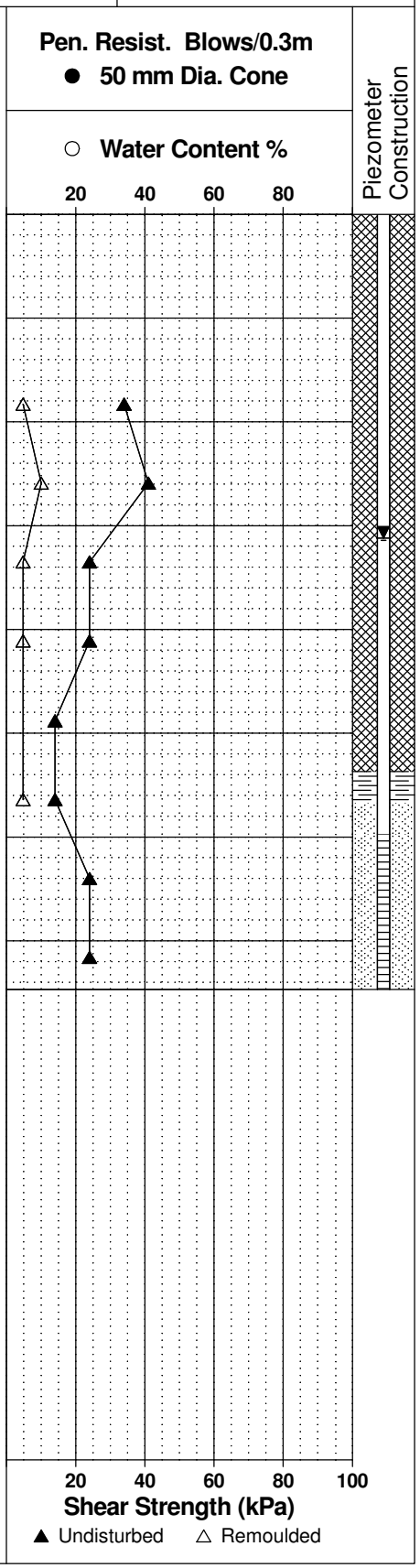
REMARKS

HOLE NO. BH 4-20

BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.46
TOPSOIL 0.08		AU	1				
Very loose, brown **SILTY SAND,** trace organics 0.60		SS	2	46	2	1	75.46
						2	74.46
Firm, brown **SILTY CLAY**						3	73.46
- soft and grey by 3.0m depth						4	72.46
						5	71.46
						6	70.46
7.47						7	69.46
End of Borehole							
(GWL @ 3.12m - July 22, 2020)							



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Ottawa, Ontario

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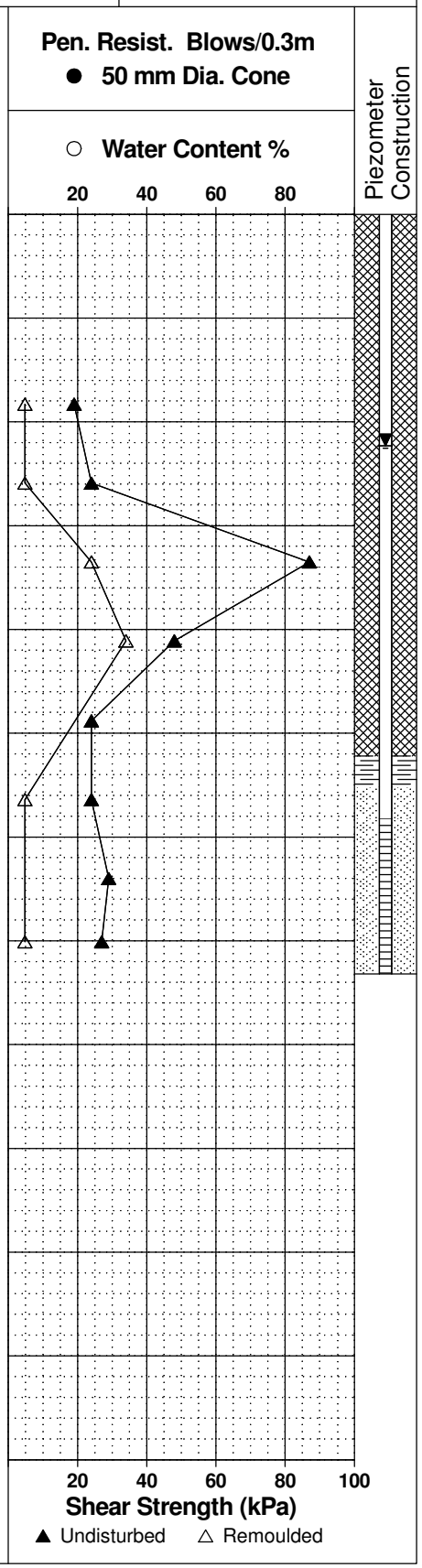
REMARKS

HOLE NO. BH 5-20

BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	77.03
TOPSOIL 0.10		AU	1				
Loose, brown **SILTY SAND,** trace organics		SS	2	42	4	1	76.03
1.30							
Firm, brown **SILTY CLAY** 1.52						2	75.03
Soft to firm, grey **SILTY CLAY,** trace sand seams						3	74.03
						4	73.03
						5	72.03
						6	71.03
7.32						7	70.03
Dynamic Cone Penetration Test commenced at 7.32m depth. Cone pushed to 15.2m depth.						8	69.03
						9	68.03
						10	67.03
						11	66.03
						12	65.03



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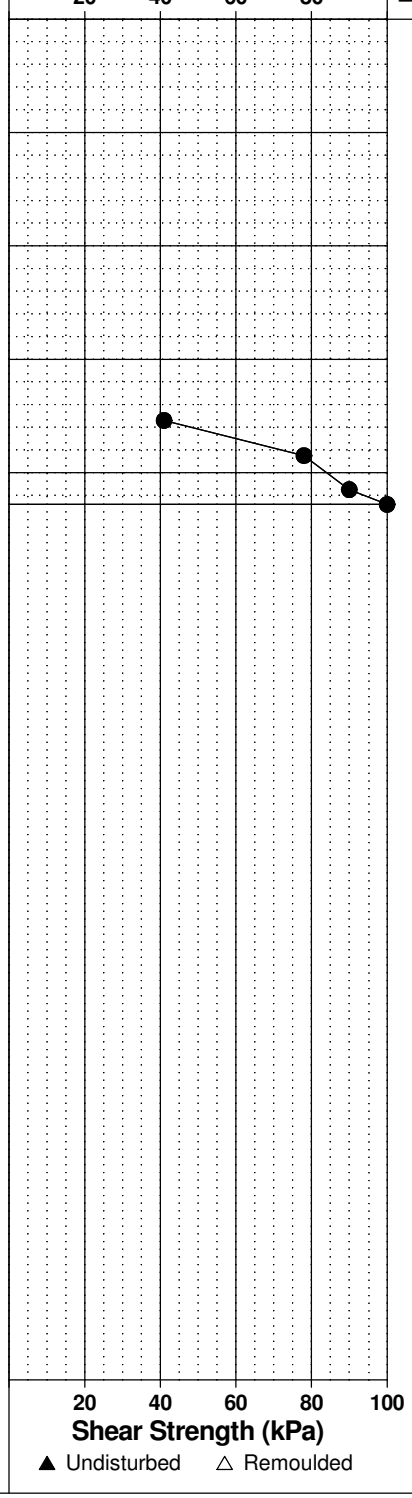
BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
						12	65.03		
						13	64.03		
						14	63.03		
						15	62.03		
						16	61.03		
16.28									
End of Borehole Practical DCPT refusal at 16.28m depth (GWL @ 2.23m - July 22, 2020)									



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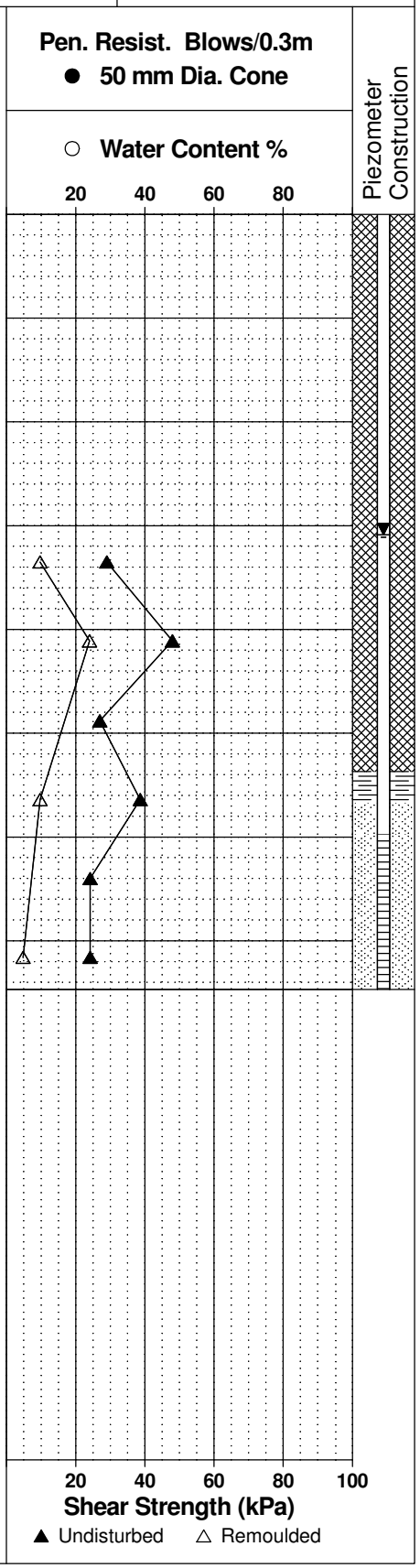
REMARKS

HOLE NO. BH 6-20

BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.93
Compact, brown **SILTY SAND**		AU	1				
		SS	2	33	10	1	75.93
1.37							
		SS	3	100	1	2	74.93
						3	73.93
Firm to soft, grey **SILTY CLAY**						4	72.93
						5	71.93
						6	70.93
7.47						7	69.93
End of Borehole							
(GWL @ 3.09m - July 22, 2020)							



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BORINGS BY Track-Mount Power Auger **DATE** June 30, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.90
TOPSOIL 0.15		AU	1				
FILL: Brown silty sand 0.81		SS	2	100	2	1	75.90
Very loose, brown **SILTY SAND** with clay		SS	3	100	W	2	74.90
- grey by 2.3m depth						3	73.90
3.81						4	72.90
Soft, grey **SILTY CLAY**						5	71.90
5.94							
End of Borehole							
(GWL @ 1.15m - July 22, 2020)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
5368 Boundary Road and 6150 Thunder Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PE4480

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** December 19, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	77.22
TOPSOIL		AU	1				
0.30							
Loose, brown **SILTY SAND**		SS	2	42	6	1	76.22
1.52							
		SS	3	83	W	2	75.22
Brown **SILTY CLAY**							
		SS	4	83	W		
- grey by 2.7m depth						3	74.22
		SS	5	71	9		
						4	73.22
		SS	6	96	W		
4.42							
End of Borehole							
(GWL @ 0.93m - Jan. 14, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
5368 Boundary Road and 6150 Thunder Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PE4480

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** December 19, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.76
TOPSOIL							
0.25		AU	1				
Very loose, brown **SILTY SAND**						1	75.76
1.07		SS	2	38	2		
Brown **SILTY CLAY**		SS	3	88	W	2	74.76
- grey by 2.2m depth		SS	4	83	4		
		SS	5	100	W	3	73.76
		SS	6	100	W	4	72.76
4.42							
End of Borehole							
(GWL @ 0.46m - Jan. 14, 2019)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
5368 Boundary Road and 6150 Thunder Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. PE4480

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** December 19, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.90
TOPSOIL							
0.30		AU	1				
Very loose, brown **SILTY SAND**							
0.97		SS	2	88	3	1	75.90
		SS	3	12	W	2	74.90
Brown **SILTY CLAY**							
		SS	4	100	W		
- grey by 3.0m depth						3	73.90
		SS	5	92	W		
						4	72.90
		SS	6	100	W		
4.42							
End of Borehole							
(GWL @ 0.42m - Jan. 14, 2019)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called "mechanical breaks") are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

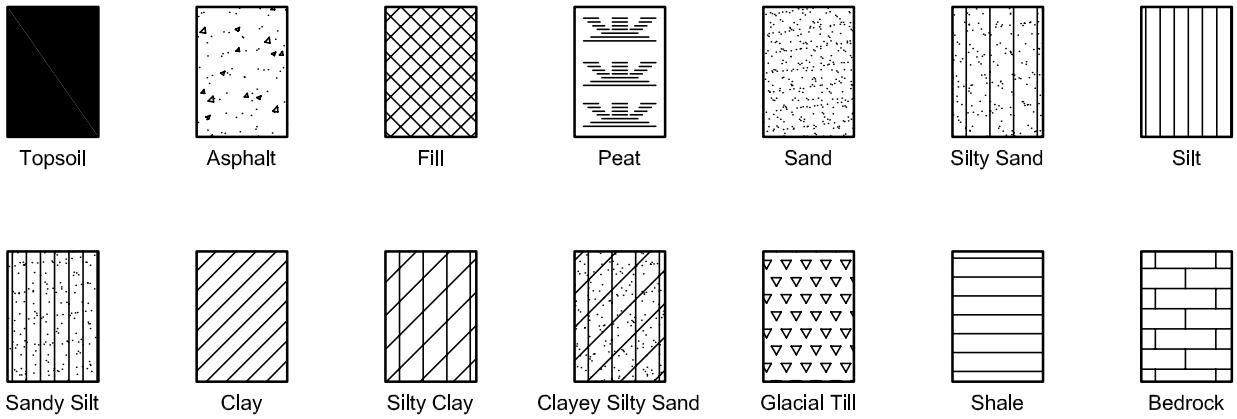
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

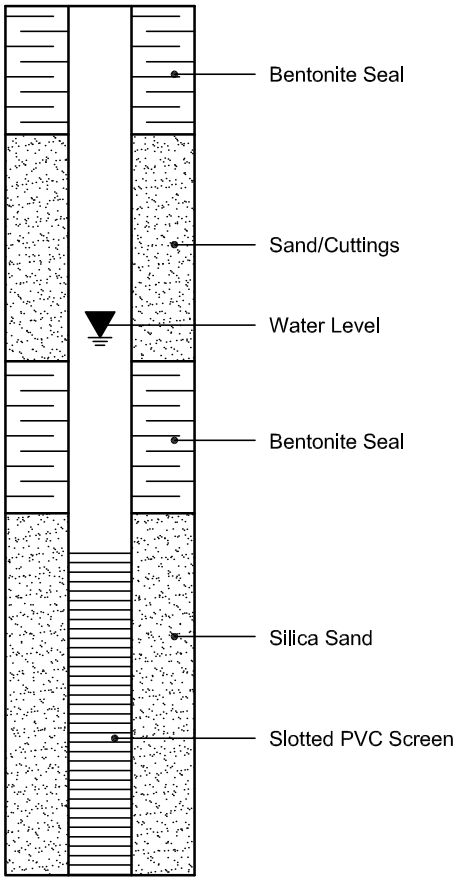
SYMBOLS AND TERMS (continued)

STRATA PLOT

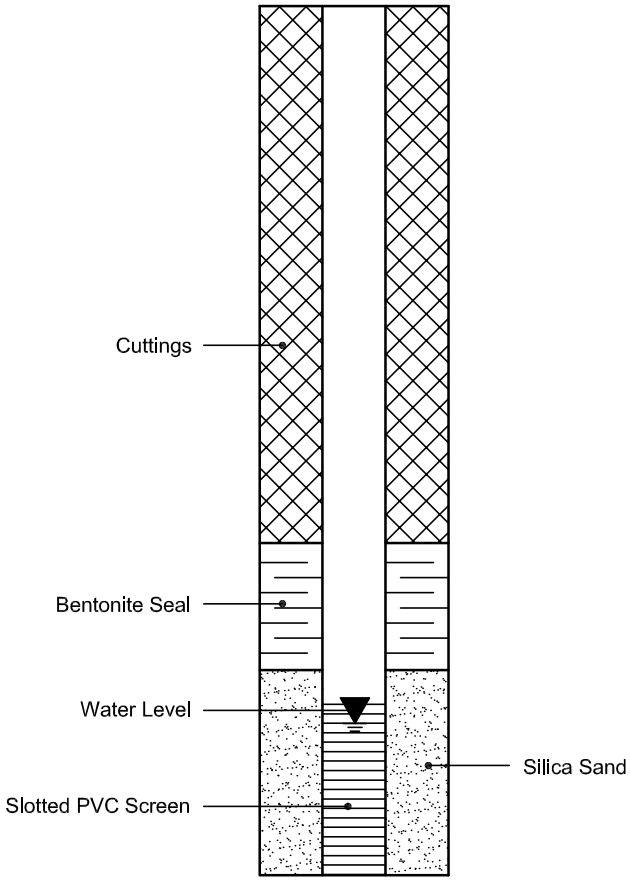


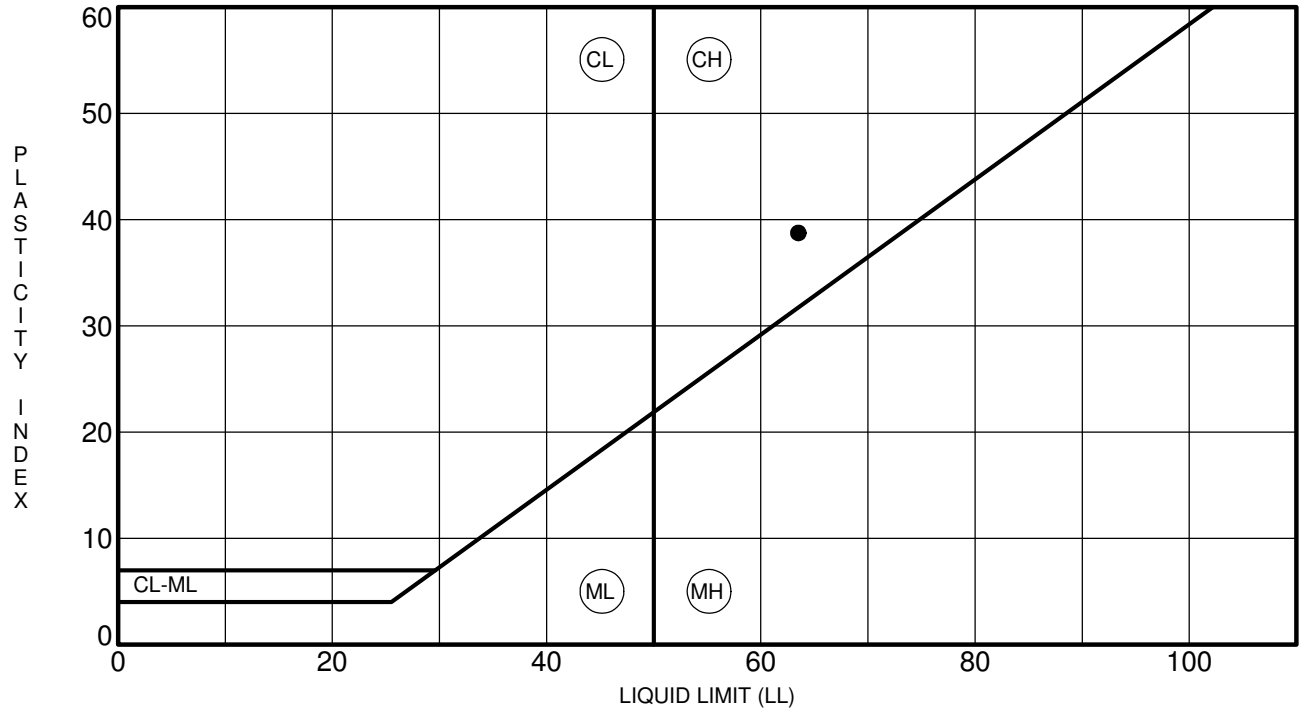
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



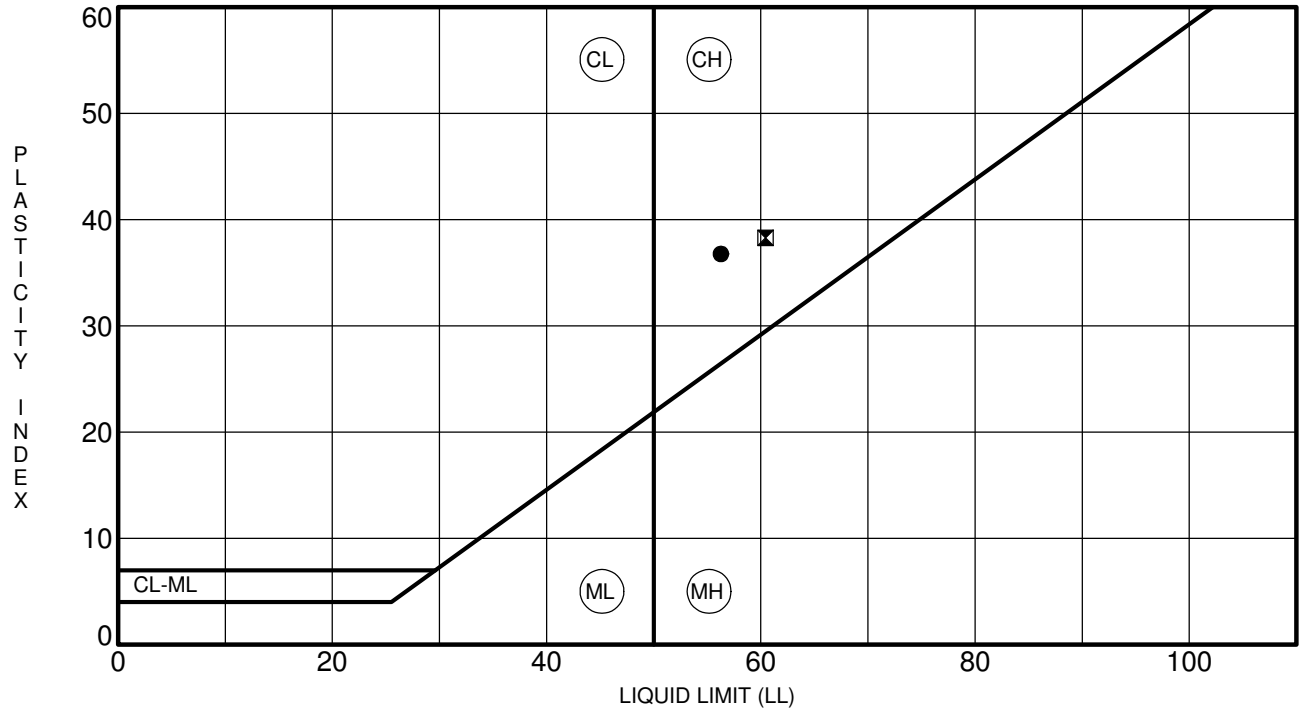


Specimen Identification	LL	PL	PI	Fines	Classification
● **BH 2-21 SS 3**	**64**	**25**	**39**		**CH - Inorganic clays of high plasticity**

CLIENT	**Exit 96 Developments**	FILE NO.	**PG5161**
PROJECT	**Geotechnical Investigation - Prop. Warehouse Development - Thunder Road**	DATE	**15 Apr 21**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

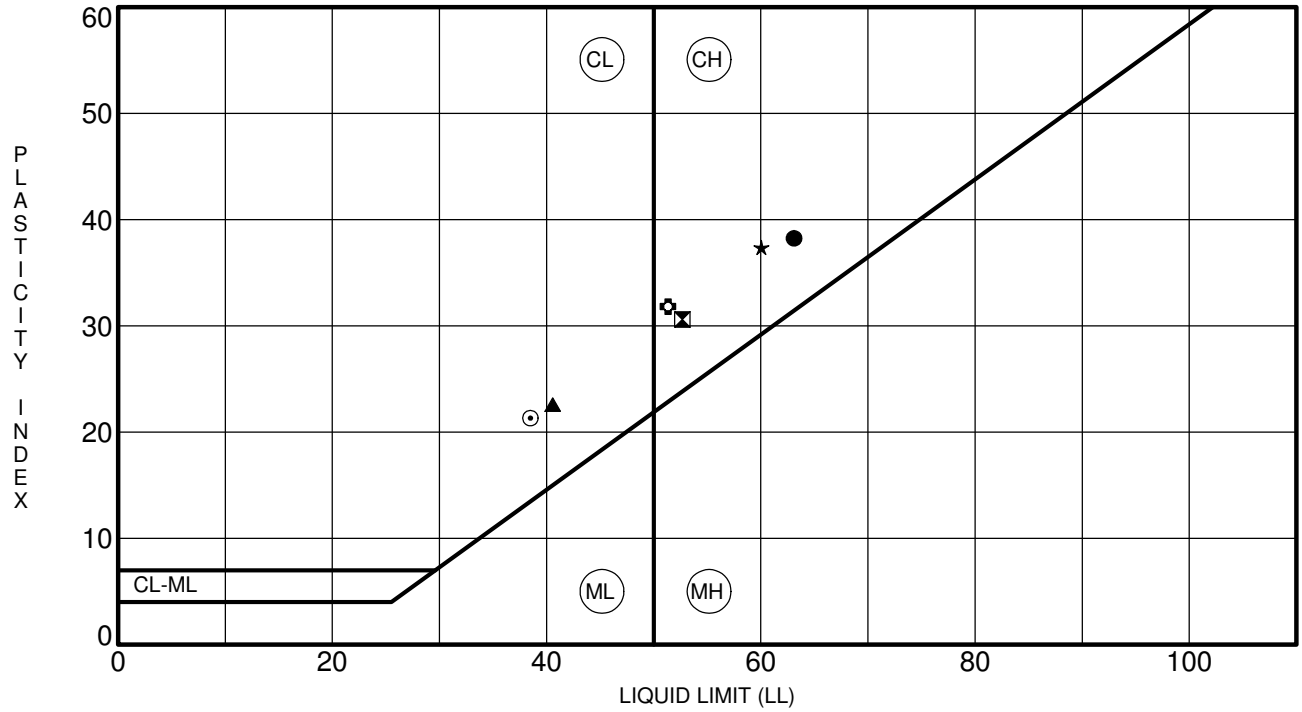


Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 5-21**	**SS 5**	**56**	**19**	**37**		**CH - Inorganic clays of high plasticity**
⊠	**BH 6-21**	**SS 5**	**60**	**22**	**38**		**CH - Inorganic clays of high plasticity**

CLIENT	**Exit 96 Developments**	FILE NO.	**PG5161**
PROJECT	**Supplemental Geotechnical Investigation - Proposed Warehouse Development - Thunder Road**	DATE	**14 Jul 21**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



Specimen Identification			LL	PL	PI	Fines	Classification
●	BH 1-20	SS 2	63	25	38		CH - Inorganic clays of high plasticity
⊠	BH 2-20	SS 2	53	22	31		CH - Inorganic clays of high plasticity
▲	BH 3-20	SS 2	41	18	23		CL - Inorganic clays of low plasticity
★	BH 4-20	SS 2	60	23	37		CH - Inorganic clays of high plasticity
⊙	BH 5-20	SS 2	38	17	21		CL - Inorganic clays of low plasticity
✿	BH 6-20	SS 3	51	20	32		CH - Inorganic clays of high plasticity

CLIENT	**Exit 96 Developments**	FILE NO.	**PG5161**
PROJECT	**Geotechnical Investigation - Prop. Warehouse Development - Thunder Road**	DATE	**30 Jun 20**

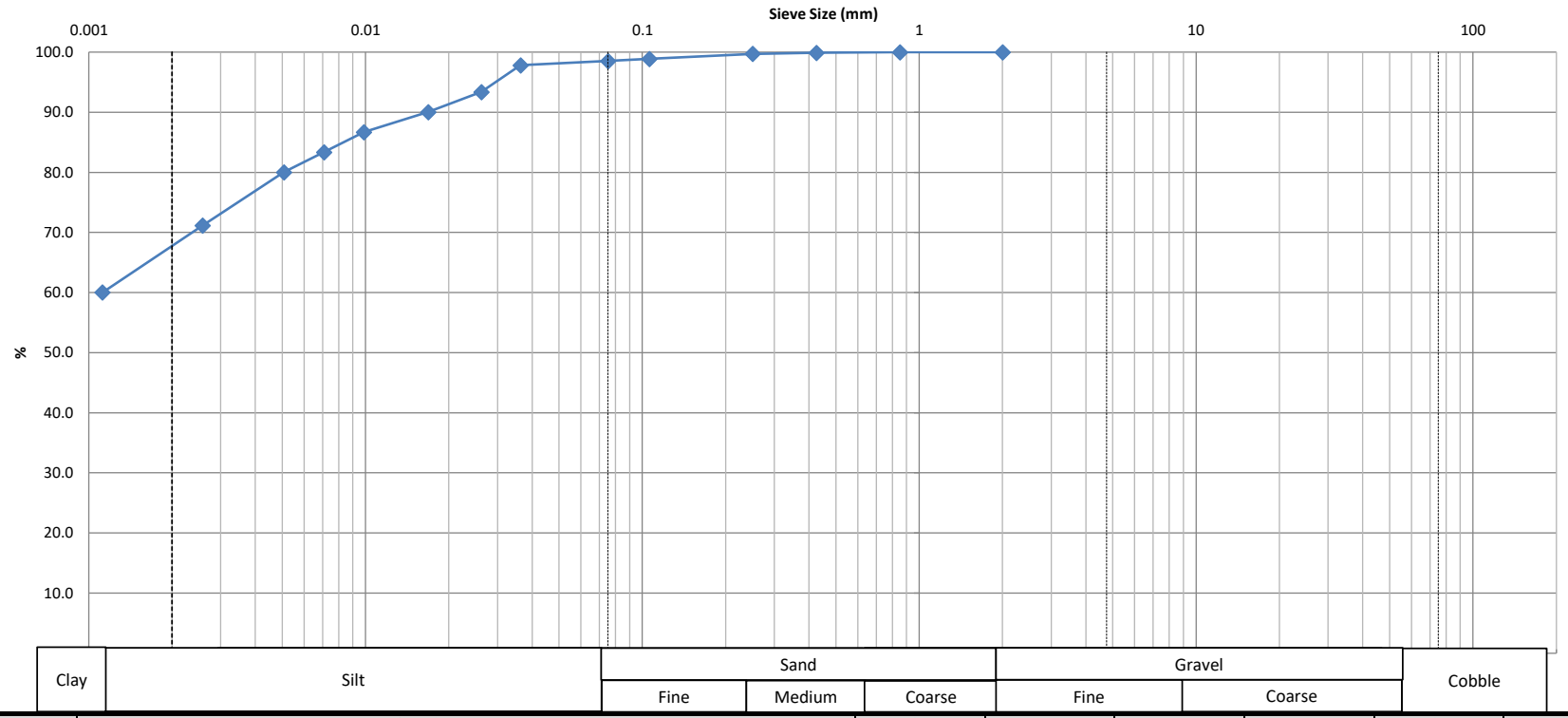
patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

patersongroup
consulting engineers

SIEVE ANALYSIS **ASTM C136**

CLIENT:	Exit 96 Developments	DEPTH:	5' - 7'	FILE NO:	PG5161
CONTRACT NO.:		BH OR TP No.:	BH6 SS3	LAB NO:	18125
PROJECT:	Thunder Road @ Boundary Road			DATE RECEIVED:	22-Jul-20
				DATE TESTED:	23-Jul-20
DATE SAMPLED:	22-Jul-20			DATE REPORTED:	0-Jan-00
SAMPLED BY:	A.C.			TESTED BY:	DB



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		40.3					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	1.5	28.0	70.5

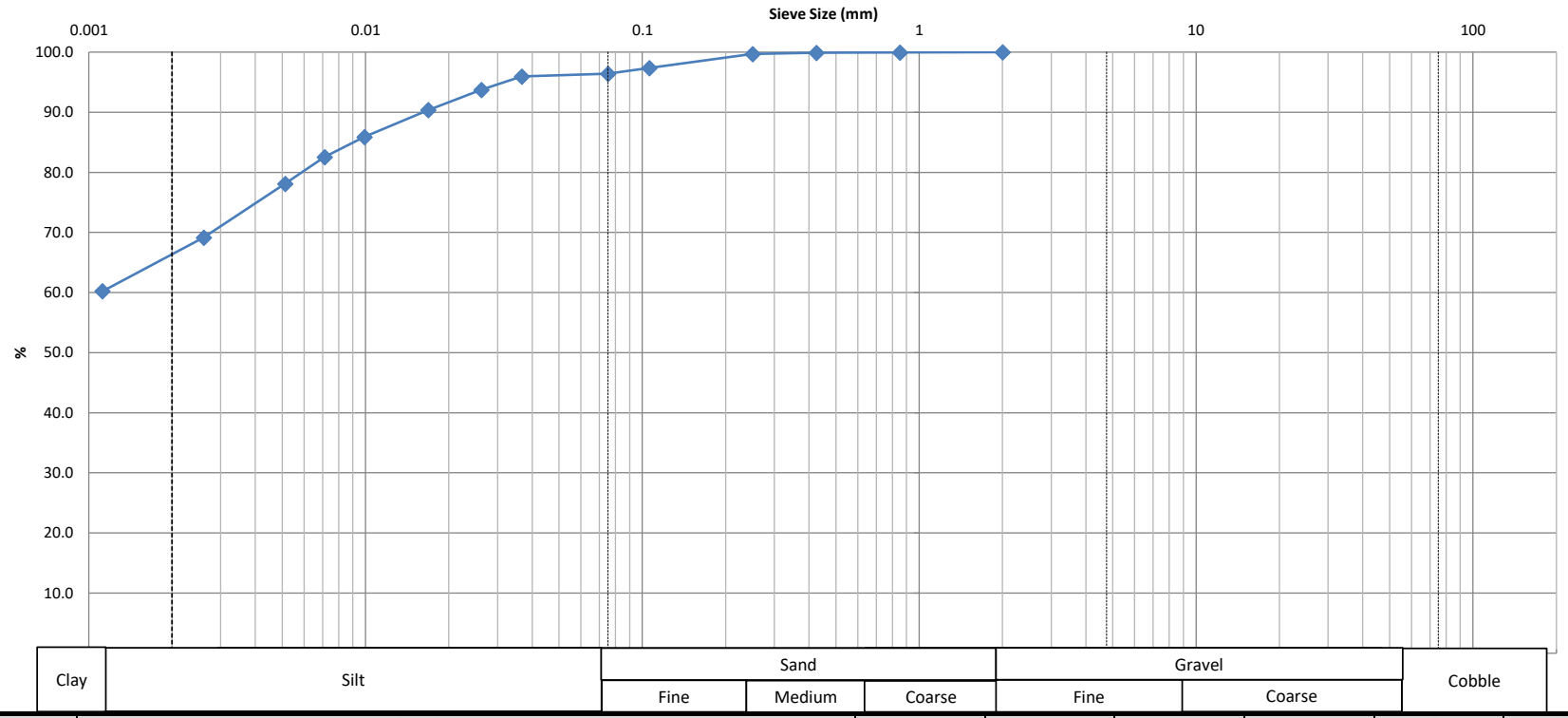
Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

patersongroup
consulting engineers

SIEVE ANALYSIS **ASTM C136**

CLIENT:	Exit 96 Developments	DEPTH:	5' - 7 '	FILE NO:	PG5161
CONTRACT NO.:		BH OR TP No.:	BH2 SS3	LAB NO:	18126
PROJECT:	Thunder Road @ Boundary			DATE RECEIVED:	22-Jul-20
				DATE TESTED:	23-Jul-20
DATE SAMPLED:	22-Jul-20			DATE REPORTED:	1-Aug-20
SAMPLED BY:	A.C.			TESTED BY:	DB



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						38.7					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	3.6		25.9		70.5	

Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

Certificate of Analysis

Report Date: 14-Jul-2020

Client: Paterson Group Consulting Engineers

Order Date: 8-Jul-2020

Client PO: 30331

Project Description: PG5161

	Client ID:	BH6-SS3	-	-	-
	Sample Date:	02-Jul-20 11:00	-	-	-
	Sample ID:	2028331-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	65.5	-	-	-
General Inorganics					
pH	0.05 pH Units	8.28	-	-	-
Resistivity	0.10 Ohm.m	30.3	-	-	-
Anions					
Chloride	5 ug/g dry	17	-	-	-
Sulphate	5 ug/g dry	58	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG6513-1 - TEST HOLE LOCATION PLAN

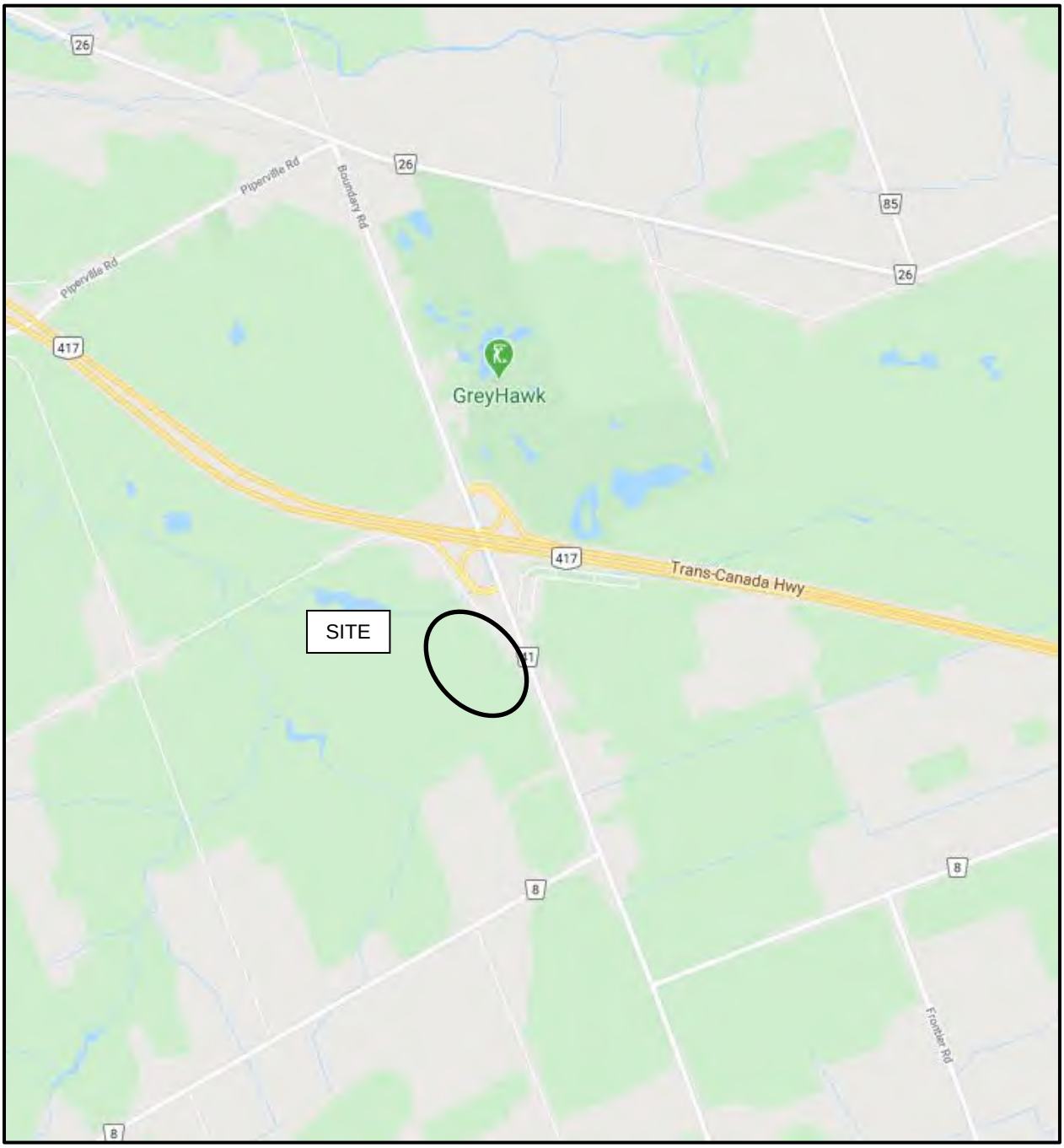


FIGURE 1

KEY PLAN

PATERSON GROUP

PATERSON GROUP

memorandum

re: **Hydrogeological Review**
Proposed Industrial Development – Northern Stormwater Management Pond
6160 Thunder Road, Ottawa, Ontario

to: Avenue 31 Capital Inc. – **Geoff Boole** – jboole@ave31.com

date: December 12, 2023

file: PG5161-MEMO.02

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to confirm the water table elevation and theoretical soil permeability at the location of the northernmost stormwater management pond being constructed as part of the proposed industrial development. The following memorandum should be read in conjunction with Paterson Report PG5161-1 Revision 3, dated July 22, 2021.

Background Information

The proposed development currently consists of several industrial structures, with associated parking/paved surfaces and servicing. As part of the proposed development, a stormwater management pond (SWMP) is being designed within the northern portion of the site to service a portion of the development. Based on existing drawings, it is understood that the SWMP is being designed with a flat bottom and an invert elevation of 75.8 m above sea level (asl). It is further understood that the outlet structure of the pond is located at the northwestern end of the pond, however the invert of the structure was not known at the time of report preparation.

Hydrogeological Review

A series of geotechnical investigations were undertaken between July 2020 and April 2021 to confirm soil and groundwater conditions on site. The soil profile at the test hole locations within the area of the proposed SWMP consisted of topsoil overlying a thin layer of sand, which was further underlain by a silty clay deposit. At the time of the field investigation, water levels within the area of the proposed SWMP (BH5-21 and BH6-21) ranged from approximate elevations of 75.5 to 75.6 m asl.

Based on the elevation of the water table at the time of the geotechnical investigation relative to the anticipated invert depth of the proposed SWMP noted above (75.8 m asl), the pond has been designed with an invert depth above the anticipated water level in that area. It is worth noting that water levels can fluctuate both seasonally and in conjunction with precipitation events. Therefore, water levels may vary at the time of construction.

Soil Permeability

As previously noted, surficial soils on site generally consist of topsoil overlying a thin layer of silty sand, further underlain by a deposit of silty clay. While in-situ testing has not been completed as of yet in support of the proposed development, theoretical permeabilities can also be used to gain an understanding of potential infiltration rates on-site. Theoretical permeabilities for the above noted materials are as follows:

- Silty sand - 50 to 100 mm/hr.
- Silty clay - <10 to 30 mm/hr.

It is important to note that the above rates are unfactored. Prior to consideration for use in stormwater management design, a minimum safety correction factor of 2.5 will need to be applied to these rates to account for progressive degradation of infiltration potential and variations in soil composition.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

Michael Laflamme, P.Geo.

APPENDIX 3

HYDROGEOLOGICAL ASSESSMENT

BOUNDARY ROAD

THUNDER ROAD

BH 1
77.22

BH 1-20
76.32

BH 1-21
76.96

BH 2-21
76.76
(55.63)

BH 2-20
76.62
(55.46)

BH 2
76.76

BH 3
76.90

BH 3-21
76.33

BH 3-20
76.90

BH 4-21
76.53
(58.17)

BH 4-20
76.46

BH 5-21
76.34

BH 5-20
77.03
(60.75)

BH 6-21
76.30

BH 6-20
76.93

BH 7-20
76.90

LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION, PATERSON GROUP REPORT PE4480, 2018
- 77.03 GROUND SURFACE ELEVATION (m)
- (60.75) PRACTICAL DCPT REFUSAL ELEVATION (m)

ALL GROUND SURFACE ELEVATIONS REFERENCE A GEODETIC DATUM (NAD83 ZONE 18T).

SCALE: 1:2500

0 25 50 75 100 125 150 175m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
2	BH 3-21 AND BH 6-21 ADDED	19/07/2021	JV
1	BH 1-21 AND BH 2-21 ADDED	21/04/2021	JV

AVENUE 31

GEOTECHNICAL INVESTIGATION
6150 THUNDER ROAD AND 5368 BOUNDARY ROAD
OTTAWA, ONTARIO

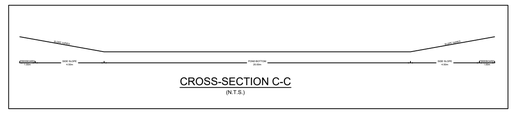
Title:

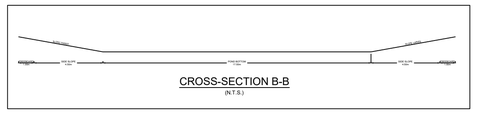
TEST HOLE LOCATION PLAN

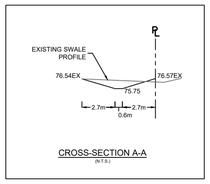
Scale: 1:2500	Date: 08/2020
Drawn by: NFRV	Report No.: PG5161-1
Checked by: JV	PG5161-1
Approved by: DJG	Revision No.: 2

p:\autocad drawings\geotechnical\pg51xx\pg5161\pg5161-1 thlp rev2.dwg

Appendix E Grading & Drainage Plan







NOTE:

- REFER TO C000 FOR LEGEND AND GENERAL NOTES

USE AND INTERPRETATION OF DRAWINGS

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION ARE PART OF THE CONTRACT DOCUMENTS AND DESCRIBE USE AND INTENT OF THE DRAWING. THE CONTRACT DOCUMENTS INCLUDE NOT ONLY THE DRAWINGS, BUT ALSO THE OWNER-CONTRACTOR AGREEMENTS, CONDITIONS OF THE CONTRACT, THE SPECIFICATIONS, ADDENDA, AND MODIFICATIONS ISSUED AFTER EXECUTION OF THE CONTRACT. THESE CONTRACT DOCUMENTS ARE COMPLEMENTARY, AND WHAT IS REQUIRED BY ANY ONE SHALL BE BINDING AS IF REQUIRED BY ALL. WORK NOT COMPLETELY DELINEATED HEREON SHALL BE CONSTRUCTED OF THE SAME MATERIALS AND DETAILED SIMILARLY AS WORK SHOWN MORE COMPLETELY ELSEWHERE IN THE CONTRACT DOCUMENTS.

BY USE OF THE DRAWINGS FOR CONSTRUCTION OF THE PROJECT, THE OWNER CONFIRMS THAT HE HAS REVIEWED AND APPROVED THE DRAWINGS. THE CONTRACTOR CONFIRMS THAT HE HAS VISITED THE SITE, FAMILIARIZED HIMSELF WITH THE LOCAL CONDITIONS, VERIFIED FIELD DIMENSIONS AND CORRELATED HIS OBSERVATIONS WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

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THESE DRAWINGS ILLUSTRATES THE WORK TO BE DONE. THE ENGINEER IS NOT RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES USED TO DO THE WORK, OR THE SAFETY ASPECTS OF CONSTRUCTION, AND NOTHING ON THESE DRAWINGS EXPRESSED OR IMPLIED CHANGES THIS CONDITION. CONTRACTOR SHALL DETERMINE ALL CONDITIONS AT THE SITE AND SHALL BE RESPONSIBLE FOR KNOWING HOW THEY AFFECT THE WORK. SUBMITTAL OF A BID TO PERFORM THIS WORK IS ACKNOWLEDGEMENT OF THE RESPONSIBILITIES, AND THAT THEY HAVE BEEN FULLY CONSIDERED IN PLANNING OF THE WORK, AND THE BID PRICE. NO CLAIMS FOR EXTRA CHARGES DUE TO THESE CONDITIONS WILL BE FORTHCOMING.

UNAUTHORIZED CHANGES:

IN THE EVENT THE CLIENT, THE CLIENT'S CONTRACTORS OR SUBCONTRACTORS, OR ANYONE FOR WHOM THE CLIENT IS LEGALLY LIABLE MAKES OR PERMITS TO BE MADE ANY CHANGES TO ANY REPORTS, PLANS, SPECIFICATIONS OR OTHER CONSTRUCTION DOCUMENTS PREPARED BY LRL ASSOCIATES LTD. (LRL) WITHOUT OBTAINING LRL'S PRIOR WRITTEN CONSENT, THE CLIENT SHALL ASSUME FULL RESPONSIBILITY FOR THE RESULTS OF SUCH CHANGES. THEREFORE THE CLIENT AGREES TO WAIVE ANY CLAIM AGAINST LRL AND TO RELEASE LRL FROM ANY LIABILITY ARISING DIRECTLY OR INDIRECTLY FROM SUCH UNAUTHORIZED CHANGES.

IN ADDITION, THE CLIENT AGREES, TO THE FULLEST EXTENT PERMITTED BY LAW, TO INDEMNIFY AND HOLD HARMLESS LRL FROM ANY DAMAGES, LIABILITIES OR COST, INCLUDING REASONABLE ATTORNEY'S FEES AND COST OF DEFENSE, ARISING FROM SUCH CHANGES.

IN ADDITION, THE CLIENT AGREES TO INCLUDE IN ANY CONTRACTS FOR CONSTRUCTION APPROPRIATE LANGUAGE THAT PROHIBITS THE CONTRACTOR OR ANY SUBCONTRACTORS OF ANY TIER FROM MAKING ANY CHANGES OR MODIFICATIONS TO LRL'S CONSTRUCTION DOCUMENTS WITHOUT THE PRIOR WRITTEN APPROVAL OF LRL AND THAT FURTHER REQUIRES THE CONTRACTOR TO INDEMNIFY BOTH LRL AND THE CLIENT FROM ANY LIABILITY OR COST ARISING FROM SUCH CHANGES MADE WITHOUT SUCH PROPER AUTHORIZATION.

GENERAL NOTES:

EXISTING SERVICES AND UTILITIES SHOWN ON THESE DRAWINGS ARE TAKEN FROM THE BEST AVAILABLE RECORDS, BUT MAY NOT BE COMPLETE OR TO DATE. CONTRACTOR SHALL VERIFY IN FIELD FOR LOCATION AND ELEVATION OF PIPES AND CHECK WITH THE UTILITY COMPANIES BEFORE DIGGING OR PERFORMING WORK.

CONTRACTOR IS ADVISED TO COLLECT INFORMATION ON SOIL CONDITIONS BEFORE START OF CONSTRUCTION.

THE ENGINEER WAIVES ANY AND ALL RESPONSIBILITY AND LIABILITY FOR PROBLEMS WHICH ARISE FROM FAILURE TO FOLLOW THESE PLANS, SPECIFICATIONS AND THE DESIGN INTENT THEY CONVEY, OR FOR PROBLEMS WHICH ARISE FROM OTHERS' FAILURE TO OBTAIN AND/OR FOLLOW THE ENGINEER'S GUIDANCE WITH RESPECT TO ANY ERRORS, OMISSIONS, INCONSISTENCIES AMBIGUITIES OR CONFLICTS WHICH ARE ALLEGED.

CONTRACTOR TO VERIFY ALL DIMENSIONS AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES BEFORE WORK COMMENCES. DO NOT SCALE DRAWINGS.

20m 10 0 20 40m

SCALE: 1:1000

No.	REVISIONS	BY	DATE
03	ISSUED FOR APPROVAL	V.J.	16 AUG 2024
02	ISSUED FOR APPROVAL	V.J.	24 MAY 2023
01	ISSUED FOR APPROVAL	V.J.	25 NOV 2021

LICENSED PROFESSIONAL ENGINEER
V. JOHNSON
100510576
08-16-2024
PROVINCE OF ONTARIO

NOT AUTHENTIC UNLESS SIGNED AND DATED

LRL
ENGINEERING | INGÉNIERIE
5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

CLIENT

AVENUE 31

DESIGNED BY:	DRAWN BY:	APPROVED BY:
V.J.	M.L.	V.J.

PROJECT

INDUSTRIAL PARK
6160 THUNDER RD AND 5368 BOUNDARY RD
OTTAWA, ON

DRAWING TITLE

GRADING AND DRAINAGE -
OVERALL PLAN

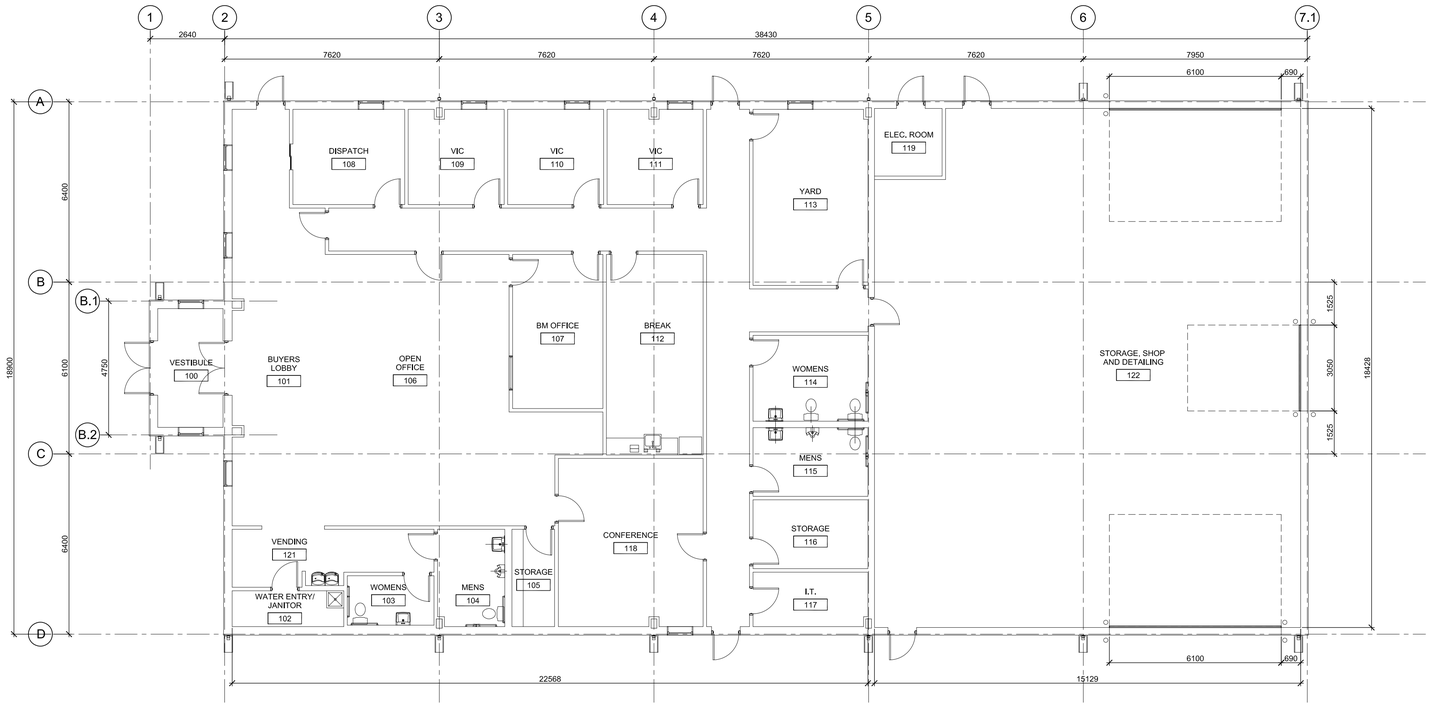
PROJECT NO.
200578

DATE
NOVEMBER 2020

C301

D07-12-21-0205

Appendix F Elevations Drawing



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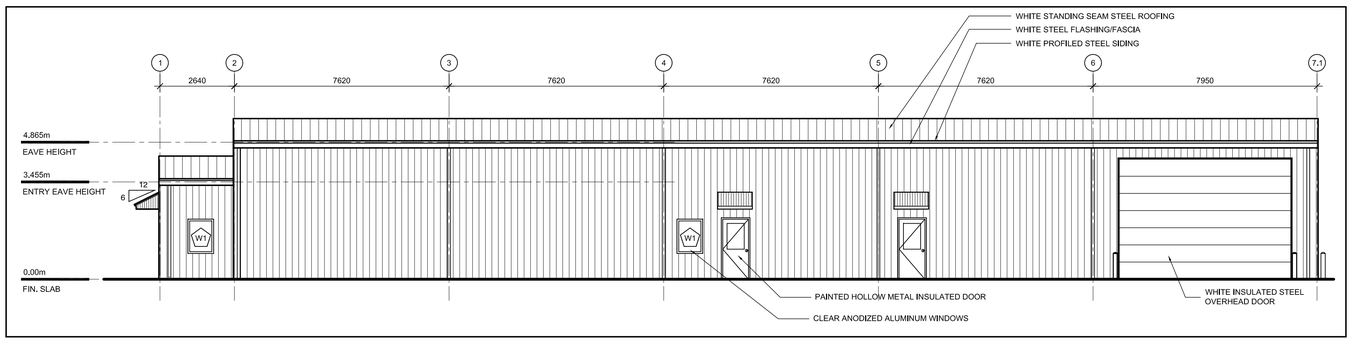

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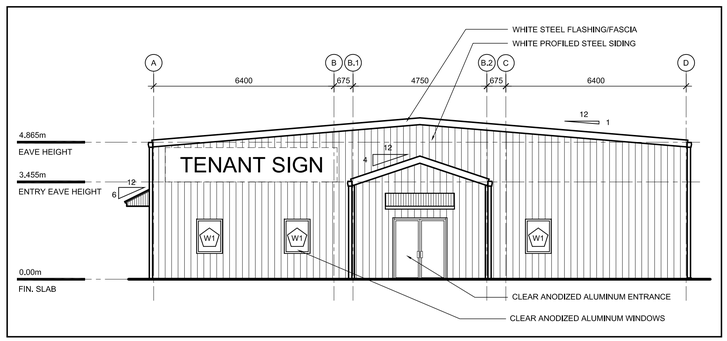

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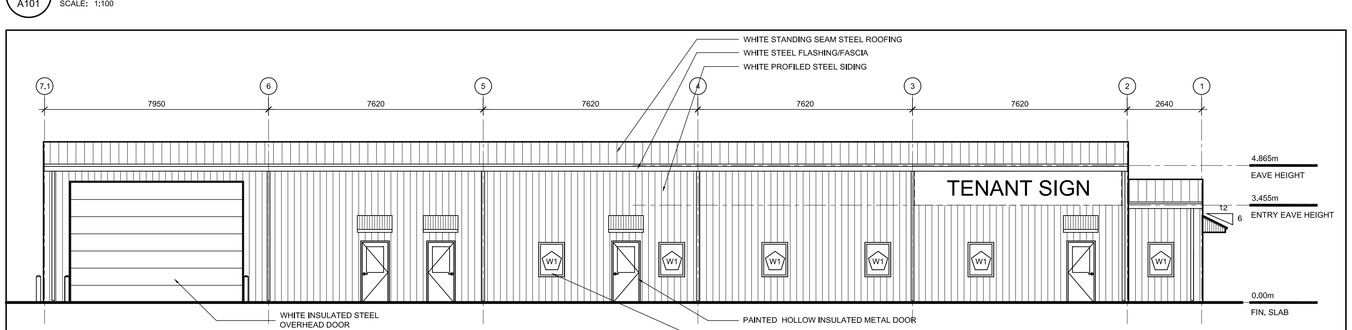

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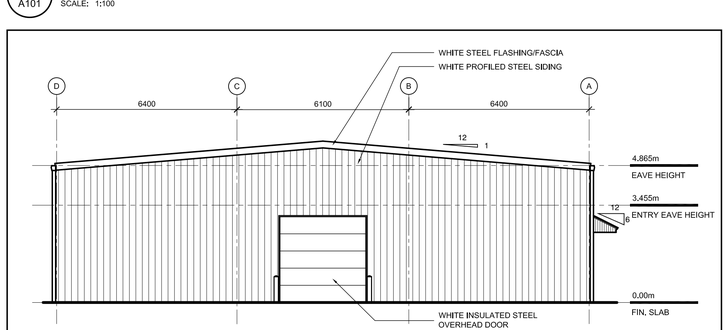


01 A101 MAIN BUILDING WEST ELEVATION
SCALE: 1:100

24 X 36 – PLOT ARCH D

MCROBIE
ARCHITECTS + INTERIOR DESIGNERS

OWNER:
AVENUE 31 CAPITAL INC.
801-250 City Centre
Ottawa, ON K1R 6R7

PLANNING CONSULTANT:
RE:PUBLIC URBANISM
Montreal, QC

CIVIL ENGINEER:
LRL ENGINEERING
5430 Canotek Road
Ottawa, ON K1J 9G2

LANDSCAPE ARCHITECTS:
JAMES B. LENNOX & ASSOCIATES INC.
3332 Carling Avenue
Ottawa, ON K2H 5A8

TRAFFIC ENGINEERING
C.F. CROZIER & ASSOCIATES INC.
211 Yonge Street, Suite 600
Toronto, ON M5B 1M4

North

Revisions

No.	By	Description	Date
01	AK	ISSUED FOR SPA	2024-08-16

Project
THUNDER ROAD INDUSTRIAL PARK

6160 THUNDER ROAD, OTTAWA

Drawing
IAAI MAIN BUILDING FLOOR PLAN AND ELEVATIONS

Scale: AS NOTED
Drawn: AK
Checked: JAS

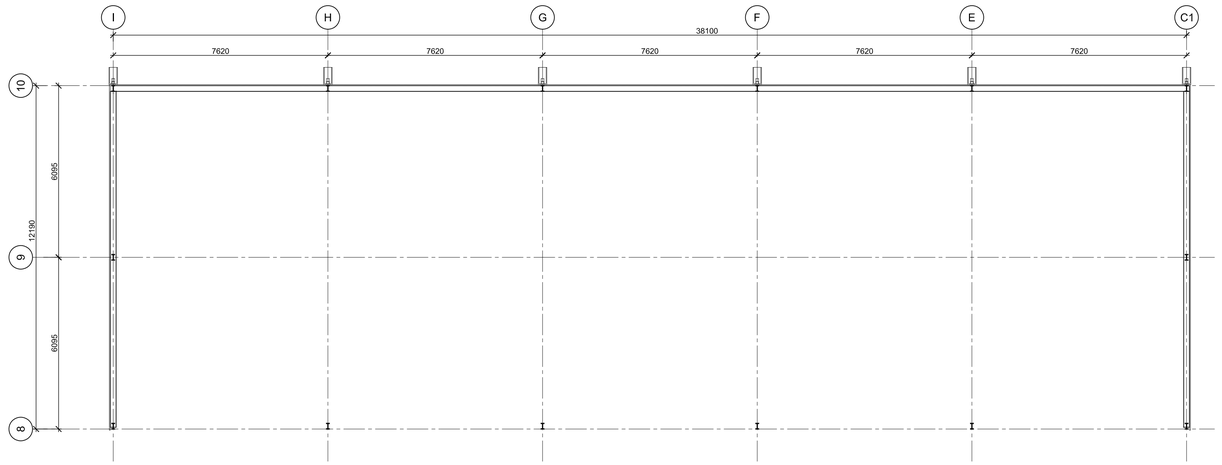
Stamp
ONTARIO ASSOCIATION OF ARCHITECTS
JILL TROWER
LICENCE 5833

Project No.: 21-135
Date: JULY 2024

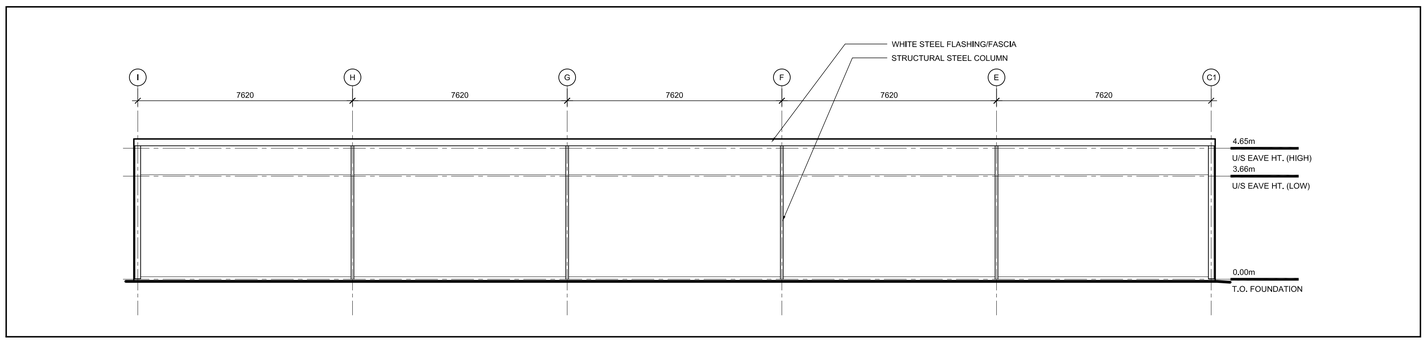
Drawing No.: A101

PLAN NO. _____

2024-12-21 07:02:05



05 FLOOR PLAN
A102 SCALE: 1:100



04 VIC/MC SHED EAST ELEVATION
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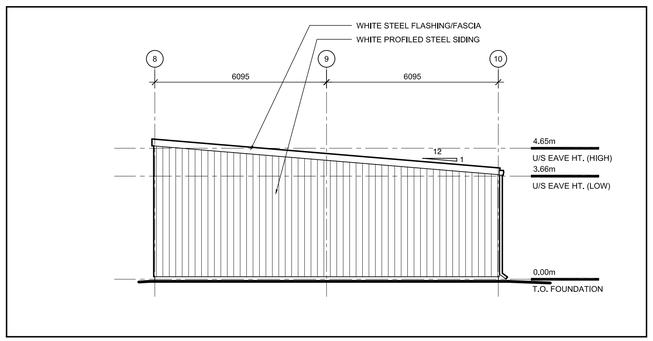

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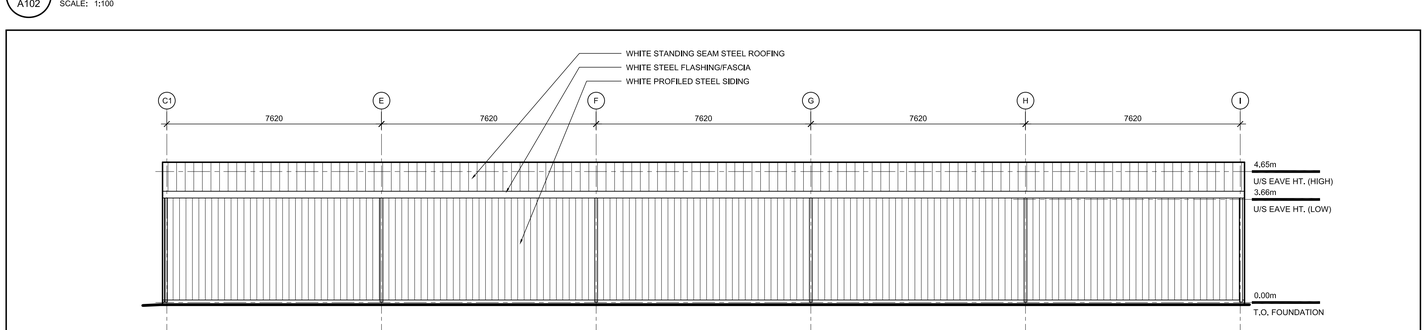

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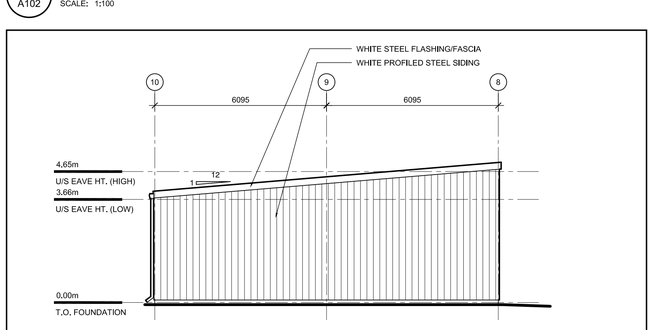

01 VIC/MC SHED NORTH ELEVATION
A102 SCALE: 1:100

24 X 36 – PLOT ARCH D

MCROBIE
ARCHITECTS + INTERIOR DESIGNERS

OWNER:
AVENUE 31 CAPITAL INC.
801-250 City Centre
Ottawa, ON K1R 6R7

PLANNING CONSULTANT:
RE:PUBLIC URBANISM
Montreal, QC

CIVIL ENGINEER:
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5430 Canotek Road
Ottawa, ON K1J 9G2

LANDSCAPE ARCHITECTS:
JAMES B. LENNOX & ASSOCIATES INC.
3332 Carling Avenue
Ottawa, ON K2H 5A8

TRAFFIC ENGINEERING
C.F. CROZIER & ASSOCIATES INC.
211 Yonge Street, Suite 600
Toronto, ON M5B 1M4

North

Revisions

No.	By	Description	Date
01	AK	ISSUED FOR SPA	2024-08-16

Project

THUNDER ROAD INDUSTRIAL PARK

6160 THUNDER ROAD, OTTAWA

Drawing

VIC/MC SHED FLOOR PLAN AND ELEVATIONS

Scale: AS NOTED

Drawn: AK

Checked: JAS

Stamp: ONTARIO ASSOCIATION OF ARCHITECTS — JILL TROWER LICENCE 5833

Project No.: 21-135

Drawing No.: A102

Date: JULY 2024

PLAN NO. _____

D07-12-21-0205

Appendix G O1R Zone Uses in the City of Ottawa

O1R Zone Uses in the City of Ottawa

ObjectID	Natural/ Naturalized	Storm water pond	Building	Hardened Surface	Unknown Structure	Description
2957078	Y					Natural, forested area bordering Rideau River
2957549	Y				Y	Natural, forested area bordering Rideau River with some sort of structure running from the road to the river
2958409	Y		Y	Y		Natural, forested area bordering Rideau River. Contains Hickman Consevration Area, the backyard of a house on Clingin Ln and a paved area on corner of Aston Rd and Clingin Ln.
2958546		Y		Y		Lawn outside of strip mall with a stormwater channel. Area contains Hazelean Rd, the sidewalk and the grassy median.
2960122	Y			Y		Natural, forested area close to Jock River containing road access to the river
2960239	Y	Y	Y	Y		Area bordering Rideau River. Contains Chapman Mills Conservation Area, bike path, roads, a house and the conservation area building, part of the vimy memorial bridge, and a storm water pond on the north end of the zone
2960443	Y	Y	Y	Y		Largely storm water pond called "Monahan Drain" near community on corner of Eagleson Rd and Hope Side Rd. Contains maintenance buidlings, some forested area, roads and paths around the storm water drain.
2960533	Y	Y		Y		Series of storm water channels and ponds. Contains patches of natural forested areas and paths/roads around the stormwater channels. Crosses and contains part of compass street
2960581	Y					Area just northeast of 2960122. Natural forested area by Jock River.
2961135	Y	Y		Y		Area just west of 2960533. Contains storm water channel, naturalized area around the channel and paths/roads.
2961176	Y			Y		Forested area bordering Jock River. Contains path near river.
2962062	Y					Forested area on other side of Jock River to 2961176
2962178	Y	Y	Y	Y		Multipurpose area containing Baxter Conservation Area, Baxter beach, roads, paths, parking lots, a pond (maybe stormwater pond) with docks, barn, houses and buildings associated with the consevration area and beach. Also contains forested and agricultural land. Designated as O1R[455r]
2962457	Y					Forested
2962467	Y					Forsted/wetland area near Rideau River
2964736	Y					Area adjacent to 2962467. Forested/wetland area called Sanders Island on Rideau River

2962652	Y	Y		Y		Contains sotrmwater ponds and natural water channels, some forested patches and roads/paths
2962728	Y			Y		Contains agricultural land (past or present), forested area and Brown Natural Area. Bordering Jock River. Contains flattened path for driveway.
2970127	Y					Forested area bordering and on other side of Jock River to
2963680	Y			Y		Forested and gravel area bordering Jock River. Contains bridge and path.
2964503	Y			Y		Forested, natural water channels, grated area.
2965604	Y	Y		Y		Forested, path, and water channel that may be a storm water drain that leads into Beaver Pond
2966305	Y	Y		Y		Area within 2967517 containing forest, manmade water channel and some flatened area for parking lot
2967517	Y	Y				Naturalized manmade channel.
2968667	Y	Y		Y		Area attached to 2967517. Naturalized manmade channel, grated area.
2966441	Y		Y	Y		Area just northwest of 2957549. Forested bordering Rideau River. Contains house and driveway
2966446	Y			Y		Forested/wetland area with road on border of area
2966578	Y			Y		Forested area, path/road. Adjacent to 2971717
2971717	Y			Y		Natural channel, forest patches, paths/roads
2966712	Y		Y	Y		Within Rideau Valley Conservation Area. Forest, grass, meadow, manmade pond, buildings, paths, roads, parking lots.
2967359	Y					Small area on Rideau River (maybe meant to be on water's edge)
2970315	Y					Small area on Rideau River adjacent to 2967359 (maybe meant to be on water's edge)
2970219	Y			Y		Natural water channel with forested and grated area surrounding. Path on north boundary.
2970817	Y			Y		Forested area with path running through. Close to Rideau River
2971509	Y		Y	Y		Forested area, buildings associated with Baxter Workshop, road, path, parking lot
2971306	Y			Y		Deforested/graveled area bordering Ottawa River near Ozie's Marina. Some forested/wetland area
2971627	Y	Y		Y		Natural (?) channel surrounding by forested/deforeseted area and paths/roads. Contains small area of a stormwater pond
2974112	Y					Natural channel surrounded by forest

Appendix H Updated Floodplain/SNCA Regulation Limit

DRAFT

MAP No. 67
CARTE No.

ONTARIO REGULATION 97/04: REGULATION
FOR DEVELOPMENT, INTERFERENCE WITH
WETLANDS AND ALTERATIONS TO SHORELINES
AND WATERCOURSES ONTARIO REGULATION 170 / 06

BEAR BROOK ET SES AFFLUENTS

BEAR BROOK AND TRIBUTARIES

ONTARIO REGULATION 97/04: DÉVELOPPEMENT,
INTERFÉRENCE AVEC LES TERRES HUMIDES ET
ALTÉRATIONS DES BERGES ET DES COURS D'EAU
ONTARIO REGULATION 170 / 06

Legend / Légende

Regulation Limit / Limite Règlementaire

Stream / Ruisseau

Road / Rue

Lot, Concession / Lot, Concession

SOUTH NATION CONSERVATION
DE LA NATION SUD

INDEX CONTOUR 1 METRE INTERVAL
NORTH AMERICAN DATUM 1983
COURBES DE NIVEAU PRINCIPALES DE 1.0 MÈTRE
SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRIQUE 1983

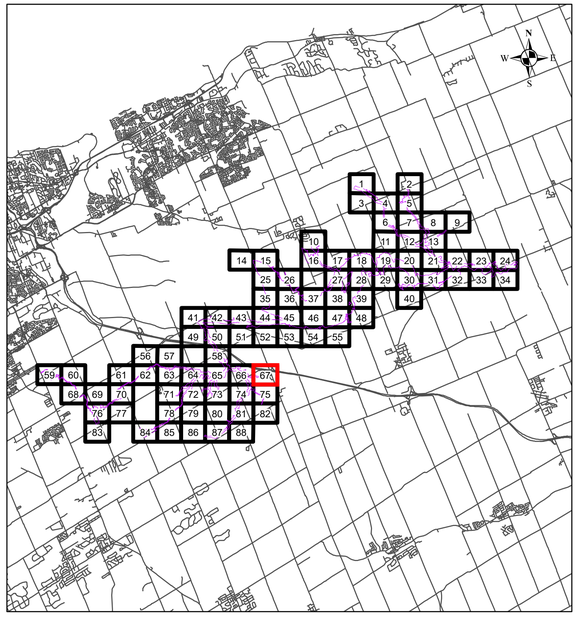
GENERAL INFORMATION

Vertical Datum: Mean sea level
Horizontal Datum: North American 1983
Map Projection: Ottawa Transverse Mercator Projection

RENSEIGNMENTS GÉNÉRAUX

Niveau de référence vertical: niveau moyen de la mer
Niveau de référence horizontal: Nord-americain 1983
Projection cartographique: Projection Mercator Transverse d'Ottawa

SHEET INDEX / TABLEAU D'ASSEMBLAGE



No.	Amendment/Revision	Date

0 50 100 200 300 400 500
Meters/Métres

1:2,000

Appendix I Landscape Plan

PROPOSED PLANT LIST (QTY. KEY)

KEY	QTY.	BOTANICAL NAME	COMMON NAME	SIZE	CONDITION	REMARKS	NATIVE SPECIES
TREES							
BW	3	Tilia americana	Basswood	50mm cal.	B&B		YES
FM	4	Acer x freemanii	Freeman's Maple	50mm cal.	B&B		YES
HB	2	Celtis occidentalis	Hackberry	50mm cal.	B&B		YES
RM	5	Acer rubrum	Red Maple	50mm cal.	B&B		YES
SI	2	Acer saccharinum	Silver Maple	50mm cal.	B&B		YES
SHRUBS							
BW	28	Cornus sericea	Red Osier Dogwood	800mm ht.	Potted		YES

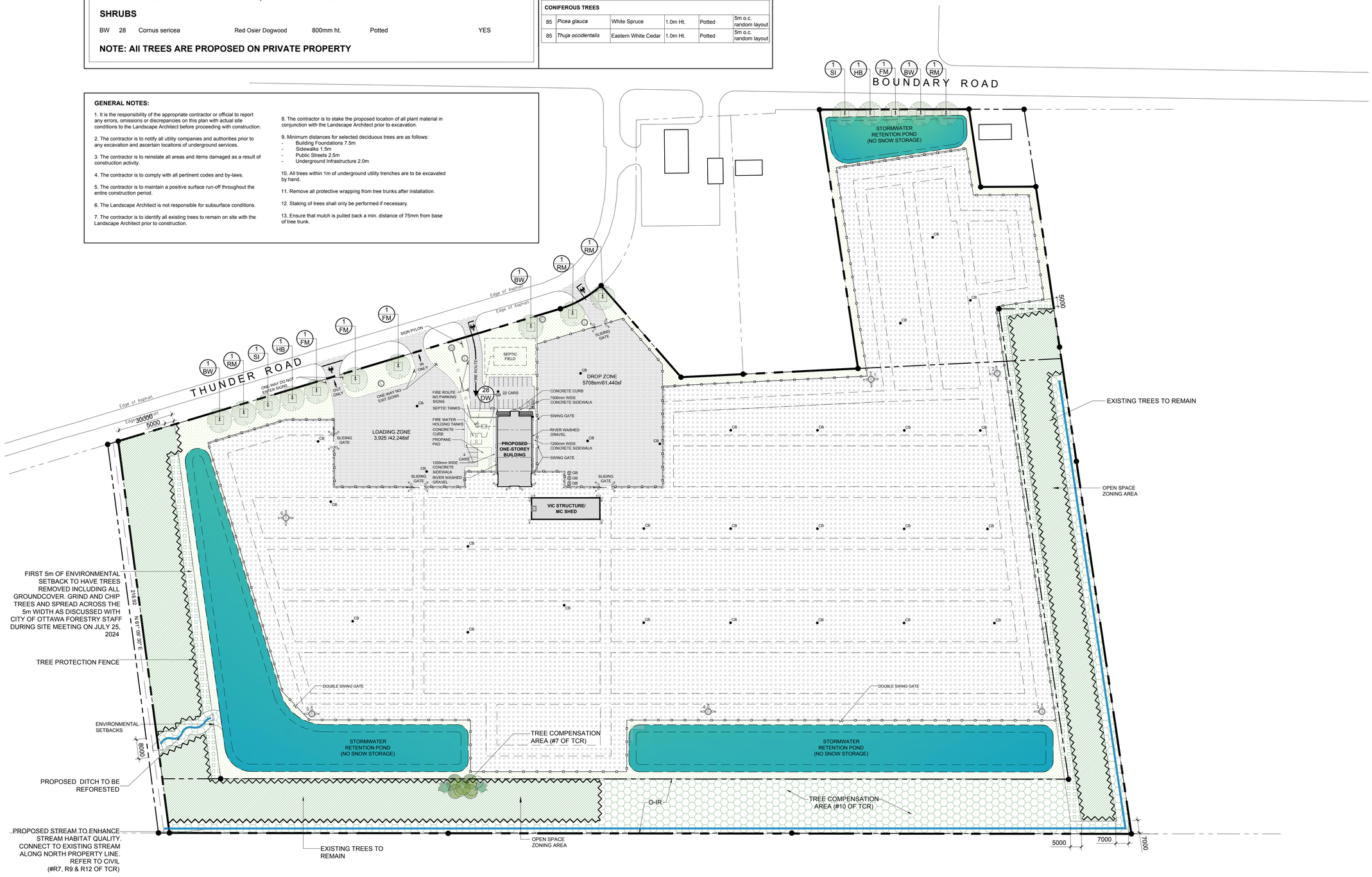
NOTE: All TREES ARE PROPOSED ON PRIVATE PROPERTY

PROPOSED TREE COMPENSATION AREA PLANT LIST

QTY	BOTANICAL NAME	COMMON NAME	SIZE	CONDITION	SPACING
DECIDUOUS TREES					
85	*Acer rubrum*	Red Maple	35mm cal.	Potted	5m o.c. random layout
85	*Betula papyrifera*	White Birch	35mm cal.	Potted	5m o.c. random layout
84	*Populus balsamifera*	Balsam Poplar	35mm cal.	Potted	5m o.c. random layout
84	*Populus tremuloides*	Trembling Aspen	35mm cal.	Potted	5m o.c. random layout
CONIFEROUS TREES					
85	*Picea glauca*	White Spruce	1.0m Ht.	Potted	5m o.c. random layout
85	*Thuja occidentalis*	Eastern White Cedar	1.0m Ht.	Potted	5m o.c. random layout

GENERAL NOTES:

1. It is the responsibility of the appropriate contractor or official to report any errors, omissions or discrepancies on this plan with actual site conditions to the Landscape Architect before proceeding with construction.
2. The contractor is to notify all utility companies and authorities prior to any excavation and ascertain locations of underground services.
3. The contractor is to reinstate all areas and items damaged as a result of construction activity.
4. The contractor is to comply with all pertinent codes and by-laws.
5. The contractor is to maintain a positive surface run-off throughout the entire construction period.
6. The Landscape Architect is not responsible for subsurface conditions.
7. The contractor is to identify all existing trees to remain on site with the Landscape Architect prior to construction.
8. The contractor is to stake the proposed location of all plant material in conjunction with the Landscape Architect prior to excavation.
9. Minimum distances for selected deciduous trees are as follows:
   - Building Foundations 7.5m
   - Sidewalks 1.5m
   - Public Streets 2.5m
   - Underground Infrastructure 2.0m
10. All trees within 1m of underground utility trenches are to be excavated by hand.
11. Remove all protective wrapping from tree trunks after installation.
12. Staking of trees shall only be performed if necessary.
13. Ensure that mulch is pulled back a min. distance of 75mm from base of tree trunk.



1 TCP-01 LANDSCAPE & TREE COMPENSATION PLAN
SCALE 1:1000

CLIENT

AVENUE 31 CAPITAL INC.
801-250 CITY CENTER OTTAWA, ON K1R 6K7
Tel: 833-283-3131

CONSULTANTS

ARCHITECTS:
MCROBIE
ARCHITECTS + INTERIOR DESIGNERS
SUITE 100, 66 QUEEN STREET, OTTAWA, ON, K1P 5C6
Tel: (613) 238-2072

CIVIL ENGINEERS:
LRL ENGINEERING
540CANOTEK ROAD OTTAWA, ON, K1J 9G2
Tel (613) 842-3434

LEGEND

- PROPERTY LINE
- PROPOSED TREE COMPENSATION AREA #7 OF TCR
- PROPOSED TREE COMPENSATION AREA TO BE SEEDED FOR EROSION PROTECTION
- PROPOSED TREE COMPENSATION AREA TO BE MULCHED
- EXISTING VEGETATION TO REMAIN
- STORMWATER RETENTION POND (REFER TO CIVIL)
- PROPOSED SEEDED GRASS AREA
- PROPOSED DECIDUOUS TREE w/ 30m3 SOIL VOLUME
- PROPOSED SHRUBS
- PROPOSED GRAVEL SURFACE
- PROPOSED ASPHALT
- PROPOSED RIVER WASHED GRAVEL
- TREE PROTECTION FENCE

No.	Issue	Date MM/DD/YY	DR	CK
8	ISSUED FOR SITE PLAN SUBMISSION	08/16/2024	ML	JL
7	ISSUED FOR DISCUSSION AND REVIEW	08/02/2024	ML	JL
6	ISSUED FOR DISCUSSION AND REVIEW	07/24/2024	ML	JL
5	ISSUED PER COMMENTS AND NEW TCR	05/16/2024	CM	JL
4	ISSUED FOR COMMENTS AND REVIEW	05/14/2024	WF	JL
3	ISSUED FOR COMMENTS AND REVIEW	05/13/2024	WF	JL
2	ISSUED FOR COMMENTS AND REVIEW	05/10/2024	WF	JL
1	ISSUED FOR COMMENTS AND REVIEW	06/01/2023	WF	JL

JAMES B. LENNOX & ASSOCIATES INC.
LANDSCAPE ARCHITECTS
3332 CARLING AVE. OTTAWA, ONTARIO K2H 5A8
Tel. (613) 722-5168 **Fax. 1(866) 343-3942**

PROJECT

THUNDER ROAD INDUSTRIAL PARK
6160 THUNDER ROAD AND 5368 BOUNDARY ROAD, OTTAWA ON

DRAWING

LANDSCAPE & TREE COMPENSATION PLAN

STAMP

SCALE: AS SHOWN
START DATE: SEPTEMBER, 2021
PROJECT NO.: 21MIS2191
PROJECT NORTH
DRAWING NO.: TCP-01
PLOT SIZE ARCH-D

#D07-12-21-0205