220 Arkell Road – Guelph, ON
Environmental Impact Study

FINAL REPORT

August 28, 2019
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Prepared for:

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Abbreviations

AMO	Atlas of the Mammals of Ontario
AMSL	Above Mean Sea Level
ANSI	Area of Natural Significance
ASTM	American Society for Testing and Materials
BSC	Bird Studies Canada
BSRD	Black, Shoemaker, Robinson & Donaldson Ltd.
CC	Coefficient of Conservatism
cm	Centimeter
COSSARO	Committee on the Status of Species at Risk in Ontario
DBH	Diameter at Breast Height
DFO	Fisheries and Oceans Canada
EAC	Environmental Advisory Committee
ECCC	Environment and Climate Change Canada
EIR	Environmental Implementation Report
EIS	Environmental Impact Study
ELC	Ecological Land Classification
ESA	Endangered Species Act
GPS	Global Positioning System
GRCA	Grand River Conservation Authority
ha	Hectare
LIO	Land Information Ontario

m	Meter
MBCA	Migratory Bird Convention Act
mm	Millimeter
MMP	Marsh Monitoring Program
MNR(F)	Ministry of Natural Resources (and Forestry)
NHIC	Natural Heritage Information System
NHS	Natural Heritage System
NRSI	Natural Resource Solutions Inc.
OBBA	Ontario Breeding Bird Atlas
OP	Official Plan
ORAA	Ontario Reptiles and Amphibians Atlas
OWES	Ontario Wetland Evaluation System
PPS	Provincial Policy Statement
PSW	Provincially Significant Wetland
PVC	Polyvinyl chloride
SAR	Species at Risk
SARO	Species at Risk in Ontario
SPT	Standard Penetration Test
Subject Property	220 Arkell Road, City of Guelph, Ontario
SWH	Significant Wildlife Habitat
SWM	Stormwater Management
TCSS	Torrance Creek Subwatershed Study
ToR	Terms of Reference

UFMP	Urban Forest Management Plan
VASCAN	Database of Vascular Plants of Canada
VPV	Victoria Park Village

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Rockpoint Properties Inc. to prepare an Environmental Impact Study (EIS) in support of a Draft Plan of Subdivision application and a Zoning By-law Amendment application to permit a mixed-use development (single-detached residential and townhouse units) located at 220 Arkell Road, in Guelph, Ontario (Subject Property). The Subject Property is approximately 7.16 hectares (ha) and is currently occupied by a single residence, manicured lawn, scattered planted trees, hedgerows, a horse pasture, and surrounded by hedgerows and the Torrance Creek Swamp Provincially Significant Wetland (PSW). The Subject Property is located south of the Victoria Park Village (VPV) development currently under construction, north of the Arkell Meadows subdivision, east of the Torrance Creek Swamp PSW, and west of active agricultural lands, **Figures 1** and **2** (**Appendix A**).

The lands are currently designated Low-Density Greenfield Residential with Significant Natural Areas and Natural Areas under the City of Guelph Official Plan (Schedule 2, March 2018 consolidation). Natural areas on the property are associated with the Torrance Creek PSW, which includes an ecological linkage (Schedule 4), significant woodlands (Schedule 4C), and significant wildlife habitat (Schedule 4E).

The purpose of this Environmental Impact Study (EIS) is to: (1) describe the significance and sensitivity of the natural features on the Subject Property and, as appropriate, the Study Area (i.e., lands within 120 meters (m) of the Subject Property), (2) identify potential impacts of the proposed development on these natural features, and (3) recommend appropriate measures to avoid or minimize potential negative impacts.

This EIS report is prepared in accordance with applicable policies and regulations described in **Section 2.0.**

1.1 AGENCY CONSULTATION

1.1.1 Ministry of Natural Resources and Forestry (MNRF)

The Ministry of Natural Resources and Forestry (MNRF) released the draft Southern Region Natural Heritage Information Request Guide (August 2018) which outlines the recommended methods of obtaining background information for a project. Additional consultation between Stantec and the MNRF (personal communication, December 3, 2018) indicated that an information request is no longer required for species at risk (SAR). Background resources as outlined in the guidance document were consulted.

1.1.2 Ministry of Environment, Conservation and Parks (MECP)

As of April 1, 2019, the responsibility for implementation of the Endangered Species Act, and therefore consultation regarding SAR, transferred from the MNRF to the MECP. Based on Stantec's recent experience, information requests are not required if the appropriate background review is conducted. Therefore, MNRF and MECP consultation regarding SAR was not completed for the Subject Property as it is not deemed necessary with a rigorous background review.

1.1.3 City of Guelph

A Development Review committee meeting between City of Guelph staff, Grand River Conservation Authority (GRCA), and Black, Shoemaker, Robinson & Donaldson Ltd. (BSRD) on behalf of Rockpoint Properties Inc. occurred on October 5, 2016 to discuss requirements to support the proposed development at the Subject Property. This meeting determined that a zoning by-law amendment and Draft Plan Of Subdivision Application would be required, supported by a planning justification report, functional servicing report, grading plan, SWM report, tree preservation plan, traffic study, archaeological report, EIS (including a wetland boundary delineation), phase I Environmental Site Assessment, and source water protection report. This EIS is required due to designation of a portion of the property as a Significant Natural Area. Correspondence was received October 13, 2016 and included staff comments, as shown in **Appendix B1**.

Additional meetings were held between Stantec, BSRD, Rockpoint Properties Inc., and the City of Guelph as detailed in Table 1-1 (below). Meeting minutes can be found in **Appendix B2**.

Table 1-1: City of Guelph Meeting Record

Date/Time	Discussion Topics
March 13, 2017	• Ecological corridor and measurement of the 50 m width (properly line vs. feature edge) • Field study requirements, specifically corridor studies and locally significant birds • Wetland delineation, significance of remnant east of the existing driveway, and applicable policies for removal • Constrains (if any) of the north-south hedgerow • SWM within the 15-30 m wetland buffer • Dry SWM facility recommended if located within ecological corridor • Water balance required.
October 10, 2017	• Emergency access • Trail and park location • SWM on adjacent property • Dawes Avenue connection
September 10, 2018	The primary purpose of this meeting was to address comments from the City received on July 19, 2018 regarding a concept submission on May 28, 2018. This included: • Temporary emergency access, location, proximity to wetland, slope, distance from lot line, restoration post-construction • Storm Water Management (SWM) strategy in consideration of 246 Arkell Road • Extension of Dawes Avenue • Location of servicing and utilities • Fencing, erosion and sediment control • Corridor studies.

In response to the comments received on July 19, 2018 and discussed during the September 10, 2018 meeting, a SWM response was submitted to the City on November 6, 2018 (to be discussed further in Section 6.1). The City responded on January 23, 2019 by providing an updated list of comments and suggesting the remaining issues be resolved during the Draft Plan Application.

Additional correspondence was undertaken between the City of Guelph and Stantec regarding the corridor studies undertaken on the Subject Property in May and August 2018. The City determined that studies completed to date, in the fall of 2017 and spring of 2018, were adequate and that no additional work was required. This decision was provided on September 12, 2018 and is included in **Appendix B3.**

An EIS Terms of Reference (ToR) was submitted on April 5, 2017 to City of Guelph staff and was heard at the May 10, 2017 Environmental Advisory Committee (EAC) meeting. Comments received from City staff and EAC were incorporated into a revised ToR, sent to the City on July 11, 2017. Conditional approval of the revised ToR was received on August 2, 2017 from City staff, with Stantec agreeing to the provided conditions on August 14, 2017. Clarification was sought on one of the conditions from the City, which was received on August 17, 2017. The approved ToR, including correspondence, can be found in **Appendix C**.

1.1.4 Grand River Conservation Authority (GRCA)

The GRCA participated in the Development Review Committee meeting on October 5, 2016, as described in Section 1.1.3. Comments received at that time outlined required documentation (EIS, SWM report) and that the wetland boundary required confirmation in the field. They also recommended that the Torrance Creek Subwatershed Study (TCSS) be referenced. This correspondence is included in **Appendix B1.**

As per requirements outlined in the Development Review Committee meeting, the boundary of the PSW was delineated in the field with the GRCA. This occurred initially on November 1, 2016, but due to the lack of vegetation late in the season, it was revisited on June 8, 2018. The wetland boundary was provided to the GRCA on November 28, 2016 with the updated boundary provided on June 22, 2017. Correspondence is provided in **Appendix B4**.

The GRCA was circulated on both versions of the ToR for comment. The ToR was deemed satisfactory to the GRCA on July 18, 2017 (**Appendix B4**).

2.0 POLICY AND GUIDANCE CONSIDERATIONS

An assessment of the natural heritage features and functions within the Study Area was undertaken to comply with the requirements of the following policy, legislation, and guideline documents.

2.1 PROVINCIAL POLICY STATEMENT

The Provincial Policy Statement (PPS) was issued under Section 3 of the *Planning Act* and came into effect on May 22, 1996. It was revised in 2005 and most recently in April 2014. Planning Authorities shall be consistent with the policy statements issued under the *Planning Act*, and the PPS includes policies on development and land use patterns, resources and public health and safety.

According to Section 2.1.4 of the PPS, development and site alteration shall not be permitted in:

a) Significant wetlands in EcoRegion 6E

b) Significant coastal wetlands

According to Section 2.1.5 of the PPS, development and site alteration shall not be permitted in the following features, unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions:

a) Significant woodlands in EcoRegion 6E

b) Significant valleylands in EcoRegion 6E

c) Significant wildlife habitat (SWH)

d) Significant areas of natural and scientific interest (ANSI)

e) Coastal wetlands in EcoRegion 6E that are not subject to policy 2.1.4(b)

Development and site alteration shall not be permitted in the following features, except in accordance with provincial and federal requirements:

a) Fish habitat

b) Habitat of endangered or threatened species

In southern Ontario, development is not permitted in significant wetlands or significant coastal wetlands. Development and site alteration may be permitted on lands adjacent to significant wetlands, coastal wetlands and the habitat of endangered and threatened species if it is demonstrated that there will be no negative impacts on the natural features or the ecological functions for which the area was identified.

Development is not permitted within, or on lands adjacent to, other significant natural heritage features unless the ecological function of these lands has been evaluated and it has been demonstrated that no negative impacts on the natural heritage features or their ecological function will occur. Development and

site alteration is not permitted within fish habitat or habitat of endangered or threatened species except in accordance with provincial and federal requirements.

The assessment of SWH follows the updated *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E* (MNRF, 2015), with consideration of previously published documents including the Natural Heritage Reference Manual (MNR, 2010) and Significant Wildlife Habitat Technical Guide (MNR, 2000).

2.2 CITY OF GUELPH

2.2.1 Official Plan

The *City of Guelph Official Plan* (OP) (consolidated March 2018) recognizes natural heritage features as part of a Natural Heritage System, including natural areas, significant natural areas, ecological linkages, restoration areas, and wildlife crossings that are important to the City's environmental, social, cultural, and economic values. It also includes hazard lands such as steep slopes, unstable soils, and lands at risk of eroding such as, but not limited to, floodways of rivers, streams, and creeks.

The purpose of the NHS is to identify and protect important natural heritage features, and to maintain, restore and where possible, improve the ecological function, biodiversity and connectivity of these features while providing for compatible development. Any development adjacent to significant natural areas (Policy 4.1.3.1(2)) or within natural areas (Policy 4.1.4.1 (1)) requires the submission of an EIS to the City of Guelph in support of the development application.

The Natural Heritage System includes Significant Natural Areas for permanent protection including:

- Significant Areas of Natural and Scientific Interest (ANSI)
- Significant Habitat for Provincially Endangered and Threatened Species
- Significant Wetlands
- Surface Water Features and Fish Habitat
- Significant Woodlands
- Significant Valleylands
- Significant Landform
- Significant Wildlife Habitat (SWH; including Ecological Linkages)
- Restoration Areas
- Minimum or Established buffers (where applicable)

Natural Areas where development may be permitted provided an EIS can demonstrate that there will be no negative impacts to the natural heritage features or their ecological function, including:

- Other Wetlands
- Cultural Woodlands
- Habitat of Significant Species
- Established buffers (where applicable)

The purpose of minimum or established buffers to development are to prevent damage and degradation to the identified features. This applies to features located within the development proposal as well as on adjacent lands. Minimum buffers are established in the OP for a PSW (30 m), dripline of significant woodland (10 m), and locally significant wetland boundary (15 m), except for general permitted uses outlined in Policy 4.1.2 (1) of the OP:

i) Legally existing uses, buildings or structures

ii) Passive recreational activities

iii) Low impact scientific and educational activities

iv) Fish and wildlife management

v) Forest management

vi) Habitat conservation

vii) Restoration activities.

2.2.2 Zoning By-law

The purpose of the City's Comprehensive Zoning By-law (1995, 2016) is to regulate the use of land, which prescribes what type and where buildings, dwellings, and structures may be located, as well as standards for parking, building height, yards, and lot sizes.

The City's current (2016) zoning does not include the Subject Property, however it was zoned Agriculture per the 1985 Puslinch Zoning By-law (see City Staff Report for the ToR, **Appendix C**). Puslinch Township has updated their zoning in 2018, which does not include the Subject Property, and as such current zoning is unclear. However, it is our understanding that these lands were annexed to the City of Guelph in 1994 and as such fall under the City's zoning by-law, which is why an amendment is being sought.

2.2.3 Urban Forest Management Plan

The framework for strategic urban forest management in Guelph was completed and approved by Council in 2007 (Urban Forestry Innovations Inc. and Dougan & Associates, 2007) and provided direction for the Urban Forest Management Plan (UFMP) which was completed in 2012.

The UFMP provides the guiding principles and goals for a 20-year period (2013-2032) as well as 22 recommendations surrounding communication, management and monitoring, as well as planning, protection, enhancement, and planting, aimed at a proactive management strategy for the City's green infrastructure.

2.2.3.1 Tree By-law

The City of Guelph's Tree By-law was created to prevent damage or destruction to trees on private property. Some trees are exempt from the by-law (e.g., hazard trees or those impacted by natural events). A permit is required to remove any tree greater than 10 centimeters (cm) in diameter at 1.4 m above the ground that is not exempt from the by-law on lots larger than 0.2 ha.

2.2.4 Torrance Creek Subwatershed Study

The proposed development is located within the Torrance Creek Subwatershed, an area studied by Totten Sims Hubicki *et. al*., (1999) as part of the TCSS. The purpose of the TCSS was to provide a management strategy which would guide future development to protect, enhance and rehabilitate natural features (e.g., woodlots, wetlands, streams, and wildlife). The impetus behind the TCSS was to address concerns of cumulative impacts to the natural environment, including concerns regarding impacts to the aquifer that provides drinking water for the City of Guelph.

2.3 GRAND RIVER CONSERVATION AUTHORITY POLICIES AND REGULATION

Pursuant to Ontario Regulation 150/06, prior permission is required from the GRCA for any development within a river or stream valley, wetland, shoreline, or other hazardous land, and any alteration to a river, creek, stream, watercourse, or any interference with a wetland. The decision-making policies for such Permits are contained within the *Policies for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation* (GRCA, 2015).

Generally, any development, interference or other alteration that may negatively impact the control of flooding, erosion, dynamic beaches, pollution, or the conservation of land are not permitted. However, development may be permitted where technical studies demonstrate no adverse impact and per general policies outlined in Sections 7.1-7.3.

The GRCA defines an area of interference as the zone where development could impact hydrologic function, which is 120 m in the case of a PSW. Development less than or equal to 30 m from a wetland may be permitted in accordance with the GRCA Policies in Sections 8.4.9 where an EIS demonstrates that:

- There are no negative or adverse hydrological or ecological impacts on the wetland
- Development is located outside of the wetland and maintains as much setback as feasible
- Development is located above the water table

Development within an area of interference between 30 and 120 meters from a wetland, which in the opinion of the GRCA may result in hydrologic impact, may be permitted where an EIS demonstrates that policies in Sections 7.1.2-7.1.3 – General Policies are met.

Policies outlined in Section 8.4.15 permit stormwater management facilities for the treatment of water quality within the area of interference of a wetland where the following conditions are met:

- All components are located outside of the wetland
- Studies demonstrate that the hydrologic and ecologic functions of the wetland will be restored, protected, and/or enhanced
- Best Management Practices are employed to minimize sedimentation during and post-construction
- Design and maintenance requirements of the GRCA are met
- Accepted engineer principles and standards are met to the satisfaction of the GRCA

2.4 MIGRATORY BIRDS CONVENTION ACT

The *Migratory Birds Convention Act* (MBCA) prohibits the killing or capturing of migratory birds, as well as any damage, destruction, removal or disturbance of active nests (i.e. incidental take). Environment and Climate Change Canada provides recommendations to reduce the risk of incidental take and avoid contravention of the MBCA. Their primary recommendation is to: *Avoid engaging in potentially destructive or disruptive activities at key locations or during key periods* (Environment and Climate Change Canada [ECCC], 2014). The key period is the region and habitat specific nesting period, which for the City of Guelph (region C2) is generally defined as the period from April 15 to August 9 for forest nesting birds (ECCC, 2014).

If potentially destructive or disruptive activities are required (e.g., vegetation clearing) during the key nesting period, a nest survey may be carried out by a qualified person in simple habitats such as an urban park, a vacant lot with few possible nest sites, a previously cleared area, or a structure.

2.5 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) protects habitat and individuals of wildlife species designated as threatened, endangered, or extirpated in Ontario. Provincial species at risk are identified and assessed by the Committee on the Status of Species at Risk in Ontario (COSSARO).

The ESA protects species listed by COSSARO as threatened, endangered or extirpated in Ontario and their habitats by prohibiting anyone from killing, harming, harassing or possessing protected species, as well as prohibiting any damage or destruction to the habitat of the listed species. All listed species are provided with general habitat protection under the ESA aimed at protecting areas that species depend on to carry out their life processes, such as reproduction, rearing, hibernation, migration or feeding. Some species have had detailed habitat regulations passed that go beyond the general habitat protection to define specifically the extent and character of protected habitats.

Activities that may impact a protected species or its habitat require the prior issuance of a Permit from the MECP, unless the activities are exempted under Regulation. The current Ontario Regulation 242/08 identifies activities which are exempt from the permitting requirements of the Act subject to rigorous controls outside the permit process including registration of the activity and preparation of mitigation. Activities that are not exempted under O. Reg. 242.08 require a complete permit application process.

2.6 SUMMARY OF POLICY IMPLICATIONS

The environmental policies and guidelines summarized above provide the context within which the proposed development for the Subject Property will be considered from a natural environment perspective. The opportunities and constraints established by this regulatory framework will be considered and addressed through the development design and supporting documentation, including the identification of appropriate mitigation, restoration and enhancement measures to offset potential negative impacts. The intent of this EIS is to demonstrate how the proposed development for the Subject Property complies with the applicable policy documents noted above and will be summarized below in **Section 8.0**.

3.0 DATA COLLECTION METHODS

Background data collection methods for the Study Area are provided below.

3.1 BACKGROUND DATA COLLECTION

Background data applicable to the Study Area were obtained through review of existing documents and information available online. Background resources reviewed include, but are not limited to:

- Current and historical air photos
- Natural Heritage Information Centre (NHIC) database
- MNRF Land Information Ontario (LIO) database
- Guelph Natural Heritage Strategy (Dougan, 2009)
- Urban Forest Management Plan (City of Guelph, 2016)
- GRCA mapping and additional background information
- Fisheries and Oceans Canada (DFO) Mapping (2015)
- The 2nd Ontario Breeding Bird Atlas (OBBA; Cadman et al., 2007)
- Ontario Butterfly Atlas (Toronto Entomologists' Association, 2017)
- Atlas of the Mammals of Ontario (AMO; Dobbyn 1997)
- Ontario Reptile and Amphibian Atlas (ORAA; Ontario Nature, 2015)
- The Physiography of Southern Ontario, 3rd Ed. (Chapman and Putnam, 1984)
- The Torrance Creek Subwatershed Study (Totten Sims Hubicki et al. 1999)
- Guelph Trail Master Plan (City of Guelph, 2005)
- 246 Arkell Road, Guelph Environmental Implementation Report – Final (North-South Environmental Inc. 2013)
- Victoria Park Village Redline Revisions Environmental Impact Study Addendum (Stantec 2013)

3.2 FIELD INVESTIGATIONS

Field investigations in 2016, 2017 and 2018 targeted wildlife and habitat types identified during the background records review (detailed in **Section 4.2**) and in accordance with the approved ToR (**Appendix C**). Surveys examined the Subject Property as shown on **Figure 3** (**Appendix A**), where access permitted. Hydrogeological investigations began in the fall of 2017 with the installation of groundwater monitoring wells. Field investigations included woodland and wetland boundary delineations, spring, summer and fall botanical inventories, tree inventory, the characterization and mapping of vegetation communities using the Ecological Land Classification (ELC) system, as well as habitat assessment for species at risk and significant wildlife habitat.

Targeted field surveys included amphibian call count surveys, crepuscular and breeding bird surveys, snake cover object surveys, winter raptor, and corridor studies comprised of pitfall trap surveys and trail cameras.

A summary of all field work completed by Stantec is provided in Table 3-1. Field investigation methods are described in the sections below with results detailed in **Section 4.4.**

Table 3-1: Summary of Field Work Conducted for the Study Area, 2016-2018

Type of Field Work	Date(s) of Field Work	Personnel
HYDROGEOLOGICAL MONITORING AND TESTING		
Borehole Drilling / Monitoring Well Installations	April 5, 2017	London Soil Test Limited (Drilling Contractor)
Wetland Piezometer installation	April 13, 2017	A. Healey
Groundwater Level Monitoring	April 2017 to May 2018 (Continuous measurements via Leveloggers) April 2017, September 2017, February 2018 and May 2018 (Manual measurements)	S. Baer, C. Davis, A. Healey, and A. Vandenhoff
Hydraulic Conductivity Testing	April 12 and 17, 2017	A. Healey (Stantec)
Groundwater Quality Sampling and Testing	April 12 and 13, 2017	A. Healey (Stantec)
VEGETATION SURVEYS		
ELC	September 23, 2016 May 9, 2017 July 10, 2018	J. Ball
Tree Inventory	May 8, 2017	J. Koskinen and A. Hosker
Spring Botanical Inventory	May 9, 2017	J. Ball
Summer Botanical Inventory	July 10, 2017	J. Ball
Fall Botanical Inventory	September 23, 2016	J. Ball
Wetland Boundary Delineation	November 1, 2016 June 6, 2017	R. Messier (GRCA), A. Labbe (City of Guelph), J. Ball (Stantec) R. Hamelin (GRCA), A. Labbe (City of Guelph), M. Straus and D. Eusebi (Stantec)
Woodland Boundary Delineation	September 7, 2017	A.Labbe (City of Guelph) and J. Ball
WILDLIFE SURVEYS		
Amphibian Call Survey #1	April 25, 2017	J. Ball and N. Burnett

Table 3-1: Summary of Field Work Conducted for the Study Area, 2016-2018

Type of Field Work	Date(s) of Field Work	Personnel
Amphibian Call Survey #2	May 25, 2017	J. Ball and B. Holden
Bat Maternity Roost Survey	May 25, 2017	J. Ball
Crepuscular Survey #1	June 7, 2017	J. Ball and N. Burnett
Breeding Bird Survey #1	June 7, 2017	B. Holden
Snake Area Search #1	June 7, 2017	B. Holden
Crepuscular Survey #2	June 12, 2017	N. Burnett and N. Kopysh
Amphibian Call Survey #3	June 21, 2017	J. Ball and J. Sosa Campos
Breeding Bird Survey #2	June 21, 2017	B. Holden
Snake Area Search #2	June 21, 2017	B. Holden
Dragonflies and Butterflies Survey	June 21, 2017	B. Holden
Snake Area Search #3	July 27, 2017	B. Holden
Snake Area Search #4	August 10, 2017	K. Zupfer and J. Sosa Campos
Pitfall Trap Surveys	August 13, 16, 18, 23, 25, 31, 2017 September 1, 5 and 8, 2017 March 30, 2018 April 4, 13, 25, 26 and 28, 2018 May 3, 4 and 10, 2018	M. Straus, K. Zupfer, J. Sosa Campos, B. Holden, J. Ball, J. Keene, A. Taylor and N. Kopysh
Winter Raptor Surveys	November 14, 2017 December 22, 2017 January 11 and 24, 2018 February 16, 2018	B. Holden, M. Straus and J. Ball
Wildlife Corridor Surveys (Trial Camera)	November 6, 2017 – February 6, 2018	B. Holden and K. Zupfer
Bat exit surveys (buildings)	Summer prior to building removal	TBD
Incidental Wildlife Surveys	All visits	All Stantec staff

3.2.1 Geotechnical and Hydrogeological

Four boreholes (BH01-17 to BH04-17) were advanced at the Site on April 5, 2017 by London Soil Test Limited (LST) as part of the geotechnical and hydrogeological investigations, with a single monitoring well being constructed at each location. The locations of the boreholes / monitoring wells are shown on

Figure 3 (**Appendix A**). Borehole depths ranged from 5.2 to 8.2 m below ground surface. Stantec personnel were onsite during the drilling to log soil samples using the *American Society for Testing and Materials (ASTM) Standard D2488 00 - Guidelines for the Manual Description and Identification of Soils* (ASTM, 2000). Borehole logs were prepared for each drilling location, containing descriptions of type, texture, colour, structure, consistency, plasticity, and moisture content of soil samples. Soil samples were collected in field and analyzed in the Stantec Kitchener geotechnical laboratory for further soil classification and testing.

LST constructed/installed the monitoring wells as per *Revised Regulations of Ontario (R.R.O) 1990*, *Regulation 903: Wells* (MOE, 1990). The monitoring wells (i.e. MW01-17, MW02-17, MW03-17 and MW04-17) were installed to confirm local water table elevations, groundwater flow direction, seasonal trends in groundwater fluctuations, and baseline groundwater quality conditions. The monitoring wells installed on the Subject Property consist of 51-millimeter (mm) PVC pipe having 3.0 m long slotted screens.

To assess if the portion of the PSW adjacent to the Subject Property functions as a groundwater recharge feature (i.e., contributes water to subsurface), discharge feature (receives water from the subsurface), or a combination of both, Stantec personnel installed one multi-level drive-point piezometer nest on April 13, 2017. The piezometer nest consists of a shallow and a deep piezometer within the portion of the PSW extending into south-central portion of the Subject Property (**Figure 3**, **Appendix A**). Each drive-point piezometer is constructed of a 0.42 m long steel screen (19 mm diameter) that is connected to 25 mm diameter steel riser pipes. Stantec personnel drove the drive-point piezometers into the substrate using a fence post driver, with shallow and deep pipes being constructed within one meter of each other and their screens being separated by a vertical distance of approximately 1.3 m.

Stantec personnel developed (i.e., manually pumped) the monitoring wells to remove drilling fluids, solids or other particulates that may have been introduced during drilling. Groundwater levels were recorded at the monitoring well and piezometer locations from April 2017 to May 2018 using a combination of automated and manual measurement methods. Solinst® Edge Leveloggers® (Leveloggers) were installed at all monitoring well and piezometer locations in to allow automatic measurement of groundwater levels. Stantec also manually measured groundwater levels at the Subject Property on April 13 and September 15, 2017, and on February 18 and May 9, 2018.

Stantec personnel collected groundwater samples from each monitoring well between April 12 and 13, 2017, which were submitted to Maxxam Analytics Inc. for analysis of general inorganic parameters and dissolved metals.

Stantec performed in-situ hydraulic response testing at each monitoring well between April 12 and 17, 2017 to estimate the horizontal hydraulic conductivity of the deposits beneath the Site.

Full details on the methods utilized for the geotechnical work is documented in the Geotechnical Investigation Report found in **Appendix D**, with full details on the methods utilized for the hydrogeological work found in the Hydrogeological Assessment report provided in **Appendix E**.

3.2.2 Vegetation

Vegetation surveys conducted on the Subject Property in 2017 and 2018 included a tree inventory, delineation of the wetland and woodland boundaries, classification of community types using the ELC system, three-seasons of botanical surveys.

3.2.2.1 Tree Inventory

A detailed tree inventory was undertaken on May 8, 2017 for any trees 10 cm diameter at breast height (DBH) and greater. Trees located within the Subject Property were tagged with a numbered steel tree tag and those within in dense planted areas were grouped in a vegetation unit identified and each tree included in the detailed inventory. Trees that could not be physically tagged were provided a letter tree identifier.

Data collected for each tree inventoried included:

- Tree identifier
- Tree species (common and scientific name)
- Diameter at Breast Height (DBH)
- Dripline radius
- Condition and Health
- Fate (e.g., retain, transplant, or remove)

The hazard tree assessment finalized during the Environmental Implementation Report (EIR) stage as tree status can change rapidly over time, particularly as new diseases occur.

Survey date, time, weather conditions, and observers in 2017 are provided below in Table 3-2.

Table 3-2: Vegetation Survey Date, Time and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	May 8, 2017 10:00 – 16:00	9	4	50	None / none	J. Koskinen A. Hosker

Full details of the tree inventory can be found in the Tree Preservation Plan in **Appendix F**.

3.2.2.2 Vegetation Communities

Vegetation communities were primarily identified using aerial photography and checked in the field. Community naming followed the ELC field guide for Southern Ontario (Lee et al., 1998), utilizing 2008

ELC code updates where required. The Subject Property was accessed in its entirety while adjacent lands (i.e., the Study Area) were assessed using alternative site investigation, comprised of aerial photography interpretation, edge assessments, and background data from adjacent developments (where applicable). ELC was completed to the finest level of resolution (vegetation type) where feasible. Provincial significance of vegetation communities was based on the rankings assigned by the Natural Heritage Information Centre (NHIC, 2018).

Survey date, time, weather conditions, and observers in 2016 and 2017 are provided below in Table 3-3.

Table 3-3: Vegetation Survey Date, Time and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	September 23, 2016 14:30 – 16:30	20	2	100	Rain / none	J. Ball
2	May 9, 2017 12:00 – 15:00	10	1	50	None / none	J. Ball
3	July 10, 2017 12:00 – 15:00	22	2	50	None / none	J. Ball

3.2.2.3 Vascular Plant Species

A 3-season (spring, summer and fall) botanical inventory was conducted on the Subject Property. Flora nomenclature was based primarily on the Database of Vascular Plants of Canada (VASCAN) (Brouillet et al. 2010+) with updates to genera, specific epithets and family names as necessary to reflect recent taxonomic revisions. The primary source of revised nomenclature was VASCAN (2016).

The provincial status of all plant species was based on NHIC (MNRF, 2018). Identification of potentially sensitive native plant species was based on their assigned coefficient of conservatism (CC) value, as determined by Oldham et al. (1995). This CC value, ranging from 0 (low) to 10 (high), is based on a species' tolerance of disturbance and fidelity to a specific natural habitat. Species with a CC value of 9 or 10 generally exhibit a high degree of fidelity to a narrow range of habitat parameters.

Rarity was based on provincial S-Ranks assigned by the NHIC as well as the City of Guelph Locally Significant Species List (2012).

Survey dates, times, weather conditions, and observers are provided below in Table 3-4.

Table 3-4: Botanical Inventory Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	September 23, 2016 14:30 – 16:30	20	2	100	Rain / none	J. Ball
2	May 9, 2017 12:00 – 15:00	10	1	50	None / none	J. Ball
3	July 10, 2017 12:00 – 15:00	22	2	50	None / none	J. Ball

3.2.2.4 Wetland Delineation

Wetland delineation was based on the protocols outlined in the Ontario Wetland Evaluation System (OWES) (MNRF 2014). Generally, wetland boundaries are defined using the 50% vegetation rule, which involves the relative cover of wetland plant species (e.g., species that may or primarily occur in wetlands) to upland plants. Wetlands exist where >50% of the cover is comprised of wetland plants. This approach begins with the tree canopy, but where a tree canopy does not exist, or is inconclusive, the shrub or herbaceous layer is then assessed using the same 50% rule. In situations where the boundary is not obvious, additional evidence such as soil samples, density of herbaceous layer, and indicators of past surface water levels are also used.

The boundary of the Torrance Creek PSW was delineated initially on November 1, 2016, but due to the lack of vegetation late in the season, Stantec determined that the delineation of the boundary should be revisited in the spring. The PSW was revisited and re-demarcated on June 6, 2017 with Ryan Hamelin of the GRCA. The final boundary was recorded in the field by Stantec using an AshTech sub-meter, hand-held GPS (Global Positioning System) Unit.

3.2.2.5 Woodland Delineation

The woodland boundary associated with the Torrance Creek PSW was delineated by Stantec in the field with the City of Guelph on September 7, 2017. The final boundary was recorded in the field by Stantec using an AshTech sub-meter, hand-held GPS.

3.2.3 Wildlife and Wildlife Habitat

3.2.3.1 Snake Surveys

As shown on **Figure 3 (Appendix A)**, snake surveys consisted of area searches by traversing the Subject Property**.** Transects targeted suitable habitat on the property, including hedgerows, wetland, and the existing onsite residence. Surveys were conducted on sunny days where air temperatures were between 8˚C and 25˚C or temperatures above 15˚C if overcast. Surveys were conducted every two weeks in June and July, generally following *Milksnake Survey Protocol* (MNR Guelph District, July 2012).

Survey dates, times and weather conditions are provided below in Table 3-5.

Table 3-5: Snake Survey Dates, Times and Weather Conditions

SURVEY	DATE	WEATHER				SURVEYORS
		Temp. °C	Wind (Beaufort Scale)	Cloud %	PPT / PPT last 24 hours	
1	June 7, 2017	16	2	10	None / none	B. Holden
2	June 21, 2017	17	2	50	None / rain	B. Holden
3	July 10, 2017 12:00 – 15:00	22	2	50	None / none	J. Ball
4	July 27, 2017	23	2	50	None / rain	B. Holden
5	August 10, 2017	16	2	40	None / none	K. Zupfer

3.2.3.2 Amphibian Surveys

Amphibian call count surveys conducted in 2017 followed the Marsh Monitoring Program (MMP) manual (Bird Studies Canada (BSC) and Environment Canada, 2008). A total of three (3) stations were surveyed, as shown on **Figure 3** (**Appendix A**).

Surveys were conducted on days that reached minimum temperatures of 5˚C in April, 10˚C in May, and 17˚C in June, and between half an hour after sunset and midnight. Each survey station consisted of a 100 m radius semicircle, with the surveyors listening for three minutes for all calling toads and frogs. Call levels were described using values of 1, 2, or 3. Level 1 indicates that individuals could be counted, and calls were not simultaneous. Level 2 denotes that calls are distinguishable, but with some simultaneous calling. Level 3 indicates a full chorus where calls are continuous and overlapping. Toads and frogs calling from outside of the survey station are also noted.

Survey dates, times and weather conditions are provided below in Table 3-6.

Table 3-6: Amphibian Call Count Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. °C	Wind (Beaufort Scale)	Cloud %	PPT / PPT last 24 hours	
1	April 25, 2017 21:17 – 22:08	9	2	100	None / light rain	J. Ball N. Burnett
2	May 25, 2017 21:39 – 22:47	11	2	100	Light rain / rain	J. Ball B. Holden
3	June 21, 2017 21:57 – 23:33	18	0	0	None / rain	J. Ball J. Sosa Campos

3.2.3.3 Corridor Studies

Two types of corridor studies were conducted in 2017 and 2018 to document existing wildlife movement across the Subject Property, in consideration of the designated ecological linkage along the northern boundary of the Subject Property. Pitfalls surveys were conducted to determine amphibian and small mammal movement while camera monitoring and track surveys focused on larger mammals (i.e. deer activity).

Pitfall Trap Surveys

The pitfall trap study consisted of two sections of buried silt fencing and 18 buckets (9 on either side) sunk into the ground approximately every 20 m. Fencing and buckets were installed on August 10, 2017 at the locations shown on **Figure 3** (**Appendix A**). The purpose of the fencing was to prevent east-west movement of the target species (small mammals and amphibians), forcing individual movement along the fence until falling into one of the buckets. Each trap had a lid that was secured when the trap was not in use, had three equidistant drainage holes punched in the bottom to prevent filling, and were lined with leaf detritus.

Studies occurred in 2017 from mid-August to mid-September, and in 2018 from late-March to mid-May. A total of nine surveys were conducted during each survey period: August 13 – September 8, 2017 and March 30 - May 10, 2018. For each survey, individual pitfall traps were opened the night before, around sunset and where possible within 24 hours of a rain event to maximize the potential for amphibian movement. Buckets were checked the following morning around sunrise with each recovered individual recorded by trap number, photographed, and released in the direction of travel.

Survey dates, times, weather conditions, and observers are provided below in Table 3-7**.**

Table 3-7: Pitfall Trap Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	August 13, 2017 7:30 – 8:00	13	0	0	None / rain	M. Straus
2	August 16, 2017 7:35 – 8:15	14	0	40	None / rain	M. Straus
3	August 18, 2017 6:30 – 9:00	20	2	40	None / rain	J. Sosa Campos
4	August 23, 2017 6:40 – 7:20	12	0	0	None / rain	M. Straus
5	August 25, 2017 6:30 – 7:00	7	0	0	None / none	M. Straus
6	August 31, 2017 6:15 – 7:15	14	3	0	None / none	K. Zupfer

Table 3-7: Pitfall Trap Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
7	September 1, 2017 6:30 – 7:40	7	2	10	None / rain	B. Holden
8	September 5, 2017 6:45 – 7:30	14	0	100	None / rain	M. Straus
9	September 8, 2017 6:35 – 7:15	10	2	90	Rain / rain	K. Zupfer
10	March 30, 2018 7:00 – 8:15	0	2	100	None / rain	M. Straus
11	April 4, 2018 6:50 – 7:50	3	5	100	None / rain	K. Zupfer
12	April 13, 2018 7:00 – 8:00	2	2	100	Rain / rain	J. Keene
13	April 24, 2018 6:30 – 7:55	9	1	100	Rain / rain	K. Zupfer
14	April 26, 2018 6:15 – 7:20	10	1	0	None / rain	N. Kopysh
15	April 28, 2018 6:35 – 7:05	5	0	100	None / rain	N. Kopysh
16	May 3, 2018 6:15 – 7:30	17	3	90	None / rain	K. Zupfer
17	May 4, 2018 6:20 – 7:45	12	4	100	Rain / rain	K. Zupfer
18	May 10, 2018 7:15 – 7:45	16	2	100	None / rain	A. Taylor

Winter Mammal Monitoring

Two wildlife cameras were set up between November 6, 2017 and February 5, 2018 to capture east-west movement of large mammals on the Subject Property, as shown on **Figure 3** (**Appendix A**). Cameras were set to take a single photograph once motion triggered. Photographs in low-light conditions (i.e., at night) were facilitated by infrared emitters located on each camera.

Mammal tracks and trails, along with other wildlife evidence (e.g., scat, incidental observations) were recorded throughout the Subject Property during 3 visits conducted in January and February after overnight snowfall.

Survey dates, times, weather conditions, and observers are provided below in Table 3-8**.**

Table 3-8: Winter Mammal Monitoring Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	January 24, 2018 14:45 – 16:15	-8	3	50	Snow / snow	M. Straus
2	February 6, 2018 10:00 – 11:15	16	0	35	None / none	M. Straus
3	February 16, 2018 9:30 – 11:00	-3	3	100	None / rain	J. Ball

3.2.3.4 Bat Maternity Roost Survey

Some bat species roost solitarily in trees or tree foliage (e.g. Hoary Bat, Red Bat, Tricolored Bat) while others form maternity colonies (i.e., Big Brown Bat, Little Brown Myotis, Northern Myotis), sometimes with more than one species in a colony. Little Brown Myotis may roost in anthropogenic (e.g., houses, churches, barns) or natural structures (e.g. tree cavities; COSWEIC 2013). Four of Ontario's bat species are designated as Endangered in the province, including Tricolored Bat, as well as Little Brown, Northern, and Small-footed Myotis due to massive die-offs caused by an exotic fungus referred to as white-nose syndrome.

Natural Habitats

Although tree cavity roosts characteristics have been well studied, e.g., tall, large diameter trees with heart rot (Olson and Barclay 2013, Jung *et al.* 2004) found in older stands (Crampton and Barclay 1998), identification of active roost trees due to roost switching behaviour and in the absence of highly invasive study techniques has proven to be very difficult in the province. For this reason, and in consideration of the MNRF Guelph District's 2017 protocol that indicates suitable maternity roost habitat may occur in treed areas, it is assumed that the PSW provides suitable bat maternity roosting habitat. As tree removal is not proposed within the PSW, except for hazard trees that the City of Guelph may require, no further study is required.

Treed hedgerows located within the development footprint were assessed for their suitability to support bat maternity roost habitat as shown on **Figure 3** (**Appendix A**).

Each tree with a DBH larger than 10 cm was assessed per provincial guidance (see Appendix B of MNRF 2017), including details recorded on:

- Species
- DBH
- Height
- Presence of loose/peeling bark
- Cavity height (if present)
- Decay class
- Presence of other snags in proximity
- Open canopy

Survey times and weather conditions are provided below in Table 3-8.

Table 3-9: Bat Maternity Roost Survey Date, Time and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	April 25, 2017 15:30 – 16:00	12	2	100	None / rain	J. Ball

Anthropogenic Habitats

The proposed development of the Subject Property includes the removal of the existing residence and all associated outbuildings. These buildings may support bat roosting habitat.

Presently, Stantec proposes to conduct bat exit surveys at the onsite buildings the summer prior to building demolition. This survey will be used to assess use of these buildings in the appropriate season and avoid potential harm to any bats that may move into these structures after the studies are conducted, but prior to demolition.

3.2.3.5 Breeding Birds

Diurnal Surveys

Breeding bird surveys were conducted on June 7 and 21, 2017 based on established protocol (e.g., Breeding Bird Atlas, 2001; North American Breeding Bird Survey, no date). Surveys were conducted by traversing the Subject Property on foot between sunrise and 10:00 a.m. All species of birds seen or heard were recorded. A conservative approach to determining breeding status was taken; that is, all birds seen or heard in appropriate habitat during the breeding season were assumed to be breeding.

Survey dates, times, weather conditions, and observers are provided below in Table 3-10.

Table 3-10: Breeding Bird Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	June 7, 2017 6:30 – 8:05	15	1-2	10	None / none	B. Holden
2	June 21, 2017 7:00 – 8:45	14-18	2	40-70	None / rain	B. Holden

Crepuscular Surveys

Two crepuscular surveys for Common Nighthawk were conducted in 2017, within the MNRF recommended timing window of June 1 – 17, 2017 (as per personal communication with Graham Buck, May 25, 2017). Surveys consisted of 3-minute auditory point counts as shown on **Figure 3** (**Appendix A**) and followed protocols established in *Eastern Whip-poor-will (Caprimulgus vociferous) and Common Nighthawk (Chordeiles minor)* Survey Protocol (MNR Guelph District, May 2013). Surveys began at sunset and occurred on calm, clear, and warm evenings (>10˚C).

Survey dates, times, weather conditions, and observers are provided below in **Table 3.6**.

Table 3-11: Crepuscular Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	June 7, 2017 20:55 – 21:11	19	0	10	None / none	J. Ball, N. Burnett
2	June 12, 2017 21:00 – 21:15	31	1	100	None / rain	N. Burnett, N. Kopysh

3.2.3.6 Raptor Surveys

Although patch sizes within the Subject Property are not large enough to meet provincial criteria for significant wildlife habitat for raptors, there may be local significance. Winter raptor surveys and searches for stick nests were requested by the City of Guelph (August 2, 2017; **Appendix C**) to be included in the field program for the Subject Property.

Surveys were conducted between November and February to determine if overwintering raptors use the open areas (i.e. pasture, lawn) on the Subject Property for hunting as well as optimize observability of stick nests during leaf-off conditions. Studies were conducted by traversing the open areas while scanning hedgerows and forest edges for hunting raptors. Hedgerows and the PSW were also searched for stick nests.

Survey dates, times, weather conditions, and observers are provided below in Table 3-12.

Table 3-12: Raptor Nesting Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	November 14, 2017 14:00-16:00	4	1	60-90	None / snow	B. Holden
2	December 22, 2017 13:00-15:00	-6	3	100	Snow / snow	B. Holden
3	January 11, 2018 12:00-14:00	9	3	100	None / rain	B. Holden
4	January 24, 2018 14:45 – 16:15	-8	3	50	Snow / snow	M. Straus
5	February 16, 2018 9:30 – 11:00	-3	3	100	None / rain	J. Ball

3.2.3.7 Insect Habitat Assessment

In 2017, a site-specific habitat assessment of the Subject Property was undertaken to determine if suitable habitat for odonates (dragonflies and damselflies) and species of conservation concern (i.e., locally rare in the City of Guelph, S1-S3, Special Concern), such as Monarch and Yellow-banded Bumble Bee were present.

Survey dates, times, weather conditions, and observers are provided below in Table 3-13.

Table 3-13: Terrestrial Insect Survey Dates, Times and Weather Conditions

SURVEY	DATE/TIME	WEATHER				SURVEYORS
		Temp. (°C)	Wind (Beaufort Scale)	Cloud (%)	PPT / PPT last 24 hours	
1	June 21, 2017 12:00 – 14:00	14-19	2	40-70	None / rain	B. Holden

3.2.3.8 Incidental Wildlife Observations

Incidental wildlife observations were recorded during all field investigations in 2016, 2017 and 2018. All wildlife species identified by sight, sound, or distinctive signs (e.g., scat, track) were recorded.

4.0 DATA COLLECTION RESULTS

The Subject Property is currently comprised of an existing residence and barns surrounded by meadow, some of which is maintained and some of which is used for pasture. Adjacent lands include the Torrance Creek PSW to the west, Victoria Park Village to the north, a housing development to the southeast and open agriculture fields to the east, as shown on **Figure 2** (**Appendix A**).

Results of the background records review and site investigations are summarized in the sections below.

4.1 LANDSCAPE CONTEXT

4.1.1 Physiography and Topography

The Study Area is situated within the physiographic region referred to by Chapman and Putnam (1984) as the Guelph Drumlin Field. The Guelph Drumlin Field consists of a series of broad oval type hills with axes trending in a northwest to southeast direction (i.e., drumlins). The drumlins and associated till plain consist of stony, calcareous till derived from dolostone of the Goat Island and Gasport Formations (formerly referred to as the Amabel Formation) and consists of sand (50%; average content based on grain-size analysis completed on till samples), silt (35%) and clay (15%) (Chapman and Putnam, 1984).

The drumlin groupings occur in swampy valleys that are flanked by terraced spillway channels of sand and gravel, which contain tributaries of the Grand River, including Torrance Creek which is located to the north of the Subject Property. Gravel ridges or eskers are also known to cut through the till plain in the same general direction of the drumlins.

The Subject Property is located within the within the Torrance Creek subwatershed of the Grand River Watershed and within the boundary of the GRCA. The subwatershed is characterized by hummocky terrain associated with the drumlins and by the network of broad, relatively flat spillway channels that cut through the drumlin fields. A topographic high point occurs within the southeastern portion of the Subject Property at an elevation of 340 m above mean sea-level (AMSL; representing the peak of a drumlin), with the land sloping from this peak elevation to the north (337 m AMSL) and southwest (334 m AMSL) to the limits of the Subject Property. Surface water drainage from the Subject Property follows two routes, with approximately 4.70 ha draining to the southwest towards the PSW.

The PSW and the remaining land area (2.47 ha) flow offsite via the northern corner of the property and discharging to an existing woodlot.

4.1.2 Regional Geology and Hydrostratigraphy

Geological conditions within the region have been mapped and described by Matrix Solutions Inc. (2017), the Lake Erie Region Source Protection Committee (LERSPC, 2015a), Golder Associates Limited (2011) and Totten Sims Hubicki Associates et al. (1998), and Jagger Hims Limited (1998). Based on these previous studies, overburden and bedrock geology near the Site is summarized as follows, listed from youngest to oldest:

Spillway Deposits: Glaciofluvial outwash and glaciolacustrine deposits of sand and gravel with minor silt and clay associated with the spillway channels.

Ice-Contact Deposits: Predominantly sand and gravel containing lenses of silt and clay left behind by the melting of enclosed ice blocks (i.e., eskers, kames).

Port Stanley Till: An occasionally stony, silty sand to sandy silt till, forming the till plain and drumlins that characterize the region. Some of the drumlins, however, can consist of an older clayey silt till core that is subsequently covered by a veneer of Port Stanley Till. In areas south of the Speed River, the till plain is often covered by a layer of glaciofluvial and glaciolacustrine sediments (i.e., fine to silty sand, sandy silt, sand and gravel) deposited from melting glacier ice, with the till extending to the bedrock surface.

Bedrock: The Guelph Formation, representing the uppermost bedrock unit throughout the region is described as a light brown/beige coloured fossiliferous dolostone and an important aquifer in the Guelph area (Brunton, 2008).

4.2 TERRESTRIAL BACKGROUND REVIEW RESULTS

The results of the background records review are detailed for terrestrial features in the sections below.

4.2.1 Designated Natural Heritage Features

The MNRF LIO website was accessed (MNRF 2017) on January 8, 2019 to determine presence or absence of known sensitive natural environment features in the Study Area, including ANSIs, PSWs, environmentally significant areas, provincial or national parks, or conservation areas.

The OP (2018 consolidation) identifies a portion of the Subject Property as part of the Natural Heritage System, including: Significant Natural Areas, comprised of the Torrance Creek PSW and associated features (e.g., an ecological linkage (Schedule 4), locally significant wetlands (Schedule 4A), significant woodlands (Schedule 4C), and significant wildlife habitat (Schedule 4E)). The locally significant wetlands identified in the Study Area consist of forested areas excluded from the PSW, including forest edges along the eastern PSW boundary, as well as two onsite hedgerows. The ecological linkage identified on the Subject Property is comprised of a 50 m wide area along the northern property boundary that joins the significant woodland on the Subject Property to another significant woodland on the adjacent property to the east.

Existing GRCA mapping for the Study Area does not appear to reflect recent updates to the Torrance Creek PSW boundary. As part of the Arkell Meadows development, the wetland pocket east of the existing driveway on the Subject Property was approved for removal in 2010. This wetland pocket removal has occurred and the Arkell Meadows development completed. Existing mapping continues to show this wetland parcel on **Figure 1** (**Appendix A**).

More recent updates to the PSW boundary were undertaken for the adjacent property to the north in 2012 (Stantec), southwest in 2015 (provided to Stantec by NRSI on October 3, 2018) and again in 2017 as part of this development and as detailed in Section 4.4.2.4, below. The GRCA regulation limit for the Torrance Creek PSWs located on the Subject Property should be 120 m from the updated PSW boundaries, falling across approximately the western half of the Subject Property.

4.2.2 Species at Risk and Provincially Rare Species

SAR are defined as those species listed as Threatened, Endangered or Extirpated on the Species at Risk in Ontario (SARO) List. These species and their habitat are provided protection under the ESA. Provincially rare species are those designated as Special Concern by SARO or ranked as S1-S3 by the NHIC.

The NHIC database was accessed on January 8, 2019 to determine presence/absence of known occurrences of SAR or rare species in the vicinity of the Study Area. One species was identified in the NHIC database as occurring in the past 30 years: Eastern Ribbonsnake.

A review of wildlife atlas records and background data sources found an additional nineteen (19) rare and/or SAR with ranges that overlap the Subject Property. Range maps provided in the various wildlife atlases are relatively coarse in nature and do not provide precise locations or information on concentrations/densities of records. The NHIC database provides more precise mapping than the atlases (1 km x 1 km squares) and is a better indicator of occurrence of significant species.

Table 4-1: Potentially Occurring Within the Study Area

Species Common Name	Species Scientific Name	S-rank	Provincial Status (SARO)	Federal Status (SARA)	Source
REPTILES					
Eastern Ribbonsnake	*Thamnophis sauritus*	S3	SC	SC	NHIC
Snapping Turtle	*Chelydra serpentine*	S3	SC	SC	ORAA
Blanding's Turtle	*Emydoidea blandingi*	S3	THR	THR	ORAA
Northern Map Turtle	*Graptemys geographica*	S3	SC	SC	ORAA
Eastern Milksnake	*Lampropeltis triangulum*	S3	-	SC	ORAA
BIRDS					
Chimney Swift	*Chaetura pelagica*	S4B, S4N	THR	THR	OBBA
Eastern Wood-Pewee	*Contopus virens*	S4B	SC	SC	OBBA
Bank Swallow	*Riparia riparia*	S4B	THR	THR	OBBA
Wood Thrush	*Hylocichla mustelina*	S4B	SC	THR	OBBA
Barn Swallow	*Hirundo rustica*	S4B	THR	THR	OBBA
Bobolink	*Dolichonyx oryzivorus*	S4B	THR	THR	OBBA
Eastern Meadowlark	*Sturnella magna*	S4B	THR	THR	OBBA

Table 4-1: Potentially Occurring Within the Study Area

Species Common Name	Species Scientific Name	S-rank	Provincial Status (SARO)	Federal Status (SARA)	Source
Red-headed Woodpecker	*Melanerpes erythrocephalus*	S4B	SC	THR	OBBA
Common Nighthawk	*Chordeiles minor*	S4B	SC	THR	OBBA
Grasshopper Sparrow	*Ammodramus savannarum*	S4B	SC	SC	OBBA
MAMMALS					
Little Brown Myotis	*Myotis lucifugus*	S4	END	END	AMO
Small-footed Bat	*Myotis leibii*	S2, S3	END	-	AMO
Northern Myotis	*Myotis septentrionalis*	S3?	END	END	AMO
Tri-coloured Bat	*Perimyotis subflavus*	S3?	END	END	AMO

NOTES:

END – Endangered - a species facing imminent extinction or extirpation
THR – Threatened - a species that is at risk of becoming endangered
SC – Species of Special Concern
S4 – Apparently secure. Uncommon but not rare: some cause for long-term concern due to declines or other factors.
S3 – Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation
S2 – Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S1 - Critically Imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province
S? – Rank uncertain
OBBA – Ontario Breeding Bird Atlas
AMO – Atlas of the Mammals of Ontario
ORRA - Ontario Reptile and Amphibian Atlas

4.2.3 Locally Significant Species

The City's Natural Heritage Strategy provides a long list of locally significant species, which includes the following that may be present within the 220 Arkell Study Area based on a desktop review of the Study Area and reports from the adjacent developments:

- Meadow Horsetail
- Common Nighthawk
- Northern Flicker
- Eastern Wood-Pewee
- Eastern Kingbird
- Barn Swallow
- Baltimore Oriole
- American Redstart

4.2.4 Torrance Creek Subwatershed Study

The Study Area is located within Area 4 (North of Arkell Road) of the Torrance Creek PSW per the TCSS, an area that provides groundwater discharge to form the headwaters of Torrance Creek, and functions as a groundwater recharge and water storage area (Totten Sims Hubicki *et al.*, 1999). Key features of Area 4 that may overlap with the Study Area include: area-sensitive and forest-interior species, small concentrations of wintering deer, amphibian breeding habitat, and a movement corridor for deer west (across Gordon Street) and south (across Arkell). Of note, this assessment of movement corridors is inconsistent with more recent guidance from the City of Guelph, discussed in Section 4.2.1 above.

Background information provided in Section 4.1.2 regarding regional geology and hydrostratigraphy is based on details from the TCSS.

The existing conditions model, precipitation events, and quantity controls incorporated into SWM design detailed in Section 6.1 are based background information provided in the TCSS.

4.2.5 Guelph Trail Master Plan

The Guelph Trail Master Plan proposes as part of their long-term priorities (Map 10; 2021+) an off-road trail through the Torrance Creek PSW that connects to the Subject Property as well as a connection to Victoria Park Village to the north.

As part of the comments received on the ToR (provided in **Appendix C**), the City (Parks) has identified a more detailed trail plan connecting the Subject Property to the adjacent developments (existing and proposed). No trails are recommended within the PSW. This guidance will take precedent over the Guelph Trail Master Plan.

4.3 AQUATIC BACKGROUND REVIEW RESULTS

No aquatic features (i.e. waterbodies or watercourses) exist on the Subject Property, or within the Study Area.

4.4 FIELD INVESTIGATION RESULTS

Results of the field studies conducted on the Subject Property in 2016, 2017 and 2018 are summarized below, with field notes provided in **Appendix G.**

4.4.1 Geotechnical and Hydrogeological Conditions

Surficial geology mapping indicates the Site is covered by glaciofluvial sand and gravel, and stone-poor, silty to sandy till deposits representing the Port Stanley Till. These deposits are consistent with the subsurface materials encountered in the onsite boreholes BH01-17 through BH04-17. In general, subsurface conditions at the borehole locations generally consist of a 0.4 m to 3.8 m thick layer of sand with trace to some gravel, overlying the Port Stanley Till (stony, silty sand to sandy silt till). The till unit is encountered at depths ranging from approximately 0.7 m to at least 8.2 m BGS (the maximum depth of investigation), or elevations ranging from 339.3 m to 328.3 m AMSL. Surficial silty sand to sandy silty fill

was encountered at BH03-17 and extended to a depth of 2.4 m BGS. Bedrock appears to be encountered at elevations ranging from 317.8 m to 322.8 m AMSL.

Groundwater depths across the Site range from being positioned at ground surface (BH01-17, BH02 17) to 2.3 m BGS (BH04-17) under high water table conditions, with about 1.9 m to 3.5 m of seasonal fluctuation occurring based on the data collected during the monitoring period (i.e., April 2017 to May 2018). The groundwater table is deepest in the northeastern corner of the Site, with groundwater levels becoming shallower moving to the southwest towards the Torrance Creek Swamp.

Groundwater flows horizontally through the subsurface overburden deposits to the south and southwest towards the Torrance Creek Swamp at an average rate of 11 m/year.

Downward vertical hydraulic gradients are consistently observed beneath the wetland area located in the future footprint of the development, indicating that this wetland is a groundwater recharge feature, consistent with GRCA (2018) mapping that shows downward hydraulic gradients to be present beneath the entire Subject Property. Under the pre-development condition, the predicted annual volume of infiltration provided to the shallow groundwater system by this wetland area represents approximately 3% of the total annual volume of infiltration that occurs across the Site.

Groundwater in the shallow groundwater system is calcium-bicarbonate type water. No tested parameters having health-related Ontario Drinking Water Standards (ODWS) were detected above their applicable standards. The ODWS for hardness was exceeded in samples collected at all wells. The presence of elevated hardness concentrations is typical of groundwater in southern Ontario.

A detailed description of the geotechnical and hydrogeological conditions that characterize the Subject Property are included in the corresponding reports provided in **Appendices D and E**, respectively.

4.4.2 Vegetation

4.4.2.1 Tree Preservation Plan

The total of 389 trees were inventoried on the Subject Property, divided into three main areas: eastern edge of the significant woodland/PSW, northern hedgerow, and eastern edge. A summary of tree species identified within these areas is provided below.

<u>Woodlot Edge</u>

Tree species were young and included Balsam Poplar, Manitoba Maple, and White Birch.

<u>Northern Edge</u>

This hedgerow consists of a mix of planted evergreens with black cherry, buckthorn, and apple present. Mature sugar maple and white elm were also noted, some of which are located on the adjacent property to the north.

Eastern Edge

Hedgerow consisting of native trees with dense buckthorn, some of which exceeded the 10 cm DBH criterion, although tagging was not undertaken due to their invasive nature.

Proposed tree protection fencing for the trees to be retained is included in the Plan, in accordance with the current City of Guelph standard.

The full Tree Preservation Plan is provided in **Appendix F**.

4.4.2.2 Vegetation Communities

Vegetation communities detailed in the Study Area are shown on **Figure 4 (Appendix A**) and described below in Table 4-2**.**

Table 4-2: Ecological Land Classification (ELC) Vegetation Types

ELC Type	Community Description
Cultural Meadow (CUM)	
CUM1-1 Dry-Moist Old Field Meadow Type	Mowed grass.
Forest (FO)	
FOCM5 Naturalized Coniferous Hedgerow Ecosite	Cedar hedgerow.
FODM11 Naturalized Deciduous Hedgerow Ecosite	Deciduous hedgerow with a mix of black cherry, Norway spruce, Norway maple, white pine, white ash and basswood in the canopy. Buckthorn dominates the sub-canopy and understory, as well as Virginia creeper and goldenrod in the ground layer.
Deciduous Swamp (SWD)	
SWDM4 Mineral Deciduous Swamp	Mineral deciduous swamp dominated by red ash and Freeman maple with trembling aspen, paper birch and balsam poplar in the canopy and European buckthorn in the sub-canopy, understorey and ground layer. Portions of the ground layer are disturbed by horses.
SWD7-1* White Birch – Poplar Organic Deciduous Swamp Type	Open-canopy organic swamp dominated by white birch, trembling aspen, and balsam poplar with a sub-canopy comprised of white cedar and balsam fir. The shrub layer is well developed with glossy buckthorn, common buckthorn, elderberry, and more white cedar. Ground cover consists of spotted touch-me-nots, dwarf raspberry, oak fern, enchanter's nightshade, and sensitive fern (excerpted from Stantec 2015).
Open Agriculture (OAG)	
OAGM1 Annual Row Crops	Corn field.
OAGM4 Open pasture	Open pasture. Disturbed by horses.
Constructed (CV)	
CVR_3	New single family residential.

Table 4-2: Ecological Land Classification (ELC) Vegetation Types

ELC Type	Community Description
Single Family Residential	
CVR_4 Rural Property	Rural residential within the Property Boundary and other properties within the Study Area.
CVI_1 Transportation	Roads.

* ELC information from Victoria Park Village Environmental Implementation Report (2015)

None of these communities are considered rare in the province.

4.4.2.3 Vascular Plant Species

A complete list of all vascular plant species recorded Stantec field investigations is included in **Appendix H1**. A total of 86 species of vascular plants were recorded in the Study Area. This total includes taxa identified to species, subspecies (ssp.) and variation (var.) levels. Fifty-seven of the 86 recorded species (66%) are native to Ontario, while the remaining 29 species (34%) are exotic species not native to Ontario. Of the native species, 49 (86%) have a provincial rank of either S5 (common with a secure population) or S4 (uncommon but not rare and populations are apparently secure), while the remaining native species are listed as other or not defined.

No provincially rare species with a provincial rank of S1, S2 or S3, or SAR flora were observed during studies on the Subject Property.

Two native species have a coefficient of conservatism value of 7 or 8, indicating these species have a high level of sensitivity to habitat disturbance. There species are: Black Ash (*Fraxinus nigra*) and Northern Black Currant (*Ribes hudsonianum hudsonianum*).

One species is considered locally rare in the City of Guelph: Swamp Gooseberry (*Ribes hirtellum*).

4.4.2.4 Wetland Delineation

The extent of the wetland boundary as determined in the field with the GRCA on June 6, 2017 is shown on **Figure 4** (**Appendix A**).

4.4.2.5 Woodland Delineation

The extent of the woodland boundary as determined in the field with the City of Guelph on September 7, 2017 is shown on **Figure 4** (**Appendix A**).

4.4.3 Wildlife and Wildlife Habitat

All wildlife and their associated scientific names recorded during the surveys details below are provided in a wildlife list found in **Appendix H2**.

4.4.3.1 Snake Surveys

During area searches for snakes and incidentally during all surveys conducted on the Subject Property, one snake observation was recorded. An Eastern Gartersnake (*Thamnophis sirtalis*) was documented basking on the moved lawn adjacent to the north-south hedgerow, north of the existing driveway. Eastern Gartersnake is ranked S5 (Secure; common and widespread) in Ontario.

4.4.3.2 Amphibian Surveys

Three amphibian calling stations were established on the Subject Property as shown on **Figure 3** (**Appendix A**). Two of the three stations were established to document amphibian numbers in the PSW while the third was included to document the temporary SWM facility on the adjacent property. Calling activity levels are provided in Table 4-3**.**

Table 4-3: Amphibian Calling Activity Levels at in 2017

STATION	MONTH	SPECIES							
		AMTO	BULL	CHFR	GRTR	GRFR	NLFR	SPPE	WOFR
1	April								
	May								
	June								
2	April								
	May								
	June								
3	April	1-1							
	May	1-2			1-1				
	June								

Low levels of calling amphibians of two species (American Toad and Gray Tree Frog) were recorded calling within the Study Area. Most calls were associated with the temporary SWM facility on the adjacent property (246 Arkell Road) located east of Station 3 (**Figure 4, Appendix A**).

No amphibian calls were recorded from the Torrance Creek PSW (Stations 1 and 2; **Figure 4, Appendix A**).

4.4.3.3 Corridor Studies

<u>Pitfall Traps</u>

Two seasons of pitfall trap surveys were conducted on the Subject Property: summer 2017 to capture juvenile amphibian dispersal and spring 2018 to capture amphibian and small mammal spring movement, as shown on **Figure 3** (**Appendix A**). Summer 2017 surveys captured a total of 25 individuals, including 15 amphibians (three different species) and 10 mammals (three different species, and others not identified to species). Pitfall traps 13 and 15 had the highest number of observations (four individuals each). These traps were located on the west side of the silt fence in the southern most section of the survey (**Figure 3 Appendix A**). The most common amphibian species recorded was Wood Frog with eight individuals and the most common mammal species recorded was Short-tailed Shew with four individuals. The most observations made in one day was on August 31, 2017 with nine individuals.

Spring 2018 pitfall trap surveys captured a total of 28 individuals, including 18 amphibians (two species) and 10 mammals (two species, others not identified to species). Pitfall trap 18 had the highest number of observations with 10 individuals. This trap was located on the east side of the silt fence in the southern most section of the survey **Figure 3** (**Appendix A**). The most common amphibian species recorded was Wood Frog (13 individuals) and the most common mammal species recorded was Short-tailed Shew (5 individuals). The most observations made in one day was on April 25, 2018 of ten individuals. Results of both the summer 2017 and the spring 2018 pitfall surveys are provided in Table 4-4.

Table 4-4: Pitfall Trap Survey Results, 2017-2018

Season	Survey Date	Pitfall Trap Number	Number of Individuals	Species Found (Common Name)	Species Found (Scientific Name)
Summer	August 13, 2017	13	1	Mouse species	*Peromyscus* sp.
		15	1	Short-tailed Shrew	*Blarina brevicauda*
	August 16, 2017	8	1	Short-tailed Shrew	*Blarina brevicauda*
		10	1	Northern Green Frog	*Lithobates clamitans*
		16	1	Meadow Jumping Mouse	*Zapus hudsonicus*
	August 18, 2017	8	1	American Toad	*Anaxyrus americanus*
		10	1	Meadow Vole	*Microtus pennsylvanicus*
		12	1	Mouse species	*Peromyscus* sp.
		13	1	Wood Frog	*Lithobates sylvatica*
		15	1	Mouse species	*Peromyscus species*
		15	1	Wood Frog	*Lithobates sylvatica*
	August 23, 2017	-	0	-	-
	August 25, 2017	-	0	-	-
	August 31, 2017	1	1	Short-tailed Shrew	*Blarina brevicauda*
		2	1	Short-tailed Shrew	*Blarina brevicauda*
		6	2	American Toad	*Anaxyrus americanus*
		7	1	Meadow Vole	*Microtus pennsylvanicus*
		13	2	Wood Frog	*Lithobates sylvatica*
		14	1	American Toad	*Anaxyrus americanus*
		17	1	Wood Frog	*Lithobates sylvatica*
	September 5, 2017	5	1	American Toad	*Anaxyrus americanus*
		11	1	Wood Frog	*Lithobates sylvatica*
		13	1	Wood Frog	*Lithobates sylvatica*
		15	1	American Toad	*Anaxyrus americanus*
		16	1	Wood Frog	*Lithobates sylvatica*
	September 8, 2017	-	0	-	-
2017 Total			**25**		

Table 4-4: Pitfall Trap Survey Results, 2017-2018

Season	Survey Date	Pitfall Trap Number	Number of Individuals	Species Found (Common Name)	Species Found (Scientific Name)
Spring	March 30, 2018	1	1	Meadow Vole	*Microtus pennsylvanicus*
		4	1	American Toad	*Anaxyrus americanus*
		17	1	Meadow Vole	*Microtus pennsylvanicus*
	April 4, 2018	-	0	-	-
	April 13, 2018	1	1	Short-tailed Shrew	*Blarina brevicauda*
	April 25, 2018	3	1	Short-tailed Shrew	*Blarina brevicauda*
		5	1	Short-tailed Shrew	*Blarina brevicauda*
		9	1	Short-tailed Shrew	*Blarina brevicauda*
		11	1	American Toad	*Anaxyrus americanus*
		14	1	Mouse species	*Peromyscus species*
		18	5	Wood Frog	*Lithobates sylvatica*
	April 26, 2018	5	1	Meadow Vole	*Microtus pennsylvanicus*
		14	1	Wood Frog	*Lithobates sylvatica*
	April 28, 2018	-	0	-	-
	May 3, 2018	2	1	American Toad	*Anaxyrus americanus*
		7	1	Meadow Vole	*Microtus pennsylvanicus*
		18	5	Wood Frog	*Lithobates sylvatica*
	May 4, 2018	7	1	American Toad	*Anaxyrus americanus*
		10	1	Short-tailed Shrew	*Blarina brevicauda*
	May 10, 2018	13	1	American Toad	*Anaxyrus americanus*
		14	2	Wood Frog	*Lithobates sylvatica*
2018 Total			**28**		

The locations of the pitfall traps were used to map movement across the Subject Property by group (i.e., amphibian, small mammal), as shown on **Figure 5** (**Appendix A**). Mapping suggests that movement for amphibians (both spring and summer combined) occurs primarily along the southern portion of the property, followed by the northern ecological linkage. Summer dispersal of amphibians tended to be easterly (although not exclusively) from the PSW, while spring movement tended to be westerly (although not exclusively) towards the PSW. Small mammal movement appeared to be distributed somewhat evenly across the property (found in both southern and northern traps as well as along southern and northern hedgerows as per track records). The central pitfall traps (9-12) had the lowest capture rate overall.

Winter Mammal Monitoring

Wildlife camera monitoring conducted fall 2017/winter 2018 recorded a total of 84 individuals of four species. White-tailed deer (*Odocoileus virginianus*) was the most commonly photographed species, with 80 individual records. Coyote (*Canis latrans*), Eastern Cottontail (*Sylvilagus floridanus*) and Gray Squirrel (*Sciurus carolinensis*) were the other three species recorded. Most observations (86%) were recorded from the north camera location, as shown on **Figure 3** (**Appendix A**).

Although 80 passes by deer were made, Stantec cannot conclude the actual number of deer that use the Subject Property, as it likely that individual deer were recorded multiple times. This conclusion is supported by the analysis of the size and shape of the antlers on nine buck photographs captured during the monitoring period. Results of the analysis have limitations in determining the number of individuals, however photo review suggests that only two different bucks were recorded during the 9 observations.

Wildlife tracks observed in 2018 recorded evidence of nine different species using the Subject Property. Species recorded included: white-tailed deer, Eastern cottontail, Eastern gray squirrel, red fox, racoon, Virginiapossum, red squirrel, coyote, and domestic cat.

To supplement the camera monitoring, evidence of white-tailed deer paths was mapped. Numerous trails and scat were noted throughout the Subject Property, particularly within the mown areas near the residence and along the northern hedgerow.

The location of each of camera and an overview of the tracks were mapped to provide movement across the Subject Property by group (i.e., mammal or deer), as shown on **Figure 5** (**Appendix A**). Results showed well used deer trails throughout the Subject Property, with the largest number of records associated with the northern ecological linkage as captured on that wildlife camera.

4.4.3.4 Bat Maternity Roost

Surveys identified three trees that had suitable characteristics for potential bat maternity roosts. Details of the three potential bat maternity roost trees are provided below in Table 4-5 and shown on **Figure 4** (**Appendix A**).

Table 4-5: Potential Bat Maternity Roost Trees within the Subject Property, 2017

Tree Number	Tree Species	Number of Cavities	DBH (cm)	Tree Height (m)	Cavity Height (m)	Bat Maternity Roost Characteristics	Location
1	Black Cherry	1	37	14	8	• Exhibits cavities/crevices • Open canopy • Early stages of decay	North-south Hedgerow
2	Sugar Maple	1	100	20	12	• Exhibits cavities/crevices • Largest DBH in community • Cavity/crevice is high up in three (>10m) • Open canopy	Hedgerow on east side of the Subject Property

Table 4-5: Potential Bat Maternity Roost Trees within the Subject Property, 2017

Tree Number	Tree Species	Number of Cavities	DBH (cm)	Tree Height (m)	Cavity Height (m)	Bat Maternity Roost Characteristics	Location
3	White Ash (dead)	1	50	25	14	• Exhibits cavities/crevices • Cavity/crevice is high up in three (>10m) • Open canopy	Hedgerow on the south side of the Subject Property

Bat exit surveys were not conducted in 2017 as tree health and characteristics change over time. Stantec proposes to conduct exit surveys the summer prior to tree removal, if required.

4.4.3.5 Breeding Birds

Diurnal Surveys

During breeding bird surveys conducted in June 2017, Stantec observed 31 species of birds, 29 of which are likely to be breeding in the Study Area. Species not expected to be breeding in the Study area include: Barn Swallow (discussed below) and Mallard which were observed flying over the Study Area and/or foraging.

A complete list of birds observed during the surveys is provided in **Appendix H2**. All species observed are ranked S5 (Secure; common and widespread), or S4 (Apparently secure; uncommon but not rare).

One rare species, Eastern Wood-Pewee, was recorded calling within the PSW as shown on **Figure 4** (**Appendix A**) during the breeding bird surveys. Eastern Wood-Pewee is provincially designated as Special Concern and is a forest bird of deciduous and mixed woods (McLaren 2007).

One federal and provincial SAR was observed during the surveys in 2017 (i.e., Barn Swallow), but is not expected to be breeding on the Subject Property. Barn Swallows nest on walls or ledges of barns as well as on other human-made structures such as bridges, culverts or other buildings (Cadman et al., 2007). Barn Swallows are generally considered grassland species, foraging over meadows, hay, pasture or even mown lawn. There was no evidence of nesting Barn Swallows in the structures located on the Study Area during any studies conducted on the property in 2016 and 2017.

Eight locally significant bird species were identified in the Study Area including: American Redstart, Baltimore Oriole, Barn Swallow (discussed above), Common Raven, Cooper's Hawk, Eastern Kingbird, Eastern Wood-Pewee (discussed above), and Northern Flicker, as shown on **Figure 4** (**Appendix A**).

Crepuscular Surveys

American Woodcocks and Common Nighthawks were observed during crepuscular surveys within the Study Area. Three Common Nighthawks were observed on June 7, 2017 at the western survey location to the north, associated with the Victoria Park Village development. No Common Nighthawks were observed during subsequent survey on June 21, 2017.

Common Nighthawk is listed as Special Concern in the province and is also considered locally rare in the City of Guelph. The Common Nighthawk is an aerial insectivore that forages at dawn and dusk, identified by its distinctive call. They nest on the ground in open habitats, including gravel pits, agricultural fields, prairies, alvars, airports, and even on gravel roofs in urban settings (Sandilands 2007). The Nighthawks observed in 2017 are not expected to be nesting on the Subject Property due to the approximate location of observations to the north, as shown on **Figure 4** (**Appendix A**). Furthermore, Victoria Park Village was under active construction during the surveys, as such providing suitable nesting habitat. Although the Subject Property may provide suitable foraging habitat for Common Nighthawks, none were observed during any of the evening survey conducted.

4.4.3.6 Raptor Surveys

No stick nests were identified on the Subject Property or within the Study Area where visual access permitted during surveys conducted in 2017 and 2018.

Raptor observations were recorded during 2 of the 5 surveys, either incidentally or during winter raptor surveys, summarized in **Table 5.6.**

Table 4-6: Winter Raptor Observations, 2017-2018

Date	Species	Number of Individuals	Location on Subject Property
November 14, 2017	Red-tailed Hawk (*Buteo jamaicensis*)	1, adult	Observed flying over the northwest corner of the Subject Property, approximately 100 m high
December 22, 2017	Cooper's Hawk (*Accipiter cooperii*)	1, adult male	Observed circling over the Subject Property, approximately 100 – 150 m high

4.4.3.7 Insect Habitat Assessment

Results of the habitat assessment for the Subject Property identified limited suitable insect habitat. Continued maintenance of the lawn, lack of standing water in the wetland where access was permitted, and a lack of wildflowers indicates that suitable habitat to support strong butterfly, dragonfly, and bee populations is absent. Due to the absence of this suitable habitat, insect-specific surveys were not conducted, although incidental observations (see Section 4.4.3.8 below) did capture insects where possible.

4.4.3.8 Incidental Wildlife Observations

Incidental wildlife observations recorded during survey not detailed above in 2016-2018 include: two mammals (striped skunk and an unknown bat species), two butterfly species (cabbage white and least skipper), and two bird species (American crow and common raven).

A full wildlife list of all species observed on the Subject Property is provided in **Appendix H2.**

5.0 SIGNIFICANT NATURAL HERITAGE FEATURES

The following analysis of significance targets development constraints recognized by the Natural Heritage Policy (Section 2.1) of the PPS (OMAH, 2014) on the following natural heritage features:

- Significant wetlands
- Significant woodlands
- Significant valleylands
- Areas of natural and scientific interest
- Significant wildlife habitat
- Fish habitat
- Habitat for endangered and threatened species

Each of these components and their applicability to the Study Area is discussed in the following sections.

5.1 WETLANDS

The province determines significance of wetlands according to standardized evaluation procedures. Additionally, the planning authority may designate other wetlands significant if they have limited representation within the planning area or are of high quality within the context of the municipality.

According to LIO mapping (2018), the Torrance Creek PSW is located within 120 m of the Project Location (**Figure 1, Appendix A**).

As part of the 246 Arkell Road development in 2010, the wetland pocket east of the existing driveway on the 220 Arkell Road property was approved for removal. This removal has since occurred, with the 246 Arkell Road development completed on the adjacent property. A small (0.02 ha) remnant portion of that pocket that was approved for removal remains on the Subject Property, solely due to the location of the property boundary that prohibited the full removal at that time.

Updates to the PSW boundary within the Study Area resulted from site investigations undertaken in 2012 on the property to the north for Victoria Park Village by Stantec (SWD7-1; **Figure 4**, **Appendix A**), in 2015 on the property to the southwest by NRSI, as well as in 2017 on the Subject Property (SWDM4; **Figure 4**, **Appendix A)** as detailed in Section 4.4.2.4.

The City of Guelph's OP (Schedule 4A, 2014) identifies the upland forested edge surrounding the PSW as well as a portion of the northern and north-south hedgerows (FODM11; Figure 4, Appendix A) as locally significant wetland. Although the full wetland block is identified as SWDM4 on Figure 4 (Appendix A), this is in accordance with ELC practices that allows for transition zones (e.g., edges, minimum 10 m) to be included within a specific vegetation community. None of these areas are wetland, as determined by

the GRCA in 2017, and as such in the interest of data management the OP can be updated at the City's discretion.

5.2 WOODLANDS

Significant Woodlands in the City of Guelph are identified on Schedule 4C of the City of Guelph Official Plan and are defined in Section 4.1.3.6 of the Official Plan:

- Woodlands ≥1ha not identified as cultural woodlands or plantations,
- Woodlands ≥0.5ha consisting of dry-fresh sugar maple deciduous forest, or
- Any woodlands ranked S1-S3 by the NHIC.

There are two significant woodlands identified within the Study Area. The first corresponds to the forested portion (i.e., SWD4; **Figure 4**, **Appendix A**) of the Torrance Creek PSW within the Property Boundary. The second is located on the adjacent property to the east.

5.3 VALLEYLANDS

Significant valleylands are identified by the GRCA and include undeveloped areas within the regulatory flood plain or riverine flooding or erosion hazards. These are identified on Schedule 4D of the OP as well as GRCA hazard mapping.

No significant valleylands occur within the Study Area.

5.4 AREAS OF NATURAL AND SCIENTIFIC INTEREST

Areas of Natural and Scientific Interest (ANSIs) are areas identified by MNRF as significant natural landscapes or features with life science or earth science (or both) value related to natural heritage protection, scientific study, and/or education. They are identified on Schedule 4a of the City's OP.

No provincially significant ANSI's occur in the Study Area.

5.5 SIGNIFICANT WILDLIFE HABITAT

Significant Wildlife Habitat (SWH), as defined by MNRF (2000, 2015; detailed below), is comprised of the following categories: seasonal concentration areas, rare vegetation communities or specialized habitat, habitat for species of conservation concern, and wildlife movement corridors. Within each category, several potential types of SWH exist, which are discussed in more detail below.

The Significant Wildlife Habitat Technical Guide (MNRF, 2000) and SWH Criteria Schedule for Ecoregion 6E (MNRF 2015) were consulted to identify candidate and then confirm SWH, where required. Prescreening provided in Table 1 in the approved ToR (**Appendix C**) guided habitat assessments and specialized field studies, as detailed in **Section 4.4,** that were undertaken in the Study Area. Specialized

forms were completed in the field for each vegetation community, found in **Appendix G**, documenting candidate habitat types as well as rare or specialized features.

The City of Guelph identified SWH on Schedule 4E, which includes the majority of the Torrance Creek PSW.

The results of the SWH assessment, studies, and analysis is provided below.

5.5.1 Seasonal Concentration Areas

Seasonal concentration areas are where large numbers of a species, or several species, gather together at one time of the year. According to MNRF (2015) this may include: bird and butterfly migratory stopover areas; raptor wintering areas; bat hibernacula or maternity colonies; reptile overwintering areas; colonially-nesting bird breeding habitat; and deer yarding areas.

Prescreening identified potential SWH within the Study Area for: bat maternity colonies, reptile hibernacula, as well as deer yarding and winter congregation areas. Although winter raptor habitat within the Study Area does not meet woodland size requirements for candidacy per MNRF 2015, the City of Guelph required winter raptor surveys be conducted to assess local significance. Results of the studies are provided below in **Section 5.5.5**.

Bat maternity colonies potentially occur within the forested areas (e.g., SWD4, SWD7-1; **Figure 4, Appendix A**). A full assessment of bat maternity habitat quality was not completed as these areas are being retained post-construction and as such is assumed to be SWH for bat maternity colonies. Potential habitat for bat species at risk is not considered under this type of SWH but is instead discussed in **Section 5.6**, below.

Building foundations appeared to be in good repair (i.e., lacking cracks or crevices to below the frost layer) and snake area searches did not identify any snake congregation areas. Therefore, reptile hibernacula are considered absent from the Study Area.

Both deer yarding and winter concentration areas are identified by the MNRF as occurring within the Study Area, as shown on **Figure 1** (**Appendix A**) within the Torrance Creek PSW. As the mapping of deer yarding and winter congregation areas are explicitly the responsibility of the MNRF (MNRF 2015) no further analysis is required. However, winter mammal surveys did identify white-tailed deer moving across the Subject Property during the fall and winter months to/from the PSW, as one would expect through habitat adjacent to deer congregation area.

5.5.2 Rare or Specialized Habitat

Rare or specialized habitats are comprised of two components; vegetation communities that are considered rare in the province (S1-S3) or microhabitats that are critical to wildlife. Rare vegetation communities were considered during ELC surveys whereas targeted habitat assessments were competed in the field for the following: woodland raptor nesting, seeps and springs, amphibian breeding habitat, and woodland area-sensitive bird breeding habitat.

No rare vegetation communities were identified within the Study Area during surveys conducted on the Subject Property in 2016-2018.

Raptor nests were sought during all surveys, which were timed to capture various stages of the raptor breeding period (e.g., nest building in the spring, nestlings in the summer) as well as during leaf off when increased visibility facilitated thorough nest searches. Seeps and springs were also sought during all surveys.

No woodland raptor, seeps, or springs were identified within the Study Area during any surveys conducted in 2016, 2017 or 2018.

Preliminary ELC conducted in 2016 identified the onsite PSW as potentially able to support woodland (SWD4) breeding amphibian habitat. Although anthropogenic features are not typically considered SWH, amphibian surveys also targeted the offsite SWM facility on the 246 Arkell Road development. No amphibians were observed calling from the PSW and a maximum of three individuals of two species were recorded from the SWM pond (see **Section 4.4.3.2**). Therefore, the listed species as per the Ecoregion Criteria (MNRF 2015) were not recorded in numbers (i.e., two or more species of at least 20 individuals each) to be considered SWH for amphibian breeding habitat.

The lack of significant amphibian breeding habitat within the Torrance Creek PSW is inconsistent with survey results reported in the EIR for Victoria Park Village. However, this report was based on studies conducted in 2004, and an older version of the Ecoregion Criterion for 6E (MNR 2012) was used for the analysis of significance.

SWH for area-sensitive breeding birds was identified in the Torrance Creek PSW by previous studies, as identified by the City in their May 10, 2017 correspondence (**Appendix C**). Results of studies conducted in 2017 did not record any area-sensitive breeding species, however; field studies were restricted to the woodlot edge due to a lack of access.

5.5.3 Species of Conservation Concern

Species of conservation concern includes:

- Species ranked as Special Concern provincially,
- Species without provincial ranking, but are ranked Threatened or Endangered federally,
- Species that have an S-rank of S1-S3 in Ontario.

Two provincial species of conservation concern were observed in the Study Area during field investigations conducted in 2017: Common Nighthawk and Eastern Wood-Pewee.

As described in **Section 4.4.3.5** above, the Common Nighthawk is not expected to be breeding on the Subject Property and as such SWH for this species is considered absent. The Eastern Wood-Pewee, however, is expected to be breeding in the Study Area and therefore SWH for this species occurs. Detailed mapping was not conducted, and as such the SWH is assumed to be the full SWD4 community.

5.5.4 Wildlife Movement Corridors

Migration corridors are areas that are traditionally used by wildlife to move to one habitat from another. This is usually in response to different seasonal habitat requirements. There are two types of animal movement corridors in Ecoregion 6E, amphibian and deer movement corridors. As per the Ecoregion Criterion Schedule, movement corridors must connect candidate or confirmed significant wildlife habitat features, including amphibian wetland breeding habitat, deer yarding, or deer winter congregation areas.

Due to the presence of a significant woodland of unknown characteristics to the east of the Subject Property as well as the known deer congregation area associated with the PSW to the west, the City of Guelph has designated a 50 m wide ecological linkage along the northern property boundary. As significance has already been determined by the City, an analysis of significance under the Ecoregion Criteria is not required. Instead, the purpose of the corridor studies was to document existing movement across the Subject Property (shown on **Figure 5** (**Appendix A**) and discussed in **Section 4.4.3.3**) and assist with proposed mitigation measures (i.e., wildlife culvert design) which are discussed in **Section 7.1.3.4** below.

Under existing conditions, deer movement across the property occurs in almost every direction while small mammals appear to favor cover (e.g., hedgerows, landscaping and the PSW). Amphibians appear to move from their overwintering habitat somewhere from the east into the PSW to breed, although amphibian call counts failed to detect calling amphibians from the PSW.

5.5.5 Locally Significant Wildlife Habitat

Results of the winter raptor surveys identified one Red-tailed Hawk and one Cooper's Hawk in 2017. Although Cooper's Hawk is considered a locally significant species by the City of Guelph, one observation of a single male flying high above the Study Area (100-150 m) does not designate the Subject Property as locally significant winter raptor habitat. Guided by criteria outlined by the MNRF in 2015, use of the area by a high number of individuals by multiple species would be required to determine significance. Due to the infrequent observations we do not consider the Study Area to support locally significant wildlife habitat for winter raptors.

Nine locally significant bird species were identified in the Study Area, including American Redstart, Common Raven, Cooper's Hawk, Baltimore Oriole, Eastern Kingbird, Northern Flicker, as well as three at risk or rare species such as Barn Swallow, Eastern Wood-Pewee, and Common Nighthawk as shown on **Figure 4** (**Appendix A**). The PSW is considered locally significant for most of these species, except for Barn Swallow (discussed below), Common Nighthawk (not expected to be breeding on the Subject Property), and Eastern Kingbird (observed within the northern hedgerow that is protected as part of the ecological linkage). Although the Cooper's Hawk and Common Raven were not noted within the forested PSW, both are forest birds and as such their habitat is also considered to be within the PSW and will be protected.

5.6 HABITAT OF ENDANGERED AND THREATENED SPECIES

Species listed as threatened or endangered in the province are protected under the ESA. One SAR was observed on the Subject Property during studies conducted between 2016 and 2018: the Barn Swallow. Although this species was observed foraging over the residence and lawn area communities during both breeding bird surveys, an assessment of the anthropogenic structures on the Subject Property (residence, pool shed, and a small barn) determined that they were not being used for breeding by this species. Therefore, habitat for threatened and endangered species was not documented on the Subject Property although it may exist within the Study Area (residences to the north and south).

5.7 SIGNIFICANT NATURAL HERITAGE FEATURES SUMMARY

In summary, significant and other natural heritage features were identified in the Study Area. The following significant natural heritage features were found in the Study Area (**Figure 4, Appendix A**):

- Torrance Creek PSW (SWD4, SWD7-1)
- Significant woodlands (SWD4, SWD7-1)
- SWH for seasonal concentration areas, specialized habitat for wildlife, habitat for species of conservation concern, and animal movement corridors, specifically:
  - bat maternity colonies (SWD4, SWD7-1)
  - deer yarding areas (SWD4, SWD7-1)
  - deer winter congregation areas (SWD4, SWD7-1)
  - woodland area-sensitive bird breeding habitat (identified by others in the PSW)
  - special concern wildlife species (Eastern Wood-Pewee, SWD4)
  - amphibian movement corridors (designed 50 m wide ecological corridor along northern hedgerow)
  - deer movement corridors (designed 50 m wide ecological corridor along northern hedgerow)

The following other (i.e. non-significant) natural heritage features were found in the Study area:

- Hedgerows
- Habitat for locally significant species (Cooper’s Hawk, Common Raven, American Redstart, Baltimore Oriole, Northern Flicker, Eastern Kingbird, and swamp gooseberry).

6.0 PROPOSED DEVELOPMENT

The Proposed Draft Plan consists of 31 single-family lots on a single road ('Street A') with 1 multi-family townhouse block, a 0.31 ha park, temporary emergency access, a trail, and a stormwater management (SWM) pond that services only these lands. The described are shown on **Figure 2** (**Appendix A**).

A trail is proposed from Dawes Avenue into the Subject Property, north along the existing driveway, around the SWM pond and connect to the Victoria Park Village subdivision, north of the Subject Property. The proposed trail will be comprised of varying widths based on the development block and additional functions required. A 4 m wide hard surface trail will be associated with the SWM facility, doubling as the maintenance access, whereas the off-road portion of the trail will be comprised of a 6 m corridor, consisting of a 3 m wide hard surface as well as mow strips to allow for grading and drainage on either side. A portion of the trail will be contained within a 10 m wide temporary emergency road allowance, 7 m of which will be restored post-development.

6.1 STORMWATER MANAGEMENT

This section outlines the analysis undertaken to assess the existing hydrology for the Subject Property and design a SWM system to meet the City of Guelph criteria using traditional SWM and Low Impact Development (LID) features to achieve the water quantity and water quality targets.

6.1.1 Design Criteria

SWM criteria were established based on the TCSS and the characteristics of the receiving systems. The SWM criteria applied to the site are as follows:

- Water Quality – Provide quality control to meet Ministry of Environment, Conservation, and Parks Enhanced (Level 1) criteria as identified in Table 3.2 of the Stormwater Management Planning and Design Manual (MOE 2003)
- Water Quantity – Control post-development peak flows to Torrance Creek, to target flow rates from the TCSS. Target peak flow rates have been pro-rated to the developed area
- Extended Detention – Provide at least 24 hours of extended detention of the 25 mm event
- Infiltration – Evaluate the infiltration potential of the Subject Property as it relates to the existing water budget, and maintain existing infiltration rates on the property where possible
- Temperature – The thermal impacts of stormwater discharge to Torrance Creek be assessed and appropriate mitigation practices implemented
- Erosion and Sediment Control – Provide appropriate erosion and sediment control during construction to protect neighbouring properties and downstream receivers from potential siltation

6.1.2 Residential Development Area

Rear yard soakaway pits infiltrating roof water are proposed for all single-family homes within the subdivision, provided that adequate separation of these pits from the high groundwater table is achieved. Similarly, centralized infiltration trenches are proposed for the multi-family block to direct shared roof areas to recharge locations. Rooftop runoff is considered 'clean' and does not require water quality treatment prior to infiltrating. As such, roof leaders from all homes are to be connected to the soakaway pits or centralized trenches via direct connection or via surface flow, with an overflow provided at grade for single family lots or an overflow connection to the storm sewer for the centralized trenches. Specific connection details will be provided at detailed design.

Both soakaway pits and centralized trenches have been sized assuming 40% of the lot is building coverage. This value was taken from *Section 5 – Residential Zones* of the City of Guelph Zoning Bylaw. There will be a mix of different residential units within the subdivision; however, this provides an accurate preliminary estimate on recharge volumes from the development. The average rooftop area has therefore been conservatively estimated as 120 m^2.

At this stage in the design, the site plan for the multi-family block is unknown. Stantec assumes that all rooftop areas within the block will be directed to centralized infiltration trenches to achieve the intended recharge target. At a minimum, the multi-family block must infiltrate all rainfall events up to and including the 25 mm storm from all rooftops (assumed rooftop coverage is 6,000 m^2 or approximately 30% of the block) for a total average annual rooftop infiltration volume of 3,500 m^3/year. This is the target annual recharge volume for the multi-block and should be met at the Site Plan Approval stage.

6.1.3 Dry Facility

The stormwater management facility was designed in consideration of recommendations made by the City of Guelph during the March 13, 2017 meeting, which included the use of a dry SWM facility to minimize barriers to wildlife movement within the ecological corridor.

End-of-pipe infiltration in the dry stormwater management facility is proposed by using a raised catchbasin grate for the facility's outlet to encourage ponding and infiltration through the bottom of the facility, and to delay the peak flow to the receiving PSW; however, due to the facility's proximity to the PSW, the high groundwater table is close to ground surface (particularly during spring months), so infiltration is anticipated to predominantly occur from June to November when groundwater levels are typically lower (as shown in the appended calculations). Despite this high groundwater condition, Stantec is recommending the incorporation of end-of-pipe infiltration to promote recharge to the adjacent PSW for as much of the year as possible. In addition to the groundwater recharge benefits, the ponded water will help to promote evapotranspiration and maintain the natural hydrologic regime of the site.

The infiltration component of the stormwater management facility provides sufficient retention volume to contain the runoff resulting from all rainfall events up to and including the 10 mm rainfall event. This event has been assumed to represent 50% of the average annual rainfall volume.

A key constraint to the proposed infiltration measures onsite is the high groundwater table. Based on the proposed grades and the seasonally high groundwater results documented in the *Hydrogeological Assessment* (**Appendix E**), the proposed lot level infiltration trenches can maintain at least one meter of separation from the bottom of the systems to the seasonally high groundwater level for the majority of the Subject Property. Trenches are not proposed in areas of the Subject Property where this separation is not achieved. This will require that the centralized trench locations (particularly in the multi-block) be located in specific areas of the property to avoid the seasonally high groundwater table.

Details of the proposed infiltration trenches for rooftop runoff, as well as potential implementation of alternative LID and/or Green Infrastructure (GI) or infiltration measures, shall be explored at the detailed design stage of the project.

6.1.4 Temporary Access

In addition to the detail outlined above, an assessment was conducted for the addition of a 10 m wide maintenance access path connecting to Dawes Avenue to the south of the site. Details of this assessment are documented within a letter from Stantec to the City of Guelph, sent on November 5, 2018 *Re: 220 Arkell Road – Response to Stormwater Management City comments dated July 19, 2018*, which has also been included in Appendix D of the Preliminary Servicing, Grading and Stormwater Management Report (**Appendix I**) for reference. The maintenance access increases the impervious area slightly within the Subject Property to the south, but this increase was shown to not result in a significant change in the overall water balance or affect the function of the rear-yard infiltration trench.

Full SWM details are provided in the Preliminary Servicing, Grading, and Stormwater Management Report (**Appendix I**).

6.1.5 Water Balance and Infiltration

A pre- and post-development water balance assessment was completed for the Subject Property as detailed in Section 5 of the *Hydrogeological Assessment* report provided in **Appendix E**. In summary, the analyses indicate the following:

- Under the pre-development conditions, the Subject Property is comprised of wetland, woodland or cultivated field, determined to be 92% previous with 8% impervious cover associated with the existing residence and driveway. The rainfall (65,580m^3) on site follows three possible pathways - evapotranspiration, infiltration and off site run off (overland flow). As pervious areas and evapotranspiration change as result of development the volumes of contribution to the three pathways change. These are shown in Table 6-1 below.

Table 6-1 - Results of Site Water Balance

Site Condition	Site Area (ha)	Annual Volumes (m^3/yr.)			
		Rainfall	ET	Runoff	Infiltration
Pre-Development	7.2	65,580	39,610	10,030	15,950
Post-Development			28,220	26,330	11,040
Post-Development with Infiltration			28,220	17,480	19,880

- The predicted annual volume of water that infiltrates under existing conditions is estimated at 15,950 m^3/year equating to an infiltration rate of 223 mm/year.
- Under post-development conditions, impervious surfaces are expected to cover 39% of the Subject Property (2.8 of 7.2 ha), which will result in an annual water volume of 11,040 m^3/year infiltrating to the subsurface via the remaining onsite pervious areas. Active infiltration from rooftops and the SWM facility provides 8,900 m^3/year to offset the annual infiltration deficit of 4,910 m^3/year calculated for the Subject Property under the post-development condition.
- Similarly, under post-development conditions, the 39% impervious coverage will result in an annual runoff volume of 26,330 m^3/year draining to the wetland. The active infiltration from rooftops and the SWM facility mentioned previously reduce the annual runoff volume to 17,480 m^3/year to the wetland.
- The seasonally high groundwater table provides constraints to the implementation of LID measures. However, measures that partially offset this deficit include: roof downspout disconnection; soakaways/infiltration trenches; bioretention cells; vegetated filter strips; (enhanced) grass swales and will be explored at the detailed design phase.

Potential impacts and proposed mitigation measures associated with this infiltration deficient are provided in **Sections 7.2.17.1.1 and 7.3.4**, below.

7.0 POTENTIAL IMPACTS OF DEVELOPMENT AND MITIGATION RECOMMENDATIONS

Potential direct and indirect impacts associated with the proposed development have been considered and appropriate mitigation measures recommended. An assessment of overall net environmental impacts is also provided based on the implementation of appropriate mitigation measures, as feasible.

7.1 IMPACTS ON SIGNIFICANT NATURAL FEATURES

Potential impacts associated with the development include an increase in impervious surface cover, impacts to the hydrologic cycle through reduced recharge and increased runoff from paved surfaces. This runoff may carry nutrient, biological, or sediment load. Potential encroachment of residential uses (e.g., ad-hoc trails, refuse dumping, garden escapees) can also degrade adjacent natural features.

Construction impacts including sedimentation and erosion, encroachment outside of development footprint, and direct (i.e., mortality) or indirect (i.e., noise, barriers to movement) impacts to wildlife may also occur, although they are expected to be short-term.

Feature-specific impacts are described below.

7.1.1 Significant Wetlands

No development is proposed within the Torrance Creek PSW; however, development is proposed in areas that are adjacent to wetland features within the Study Area.

Potential impacts to the Torrance Creek PSW (SWDM4, SWD7-1) during and post-construction include:

- increased overland flow during storm events due to a higher proportion of impervious surfaces
- increased sediment load to the wetland during development
- increased salt inputs to the wetland (via runoff) from winter road maintenance activities (i.e., road salting)
- increased biological contamination (e.g., invasive species)
- encroachment (i.e., ad-hoc trails, lawn and garden waste dumping, garden escapees)
- construction impacts (dust, encroachment).

Existing condition of the PSW includes a high percentage of common buckthorn in the understorey. The City of Guelph has recommended management of the PSW and proposed buffer for invasive species and hazard trees in their April 27, 2017 memo (**Appendix C**). As such, impacts associated with vegetation removal (discussed in **Section 7.2.2**) are anticipated in the wetland.

No other wetlands occur within the Study Area.

7.1.2 Significant Woodlands

The significant woodlands associated with the Torrance Creek PSW may experience some of the same impacts as wetlands post-construction:

- Increased overland flow during storm events due to a higher proportion of impervious surfaces
- Increased sediment load during development
- Increased salt inputs from winter road maintenance activities (i.e., road salting)
- Sedimentation
- Increased biological contamination (e.g., invasive species)
- Encroachment (i.e., ad-hoc trails, lawn and garden waste dumping, garden escapees)
- Construction impacts (dust, encroachment).

Impacts associated with vegetation removal (discussed in **Section 7.2.2**) may also occur during invasive species management and hazard tree removal required by the City of Guelph.

7.1.3 Significant Wildlife Habitat

Potential direct and indirect long-term impacts of the proposed development on wildlife in the Study Area include fragmentation and isolation of habitat, changes in the wetland water balance and vegetation, and increased disturbance due to human activity (e.g., exotic plants, domestic pets, noise, light, etc.).

Short-term impacts associated with construction includes encroachment into the natural areas and noise, which may lead to habitat avoidance/disturbance within the adjacent property. These effects are expected to be mitigatable and short term in duration, with wildlife expected to return to the adjacent habitats after construction is complete.

7.1.3.1 Seasonal Concentration Areas

<u>Bat Maternity Roosts</u>

Potential loss of suitable trees to support bat maternity colonies may occur along the edge of the PSW due to hazard tree removal required by the City of Guelph for the health and safety of residents. However, the large PSW is expected to support an adequate number of hazard trees to offset any minor losses that may be required. Additional mitigation measures (i.e., timing) can further offset any potential impacts to bat maternity colony SWH. Consultation with Guelph District MNRF in 2017 (personal correspondence, Graham Buck June 9, 2017) has indicated that this is an acceptable approach for bat species at risk, which Stantec has extended to bat SWH. Although this approach has been implemented to date in the City of Guelph, any future guidance from MECP that becomes available on bat roost trees will be considered for implementation at that time.

<u>Overwintering Deer</u>

White-tailed deer were documented approximately 136 times (**Figure 5**, **Appendix A**) on the Subject Property during corridor studies conducted in late 2017/early 2018, representing the largest number of

observations of all documented wildlife. This high number of observations is likely attributable to the presence of a deer wintering area associated with the PSW, suitable foraging habitat (i.e. presence of apple trees), and open fields. As vegetation removal will be limited within the PSW and along the designated ecological linkage, direct impacts to habitat suitability is not anticipated in the two areas associated with high deer use as shown on **Figure 5** (**Appendix A**). Loss of the existing open pasture and lawn areas adjacent to the PSW will impact deer as these areas offer deer access to high quality food (MNRF 2014). To compensate for this loss, deer are expected to move into the agricultural fields to the east because deer are highly mobile and resilient animals (e.g., Alverson *et al.*, 1988; Gaughan and DeStefano, 2005, etc.). White-tailed deer are not expected to be at risk of direct impact during construction, with collision-risk along roadways not being expected to change post-construction.

White-tailed deer exploit suburban environments because edges provide ample food (Gaughan and DeStafano, 2002) and safety from predation and hunting, which are two of the largest limiting factors for white-tailed deer populations in Canada (Patterson *et al.*, 2002). In some cases, individuals living in an area may feed deer to promote wildlife viewing. This activity can have both positive (offsetting loss of foraging habitat) and negative (browse of landscaped areas, disease) effects. Furthermore, disturbance by people and dogs may occur, particularly during the late winter when food reserves are low (MNRF 2014).

Coincidentally, invasive species management proposed for buckthorn may improve habitat suitability for deer, as research suggests they may avoid sites with buckthorn, although the opposite is true for coyotes and Virginia opossums (Vernon et al. 2014). Shrubby wetland and edge vegetation will persist post-construction, with additional plantings (i.e., food) being provided post-construction within the Subject Property.

Although the pattern of use on the Subject Property by white-tailed deer will change post-construction, no long term impacts to the deer population are expected given that this species is highly adaptable to changes in the environment combined with the fact that the planned development will avoid disturbing the existing core overwintering area, remove minimal vegetation, and will be subject to the implementation of mitigation measures discussed in **Section 7.3.3** below (i.e., 50 m wide corridor along the northern property boundary, buckthorn removal, landscape plantings).

7.1.3.2 Rare or Specialized Habitat

One type of specialized habitat was identified within the Study Area (i.e., area-sensitive breeding birds) and is discussed below.

<u>Area-Sensitive Breeding Birds</u>

Area-sensitive birds were not identified within the Study Area during studies conducted in 2017. As such, area-sensitive breeding bird habitat is expected to be located deeper in the PSW to the west; that is a minimum of 200 m from the forest edge as defined by the MNRF (2015). Temporary noise disturbance during construction may cause movement of birds farther into the PSW, while long-term impacts would be restricted to unauthorized use of the PSW by people and their pets resulting in a potential reduction of bird breeding success (MNRF 2015), particularly during the sensitive breeding period (May-August). As vegetation removal is not proposed, fragmentation effects (e.g., increased parasitism) are not anticipated.

7.1.3.3 Habitat for Species of Conservation Concern

Two species of conservation concern, Eastern Wood-Pewee and Common Nighthawk, were recorded during surveys conducted at the Study Area.

Potential impacts to Eastern Wood-Pewee are identical to those outlined for area-sensitive breeding birds above, with the species potentially moving farther into the PSW to avoid noise and the possibility of increased depredation due to unauthorized human and pet use of the PSW.

Impacts of the proposed development are not anticipated on Common Nighthawk as it was associated with the VPV property to the north. Common Nighthawks are not anticipated to remain in the Study Area due to ongoing construction at the VPV property.

7.1.3.4 Wildlife Movement Corridors

Wildlife movement across the Subject Property under existing conditions is complex, as demonstrated by **Figure 5** (**Appendix A**). As discussed in **Section 7.1.3.1**, white-tailed deer are expected to continue to use the northern corridor and avoid the developed areas without major impact.

Most of the amphibians that were documented during pitfall trap surveys conducted on the Subject Property (American toad and wood frog) hibernate terrestrially, underground below the frost line or under cover objects such as leaf litter, logs, etc. Other species, such as the single green frog that was recorded on August 16, 2017, hibernate aquatically in wetlands or ponds (Ontario Nature, no date). Stantec is unclear where the American toad and wood frogs are hibernating in the Study Area, with potentially suitable habitat being associated with the upland portions of the PSW, gardens of the residences on the adjacent lands and/or Subject Property, hedgerows, or the woodland to the northeast. These habitats are all within the known annual migration distance of American toads, which is typically less than 500 m (Wells, 1992), but can be up to a kilometer (Ewert, 1969). Habitat for aquatic-hibernating species such as green frogs is present within the stormwater management pond located on the adjacent property (246 Arkell Road).

Although calling amphibians were restricted to the SWM facility and not recorded in the PSW, movement patterns documented during the corridor studies appear to refute that amphibians are not using the PSW. Summer amphibian movement generally occurs away from the PSW, which based on timing are expected to be dispersing juveniles. Spring movement generally appeared towards the PSW, which are expected to be adults moving from hibernation sites to the PSW to breed, although overall capture rates are quite low. Based on this general movement pattern, amphibian use post-construction is expected to be redirected to the north along the designated ecological corridor. Although migratory distances are expected to generally increase, this rerouting through the northern portion of the Subject Property does not appear to exceed known migratory distances between the PSW, SWM facility, and northeastern woodland (<1 km). Impact of increased migratory distance includes increased predation risk and metabolic demand; however, vegetative cover would be higher through the PSW, which has been shown to facilitate longer migration distances (Rothermel and Semlitsch 2008), possibly due to lower risk of desiccation.

The greatest potential impacts to amphibians include direct impact through mortality from roads, particularly on rainy warm nights in the spring and late summer. A road is required to connect this proposed development to VPV to the north, which bisects the ecological corridor. Internal roads are also

proposed in proximity to the SWM pond, although separated by single detached homes. Lawn mowing may also pose a direct impact to amphibians on the Subject Property post-development.

Indirect impacts are associated with habitat degradation and fragmentation, such as increased siltation or salt runoff into the PSW or SWM pond. Impacts to hibernating areas will include the loss of potential hibernating areas (e.g., hedgerows, existing gardens), however plantings within the ecological corridor and an increase in gardens available at the detached homes is anticipated post-construction.

Post-construction wildlife movement for all wildlife species documented on the Subject Property is expected to occur within the designated 50 m wide ecological corridor along the northern boundary of the property.

7.1.4 Locally Significant Species

Six locally significant bird species that have not been discussed elsewhere (e.g., under species of conservation concern or species at risk) were identified in the Study Area, including American Redstart, Common Raven, Cooper's Hawk, Baltimore Oriole, Eastern Kingbird, Northern Flicker. The PSW is considered locally significant for most of these species, except for the Eastern Kingbird that was observed within the northern hedgerow that is protected as part of the ecological linkage. Although the Cooper's Hawk and Common Raven were not noted within the forested PSW, both are forest birds and as such their habitat is likely associated with the PSW and will face impacts previously discussed (e.g., noise, hazard tree removal, unauthorized use of the PSW by humans and pets).

Swamp gooseberry was recorded within the northern hedgerow, which is to be protected as part of the ecological corridor. Impacts are restricted to accidental removal during invasive species management.

Long-term impacts are not expected to SWH on or adjacent to the Subject Property if mitigation measures detailed in **Section 7.3** are implemented.

7.2 OTHER IMPACTS

7.2.1 Hydrologic Impacts

Post-development hydrologic impacts are primarily associated with the increase of impervious surfaces across the Subject Property from pre- to post-construction conditions (i.e., 8% to 39%, respectively; Section 6.1.5). This reduction in pervious cover decreases evapotranspiration and infiltration volumes results in a significant increase in overland flow/runoff during any given storm event. This increased quantity of stormwater may also of be lower quality, which ultimately can impact the water quality of downstream receptors (e.g., watercourses). The purpose of the proposed infiltration and SWM facility as discussed in **Section 6.1** is to mitigate the infiltration deficit and runoff surplus as well as to control and treat runoff prior to discharging to these receptors.

Potential hydrological impacts specific to the Torrance Creek PSW are discussed above in **Section 7.1.1**.

7.2.2 Vegetation Removal

Removal of the existing hedgerow along the southern boundaries of the Subject Property as well as landscaping around the residence will be required to facilitate development. Preservation will occur along the perimeter of most of the north and eastern boundaries of the Subject Property. Removal to facilitate the road connection to the north is also required. Stantec considered the retaining the hedgerows, but this was not considered an option due to the following reasons:

- Steep grade differences between the Subject Property and Dawes Avenue preclude retention of the hedgerow along the southern boundary to facilitate the trail as well as servicing of the townhouse block.
- Grading and servicing requirements and a fixed road connection based on the previously approved VPV development to the north require removal of the northern portion of the north-south hedgerow.
- Existing cedar hedgerow along the driveway and to the north require removal due to required emergency access turning and provisioning of on-road and off-road trail connections.

A total of 137 trees are proposed to be retained and 252 requiring removal, as detailed in the TPP (**Appendix F**).

7.2.3 Trail

Potential impacts associated with construction of the trail (during and post-construction) include:

- Stormwater management issues (i.e., decreased or concentrate hydrologic input to adjacent wetland)
- Vegetation removal, including hazard trees
- Erosion and sedimentation into adjacent natural features
- Encroachment into natural features
- Creation of ad-hoc trails
- Invasive species introduction
- Dumping

The proposed trail is shown on **Figure 2**, **Appendix A,** which is set back considerably throughout most of the route from the PSW boundary. Mitigation measures recommended to offset the potential impacts discussed in **Section 7.1** and **7.2** are provided in **Section 7.3**.

7.3 RECOMMENDED MITIGATION MEASURES

Mitigation measures will be implemented to help avoid or minimize the potential negative effects of the proposed development. Such measures include the incorporation of compensation measures to offset any residual impacts that may occur as well as construction controls (i.e. construction timing windows and stormwater management). Management and mitigation measures are discussed below.

7.3.1 Buffers to Development

The primary mechanism to avoid impacts on significant or sensitive natural features is to identify and avoid site-specific constraints to the greatest extent possible. In addition to being outside of natural features, the proposed development is setback from these feature boundaries (e.g., wetland, woodland, SWH). The purpose of this setback (i.e., a buffer) is to reduce impacts and protect the long-term ecological functions of the features, specifically (expanded from Castelle et al. 1992):

- Improve water quality through:
  - reducing sediment load to the wetland
  - reducing heavy metal load to the wetland
  - reducing phosphorus to the wetland
  - reducing pesticide load to the wetland
- Moderate water level fluctuations
- Reduce impact of invasive species
- Reduce and prevent impacts from human disturbance
- Provide fish and wildlife habitat protection

Except for permitted uses within the buffers to development (e.g., trails and SWM), the buffers to the significant woodland feature (10 m) and PSW (30 m) are consistent with the Official Plan and are shown on **Figure 4** (**Appendix A**).

These buffers to development are considered adequate based on the following conclusions:

- Disturbance-resistant vegetation has been fostered at woodland edges due to adjacent agricultural land uses and invasive species (i.e. Buckthorn)
- Wetland vegetation outside of the woodland boundary has undergone grazing and mowing, which will cease post-development
- Historical agricultural practices providing chemical inputs will cease post-development
- Provisioning of a 50 m wide ecological linkage together with a dry SWM facility will continue to support wildlife movement, especially for deer, and the ecological function of the SWH associated with the wetland and woodland
- native plantings are part of the landscaping plan.

7.3.2 Access Control Fencing

Property demarcation fence will consist of 1.5 m high chain-link fencing located at the limits of development to separate the site from the wetland, SWM pond, and ecological corridor. Restricting

access of landowners into the adjacent natural spaces is an important part of reducing potential impacts on the adjacent natural features.

7.3.3 Restoration and Enhancement Measures

Restoration and enhancement measures for the proposed 220 Arkell Road development are summarized below.

7.3.3.1 Tree Preservation and Compensation

Stantec performed a tree inventory and assessment on the Subject Property in 2017 (**Appendix I**). The following is a summary of the total inventoried trees located within the Subject Property: trees to be retained, trees to be removed, and trees that require compensation:

- Total trees inventoried: 389
- Trees to be retained: 137
- Trees to be removed: 252
- Removals that are invasive species or trees in poor condition (with greater than 70% dead crown), or dead that will do not require compensation: 26
- Trees to be removed that will be compensated: 226

A total of 226 tree require compensation based on City of Guelph requirements (i.e., trees in fair to excellent condition, excluding invasive species). At a replacement ratio of 3:1, a total of 678 native trees are required for compensation and/or or cash in lieu of $500 per tree.

Planting of small tree, shrubs, and pollinator-friendly flowers is recommended adjacent to the PSW as discussed in **Section 7.3.1** above, with the purpose for providing additional separation of the wetland from the development. Plantings are also recommended within the ecological corridor, described below.

7.3.3.2 Invasive Species and Hazard Tree Management

Field studies identified common buckthorn throughout the vegetated areas of the Subject Property, including the PSW and hedgerows. Common Buckthorn is native to Europe and has spread rapidly throughout southern Ontario and is common in the City of Guelph. Buckthorn is highly invasive and can out-compete native plants, which in turn degrades the quality of wildlife habitat and reduces biodiversity (Anderson 2012). Due to the prevalence and invasive characteristics of common buckthorn, the City of Guelph has recommended removal within the trail corridor.

To control buckthorn the Recommended Best Management Practices (Anderson 2012) are:

- Pulling (mid-October to mid-November)
- Cutting/girdling with herbicide application (any time of year, late spring/early summer recommended)

Any tree, typically in poor condition, that has the potential to fall and hit something (i.e., person, house, car, etc.) is considered a hazard tree. These trees provide a hazard to human life and therefore the City of Guelph requires their removal prior to dedication if within striking distance of a trail or private property

line. This removal requirement would include trees impacted by Emerald Ash Borer or any other issues leading to their decline.

A review of hazard trees will be conducted at the time of vegetation removal by a qualified arborist.

7.3.3.3 Ecological Linkage and Wildlife Culvert

Due to the presence of the designated ecological linkage along the northern boundary of the Subject Property, the demonstrated use of this area by wildlife during corridor studies, and the expectation that use will increase post-development, a wildlife culvert is proposed under the road that connects this development to VPV to the north. The purpose of this wildlife culvert would be to reduce potential road mortalities for amphibians and small mammals using the Subject Property. Reduced speed limits, signage, and/or traffic calming measures may be implemented to avoid collisions with white-tailed deer.

With respect to the wildlife culvert, the following recommendations will be considered at the detailed design phase:

- Minimize length and maximize width/height of the culvert (i.e., strive for a high openness ratio)
- Provide as level a crossing as possible
- Consider habitat preferences of species identified during corridor studies and incorporate natural cover, substrate, and if possible, light into the design
- Consider funnel fencing and associated plantings
- Fencing approaches tunnel entrance in a “v” formation (i.e., 45°)
- Education through the provisioning of wildlife crossing signage

A structurally diverse planting plan is proposed for the designated ecological corridor with trees, shrubs, and pollinator-friendly flowers. This planting plan will provide structural variety for wildlife using this corridor between the PSW and significant woodland to the east.

7.3.3.4 Trail

Potential impacts of the trails described in **Section 7.2.3** can be lessened with the implementation of construction Best Management Practices (e.g., erosion and sediment control plans), access control fencing, educational signage, monitoring, and other considerations during detailed design (e.g., hazard tree removal, trail detail).

Educational signage is proposed along the trail corridor, with potential information on the following potential topics:

- The purpose of the ecological linkage and documented species use of the linkage on the Subject Property
- Function/purpose of the proposed wildlife culvert crossing

- Information on the Torrance Creek PSW related to water attenuation and quality
- Details of a dry SWM pond

Material development will be undertaken during the preparation of the Environmental Implementation Report (EIR).

7.3.4 Stormwater Management

Urban development is typically associated with an increase in the quantity and a decrease in the quality of post-development flows. Appropriate quantity and quality controls must be proposed in accordance with the *Stormwater Management Practices Planning and Design Guidelines (*MOE, 2003). Enhanced water quality control and peak flow detention will be provided through the proposed SWM design as part of the proposed development. Preliminary erosion and sediment control plans, as well as detailed SWM facility designs are provided in the Preliminary Servicing, Grading and Stormwater Management Report (**Appendix I**).

SWM strategies in place on the adjacent 246 Arkell Road development and proposed for the Subject Property to mitigate impacts to the wetland flora and fauna include:

- Elevate the proposed emergency access road (see Figures 2 and 10 of the Preliminary Servicing, Grading and Stormwater Management Report, Appendix I) direct runoff north to a grassed swale and catchbasin at the northern boundary of 246 Arkell Road Development
- Direct runoff from the access road to the catch basin that is connected to an existing infiltration gallery
- Install a culvert under the proposed access road near the property line to maintain surface water input to the PSW to the west
- Water quality treatment through conveyance and end-of pipe controls (e.g., grassed swale, catchbasin insert)
- Explore the potential to include LID measures where possible during detailed design, which may include roof downspout disconnection, soakaways / infiltration trenches, bioretention cells, vegetated filter strips, and/or grass swales or enhanced grass swales. As discussed in Section 6.1, rear yard soakaway pits are proposed for all single-family homes in the proposed development, which will receive clean rooftop water from these homes and infiltrate an annual estimated volume of 5,800 m^3. In addition, stormwater runoff from the remainder of the development will be directed to the dry SWM facility, which is designed to encourage ponding and infiltration of this stormwater through its base. The annual volume of infiltration estimated to occur at the SWM facility is 3,100 m^3. Consequently, this combined infiltration volume of 8,900 m^3 will offset the annual infiltration deficit of 4,910 m^3 calculated for the Subject Property under the post-development condition. Similarly, the surplus of infiltrated volume will help to reduce the surplus of overland runoff to the wetland by 8,900 m^3/year to 7,450 m^3/year (total overland runoff of 17,480 m^3/year).

7.3.5 Construction Mitigation

7.3.5.1 Construction Site Delineation

A construction fence (or heavy duty silt fence) must be installed prior to any onsite work, with this fencing being maintained during all phases of construction to control potential sediment transport arising from erosion, to function as a visual boundary to mark the limits of the work site, and to assist in controlling encroachment into adjacent properties during construction and grading activities.

7.3.5.2 Erosion and Sediment Control

Prior to any grading or servicing works commencing onsite, erosion and sedimentation control measures will be implemented. The purpose of appropriate erosion and sediment controls during construction is to minimize the potential deposition of sediment onto adjacent properties resulting from onsite grading works. The proposed erosion and sedimentation controls include the following items:

- Steep slopes (>3:1) shall have erosion blankets.
- Light and/or heavy-duty silt fencing will be erected along all boundaries of the Subject Property where there is potential for runoff to be discharged offsite. This measure is to protect adjacent and downstream lands from sediment transported in overland flow. The location of this fencing will be adjacent to the limit of grading. Silt fencing must be erected before grading begins.
- Erosion control berms/swales will be located in appropriate (critical) areas to divert flows to temporary sediment basins.
- A construction entrance feature (“mud-mat”) will be provided at all site entrances to minimize the offsite transport of sediment via construction vehicles.
- Swales constructed onsite will have temporary rock check dams to help attenuate flows and encourage deposition of suspended sediment where appropriate.
- All disturbed areas where construction is not expected for 30 days shall be re-vegetated with 50 mm of topsoil and hydro-seeding according to OPSS 572.
- During construction, all catchbasins are to be sealed until roads are paved to prevent sediment deposition in the catchbasin’s sumps and, subsequently, the conveyance of silt to the SWM facility.
- An Erosion Control Implementation Schedule will be included with the Detailed Erosion and Sedimentation Control Plan, prepared in conjunction with the pre-grading application and/or final engineering design.
- Following completion of construction (defined as 90% house construction) and site stabilization, all erosion and sediment control measures and accumulated sediment are to be removed.

7.3.5.3 Construction Timing

Given the presence of breeding birds on and adjacent to the Subject Property, Stantec recommends that tree and vegetation removal (i.e. disturbance to nests) avoid the primary breeding bird window between April 15 and August 9 as per the *Migratory Bird Convention Act*.

If vegetation removal is required during this period (except for hazard tree removal within the PSW), a nest survey of the area will be completed by a qualified individual prior to vegetation removal to confirm whether there are any active nests in the area. Stantec recommends that vegetation removal occur immediately following the nest survey to avoid the opportunity for any new nests to be constructed. A nest survey is valid for a maximum of seven days and can be repeated as many times as needed depending on the construction schedule. Any nests or suspected nests identified during these surveys will be with protected with appropriate construction buffers until deemed appropriate by a qualified individual. The length of time the nest will be protected will depend on the natural history of the bird species and stage of nesting upon discovery.

8.0 POLICY CONFORMITY

An assessment of the conformity of the proposed development at 220 Arkell with the policies outlined in Section 2.0 is provided below.

8.1 PROVINCIAL POLICY STATEMENT

Significant natural features were identified within the Subject Property and in the Study Area. These features include provincially significant wetlands (Torrance Creek PSW), significant woodlands, and significant wildlife habitat (bat maternity colonies, deer yarding and winter congregation areas, woodland area-sensitive bird habitat, special concern wildlife species, and movement corridors).

The proposed development is directed outside of the Torrance Creek PSW, consistent with Section 2.1.4 of the PPS, which prohibits development within significant wetlands in Eco-Region 6E. Development has also be directed outside of the significant woodlands and significant wildlife habitat for bat maternity colonies, deer yarding and winter congregation areas, woodland area-sensitive bird habitat, and special concern wildlife species, as per Section 2.1.5.

Development occurring adjacent to natural features is permissible if negative impacts on the features and their ecological functions are not anticipated. With the implementation of the avoidance and mitigation recommendations described in **Section 7.3**, significant negative impacts on the adjacent natural features from the proposed development are not anticipated.

8.2 CITY OF GUELPH

8.2.1 City of Guelph Official Plan

The City's OP does not permit development within Significant Natural Areas, except in accordance with the general policies outlined in Section 4.1.2 and 4.1.3 of the OP. For the Subject Property, the development will be sited outside of the PSW, significant woodland, and SWH for bat maternity colonies, deer yarding and winter congregation areas, woodland area-sensitive bird habitat, special concern wildlife species.

The SWM facility and a roadway that connects the proposed development to the development to the north (VPV) are proposed within the ecological linkage. The roadway connection was approved as part of the VPV development and, as such, is considered to meet the criteria for essential infrastructure under the OP. This point was also discussed with City Staff in 2017. Essential infrastructure and SWM is permitted within ecological linkages under Policy 4.1.3.9 (5) of the OP.

Minimum setbacks to Significant Natural Areas are provided in the proposed development (i.e., 30 to PSW, 10 to significant woodland), which is consistent with the OP notwithstanding permitted uses (e.g., stormwater management, passive recreation, essential linear infrastructure) as prescribed by Policy 4.1.2 of the OP.

The OP also permits development on lands adjacent to Significant Natural Areas or within Natural Areas if an EIS can demonstrate no negative impacts on the features or on their associated ecological functions. Significant impacts of the proposed development are not anticipated with the implementation of the avoidance and mitigation recommendations described in Section 7.3. Therefore, the proposed development is in accordance with the OP.

8.2.2 Zoning By-Law

A zoning by-law change is being sought for the proposed development because the existing zoning (agricultural) under the 1985 Puslinch Zoning By-law is inconsistent with the proposed development.

8.2.3 Urban Forest Management Plan

Tree removal is required within the central portion of the Subject Property to facilitate the proposed development. However, no tree removal is proposed within the PSW or ecological linkage which will strengthen landscape connectivity through plantings. Hazard tree management, particularly for disease such as Emerald Ash Borer, and invasive species management adjacent to the development will also benefit the health of the City's urban forest.

8.2.4 Tree By-law

As trees greater than 10 cm DBH require removal to facilitate the proposed development, a tree cutting permit will be secured.

8.2.5 Torrance Creek Subwatershed Study

The TCSS was consulted to support the background analysis for the Study Area. The proposed development respects the PSW and SWH (for area-sensitive bird and local deer wintering area) boundaries detailed within the TCSS.

8.3 GRAND RIVER CONSERVATION AUTHORITY

Approximately half of the Subject Property is located within the GRCA's regulated area, as shown on **Figure 1** (**Appendix A**), within the area of interference (i.e., 120 m) of the Torrance Creek PSW.

The development is consistent with Policies described in **Section 2.3** for the reasons outlined below.:

- As discussed in Section 4.2.2 of the *Hydrogeological Assessment* report in **Appendix E**, the Torrance Creek PSW adjacent to the Subject Property is mapped as occurring in an area characterized by downward vertical hydraulic gradients, indicating that the wetland is a groundwater recharge feature. As discussed in Section 7.3.4 of this report, the development will involve the installation of a culvert under the proposed access road near the property line, which will maintain surface water inputs to the wetland and, subsequently, maintain the groundwater recharge function of this feature under the post-development condition.

- Pre-development infiltration and surface water input volumes will be exceeded throughout the Subject Property under the post-development condition using LID stormwater infiltration measures (refer to Sections 6.1 and 7.3.4 of this report). These surpluses are not considered to be detrimental to the wetland as swamps are relatively resilient, given seasonal inundation in the spring under existing conditions. Additionally, this recharge area will infiltrate the surplus water received and inundated conditions are not expected to the extent that would negatively influence the swamp flora during drier summer month. In a worst-case scenario, the understory vegetation may change in composition to species with a higher wetness index or more wetland species in drier areas of the wetland. The wetland will remain as a functioning feature with will continue to provide the associated flora and fauna habitat.

- The development will not extend into the wetland.

- Although groundwater levels are anticipated to occur above utility infrastructure inverts (e.g., watermain, storm and sanitary sewers), the use of anti-seepage (cut-off) collars can be utilized to prevent the preferential movement of groundwater along the servicing alignments (potentially directing groundwater away from the wetland, if portions of the wetland receive groundwater inputs from the Subject Property). An assessment for the need, total number and exact placements of anti-seepage collars along the servicing alignments is planned to be explored in more detail during the detailed design phase of the Project.

- Construction Best Management Practices will be utilized for the development.

- A permit from the GRCA will be sought prior to construction.

8.4 MIGRATORY BIRD CONVENTION ACT

Vegetation removal is recommended to occur outside of the core breeding bird season (i.e., April 1 to August 25) to avoid accidental destruction of any migratory bird nests.

Nest sweeps are a secondary tool to avoid incidental take, but only if timing windows described above cannot be met and in simple habitats (i.e., scattered trees, hedgerows, parkland) where vegetation is easy to search. As vegetation removal for the proposed development is restricted to simple habitats, nest sweeps could be effectively conducted if required.

8.5 ENDANGERED SPECIES ACT

The proposed development is not expected to impact species or their habitats protected under the ESA. However, the required removal of hazard trees by the City of Guelph has the potential to impact Endangered bats. A detailed tree assessment and the application of timing windows (i.e., avoid tree removal between May 1 and August 31) are proposed to avoid impacts to bats. The MNRF was consulted on this approach in 2017 for another project in the City of Guelph, and they were satisfied with Stantec's proposed approach. If additional guidance is provided by the MECP, these changes will be implemented as required.

9.0 PROPOSED MONITORING PROGRAM

During construction and post-construction monitoring is proposed for the Subject Property to avoid residual impacts associated with the development.

9.1 CONSTRUCTION MONITORING

Stantec is recommending the completion of during construction compliance monitoring, which will include the daily inspection of:

- Erosion and sediment controls
- Grading activities and compliance with the Grading Plan
- Limits of construction and that retained trees are protected

Compliance monitoring reports will be provided monthly to the City of Guelph while the Subject Property is being actively developed, with the reports including a log of the inspection dates, condition of facilities, and any recommended remedial actions.

9.2 POST CONSTRUCTION MONITORING

Compliance and performance monitoring is recommended as detailed below.

9.2.1 Stormwater Management Monitoring

Monitoring and maintenance activities are an important part of a SWM strategy to ensure the designed features continue to operate as intended. As such, Stantec is recommending that regularly scheduled inspections take place to observe any evidence of sediment deposition or malfunctioning of the proposed infiltration trenches or SWM facility. Given the proximity of the Subject Property to the Torrance Creek PSW, the details and frequency of these inspections are to be discussed with the City and the GRCA, with these details being provided at the detailed design stage of the Project. Similarly, upon receipt of an Environmental Compliance Approval (ECA) from the MECP, the maintenance and monitoring schedule outlined in the ECA should be incorporated into the development plan. The inspections will occur following significant rainfall events (where possible) and will also include inspection of the conditions of any temporary SWM controls (such as temporary sedimentation basins and sediment traps).

9.2.2 Landscape Plantings

Qualitative vegetation monitoring will be undertaken following the implementation of any rehabilitation plans. A standard two-year guarantee will be provided on any plantings.

9.2.3 Homeowner Encroachment

Homeowner encroachment monitoring is recommended through the use of photo monitoring and examination of access control fencing one-year post-development into buffer areas along the wetland and ecological corridor. A photo record will be submitted to the City once the site visit has been completed with commentary on impacts and a map.

9.2.4 Invasive Species

Monitoring for common buckthorn in adjacent buffers is recommended. This could consist of photographic monitoring at designated stations within these areas for two years post-removal.

9.2.5 Other Monitoring

Post-construction amphibian call counts and breeding bird studies are not proposed due to a lack of notable findings during the pre-construction field studies on the Subject Property. Furthermore, proposed mitigation measures (e.g., siting the development outside of the PSW, timing restrictions for vegetation removal) and temporary nature of the construction disturbance are not expected to impact breeding birds or the limited calling amphibians documented in 2017.

Species at risk monitoring is not proposed due to a lack of habitat on the Subject Property. However, proposed mitigation measures for bats within the Study Area are outlined in **Section 8.5.**

9.3 NET ENVIRONMENTAL ASSESSMENT

Avoidance, mitigation, numerous enhancement measures, and a monitoring program are proposed during the design of the proposed development to avoid and mitigate negative impacts to the identified significant natural features located within the Study Area, including the PSW, woodland, and SWH.

Overall, the proposed development has been sited outside of the PSW and significant woodland boundaries. Except where OP policies permit (e.g. essential infrastructure, SWM), development has also been sited outside of significant wildlife habitat.

In addition to siting development outside of the natural feature boundaries, setbacks to the development are proposed in accordance with OP policies, including 10 m from the edge of the significant woodland and 30 m from the edge of the PSW. Permitted uses proposed within the buffers include the siting of the SWM facility and a secondary trail.

Measures to mitigate potential impacts to wildlife during and post-construction will be provided. These measures include removal of vegetation outside of the breeding bird window (or the use of nest sweeps) and provisioning of a wildlife culvert to offset potential impacts of the proposed road linking to the development to the north. Access control fencing will avoid impacts to wildlife using natural areas during construction, as well as by homeowner encroachment post-construction.

General Best Management Practices including appropriate stormwater management (including the use of LIDs) as well as erosion and sediment controls will also be implemented to manage surface runoff during construction and following development to meet the water quality and quantity requirements of the City of Guelph and the Torrance Creek Subwatershed to protect the adjacent natural areas.

The post development surplus in infiltration and overland flow is not considered to be detrimental to the wetland environment adjacent to the development area. Additional infiltration to the groundwater is not considered to be a negative effect in urban environments that are generally subject to storm water collection that is discharge to watercourse systems before it can be recaptured as infiltration. With respect to overland flow surplus to the wetland, swamps are relatively resilient to fluctuating water levels given that the vegetation absorbs water and the area is seasonally inundated in the spring as part of natural processes. The water surplus will predominantly occur in the spring consistent with normal conditions in these swamp areas. Inundated conditions to the extent that would negatively influence the swamp flora during drier summer month are not anticipated. In a worst-case scenario, the understory vegetation may shift to wetland species with a higher wetness index.

Proposed enhancements on the Subject Property (i.e., invasive species management and compensation plantings) will offset any residual impacts that may occur from the development. Stantec is proposing the removal of 252 trees to accommodate the development, with a total of 226 trees removed requiring compensation. Tree removal compensation will involve the planting of 678 native trees or $500 cash in lieu for each tree removed. Plantings will be directed towards enhancing proposed buffers to the wetland as well as the ecological linkage to enhance wildlife habitat on the Subject Property post-development.

Finally, a trail and accompanying educational signage is proposed to enhance the use of the Subject Property and support an appreciation for the adjacent natural areas post-development for residents.

10.0 SUMMARY AND RECOMMENDATIONS

10.1 REPORT SUMMARY

The purpose of the EIS was to characterize existing conditions, describe potential impacts, and provide recommendations to alleviate identified potential impacts. Documentation found in the Appendices provides additional information on: geotechnical; hydrogeological; tree preservation; functional servicing; site servicing; and stormwater management design.

The following is a summary of the findings of this EIS:

- Surficial geology mapping indicates the Site is covered by glaciofluvial sand and gravel, and stone-poor, silty to sandy till deposits representing the Port Stanley Till. These deposits are consistent with the subsurface materials encountered in the onsite boreholes BH01-17 through BH04-17. In general, subsurface conditions at the borehole locations generally consist of a 0.4 m to 3.8 m thick layer of sand with trace to some gravel, overlying the Port Stanley Till (stony, silty sand to sandy silt till). The till unit is encountered at depths ranging from approximately 0.7 m to at least 8.2 m BGS (the maximum depth of investigation), or elevations ranging from 339.3 m to 328.3 m AMSL. Surficial silty sand to sandy silty fill was encountered at BH03-17 and extended to a depth of 2.4 m BGS. Bedrock appears to be encountered at elevations ranging from 317.8 m to 322.8 m AMSL

- Groundwater depths across the Subject Property range from being positioned at ground surface (BH01-17, BH02 17) to 2.3 m BGS (BH04-17) under high water table conditions, with about 1.9 m to 3.5 m of seasonal fluctuation occurring based on the data collected during the monitoring period (i.e., April 2017 to May 2018). The groundwater table is deepest in the northeastern corner of the Site, with groundwater levels becoming shallower moving to the southwest towards the Torrance Creek Swamp

- Groundwater flows horizontally through the subsurface overburden deposits to the south and southwest towards the Torrance Creek Swamp at an average rate of 11.1 m/year

- Downward vertical hydraulic gradients are consistently observed beneath the wetland area located in the future footprint of the development, indicating that this wetland is a groundwater recharge feature, consistent with GRCA (2018) mapping that shows downward hydraulic gradients to be present beneath the entire Subject Property. Under the pre-development condition, the predicted annual volume of infiltration provided to the shallow groundwater system by this wetland area represents approximately 3% of the total annual volume of infiltration that occurs across the Site

- Groundwater in the shallow groundwater system is calcium-bicarbonate type water. No tested parameters having health-related Ontario Drinking Water Standards (ODWS) were detected above their applicable standards. The ODWS for hardness was exceeded in samples collected at all wells. The presence of elevated hardness concentrations is typical of groundwater in southern Ontario

- Various studies were conducted to characterize the vegetation, reptile, amphibian, avian, bat, and incidental mammal composition within the Study Area. Wildlife movement across the Subject Property was also studied using pitfall traps in summer 2017 and spring of 2018. Results of the field studies as presented in **Section 4.4**

- A PSW (i.e., Torrance Creek Swamp) and Significant Woodland occur adjacent to the Subject Property

- One plant species identified during studies is considered locally rare in the City of Guelph: Swamp Gooseberry (*Ribes hirtellum*)

- SWH occurs adjacent to the Subject Property, as detailed in **Section 5.5**, including:
  - bat maternity colonies (SWD4, SWD7-1)
  - deer yarding areas (SWD4, SWD7-1)
  - deer winter congregation areas (SWD4, SWD7-1)
  - woodland area-sensitive bird breeding habitat (identified by others in the PSW)
  - special concern wildlife species (Eastern Wood-Pewee, SWD4)
  - amphibian movement corridors (designed 50 m wide ecological corridor along northern hedgerow)
  - deer movement corridors (designed 50 m wide ecological corridor along northern hedgerow)
- Habitat for bat SAR occurs within the forested portions of the Study Area, as outlined in **Section 5.6**

- Locally significant bird species were identified in the Study Area, including American Redstart, Common Raven, Cooper's Hawk, Baltimore Oriole, Eastern Kingbird, Northern Flicker, as well as three at risk or rare species such as Barn Swallow, Eastern Wood-Pewee, and Common Nighthawk (**Section 5.5.5**)

- Locally significant ecological linkage is identified on the Subject Property as a 50 m wide area measured from the northern property boundary (**Section 5.5.4**)

- The proposed development consists of 31 single-family lots on a single road ('Street A') with 1 multi-family townhouse block, a 0.31 ha park, temporary emergency access, a trail, and a SWM pond that services only these lands

- A Tree Preservation Plan was completed for the Subject Property which identifies a total of 252 trees are proposed to be removed, of which 226 require compensation. Tree removal will be compensated for either by planting native trees or $500 cash in lieu for each tree removed

- The proposed SWM services only these lands and is comprised of a dry pond to provide water quality, extended detention, flood control of stormwater runoff, and end-of-pipe infiltration. SWM control will be augmented by a reduction in lot grades, the provisioning of rear and side yard swales, and discharge of roof leaders to pervious surfaces, promoting infiltration where possible

- A calculated 15,946 m^3 (223 mm) of annual infiltration occurs under pre-development conditions on the Subject Property. Under post-development conditions, Stantec estimates that 39% of the land surface will be converted to impervious cover, reducing annual infiltration to 11,038 m^3 (154 mm), and resulting in an annual infiltration deficit of approximately 4,908 m^3

- Lot level soakaway/infiltration trenches and end-of-pipe infiltration provides sufficient infiltration to match and enhance annual recharge volumes within the site. The annual infiltration volume following implementation of the mitigation measures is 8,900 m^3/year which offsets the anticipated deficit of 4,910 m^3 calculated under post-development conditions

- Further LID measures which may include roof downspout disconnection, soakaway/infiltration trenches, bioretention cells, vegetated filter strips, and/or enhanced grassed swales will be explored at detailed design to further enhance the expected recharge surplus within the Site

- The future development of the Site will increase the overall imperviousness of these lands, resulting in an overall reduction in infiltration under the post-development condition. The proposed development will require strategies to infiltrate as much stormwater as possible post-development to mimic the existing recharge function provided by these lands. Potential LID infiltration augmentation options available to the Site are roof downspout disconnection, soakaways / infiltration trenches, bioretention cells, vegetated filter strips and/or grassed swale or enhanced grassed swales. High water table conditions may present a constraint for the using of LIDs in certain areas of the Site. The suitability of using these infiltration augmentation options will be evaluated further at the detailed design stage of the project

- Potential impacts of the proposed development on the adjacent natural features are associated with construction, traffic, input to the wetland (i.e., sedimentation, contamination, invasive species, change in water input), encroachment (i.e., ad-hoc trails, dumping), vegetation removal, the trail, and potential impacts to wildlife (i.e., building collisions and road mortality) as summarized in **Section 7.0**

- Mitigation measures to offset potential impacts of the proposed development include the use of buffers, LID and SWM strategies, timing windows, access control, tree compensation, invasive species management, provisioning of a wildlife culvert, construction mitigation, and a Post-Construction Monitoring Program

10.2 RECOMMENDATIONS

Impacts to adjacent natural features and wildlife are expected to be minor, and can be minimized with the following mitigation measures and/or offset with enhancement measures, including:

- Prior to the start of any construction activities, the limits of construction must be clearly marked

- Standard sediment and erosion control measures are recommended. All sediment and erosion controls must be monitored regularly and properly maintained, as required

- Where evidence of sedimentation or erosion exists, corrective action must be taken as soon as conditions permit
- Sediment and erosion controls are to be removed only after the soils of the construction area have been stabilized and adequately protected until cover is reestablished
- Include access control fencing to prevent the creation of ad-hoc trails and landowner encroachment
- Management of invasive buckthorn should be undertaken within the buffer areas
- Tree removal should be compensated for at a ratio of 3:1 with plantings provided within the wetland buffer and ecological linkage
- Provide a wildlife culvert under the connecting road to the subdivision to the north
- Include a trail and educational signage to enhance the open spaces of the Subject Property for the residents
- Implementation of a during and post-construction monitoring program, including the monitoring of SWM infrastructure, success of landscape plantings, invasive species and homeowner encroachment

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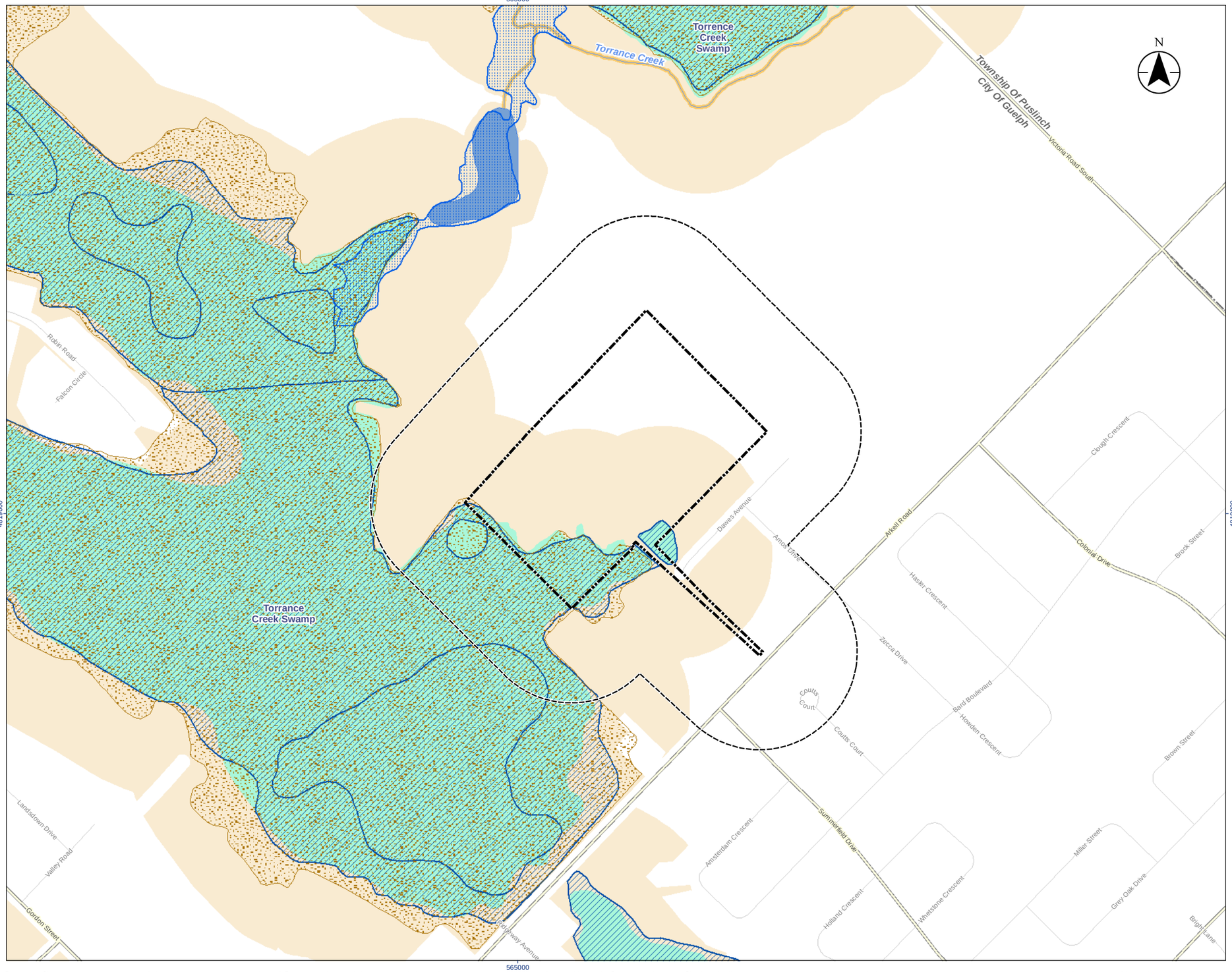
APPENDIX A
Figures



Stantec

- Subject Property
- Study Area
- Major Road
- Minor Road
- Watercourse
- Deer Wintering Area
- Municipal Boundary - Lower Tier
- Regulatory Floodplain (GRCA)
- Regulation Limit (GRCA)
- Waterbody
- Wetland - Evaluated - Provincial (LIO)
- Wetland Boundary (GRCA)

Aquatic Resource Area

- Thermal Regime, Warm
- Thermal Regime, Cold

0 100 200 metres

1:5,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.

Project Location

Guelph, Ontario

161413338 REVA

Prepared by PRM on 2019-07-30

Technical Review by DH on 2019-01-09

Client/Project

ROCKPOINT HOLDINGS INC.

ENVIRONMENTAL IMPACT STUDY

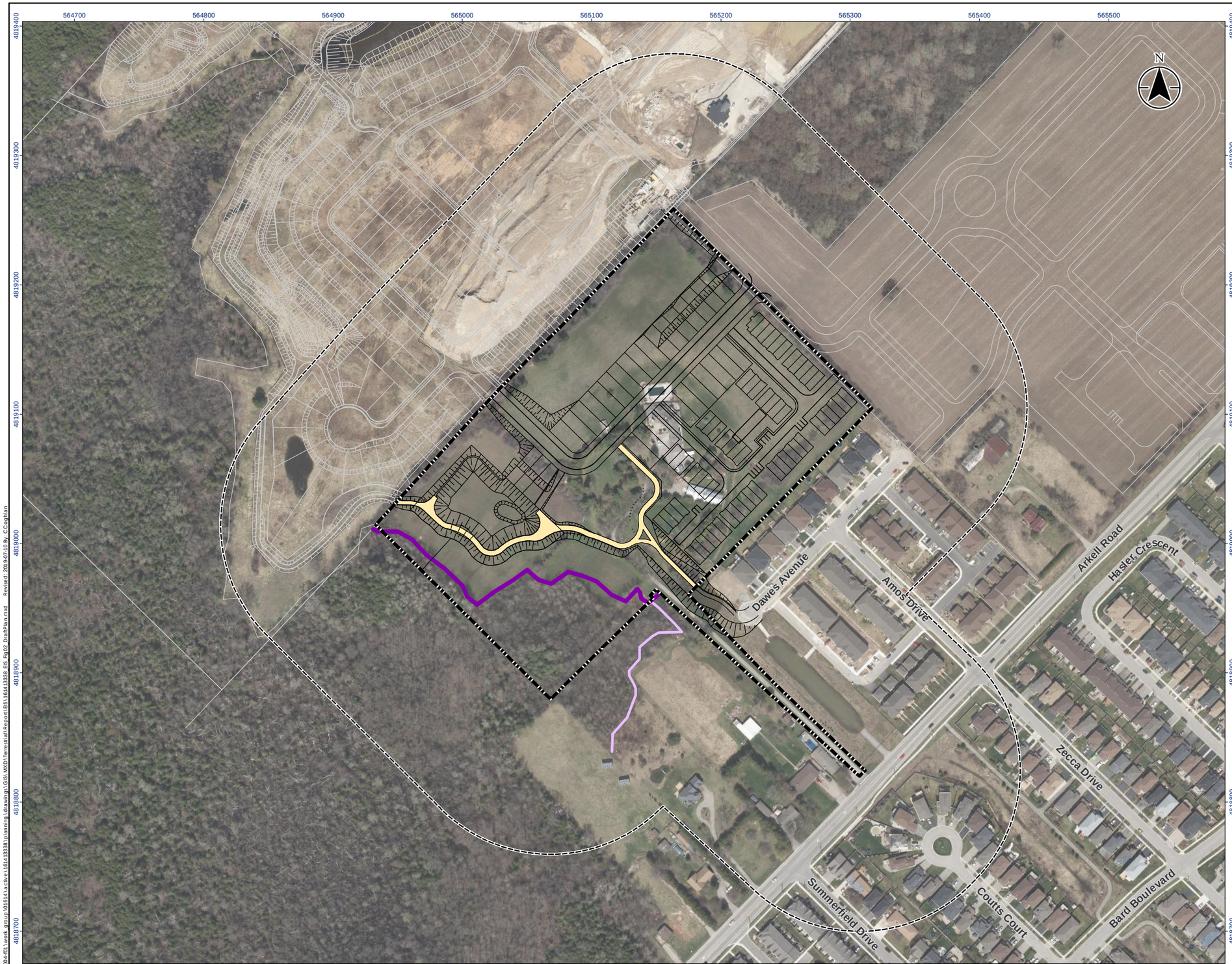
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.

1

Title

Subject Property and Environmental Features



Stantec

- Subject Property
- Study Area
- Proposed Subdivision
- Wetland Boundary (Stantec, June 2017)
- Wetland Boundary (NRSI)
- Community Trail

0 50 100 metres

1:3,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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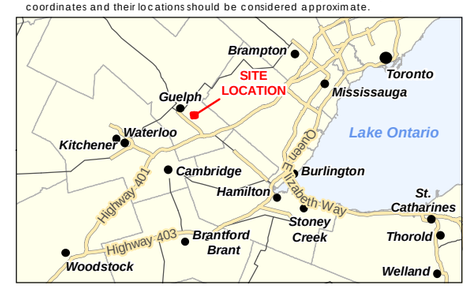
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
4. MECP water well record locations have been positioned based on published UTM coordinates and their locations should be considered approximate.



Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-07-10
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT HOLDINGS INC.
ENVIRONMENTAL IMPACT STUDY
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
2

Title
Proposed Draft Plan of Subdivision

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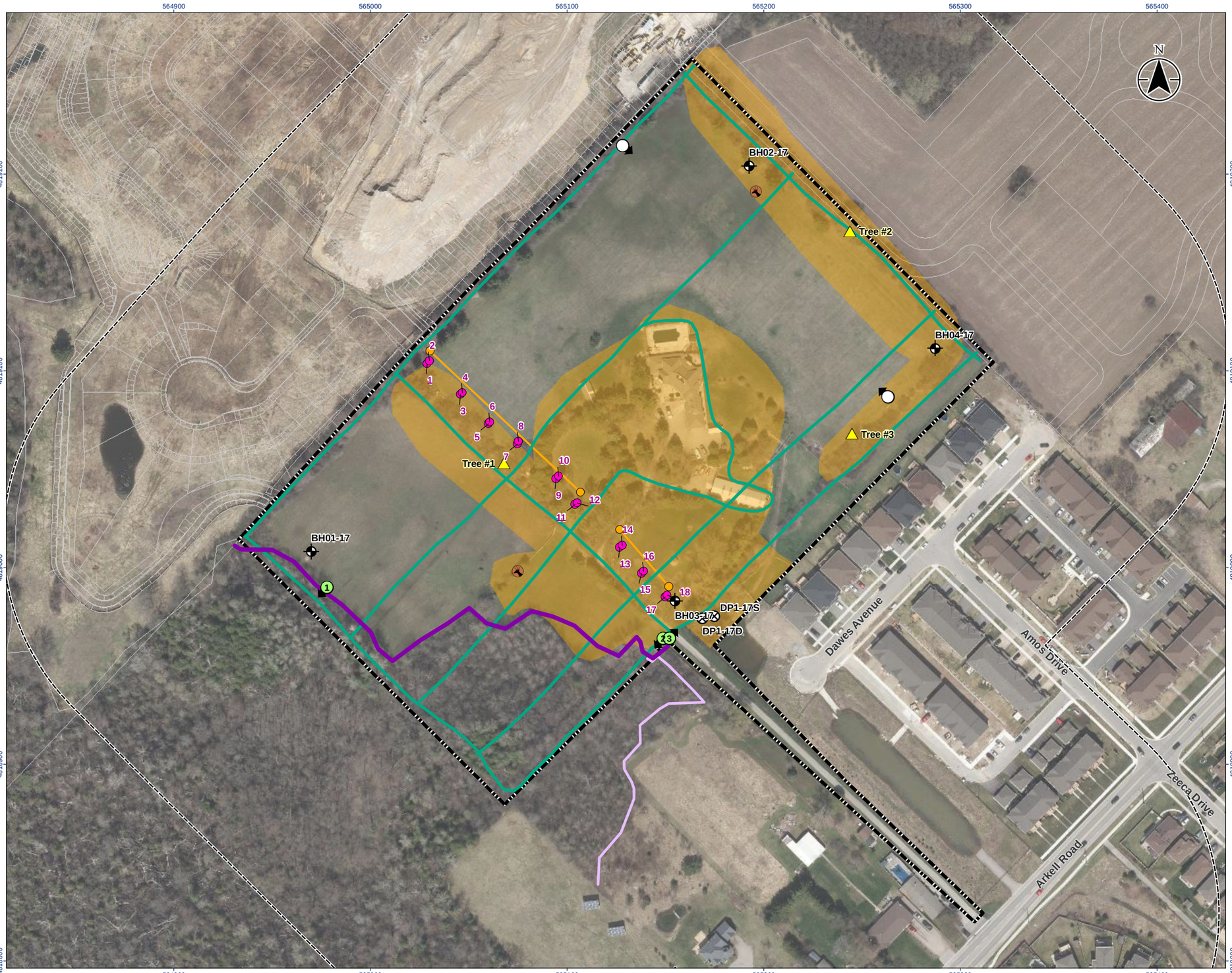

Stantec

- Subject Property
- Study Area
- Potential Bat Maternity Roost Tree
- Amphibian Station
- Wildlife Camera Location
- Crepuscular Survey Location
- Pitfall Trap Location
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2017)
- Snake Area Search Transect
- Corridor Study Location
- Wetland Boundary (Stantec, June 2017)
- Wetland Boundary (NRSI)
- Bat Maternity Roost Search Area

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes
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Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-07-15
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT HOLDINGS INC.
ENVIRONMENTAL IMPACT STUDY
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
3

Title
Field Study Locations

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Stantec

Subject Property
Study Area
Proposed Subdivision
Woodland Boundary (Stantec, September 2017)
Wetland Boundary (Stantec, June 2017)
Woodland Boundary (NRSI)
Wetland Boundary (NRSI)
10 Buffer to Woodland
30m Buffer to Wetland
Potential Bat Maternity Roost Tree

Species at Risk and Special Concern

Barn Swallow (Threatened)
Common Nighthawk (Special Concern)
Eastern Wood-Pewee (Special Concern)

Locally Significant Plant

Swamp/Smooth Gooseberry

Locally Significant Wildlife

American Redstart
Baltimore Oriole
Common Raven
Cooper's Hawk
Eastern Kingbird
Northern Flickers

ELC Communities

CUM1-1 (Mowed) - Dry-Moist Old Field Meadow Type
FOCM5 - Hedgerow
FODM11 - Hedgerow
SWD7-1 - White Birch – Poplar Organic Deciduous Swamp Type
SWDM4 - Mineral Deciduous Swamp Ecosite
OAGM1 - Annual Row Crops
OAGM4 - Open Pasture
CVI_1 - Transportation
CVI_3 - Stormwater Pond
CVR_3 - Single Family Residential
CVR_4 - Rural Property

0 50 100 metres
1:3,000 (At original document size of 11x17)

Notes

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4. MECP water well record locations have been positioned based on published UTM coordinates and their locations should be considered approximate.

Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-07-15
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT HOLDINGS INC.
ENVIRONMENTAL IMPACT STUDY
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
4

Title
Natural Features

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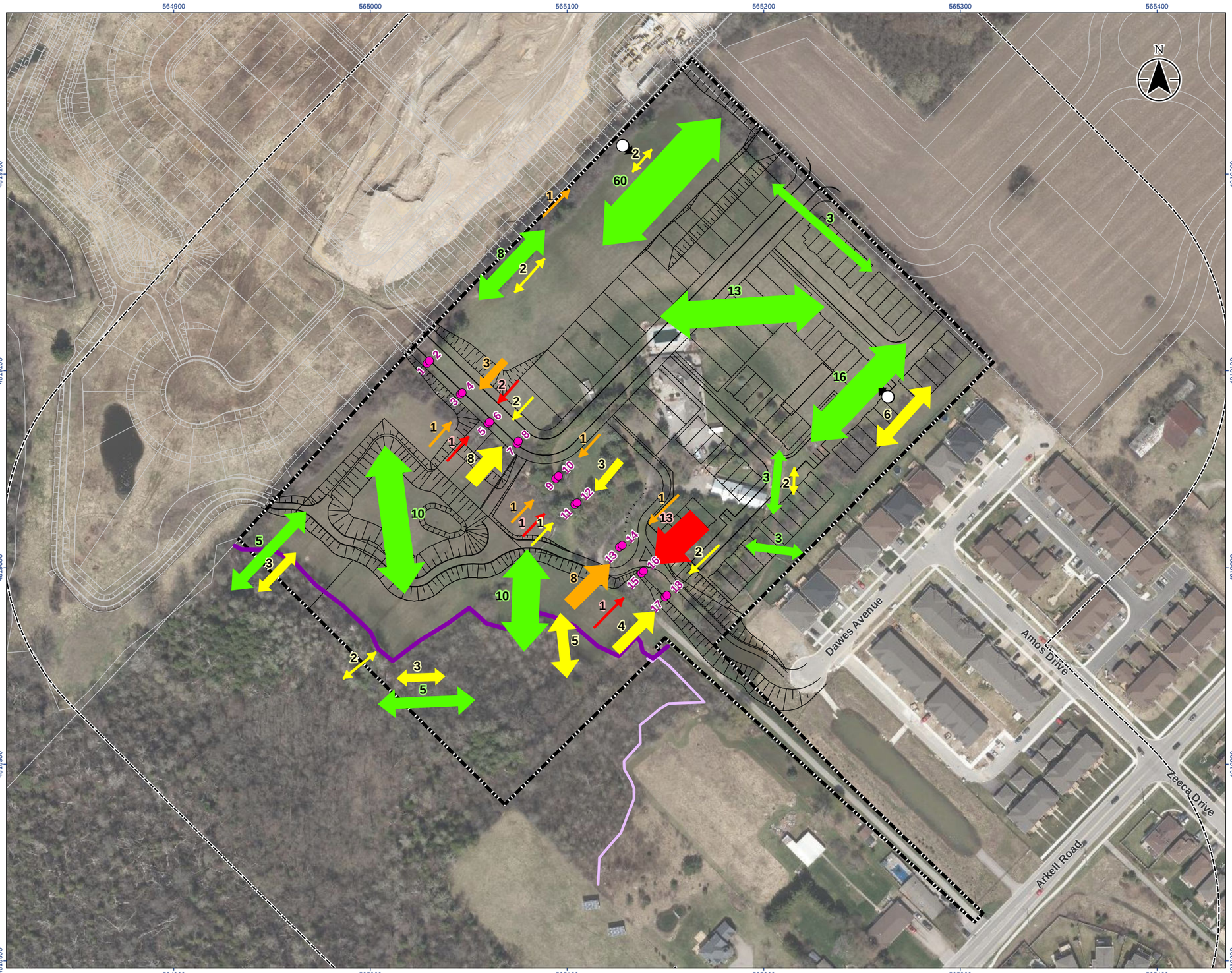

Stantec

- Subject Property
- Study Area
- Proposed Subdivision
- Wetland Boundary (Stantec, June 2017)
- Wetland Boundary (NRSI)
- Wildlife Camera Location
- Pitfall Trap Location

Wildlife Movement

- Amphibian - Summer
- Amphibian - Spring
- Deer
- Mammal (Mouse, Shrew, Raccoon, E. Squirrel, E. Cottontail, Possum, Coyote)

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes

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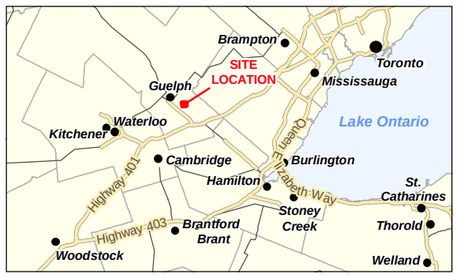


Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-07-10
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT HOLDINGS INC.
ENVIRONMENTAL IMPACT STUDY
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
5

Title
Wildlife Movement

APPENDIX B
Correspondence

APPENDIX B1

PRE-CONSULTATION MEETING_20161005

October 13, 2016

Nancy Shoemaker, MCIP, RPP
Black, Shoemaker, Robinson & Donaldson Ltd.
351 Speedvale Avenue West
Guelph, Ontario
nancy@brsd.com

Dear Ms. Shoemaker

The City of Guelph would like to thank you for attending the Development Review Committee meeting on **October 5, 2016** to discuss the proposal and complete application requirements for the lands located at 220 Arkell Road.

The proposal is to develop a residential subdivision containing single detached and townhouse dwelling units. It requires both a Zoning By-Law Amendment and draft Plan of Subdivision applications.

Please see the attached form where staff have identified the required planning applications, studies and plans needed to be able to deem your formal application(s) complete under the Planning Act

If there are any questions please contact the undersigned or the specific department staff noted on the attached form.

Chris DeVriendt
Senior Planner
Planning Services
Infrastructure, Development & Enterprise

T 519-822-1260, ext. 2360
F 519-822-4632
E chris.devriendt@guleph.ca

Attachments:

1. Mandatory Pre-consultation Requirement Summary
2. Section 59 form for Source Water Protection
3. GRCA letter

City Hall
1 Carden St
Guelph, ON
Canada
N1H 3A1

T 519-822-1260
TTY 519-826-9771

guelph.ca

Mandatory Pre-Consultation Summary

Site Address: 220 Arkell Road

Existing Official Plan Designation: General Residential and significant natural area.

Conformity with City Official Plan land use designation? YES __X__ NO _____

Existing Zoning: Agicultural

Conformity with existing City's zoning? YES _____ NO ____X__

Application Type:

☒ Plan of Subdivision ☐ Official Plan Amendment

☒ Zoning By-law Amendment ☐ Plan of Condominium

Application Fees:

Application	City of Guelph	GRCA	
Official Plan Amendment			
Zoning By-law Amendment	X	X	
Plan of Subdivision	X		
Plan of Condominium			
Multiple Application Fee			

Separate cheques are required and payable to the City of Guelph and the GRCA.

Submission Requirements **Reports, Studies, Plans** (see Appendix for additional details)			
	Required	Paper Copies	Notes/Staff
Completed Application Form (s)	☒	4	With original Signature
Conceptual Site Plan	☐		
Draft Plan of Subdivision/Condo	☒	12	
Planning Justification Report/Letter	☒	12	*
Draft Proposed Zoning By-law Amendment	☒	2	
Urban Design Brief	☐		
Streetscape Plan	☐		
Building Elevations/Renderings	☐		
Functional Servicing Report	☒	4	
Preliminary Grading Plans	☒	4	
Storm Water Management Report	☒	4	
Landscape Plan	☐		
Lighting Plan/Photometric Plan	☐		
Tree Inventory/Preservation Plan	☒	14	

Traffic/Transportation Impact Study	☒	4	
Truck Turning/Movement Plan	☐		
Hydrology Study	☐		
Geotechnical/Soil Report	☐		
Agricultural Impact Assessment Report	☐		
Commercial Market Impact Study	☐		
Financial Impact Study	☐		
Noise Study	☐		
Vibration Study	☐		
Shadow Analysis	☐		
Heritage Impact Study	☐		
Archaeological Report	☒	4	
Cultural Heritage Impact Assessment	☐		
Wind Impact Study	☐		
Environmental Impact Study (EIS)	☒	14	*
Environmental Implementation Report (EIR)	☐		
Phase I Environmental Site Assessment	☒	4	
Phase II Environmental Site Assessment	☐		
Record of Site Condition Report	☐		
Source Water Protection	☒	1	Section 59 form req'd
Height Survey of Adjacent Buildings	☐		
Digital Submission of all plans/reports PDF	☒	All	
Other (Specify) GRCA	☒		See attached letter

***Additional Staff Comments:**

Planning (Chris DeVriendt):

- Staff noted at the meeting that the planning justification report should include how the site can connect with adjacent lands
- Need for, and location of a park should be considered (see Janet Sperling, Parks Planning for further details)

Environmental Planning (Adele Labbe):

- Portions of the site are identified as a Significant Natural Area in the City's Official Plan – as such an EIS is required to ensure that there are no negative impacts to protected features in relation to the proposed development;
- Consideration needs to be given to unmapped/unknown natural heritage features and areas and an application, including the EIS will need to incorporate and consider all of the City's natural heritage system policies that may apply;
- As a starting point an EIS should include: screening for SAR and SWH, feature delineation, breeding bird surveys, amphibian surveys, floral inventory (three seasons), confirm/update ELC, Tree Inventory, Preservation and Compensation Plan & incidental observations;
- The site is in the Torrance Creek subwatershed and contains portions of the Torrance Creek PSW. The Torrance Creek SWS should be used as Background information.
- Wetland hydrology should be characterized and a wetland water balance prepared as part of a Hydrogeological Report to support the EIS.
- It should be noted that the City's OP does not support development within a PSW or its established buffer, as such the draft concept plan should be revised accordingly.

- The site is also regulated under the City's Tree By-law and any tree removals would require authorization from the City. There are hedgerows on site which need to be considered under the city's woodland and/or urban forest policies.
- If the hedgerows do not meet the criteria for designation as significant or cultural woodlands, which are premised on the definition of woodland, consistent with the City's Official Plan, identify opportunities for protection, enhancement and restoration of trees within the Urban Forest. Demonstrate where preservation is not possible through describing the iterative process between the design team and providing examples of site designs that were not pursued and a rationale as to why not.

Source Water Protection (Kristin Pressey)

- A Section 59 PAR form for Source Water Protection to be completed and submitted with the planning application.

Mandatory Pre-Consultation Notes

1. The purpose of this document is to identify the information required to commence processing a complete application as set out in the *Planning Act*. Pre-consultation does not imply or suggest any decision whatsoever on the part of City staff or the Corporation of the City of Guelph to either support or refuse the application. Comments provided at a pre-consultation are preliminary and solely based on the information submitted for review at that time.

2. The *Planning Act* timelines associated with a formal full application will not begin if that application is submitted without the information identified in the mandatory pre-consultation meeting, and all of the required fees paid.

3. When a full application is made, the cheque for the application fee may be processed immediately; however this does not constitute the application being deemed complete for *Planning Act* purposes.

4. Digital copies of the all the reports/studies are required to be submitted in PDF format as part of the application. Plans are to be submitted in JPEG format.

5. The City of Guelph may require the peer review of a technical report submitted by the applicant. If this is required, the applicant will be advised and will be charged a fee equal to the cost of the peer review.

6. Once an application has been submitted, deemed complete and circulated for comments, it may be determined that additional studies/ reports or information will be required as a result of issues arising during the review of the application. The applicant will be required to provide this at their expense.

7. An application submitted without the requisite information and number of copies identified in the pre-consultation letter will not be considered a complete application.

8. This document and the comments expire 6 months from the day of signing or at the discretion of the Manager of Planning or his/her designate. If after 6 months no applications are received, staff may identify a need for an additional pre-consultation meeting prior to submission.

9. There may also be financial requirements arising from the applications, including, but not limited to, park dedication, development charges, payment of outstanding property taxes, deferred local improvements charges, costs of lifting 0.3 metre reserves, and reimbursement for road widening acquisition or road improvements.

Appendix – Reports and Plans Summary

Archaeological Assessment Report

Required for all applications in or near areas of archaeological potential, as determined by Planning Staff. A report must be completed in accordance with Provincial requirements in or near areas of archaeological potential.

Building Elevations/Renderings

Drawings or Plans which illustrate the exterior design of the building including the proposed building materials. Drawings can be either 2- dimensional or 3 dimensional. Drawing sets in colour are preferred.

Planning Justification Report

A Registered Professional Planner must submit a report providing planning justification for the proposed amendment in light of the principals, objectives and policies of the City's Official Plan and the technical studies accompanying the application. The goal of the report is to document how the proposed departure from the local policies and regulations represents good planning and is in the public interest. There are terms of reference that are to be followed as set out by the City of Guelph.

Conceptual Site Plan Layout

Concept plan showing the proposed development in context of adjacent lands including land. The plan is to show all buildings, land uses, sidewalks, driveways, street trees, street intersections and any other natural or made elements.

Cultural Heritage Impact Assessment Report

A Heritage Impact Assessment demonstrates how new development involving a heritage resource will preserve, protect, improve and/or manage heritage resources.

Draft Official Plan Amendment

The applicant must provide proposed amended Official Plan text and/or map amendments for consideration.

Draft Plan of Subdivision and/or Draft Plan of Condominium

The information required on plans is to be in accordance with the Planning Act and its regulations. All drawings are to be folded approximately to 8.5 x 11.

Stormwater Management Report

Stormwater management reports address howm water runoff is managed. There are terms of reference that are to be followed as set out by the City of Guelph.

Urban Design Brief

Required for all applications where, in the opinion of the Senior Urban Designer. Urban Design Briefs will be required in larger projects and in key areas within the City's urban structure such as the Downtown, Mixed Use Nodes, and Intensification corridors in addition to sensitive infill. The Urban Design Brief is one of the City's tools to ensure that new development has been consciously examined and evaluated on sites, and provided design solutions that are context-sensitive and respond to urban design policy context. It will also help co-ordinate and articulate how the elements of the public and private realm will work together. The Design Brief shall explain and illustrate why the proposed development represents the optimum design. Contact the City Planning department for the terms of reference for the Urban Design brief.

Streetscape Plan

A plan that identifies how the area of the property in the private realm will intergrate with the existing or proposed streetscape design in the public realm. The plan generally needs to identify paving and planting materials.

Functional Servicing Report

Functional servicing studies address how the site will be serviced. There are terms of reference that are to be followed as set out by the City of Guelph Engineering Department.

Tree Inventory and Preservation Study

Required when a site contains woodlots, tree stands or hedgerows. A tree survey must be prepared by a qualified professional, identifying all existing trees, their type, size and condition, those trees proposed to be removed and retained, and the methods to be used to ensure preservation of those trees to be retained.

Traffic/Transportation Impact Study

The purpose of a Traffic Impact Study is to identify the need for modifications to the city's transportation system regarding a new development/redevelopment by estimating the travel demands related to the development and assessing the impacts that the development would have on the present and future transportation system. Transportation Demand Management (TDM), transit and non-motorized modes will all be taken into account in estimating travel demand. . There are terms of reference that are to be followed as set out by the City of Guelph.

Truck Turning/Movement Plan

This plan illustrates how delivery trucks and /or garbage trucks will load and unload materials on the site and the location of travel through the site.

Geotechnical/Soils Report
The purpose of the investigation will be to determine the type of soil, its engineering properties, bearing capacity, soil permeability, location of groundwater, and to verify whether contamination is present. Soil investigation work is to take place after determining the proposed sewer or watermain alignment, so that the required boreholes and test pits follow the same alignment.

Noise and Vibration Study
A noise and/or vibration study determines the impact on adjacent developments and recommends mitigation measures.

Shadow Analysis Plan
Required for all applications where, in the opinion of the Planning and Building Department, the proposal may result in impacts on adjacent properties from sun shadowing.

Heritage Impact Study
Required as determined by Planning Staff for any property designated pursuant to the Ontario Heritage Act, identified on the City's Inventory of Heritage Resources, or for any property located adjacent to a designated or otherwise inventoried property.

Market Impact Study
The purpose of this study is to address the existing market and potential impacts of an application. These studies will be evaluated by the City on the basis of a peer review to be undertaken at the applicant`s expense. A site specific Terms of reference will be provided.

Section 59 Policy Applicability Review

1. This form is to be prepared by, or on behalf of, an Applicant for a planning development application, building permit, or for an approval by the Committee of Adjustment. The Source Water Protection Program Coordinator is available to assist Applicants in completing this form.

2. The Section 59 Policy Applicability Review form is organized to first provide an initial screening (Part 4). The Source Water Protection Program Coordinator will review the information presented in Part 4 and make a decision as to whether additional information is required for specific activities (Part 4-1 through Part 4-22). In some cases where sufficient background information is available, the Source Water Protection Program Coordinator will request the additional information at the same time as the initial screening component.

3. The completed Section 59 Policy Applicability Review form will provide the basic information necessary to allow the City of Guelph to assess whether policies under Section 59 of the *Clean Water Act*, 2006 apply. he Source Water Protection Program Coordinator or the Risk Management Official may request additional information, conduct a detailed interview or site inspection.

4. The Source Water Protection Program Coordinator will conduct a preliminary review to assess the information to determine whether Section 59 policies apply. The Risk Management Official will review the findings of the Source Water Protection Program Coordinator and make a decision with respect to whether policies of the approved Grand River Source Protection Plan for restricted land use under Section 59 of the *Clean Water Act, 2006* apply.

5. An Application for a planning approval where Section 59 policies apply will not be deemed complete until the Risk Management Official has issued a Notice – Section 59 (2) in accordance with Section 59(2) of the *Clean Water Act, 2006*. Similarly, an application for a building permit where Section 59 policies cannot be approved until the Risk Management Official has issued a Notice – Section 59 (2) in accordance with Section 59(2) of the *Clean Water Act, 2006*. The City of Guelph has established a procedure to identify applications that are for solely residential land use or for other purposes that in the opinion of the Risk Management Official do not have the potential to result in a significant drinking water threat.

Section 59 Policy Applicability Review

Part 1 – Property/Applicant Information:	
Assessment Roll Number:	
Legal Description of Property:	
Property Address:	
Postal Code (Property):	
Applicant:	
Contact Information: Phone:	
E-Mail:	
Property Owner:	
Owner Contact Information: Phone:	
E-Mail:	
Type of Application:	☐ Building Permit ☐ Minor Variance ☐ Site Plan Approval ☐ Consent/Severance ☐ Plan of Subdivision ☐ Zoning By-Law Amendment ☐ Plan of Condominium ☐ Official Plan Amendment
Brief Description (Overview) of Proposed Application for which the Review of Section 59 Policy Applicability is required:	
Has a *Section 59 Policy Applicability Review* been carried out previously for all or part of the property that is the subject of this application?: (Yes/No/Unsure)	Yes ☐ No ☐ Unsure ☐
Has the Risk Management Official Previously Issued a Notice - S. 59 (2) for all or part of the property that is the subject of this application?: (Yes/No/Unsure)	Yes ☐ No ☐ Unsure ☐
If a Section 59 Policy Applicability Review has been carried out previously, please identify changes to the proposed activities:	

Section 59 Policy Applicability Review

Part 2. Existing and Proposed Land Use (Check all that apply):

A. Existing Land Use

- ☐ Low Density Residential (single detached and semi-detached)
- ☐ High Density Residential (Including townhouses and apartments)
- ☐ Vacant/Undeveloped
- ☐ Other (Describe):
- ☐ Commercial – Mixed Use (including home businesses)
- ☐ Commercial - Retail
- ☐ Commercial – Food Service
- ☐ Commercial – Warehousing
- ☐ Commercial/Institutional – Office
- ☐ Institutional
- ☐ Industrial
- ☐ Agricultural
- ☐ Parks/Parkettes
- ☐ Conservation lands
- ☐ Roads/Walkways/ Parking Areas

Describe Existing Land Use/Activities:

B. Proposed Land Use

- ☐ Low Density Residential (single detached and semi-detached)
- ☐ High Density Residential (Including townhouses and apartments)
- ☐ Vacant/Undeveloped
- ☐ Other (Describe)
- ☐ Commercial – Mixed Use (including home businesses)
- ☐ Commercial - Retail
- ☐ Commercial – Food Service
- ☐ Commercial – Warehousing
- ☐ Commercial/Institutional – Office
- ☐ Institutional
- ☐ Industrial
- ☐ Agricultural
- ☐ Parks/Parkettes
- ☐ Conservation lands
- ☐ Roads/Walkways/ Parking Areas

Describe Proposed Land Use/Activities:

Provide Sketch or drawing of property to illustrate location of proposed land uses/activities:

Section 59 Policy Applicability Review

Part 3. Information on Water Sources and Vulnerable Areas

Information for Part 3 to be provided by the Source Water Protection Program Coordinator

Nearest Municipal Well(s):										
Vulnerable Areas: ***(Check all that apply)***	**Wellhead Protection Area (WHPA)**							**Intake Protection Zone**		
	A	**B**	**C**	**D**	**E**	**Q1**	**Q2**	**IPZ-1**	**IPZ-2**	**IPZ-3**
Vulnerability Scores: ***(List all that apply)***										
Issue Contributing Area:	☐ Yes ☐ No				**Issue Parameter:**			☐ TCE ☐ NIT		

Part 4. Review of Proposed Activities - Screening

Please describe the proposed Activities that may be considered to be Prescribed Drinking Water Threats under the Clean Water Act, 2006.

A response is required for each of the 21 Prescribed Drinking Water Threat Activities (#1 to 21). Information to assist applicants in filling out this form is provided in Appendix A.

Please respond to the best of your knowledge. If there is potential that one of the described activities may occur, please respond "Not Sure". If an activity may occur (Yes or Not Sure response), the Source Water Protection Program Coordinator, or the Risk Management Official may request additional information to further define the nature of the proposed activities (for each specific threat activity category (1-21). These additional questions will assist the Risk Management Official in identifying the requirement for a Risk Management Plan. Additional information may be requested as part of the negotiation of a Risk Management Plan, if required.

The Risk Management Official will review information provided on this screening and on supplemental forms submitted to described proposed activities and will make a decision regarding whether Section 58 policies apply, based on both the activity and the vulnerable areas/vulnerability scores mapped on the property.

Section 59 Policy Applicability Review

Part 4. Review of Proposed Activities - Screening

	Are any of the following Activities proposed to take place on the property? (Shaded activities may require a RMP)	No	*Yes	*Not Sure
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*. (See Appendix)			
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.			
3	The application of agricultural source material to land.			
4	The storage of agricultural source material.			
5	The management of agricultural source material.			
6	The application of non-agricultural source material to land.			
7	The handling and storage of non-agricultural source material.			
8	The application of commercial fertilizer to land.			
9	The handling and storage of commercial fertilizer.			
10	The application of pesticide to land.			
11	The handling and storage of pesticide.			
12	The application of road salt.			
13	The handling and storage of road salt.			
14	The storage of snow.			
15	The handling and storage of fuel.			
16	The handling and storage of a dense non-aqueous phase liquid.			
17	The handling and storage of an organic solvent.			
18	The management of runoff that contains chemicals used in the de-icing of aircraft.			
19	An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.			
20	An activity that reduces the recharge of an aquifer.			
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.			
	The use, handling, or storage of liquid chemicals in containers > 1 L.			
	An existing or future Transport Pathway?			

* *Please respond to the best of your knowledge. If there is potential that one of the described activities may occur, please respond "Not Sure". If an activity may occur (Yes or Not Sure response), the Source Water Protection Program Coordinator, or the Risk Management Official, may request additional information on a "Review of Proposed Activities" form for specific threat activity categories (1-21)). These additional questions will form part of the Section 59 Policy Applicability Review and will assist the Risk Management Official in identifying the requirement for a Risk Management Plan. Further information may be requested as part of the negotiation of a Risk Management Plan, if required. Information to assist applicants in filling out this form is provided in Appendix A*

Section 59 Policy Applicability Review

Part 5 – Certification

I (We) confirm that the information presented in Parts 1-4 is accurate and complete to the best of my (our) knowledge. I (We) acknowledge that incomplete or inaccurate information may result in future involvement of the Risk Management Official to confirm that site activities conform to applicable provincial legislation and that the Risk Management Official will have powers to lay charges under Part IV of the *Clean Water Act*, 2006.

I (We) am (are) aware of our rights to appeal the decisions of the City of Guelph Risk Management Official to the Environmental Review Tribunal.

I (We) confirm that I (we) have the authority to bind the corporation that is submitting the application to which this *Section 59 Policy Applicability Review* form applies.

Name: **(Please print)**	
Position:	
Company:	
☐	**I am the property owner.**
☐	**I represent the property owner.**
Signed:	
Date:	

Pursuant to Section 53(3) of Ontario Regulation 287/07 made under the *Clean Water Act*, 2006, this "*Section 59 Policy Applicability Review*" form, once signed in conjunction with a Section 59 Notice, is a public document. All information received by the City of Guelph for decision-making based on this form is subject to the *Municipal Freedom of Information and Protection of Privacy Act (MFIPPA).*

For Office Use Only:	
Received By:	
Title:	
Signed:	
Date:	

Appendix A

Guidance Information for Responding to Part 4. Review of Proposed Activities - Screening

The following information provides additional information on the 21 prescribed threat activities and is to be used in making a general decision as to whether or not the proposed activity could be a threat to drinking water sources and would be regulated by the policies in the Source Protection Plan. The purpose of this review is to identify activities that may present a threat to drinking water source and thereby are to be managed in accordance with the Source Protection Plan. The Source Water Protection Coordinator or the Risk Management Official will review all submissions and follow-up to confirm that responses are consistent with standard practices for the proposed purposes.

Prescribed Threat Activity #1 - Waste

A *waste disposal site* within the meaning of Part V of the *Environmental Protection Act* (*EPA*) refers to**:**

(a) any land upon, into, in or through which, or building or structure in which, waste is deposited, disposed of, handled, stored, transferred, treated or processed, and

(b) any operation carried out or machinery or equipment used in connection with the depositing, disposal, handling, storage, transfer, treatment or processing referred to in clause (a) *[EPA S.25]*.

Waste includes ashes, garbage, refuse, domestic waste, industrial waste, or municipal refuse and such other materials as are designated in the regulations *[EPA S.25]*. *Additional definitions are provided in Section 1 of O. Reg. 347*

Waste Management System means any facilities or equipment used in, and any operations carried out for, the management of waste including the collection, handling, transportation, storage, processing or disposal of waste, and may include one or more waste disposal sites *[EPA S.25]*.

The majority of activities that are considered as a ***Waste Disposal Site*** require an ***Environmental Compliance Approval (ECA).*** Activities that are exempt from an *ECA* and not identified in clause (p), (q), (r), (s), (t), or (u) of the definition of hazardous waste will need to be managed by a ***Risk Management Plan***. Exempt activities include waste generators that are registered with the Ontario Hazardous Waste Information Network (HWIN). Other exemptions are listed in Section 3 of O.Reg. 347. Handling and storage of materials listed in clause (p), (q), (r), (s), (t), or (u) of the definition of hazardous waste will be managed via education and outreach.

Hazardous Waste and the activities that are exempt from an ECA are fully defined in O.Reg. 347. The primary definition of Hazardous waste is "A waste that is a,

(a) hazardous industrial waste,

(b) acute hazardous waste chemical,

(c) hazardous waste chemical,

(d) severely toxic waste,

(e) ignitable waste,

(f) corrosive waste,

Appendix A

(g) reactive waste,

(h) radioactive waste, except radioisotope wastes disposed of in a landfilling site in accordance with the written instructions of the Canadian Nuclear Safety Commission,

(i) pathological waste,

(j) leachate toxic waste, or

(k) PCB waste,

but does not include,

(l) hauled sewage,

(m) waste from the operation of a sewage works subject to the *Ontario Water Resources Act* where the works,

(i) is owned by a municipality,

(ii) is owned by the Crown or the Ontario Clean Water Agency, subject to an agreement with a municipality under the *Ontario Water Resources Act*, or

(iii) receives only waste similar in character to the domestic sewage from a household,

(n) domestic waste,

(o) incinerator ash resulting from the incineration of waste that is neither hazardous waste nor liquid industrial waste,

(p) waste that is a hazardous industrial waste, hazardous waste chemical, ignitable waste, corrosive waste, leachate toxic waste or reactive waste and that is produced in any month in an amount less than five kilograms or otherwise accumulated in an amount less than five kilograms,

(q) waste that is an acute hazardous waste chemical and that is produced in any month in an amount less than one kilogram or otherwise accumulated in an amount less than one kilogram,

(r) an empty container or the liner from an empty container that contained hazardous industrial waste, hazardous waste chemical, ignitable waste, corrosive waste, leachate toxic waste or reactive waste,

(s) an empty container of less than twenty litres capacity or one or more liners weighing, in total, less than ten kilograms from empty containers, that contained acute hazardous waste chemical,

(t) the residues or contaminated materials from the clean-up of a spill of less than five kilograms of waste that is a hazardous industrial waste, hazardous waste chemical, ignitable waste, corrosive waste, leachate toxic waste or reactive waste, or

(u) the residues or contaminated materials from the clean-up of a spill of less than one kilogram of waste that is an acute hazardous waste chemical;"

Appendix A

Prescribed Threat Activity #2 - Sewage

Sewage may contain soluble chemicals that can affect the quality of drinking water. Activities that involve the establishment, operation or maintenance of a system that collects, stores, transmits, or disposes of sewage will be managed either by ***Prescribed Instruments*** under the *Ontario Water Resources Act (OWRA)*, planning controls, or education and outreach policies. Sewage systems include facilities for stormwater management, including pipes and low impact development (LID) measures; sanitary sewage pipelines, and private sewage systems.

Prescribed Threat Activity #3 – 5, 8, 21 – Agricultural Activities

Prescribed Drinking Water Threats 3, 4, 5, 8, and 21 apply to agricultural land use. The Risk Management Official must determine whether a Prescribed Instrument under the Nutrient Management Act)is in place and conforms to the Grand River Source Protection Plan. A **Risk Management Plan** will be required for activities not managed by a Prescribed Instrument.

Agricultural Source Material (ASM) refers to material used for land application of nutrients that originate from agricultural activities such as livestock operations. ASM may include manure, livestock bedding, runoff water from animal yards or manure storage and compost (*see Nutrient Management Act, 2002* for full legal description).

Management of ASM includes operations that may generate ASM to be stored temporarily prior to off-site disposal.

Prescribed Threat Activity #6,7– Non-Agricultural Source Material

Non-Agricultural Source Materials (NASM) refers to materials applied to land as nutrients that do not originate from agricultural activities. Includes pulp and paper biosolids, sewage biosolids, non-agricultural compost and any other material capable of being applied to land as a nutrient that is not from an agricultural source (see Nutrient Management Act, 2002 for legal description). The Source Protection Plan policies only apply for NASM materials that are generated from a meat plant or sewage works.

Prescribed Threat Activity #8,9– Commercial Fertilizer

Commercial Fertilizers may contain chemicals, particularly nitrates that are soluble in water and have potential to affect ground water quality. Storage and application of commercial fertilizer are typically managed under the *Nutrient Management Act*. A ***Risk Management Plan*** may be required for storage of more than 2,500 kg of commercial fertilizer within a designated vulnerable area.

Prescribed Threat Activity #10,11 – Pesticide

Pesticides refer to any organism, substance or thing that is manufactured, represented, sold or used as a means of directly or indirectly controlling, preventing, destroying, mitigating, attracting or repelling any pest or of altering the growth, development or characteristics of any plant life that is not a pest and includes any organism, substance or thing registered under the *Pest Control Products Act (Canada). (From Pesticides Act, 1990).*

Appendix A

For the purposes of the *Clean Water Act*, the following pesticides are considered to have potential to be significant drinking water threats:

Pesticides (Active Ingredient) Referenced in the Table of Drinking Water Threats:		
MCPA	2.4-D	Pendimethalin
Mecoprop	Dichloropropene-1,3	Glyphosate
Atrazine	MCPB	Metalochlor or s-Metalochlor
Dicamba	Metalaxyl	

Application of Pesticide will be managed by a Prescribed Instrument or under the *Planning Act*. Handling of Storage of Pesticide may require a ***Risk Management Plan*** depending upon the volume stored and circumstances.

Prescribed Threat Activity #12-14 – Road Salt/Snow Disposal

Use of salt for winter road maintenance can result in release of sodium and chloride, and possibly other chemicals to surface water and groundwater. The application of road salt is currently managed through best management practices and is not regulated by the Source Protection Plan at this time. The handling and storage of more than 5,000 kg of road salt is to be prohibited in sensitive vulnerable areas (Vulnerability Score -= 10).

The storage of snow may include road salt and other contaminants that become concentrated. Snow storage may be managed by a ***Risk Management Plan*** in specific vulnerable areas. The trigger to require a Risk Management Plan is the area used for snow storage.

Prescribed Threat Activity #15– Fuels

Fuels refer to chemical mixtures refined from petroleum hydrocarbons. Fuels are typically slightly soluble in water and are often observed as a separate oil-like phase. Most common fuels are less dense than water and will float upon a water surface. Common fuels include: gasoline, diesel fuel, fuel oil (heating fuel), aviation fuel, and bunker C fuel. Fuel handling and storage may be prohibited in some vulnerable areas and may require a Risk Management Plan under some circumstances, triggered by volume stored and the vulnerability score.

Fuel handling and storage for an activity regulated under the Aggregate Resources Act will be managed via a Prescribed Instrument.

Emergency generators for a municipal facility are exempt from prohibition within WHPA-A.

Prescribed Threat Activity #16 – DNAPL

Dense Non-Aqueous Phase Liquids (DNAPL) are a class of chemicals or chemical mixtures that are slightly soluble in water and are therefore often observed as a separate "oil-like" phase in the subsurface. The oil-like phase is denser than water and as a result, the presence and migration of the DNAPL liquids is

controlled more by gravity and the distribution of permeable and conductive features in the subsurface, rather than by the groundwater flow directions. Common DNAPLs include dry cleaning fluid, industrial degreasers, creosote, For the purposes of the *Clean Water Act* the following chemical constituents of a DNAPL are considered to have potential to be significant drinking water threats:

Tetrachloroethylene/ Perchloroethylene (PCE)	Vinyl Chloride	Dioxane-1,4 (1,4-Dioxane or 1,4D))
Trichloroethylene (TCE)	Polycyclic Aromatic Hydrocarbons (PAH) *[See List in PAH Definition in Appendix B].*	

Activities that involve the handling and storage of a DNAPL are prohibited in WHPA-A and may require a ***Risk Management Plan*** in other vulnerable areas.

Prescribed Threat Activity #17– Organic Solvent

An **Organic Solvent** is considered to be any volatile organic compound that is used as a cleaning agent, dissolver, thinner, or viscosity reducer, or for a similar purpose. (From O.Reg. 153/04 -Record of Site Condition Regulation, under the Environmental Protection Act). For the purposes of the Clean Water Act the organic solvents that are considered to have potential to be significant drinking water threats include:

Carbon Tetrachloride (CT)	Methylene Chloride (MC)	Pentachlorophenol (PCPH)
Chloroform (CFM)		

Activities that involve the handling and storage of an organic solvent are prohibited in WHPA-A and may require a ***Risk Management Plan*** in some other vulnerable areas.

Prescribed Threat Activity #18 – Run-off for Deicing of Aircraft

This activity is specific in relation to water quality that may be associated with facilities constructed to de-ice aircraft. This activity is not anticipated to occur within the City of Guelph.

Prescribed Threat Activity #19,20 – Water Quantity Threats

Water taking and the construction of impervious surfaces or similar measures to divert water can reduce the quantity of water available to a municipal water supply system. Source Protection Plan policies to address significant threats related to water quantity are under development.

Water taking refers to removal of water via wells, or directly pumping from a surface water for use that is not returned to the originating water body.

Recharge can typically be reduced through the construction of impervious surfaces, such as buildings, paved roads, sidewalks, parking lots, swimming pools, etc. Current best management practices typically require diverted recharge to be returned to the subsurface to off-set the impact of the proposed construction.

Appendix A

Prescribed Threat Activity #21 – Livestock

Wastes, such as manure that are associated with livestock grazing have potential to impact groundwater and surface water resources. A ***Risk Management Plan*** may be required for Activities that involve use of land for livestock grazing, etc. where a Nutrient Management Plan or Nutrient Management Strategy (Prescribed Instrument) are not required.

Liquid Chemical Handling and Storage

The prescribed drinking water threat activities provide details regarding the specific chemicals, substances, and circumstances that are a significant drinking water threat. Part 4 – Review of Proposed Activities – Screening provides an opportunity for the applicant to advise the Source Water Protection Coordinator or Risk Management Official of chemical storage that may be associated with the proposed activities. The Source Water Protection Coordinator and Risk Management Official will request an inventory of chemical products to make a determination as to whether or not source protection plan policies will apply.

Transport Pathways

Transport Pathways are defined as "*a condition of land resulting from human activity that increases the vulnerability of a raw water supply of a drinking water system*." The following questions are intended to identify if Transport Pathways may occur in association with the proposed Activity. In event that a Transport Pathway exists or will be created, the Risk Management Official will take this into consideration in making a determination as to whether Section 59 restrictions apply and will incorporate the findings into the Risk Management Plan or Section 59 Notice.

The following features are examples of typical transport pathways that are to be considered by the Risk Management Official:

- Drinking Water Wells
- Geotechnical boreholes
- Groundwater monitoring wells
- Oil and Gas Wells/Boreholes
- Geothermal Systems
- Man-made ponds
- Foundations > 3 m deep
- Utility Corridors with non-native backfill (sanitary sewers, storm sewers, pipelines, etc.).
- A pit or quarry for removal of soil/sand/gravel or rock
- Alterations to natural grade of more than 3 m

Part 4 – Review of Proposed Activities – Screening provides an opportunity for the applicant to advise the Source Water Protection Coordinator or Risk Management Official of existing or proposed transport pathways associated with the application.

Appendix B

Selected Definitions:

Agricultural Source Material (ASM): Material used for land application of nutrients that originate from agricultural activities such as livestock operations. May include manure, livestock bedding, runoff water from animal yards or manure storage and compost (*see Nutrient Management Act, 2002* for legal description).

Best Management Practices (BMP): Best Management Practices can be defined as those measures intended to provide an on-the-ground practical solution to pollution and other environmental impacts from all sources and sectors.

Biosolids: The by-product of domestic and commercial sewage and wastewater treatment. Also referred to as sludge.

Dense Non-Aqueous Phase Liquid (DNAPL): A class of chemicals that are slightly soluble in water and are therefore often observed as a separate "oil-like" phase in the subsurface. The oil-like phase is denser than water and as a result, the presence and migration of the DNAPL liquids is controlled more by gravity and the distribution of permeable and conductive features in the subsurface, rather than by the groundwater flow directions. For the purposes of the *Clean Water Act* the following chemical constituents of a DNAPL are considered to have potential to be significant drinking water threats.

DNAPLs Referenced in the Table of Drinking Water Threats:		
Tetrachloroethyene/ Perchloroethylene (PCE) and breakdown products	Trichloroethylene (TCE) and breakdown products	Vinyl Chloride
Dioxane-1,4 (1,4-Dioxane or 1,4D) and breakdown products	Polycyclic Aromatic Hydrocarbons (PAH) (*See List in PAH Definition in Appendix B*)	

Drinking Water Issue: A substantiated (through scientific means) condition relating to the quality of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipal residential system or designated system (See Technical Rules 114 to 117).

Drinking Water Threat: An activity or condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water, and includes an activity or condition that is prescribed by the *Clean Water Act* as a drinking water threat.

Hazardous waste: (See O.Reg. 347 for additional information) A waste that is a,

(a) hazardous industrial waste,

(b) acute hazardous waste chemical,

(c) hazardous waste chemical,

(d) severely toxic waste,

(e) ignitable waste,

(f) corrosive waste,

(g) reactive waste,

(h) radioactive waste, except radioisotope wastes disposed of in a landfilling site in accordance with the written instructions of the Canadian Nuclear Safety Commission,

(i) pathological waste,

(j) leachate toxic waste, or

(k) PCB waste,

but does not include,

(l) hauled sewage,

(m) waste from the operation of a sewage works subject to the *Ontario Water Resources Act* where the works,

(i) is owned by a municipality,

(ii) is owned by the Crown or the Ontario Clean Water Agency, subject to an agreement with a municipality under the *Ontario Water Resources Act*, or

(iii) receives only waste similar in character to the domestic sewage from a household,

(n) domestic waste,

(o) incinerator ash resulting from the incineration of waste that is neither hazardous waste nor liquid industrial waste,

(p) waste that is a hazardous industrial waste, hazardous waste chemical, ignitable waste, corrosive waste, leachate toxic waste or reactive waste and that is produced in any month in an amount less than five kilograms or otherwise accumulated in an amount less than five kilograms,

(q) waste that is an acute hazardous waste chemical and that is produced in any month in an amount less than one kilogram or otherwise accumulated in an amount less than one kilogram,

(r) an empty container or the liner from an empty container that contained hazardous industrial waste, hazardous waste chemical, ignitable waste, corrosive waste, leachate toxic waste or reactive waste,

(s) an empty container of less than twenty litres capacity or one or more liners weighing, in total, less than ten kilograms from empty containers, that contained acute hazardous waste chemical,

(t) the residues or contaminated materials from the clean-up of a spill of less than five kilograms of waste that is a hazardous industrial waste, hazardous waste chemical, ignitable waste, corrosive waste, leachate toxic waste or reactive waste, or

(u) the residues or contaminated materials from the clean-up of a spill of less than one kilogram of waste that is an acute hazardous waste chemical;

Issues Contributing Area (ICA): The area within a vulnerable area where activities, conditions that result from past activities, and naturally occurring conditions may contribute to the parameter or pathogen issue (Technical Rule 115(3)).

Appendix B

Non-Agricultural Source Materials (NASM): Used to apply to land as nutrients that do not originate from agricultural activities. Includes pulp and paper biosolids, sewage biosolids, non-agricultural compost and any other material capable of being applied to land as a nutrient that is not from an agricultural source (see Nutrient Management Act, 2002 for legal description).

Non-Aqueous Phase Liquid (NAPL): A group of chemicals that is insoluble in water, including light and dense NAPLs.

Organic Solvent: Any volatile organic compound that is used as a cleaning agent, dissolver, thinner, or viscosity reducer, or for a similar purpose. (From O.Reg. 153/04 -Record of Site Condition Regulation, under the *Environmental Protection Act*). For the purposes of the *Clean Water Act* the following organic solvents are considered to have potential to be significant drinking water threats.

Organic Solvents Referenced in the Table of Drinking Water Threats:		
Carbon Tetrachloride (CT)	Chloroform (CFM)	Methylene Chloride (MC)
Pentachlorophenol		

Pesticide: Any organism, substance or thing that is manufactured, represented, sold or used as a means of directly or indirectly controlling, preventing, destroying, mitigating, attracting or repelling any pest or of altering the growth, development or characteristics of any plant life that is not a pest and includes any organism, substance or thing registered under the *Pest Control Products Act (Canada). (From Pesticides Act, 1990).* For the purposes of the *Clean Water Act*, the following pesticides are considered to have potential to be significant drinking water threats:

Pesticides Referenced in the Table of Drinking Water Threats (Active Ingredient):		
MCPA	2.4-D	Pendimethalin
Mecoprop	Dichloropropene-1,3	Glyphosate
Atrazine	MCPB	Metalochlor or s-Metalochlor
Dicamba	Metalaxyl	

Polycyclic Aromatic Hydrocarbons (PAHs): Hydrocarbons formed from a series of benzene rings. These compounds are components of ancient sediments and crude oils.

Polycyclic Aromatic Hydrocarbon Compounds Referenced in the Table of Drinking Water Threats:		
Acenaphthene	Benzo(b)fluoranthene	Fluoranthene
Acenaphthylene	Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene
Anthracene	Benzo(k)fluoranthene	Naphthalene
Benz(a)anthracene	Benzo(a)phenanthrene	Phenanthrene
Benzo(a)pyrene	Dibenz(a,h)anthracene	Pyrene

Appendix B

Significant Drinking Water Threat: A drinking water threat that, according to risk assessment, poses or has the potential to pose a significant risk.

Technical Rules: The Technical Rules prescribe the information that needs to be included in the Assessment Report to meet the requirements of the *Clean Water Act (Ministry of the Environment, 2009),*

Transport Pathway: A condition of land resulting from human activity that increases the vulnerability of a raw water supply of a drinking water system set out in clause 15(2)(e) of the *Clean Water Act, 2006*.

Vulnerable Area: Under the *Clean Water Act*, *2006* includes:

- significant groundwater recharge areas
- highly vulnerable aquifers
- surface water intake protection zones
- wellhead protection areas

Vulnerability Rating: A value of high, medium, or low vulnerability assigned within a Source Protection Area as per Technical Rules 37 to 41. High vulnerability would indicate that contaminant parameters could move from ground surface down to the water supply aquifer quickly. Low vulnerability indicates that contaminants would move slowly from ground surface down to the water supply aquifer.

Waste Disposal Site within the Meaning of Part V of the Environmental Protection Act:

(a) any land upon, into, in or through which, or building or structure in which, waste is deposited, disposed of, handled, stored, transferred, treated or processed, and

(b) any operation carried out or machinery or equipment used in connection with the depositing, disposal, handling, storage, transfer, treatment or processing referred to in clause (a).

Wellhead Protection Area: An area that is related to a wellhead and within which it is desirable to regulate or monitor drinking water threats.

Grand River Conservation Authority
Resource Management Division

400 Clyde Road, P.O. Box 729
Cambridge, Ontario N1R 5W6
Phone: (519) 621-2761 ext.
Fax: (519) 621-4945
E-mail: ngarland@grandriver.ca

City of Guelph:
Development Review Committee, October 5th, 2016

RE: 220 Arkell Road

GRCA COMMENT:

- Environmental Impact Study required
- Stormwater Management Report required (quality and quantity)
- Confirmation of Wetland Boundary
- Site is located within the Torrence Creek Subwatershed and Torrence Creek Subwatershed study should be referenced.

BACKGROUND

The site is located within the Torrence Creek Subwatershed and contains a portion of the Torrence Creek Provincially Significant Wetland. Groundwater levels in the area are typically quite high and near the surface. Adjacent developments have been – Victoria Park Village (North), 246 Arkell Road (South)

Respectfully submitted

Nathan Garland, GRCA Resource Planner

**** These comments are respectfully submitted as advice and reflect resource concerns within the scope and mandate of the Grand River Conservation Authority.***

APPENDIX B2

MEETING MINUTES

Meeting Notes

220 Arkell Road Consultation Meeting

220 Arkell Road / 16143338

Date/Time:	March 13, 2017 / 11:00 AM
Place:	City Hall, Room 364
Attendees:	Adèle Labbé, Enviromental Planner, and Chris DeVriendt, Senior Development Planner, City of Guelph Kevin Brousseau, Project Manager, and Melissa Straus, Terrestrial Ecologist, Stantec Consulting Ltd. Carson Reid, and Spencer Reid, Carson Reid Homes
Distribution:	Attendees Nancy Shoemaker, Planner, BSR&D

Item:	**Action:**
Ecological Corridor	
1. KB asked where the 50 m width required to support the ecological corridor along the existing east-west hedgerow that shares the property boundary with Victoria Park Village (VPV) is measured from.	It was requested that the City confirm that the 50 m wide ecological corridor is to be measured from the north property line or edge of feature (i.e., east-west hedgerow).
2. AL indicated that it is her understanding based on current mapping that the 50 m width would be measured from the property line. This is based on a requirement to zone the corridor in the future appropriately (e.g., open space), and since the small portion of the hedgerow that is on the VPV property is zoned residential, this portion would not be included in the ecological corridor.	
3. It was also indicated that the zoning is based on landscape function and connection of core areas, and in this case connecting the Torrance Creek Provincially Significant Wetland (PSW) along the western portion of the property to the Staples woodlot to the east.	
4. KB asked if there was any way that a conservation easement could be used to alleviate this zoning issue, as it is important to gain whatever extra space possible for the subject lands. It was discussed but determined that this would not be a suitable solution.	
5. MS indicated that measuring from the property line makes sense from a planning from perspective but not from an ecological one.	
Field Studies	
1. MS asked if corridor studies would be required as part of the scope of work required for this project, as determination of poor usage of the feature would not change the ecological linkage designation.	Stantec to follow up with ToR submission as soon as possible.
2. AL indicated that corridor studies would help inform which species or groups to target for the installation of any corridor crossing that may be required.	MS to request referenced studies from AL if required.

Item:	Action:
3. MS indicated that the Staples woodlot is considered significant solely based on its size, and that studies completed by Dougan and Associates as part of the Natural Heritage work for OPA42 did not identify significant wildlife habitat for amphibians or for breeding birds in that woodlot. However, it was noted that studies were likely done from Victoria Road and that those studies were not expected to adequately cover that woodlot [NB: *MS checked the EIS for VPV, which also determined that the Staples woodlot was not significant for amphibians nor breeding birds in 2002*].	
4. The level of effort required for corridor studies was discussed, with recommendations to review the EIR for the Dallan lands (North-South Environmental), as well as the Hanlon Creek and Southgate industrial development (NRSI).	
5. MS indicated that an Environmental Impact Study (EIS) Terms of Reference (ToR) was ready in draft for submission but that had not been submitted yet to the City as it was unclear what development constraints were in place and we were investigating further. AL indicated that the ToR should be submitted right away as she is reviewing items right into the middle of April currently. The previously discussed items will be used to scope the ToR.	
6. AL indicated that locally significant birds should be included on mapping to illustrate where they were observed.	
Wetlands	
1. KB indicated that we were intending to revisit the onsite wetlands in the spring at a time when vegetation would be more useful in the determination of the wetland boundary. Surveys completed in the fall were during a borderline time of year and based almost exclusively on soils.	Stantec to review GRCA policies and coordinate an onsite staking review.
2. MS pointed out the small wetland remnant east of the existing driveway – approximately 214m^2 (0.02 ha) which does not meet the 'other wetlands' size criterion in OPA 42.	Botanical inventory in 2017 will determine if any significant plant species are present.
3. AL pointed to the various wetland policies, including: GRCA, as well as Other and Local in OPA42 and possible complexing with the PSW under Ministry of Natural Resources and Forestry policy. It was recommended that we deal with the GRCA on the small wetland piece and that the proposed detailed vegetation inventory would be required to confirm if any significant species were present in its assessment.	

Item:	Action:
North-South Hedgerow	
1. MS indicated that the Torrance Creek Subwatershed Study (SWS) does not include the north-south hedgerow in their monitoring or as a locally significant ecological linkage. AL indicated she had not double checked this but to make sure that this was the case before proceeding to ensure that this would not cause an issue for the proposed development.	MS to double check that the N-S hedgerow is not deemed significant by the SWS.
2. Advice given with respect to the proposed removal of the north-south hedgerow included: review OPA 42 policy 6A5.3; preserve as much of the hedgerow as possible, demonstrate that it cannot be incorporated into the urban forest including various design considerations, slopes, and grading, sanitary sewer, etc.; if you cannot keep make sure that the removal is justified, which does not include the number of units to be impacted or that the road has to be in that location; e.g., we looked at retaining the hedgerow but due to x, y, and z it cannot be accommodated; make sure the justification is based on the true ability to retain the hedgerow or not; mitigation measures such as planting in the ecological corridor are good but not a justification for removal; the stronger and more defensible the removal is based on the application the easier approval will be; the community loves cedar hedgerows.	Development team to look at various options for the site plan that considers retention of the N-S hedgerow. Solid justification to be included in the EIS for N-S hedgerow removal.
3. A photo of the north-south hedgerow was distributed for context (see attachments).	
Stormwater Management (SWM)	
1. KB indicated that there is capacity to the north on the VPV lands for stormwater management, however the development is considering an onsite pond within the PSW buffer and ecological linkage within the northeast portion of the site (see attachment).	
2. A SWM pond is an acceptable use within the outer 15 m of the buffer to the PSW. Review policy 6A.2.4 (Significant Wetlands) which also references 6A.1.2 (General Permitted Uses), 6A.2.6.6 (Significant Woodland).	Stantec to consider dry SWM pond during design.
3. There is a test of 'no negative impact' that must be demonstrated to allow SWM to be located in the 30 m PSW buffer, which is established as part of the EIS.	Stantec to complete a water balance as part of the EIS.
4. KB indicated that the major storm events would be directed to the PSW to maintain the existing drainage pattern but note that the minor storm events may be directed elsewhere.	
5. AL indicated that a water balance that mimics pre- and post-construction conditions would be required as part of the submission. AL also noted that minor events may be just as important as major storm events.	

Item:	Action:
6. Policy 6A.2.910.iii does allow SWM facilities within ecological linkages. However, the function of the linkage needs to be maintained. Therefore for amphibians, a wet pond would be suitable but this corridor is also intended to funnel deer out of the City and as such a dry pond would be preferred. Fencing around SWM facilities can inhibit animal movement and that is not a compatible use. AL asked if SWM facilities must be fenced, and KB indicated if the slope is 5:1 it does not.	
Servicing	
1. KB indicated that there is a sanitary outlet to the north to VPV to along Street A (see concept, attached). CD indicated that the City Engineering department had indicated a potential issue and that a connection along Future Road (see concept, attached) would be preferred. KB indicated that this is outside the site property boundaries.	KB to follow up with Engineering at the City (Mary Angelo)
Miscellaneous	
1. Brief discussion on engaging the proponent to the southwest as the connection, driveway, and proposed roadway, trail, and park, etc. would benefit from coordination.	CR to consider reaching out to proponent to the southwest
2. KB indicated that emergency access will be provided temporarily along the existing driveway.	
3. There is a significant grade difference between the properties at the proposed roadway connection.	

The meeting adjourned at 12:00 PM
The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

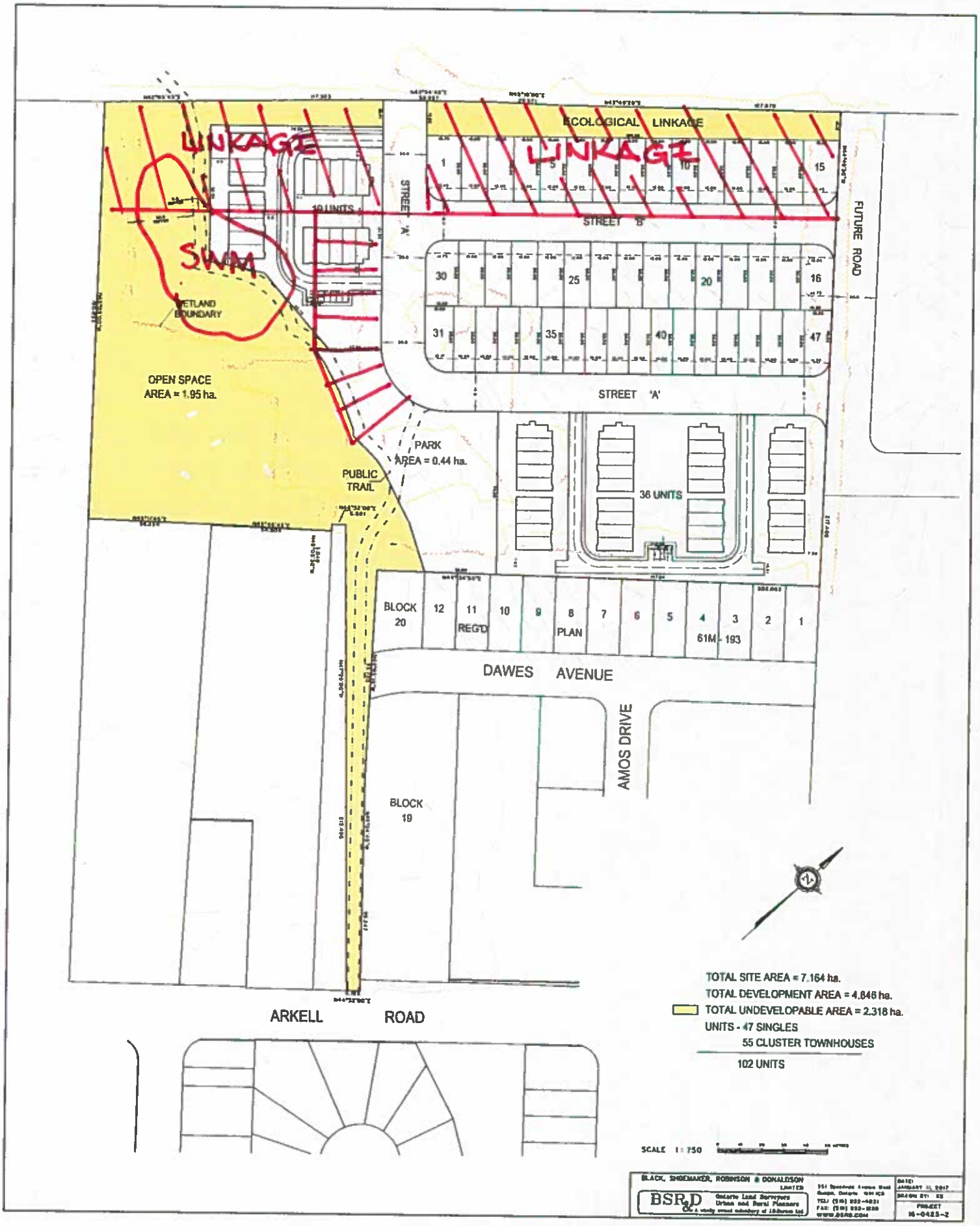
Stantec Consulting Ltd.

Melissa Straus

Melissa Straus, M.Sc.
Terrestrial Ecologist
Phone: (519) 780-8103
Fax: (519) 836-2493
Melissa.Straus@stantec.com

Attachment: Site concept
Photograph of the North-South Hedgerow
Wetland boundary

ATTACHMENT


ECOLOGICAL LINKAGE
LINKAGE
LINKAGE
SWM
WETLAND BOUNDARY
OPEN SPACE AREA = 1.95 ha.
10 UNITS
STREET 'A'
STREET 'B'
FUTURE ROAD
STREET 'A'
PARK AREA = 0.44 ha.
PUBLIC TRAIL
36 UNITS
BLOCK 20
REG'D PLAN 61M-193
DAWES AVENUE
AMOS DRIVE
BLOCK 19
ARKELL ROAD
TOTAL SITE AREA = 7.164 ha.
TOTAL DEVELOPMENT AREA = 4.846 ha.
TOTAL UNDEVELOPABLE AREA = 2.318 ha.
UNITS - 47 SINGLES
55 CLUSTER TOWNHOUSES
102 UNITS
SCALE 1:750
BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED
BSR&D
Ontario Land Surveyors
Urban and Rural Planners
PROJECT
16-0425-2


SLOW

Meeting Notes

220 Arkell Road Land Conveyance

220 Arkell Road / 161413338

Date/Time:	October 10, 2017 / 1:30 PM
Place:	Guelph City Hall, Room 322
Attendees:	Katie Nasswetter, Jim Hall, Chris DeVriendt, Jyoti Pathak, Mary Angelo, City of Guelph Nancy Shoemaker, BSRD John Vleeming, Melissa Straus, Stantec Carson Reid, Spence Reid, Carson Reid Homes
Distribution:	Attendees

Background

Carson Reid has been approached by the Developer to the southwest regarding conveyance of lands which currently serve as the existing driveway on 220 Arkell, south of the proposed Dawes Road connection. The purpose of the meeting was to discuss what this conveyance would mean for the development at 220 Arkell in terms of a variety of topics, including: emergency access, trail connection, encroachment into feature buffers, fill requirements, and timing.

The City is amicable to this conveyance as they would like to see Dawes Avenue proceed through the 220 Arkell property as shown in preliminary designs discussed during the meeting.

Item: Emergency Access

A second access (emergency access) is required if the distance between proposed Jell Street and the termination of the Street "A" is >150m. This would leave very little development available along "Street A" which is therefore not feasible, an emergency access is therefore required. The City indicated that they want to see Dawes Ave. extended, it was then concluded that the connection to Dawes Ave. would be the best solution, if feasible.

Action: An emergency access route is required. City of Guelph to determine width of access required (6 m or 10 m?) looking at past projects for reference to see if existing driveway is sufficient for temporary access.

The location and design of emergency access requires additional investigation both for environmental and engineering concerns, prior to proceeding with the conveyance.

Item: Trails

Parks is open to having an on-road trail connection along Dawes. This would facilitate conveyance and closure of the existing driveway, which is the currently proposed trail route to Arkell.

Based on the proposed location of the park, Parks would prefer the trail be put as close to the wetland edge as possible, noting that Environmental Planning would require consultation. In the past, trails within the outer 15 m of the buffer have been acceptable. That would allow Parks the largest park possible.

Trails would be designed to City Standards, with this connection shown on the Trails Master Plan. Futhermore, to ensure that the trail functions cohesively, Parks would like to see the overall trail plan for that area. Nancy asked, and it was indicated, that this would be a DC trail.

Action: The location and design of the trails requires additional investigation, considering both conveyance and non-conveyance scenarios.

Item: Stormwater Management (SWM) on Adjacent Property

It is unclear how stormwater is going to be managed on the southwest adjacent property. There is a 3-4 m difference in elevation with the SWM facility to the east at 246 Arkell Road. To tie into this, they would likely have to bring up the entire site and retrofit the SWM facility. The existing SWM facility is comprised of a clay liner and clay wall, which would be technically difficult (but possible) to alter.

It was also brought up whether Grand River Conservation Authority (GRCA) would allow significant filling within proximity to a Provincially Significant Wetland.

Road geometrics are a concern on newest concept on adjacent property due to an unusual hitch in the road. Filling would require half of the buffer and it would would need to be sloped into the wetland buffer.

Action: None required, issues on adjacent property to contend with.

Item: Dawes Avenue Connection

Environmental

Environmental Planning was not at the meeting, and as such the encroachments would need to be approved and formalized through the Environmental Impact Study.

Block 20 is the location of a previous wetland that was approved to be removed as part of the 246 Arkell Road development. This left a small remnant on the 220 Arkell Road property.

Stantec indicated that during the onsite wetland boundary delineation with the Grand River Conservation Authority (GRCA) the small wetland remnant was not included in the area delineated. This is not yet reflected in the GRCA website mapping despite Stantec providing the updated wetland layer in spring 2017. Furthermore, while onsite in the fall of 2016 Environmental Planning indicated that the City's wetland policies would need to be addressed to remove the remnant.

Engineering

The most significant challenge with tying into Dawes Avenue is the significant difference in grade. To accommodate appropriate slope for the trail and appropriate emergency access (5%), this would likely require encroaching onto the open space (Block 20) and the small wetland remnant on 220 Arkell.

Timing

The timing of the development would be ideal if they would proceed together. The chance of that occurring is unlikely, therefore care needs to be taken to not inhibit either development. It is

expected that a conveyance with a condition of an easement would be the best way forward for Carson Reid, particularly in the event that the adjacent property is developed first.

Action: Stantec to look at grades and fill requirements to see if possible to make the connection work. Stantec also to review 246 Arkell EIS and further the conversation with required agencies (City, GRCA) on encroachment into Block 20 and wetland remnant.

Item: Victoria Park Village (VPV)

Status of VPV was questioned. To date phase 1 of the Development.

A second sanitary stub is required on the VPV block. The method to proceed that was deemed best was to get a letter to the City from Nancy, with input from J. Vleeming, so that the manner will be in the hands of the City.,

Action: Create drawings, check if water is available under current design, and create letter for City for second sanitary stub.

Item: Potential Road Connection to the East

City indicated that a holding on the last lot (eastern most, see 18 on attached) where a future road is pre-planned would be required. No holding would be required to the south.

The flexibility to build a road in the future on that side is preferred.

Action: Hold lot during sales.

The meeting adjourned at 2:30 PM

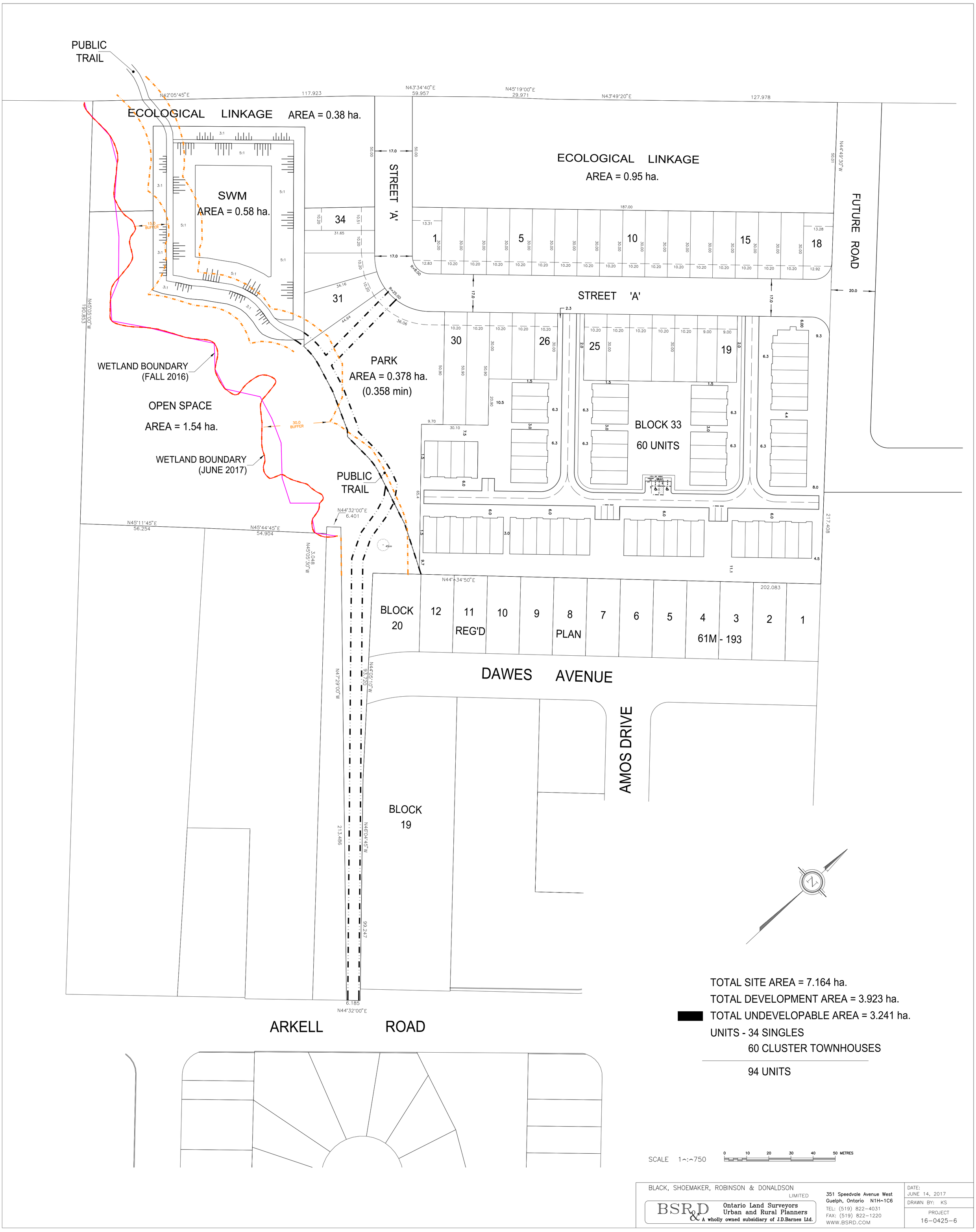
The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

Stantec Consulting Ltd.

Melissa Straus, M.Sc.
Terrestrial Ecologist
Phone: (519) 780-8103
Fax: (519) 836-2493
Melissa.Straus@stantec.com

Attachment: Concept

Cc: Kevin Brousseau, Stantec



TOTAL SITE AREA = 7.164 ha.

TOTAL DEVELOPMENT AREA = 3.923 ha.

TOTAL UNDEVELOPABLE AREA = 3.241 ha.

UNITS - 34 SINGLES

60 CLUSTER TOWNHOUSES

94 UNITS

SCALE 1~:~750

0 10 20 30 40 50 METRES

BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED

BSR&D Ontario Land Surveyors Urban and Rural Planners A wholly owned subsidiary of J.D.Barnes Ltd.

351 Speedvale Avenue West
Guelph, Ontario N1H~1C6
TEL: (519) 822-4031
FAX: (519) 822-1220
WWW.BSRD.COM

DATE: JUNE 14, 2017

DRAWN BY: KS

PROJECT 16-0425-6

Stantec

Meeting Notes

220 Arkell / 161413338

Date/Time:	September 10, 2018 / 11:00 am
Place:	City Hall
Attendees:	Jim Hall, City of Guelph Mary Angelo, Engineering, City of Guelph Katie Nasswetter, Planning, City of Guelph Jyoti Pathak, Parks Planning, City of Guelph Leah Lefler, Environmental Planning, City of Guelph Carson Reid, Carson Reid Homes Spencer Reid, Carson Reid Homes Nancy Shoemaker, BSRD Kevin Brousseau, Stantec Consulting Ltd. Melissa Straus, Stantec Consulting Ltd.
Distribution:	Attendees

Background

The purpose of the meeting was to discuss comments received from the City of Guelph on July 19, 2018 regarding a concept submission on May 28, 2018. Kevin Brousseau lead the meeting and reviewed comments that required additional discussion/direction.

Item:	Action:
Original comments provided by the City on Dec. 20, 2017 remain in effect: **Comments 1 and 2:** *Staff scoped our review/discussion to just the temporary emergency road connection to Dawes Avenue and your proposal to use the existing City-owned Open Space Block fronting Dawes Avenue. We did not review the remainder of the plan, the remainder of the trail alignment, and don't feel it appropriate to respond to questions outside of this scope. Those items will need to be reviewed comprehensively with supporting impact assessment(s) as part of a complete submission package.* *It is worth repeating that staff's consideration of this proposal is specific to this area because of the known challenge we will have in extending Dawes outside of the 220 Arkell subdivision and anticipated impacts there, and shouldn't be viewed as something that can be explored at other locations in the City.* Response: Noted. Not discussed during the meeting.	None

Item:	Action:
Comment 3: *At our meeting in October we briefly discussed the length of road permitted with the temporary emergency access in place; we have further discussed internally and provide the following for your consideration: The City of Guelph Development Engineering Manual states that no cul-de-sac can be longer than 150m without an emergency access, which typically is placed at the bulb of the cul-de-sac. The DEM also states that no road can be longer than 300m without dual access. To this end, and based on the sketch provided with your proposal, we would consider permitting no more than 150m of road beyond (to the east of) the temporary emergency access road, including a temporary terminating cul-de-sac. Please note that permitting this would be beyond the intent of the DEM, but would be considered here with provided justification and rationale, due to the specific circumstances at this location at this time.* Response: As discussed during the meeting, the justification for the proposed temporary configuration is due to the timing of development for the adjacent lands to the east. It was also clarified during the meeting that it was understood the proposed temporary configuration will allow for the development of the Multifamily Block.	None
Comment 4: *Staff Support would increase if the road and grading was shifted to the east as much as possible, with leaving a 3 m buffer from lot 12 to the toe of the new slope. This allows the wetland/woodland buffer to be maximized while still considering a temporary road alignment. Please include the approved grading for the Open Space Block, and the adjacent lots of this subdivision, and design the grading/servicing so that the objectives of the adjacent subdivision are not disrupted, and the area (including the Open Space Block and the lands to the north) is adequately and appropriately designed. Please take special note that the current design shows the proposed temporary road crossing an infiltration gallery and related structures; this will have to be redesigned accordingly.* ***Latest proposal does not provide sufficient separation between the existing lot and the toe of 3:1 slope, and does not appear to design for the objectives of the adjacent subdivision (infiltration requirements, drainage patterns, etc.).*** Jim Hall (City) indicated that • insufficient separation and 3:1 slope. • convey drainage along the trail. • Intent is, toe of 3:1m slope should be from 3 m from existing lot line.	Leah to provide wetland boundary for the property to the south west if available. Stantec to update Temporary Emergency access alignment & 3:1 slope to be 3m from Lot Line and minimize disturbance to the west. Stantec to vet infiltration strategy with the City to ensure targets are maintained.

Item:	Action:
• Shift as far east as possible but want separation of 3 m from the lot line. • Would like to see the wetland limit east of the existing driveway on the plans. Kevin (Stantec) indicated that • The intent is to ensure the proposed disturbance is as far as possible from the existing wetland. • Adjustments to the infiltration galleries & existing RLCB will be addressed in the Preliminary SWM Report in support of the Draft Plan. Strategy for maintaining the infiltration targets is to be vetted with the City prior to submission.	
Comment 5: *It should be noted that it is our expectation that the 10 m wide temporary road allowance would be restored to a 3m wide trail surface, at your client's sole expense, once the temporary access is no longer required. The 7 m restoration area should be planned on the west side and closer to the NHS and the restoration should include consideration for an alley of trees along the trail as well as other vegetation to stabilize, etc.* ***Please include a restoration plan to show the ultimate state of these lands once the temporary emergency access has been removed. Keep City standards for pathways and tree planting in mind while completing this design, and ensure that the restoration plan provided for Block 20 should (at a minimum) reflect the street tree plan in terms of number and variety of deciduous/coniferous trees and shrubs. Note that preference is given to indigenous species.*** Kevin (Stantec): requested to provide a restoration plan at the detailed design phase. This could also be included as a draft plan condition. Jim (City): Concerns to get elevation up to Dawes Ave. Plan grading and landscaping now to show what the configuration would look like. This is required so the City can determine if a temporary road can be put through. Kevin: Currently Dawes Avenue is perched in the air. Suggest addressed at detailed design. Jotyi (City): Clearly sees connection as a 6.0m walkway block, however the 6 m is not included in the parkland dedication area. Kevin (Stantec): This is a continuation of the trail network from Victoria Park Village (VPV) which is only 3 m wide trail. As the trail will also be included as a maintenance access for SWM, it is required to be 4 m wide hard surface.	Stantec/BSRD to provide updated sketch showing revised temporary emergency access c/w walkway block and park area layout. Restoration area to be identified on plan.

Item:	Action:
Jim (City): City will look at the block for SWM access. Final width is 4 m for SWM access with mow strips on either side. Didn't look at for SWM during initial review, simply looked at connection itself. Jotyi (City): The walkway block is different than off-road trail. Connects streets to street. OK with off-road being 3 m wide. 6 m for the walkway block section only. Trail is 3 m plus mowing strip. Kevin (Stantec): In summary, a 6 m wide block with 3 m trail, provision for swales and drainage. Jim (City): Would prefer that park and emergency access to be separate blocks. This is such that one doesn't impede the other. Kevin (Stantec): Once the 10 m temporary access is no longer required, the 6 m is incorporated into the walkway block, what do we do with the extra 4 m. Can the 4 m not be parkland? Jotyi (City): The biggest concern is that we don't know the timeline. Leah (City): In consideration of these widths and requirements, the PSW is quite close. How does the trail line up with the limit of the wetland? Kevin (Stantec): Underneath is existing asphalt driveway, max slopes of 5%. Staying on east side of driveway. It has been disturbed already. To accommodate Jim's comment, have to move to within 15 m outside of 30 m. Kevin (Stantec): To wrap up comment 5 in summary, the draft plan will show a 6 m walkway block with a 3 m wide trail. Swales for drainage. SWM 4 m access with mow strips as per City's standard. Could restoration details be deferred to a later time? Jyoti (City): Parks is Ok with that. Leah (City): It would be helpful to be provided an opportunity to review and look at potential impacts in basic detail. More detail will be provided in the EIS. Kevin: What would it look like? We can provide the drawing layer that shows the linework, with a hatched area that will be restored. Acceptable to the City (Leah and Jyoti).	
Comment 6: *The design must include provision for the extension of Dawes Avenue; please show the design under existing conditions (Dawes Ave. cul-de-sac) and with the extension in place. Please note the location of the existing fire hydrant, and the potential relocation of the hydrant when extending Dawes Avenue.* ***This information has not been submitted to date.***	Stantec to provide the temporary access road profile and preliminary grading plan to show interim and ultimate conditions.

Item:	Action:
Kevin: Stantec plans to include more detail at the detailed design phase. Hydrant can be moved. Jim: not just the hydrant. Grading and if Dawes extends or not. What are the various versions in those two different scenarios? Concern is going to the cul-de-sac. How does it connect? How does that impact the design of this road? Curb offsets. Kevin: We can provide the grading sketch for the interim and final conditions. Jim: would like to see more details than what has been provided. Yes, detailed later, but what grades are around turning and curb cuts, grades are really tight. Designing everything to the max. Don't know if lines up height-wise. If extends how does that impact? Kevin: property should be designed to the ultimate, not at curb today. A sketch will be provided to vet the grading details.	
Comment 7: *Given the area constraints, the existing and proposed grades, and the existing design within the 246 Arkell subdivision, please provide additional information on the proposed stormwater management for this area.* ***This information has not been provided to date. Please provide preliminary information on how SWM will be handled for Block 20, how that might differ from the previously approved SWM, and what the impacts are to the previously required SWM conditions.*** Kevin: Prelim SWM, change to hard surface, to achieve water balance. Jim: Block 20 needs to be considered. Existing subdivision set targets and design, if change for 1 block, that development had high infiltration rate, then how will that impact adjacent development. Not sure if Stantec wants to provide this information up front or if want to do it as part of an application. Difficult for City to provide specific feedback without the additional details if temporary access is supported. Kevin: Can we overcompensate on 220 to make up for any changes to 246 development? City hasn't discussed this option yet. Kevin: The temporary access will be a hard surface, water will shed quicker. Can we not compensate for that by throttling back the SWM design for 220? Leah: try to mimic the natural process as much as possible. Same broad location, where the water is discharged, need more time details and	Stantec to provide SWM rational of how the revised surface drainage will be addressed and targets maintained.

Item:	Action:
implication of that switch. Would Stantec have an opportunity to provide justification and rationale in an email? Kevin: Yes.	
Comment 8: *Currently the plan shows a storm sewer pipe located within the proposed park block and within the wetland buffer. All major servicing and utilities must be located outside of the park block and wetland buffer. (Although this comment is on an element outside of our current review scope, we felt it important to note, for your future subdivision design work.)* Kevin: in relation to the wetland the pipe is beyond 15 m setback but within 30 m. With respect to crossing the park, this is OK elsewhere, Sanitary Trunk Sewer along Eramosa River from Victoria Rd to the treatment plant crossing several parks. Jyoti: want full development potential as this is a small park. Don't want to be constrained by putting footings for a play structure. Kevin: 2 options, through park block, or servicing block bisecting the lots, takes away developable frontage and land. Some transition land, position sewer tucked up against the lot line, would that be acceptable to the City? Jyoti: will go back and talk with management about putting against lot lines. Jim: Easement may be required. Kevin: 1:1 slope at toe of the pipe? Mary: 1:1 is what is required. Can be up to face of the building: yes, not ideal. Nancy: Note lotting proposed with 0.6 m side yard setback. Kevin: any overlap with park block would be preferable. Mary: Major flows are going to the conservation easement. Will this be between homes? Kevin: Not between homes. In the ecological linkage. Want longest distance between inlet and outlet structures in SWM facility. Can the City investigate any concessions?	Stantec to provide sketch of proposed storm sewer and easement layout for City review and consideration. Jyoti to follow up with management regarding proposal of pipe placement and easement.
Comment 9: *The proposed temporary access road should be located outside of the proposed neighbourhood park block so as to not have any direct impact on construction timing of either the temporary road or park. To this end, please place the temporary emergency access road within a dedicated block, its width sized to accommodate the temporary road*	Stantec to provide an updated emergency access layout sketch based on items discussed.

Item:	Action:
and offsets to adjacent private property (based on the current layout, the block would be a minimum of 13m wide). The concern of the City is when will it be available?	
Comment 10: *City standard fencing will be required adjacent to the proposed/existing private properties. Additional fencing will be required adjacent to the temporary emergency access road where the grade slopes away from the road greater than 7% (ie. where 3:1 terracing is currently proposed sloping away from the road surface). Details on the required fencing will be discussed at a later stage of your subdivision submission, however please note required fencing on the resubmitted concept plans.* Jim: Looking for an acknowledgement on preliminary plans somewhere noted. Kevin: Yes. Is the City looking for Draft plan wording? Jim: No just on preliminary plans.	Stantec to provide an updated emergency access layout sketch showing locations of fencing.
Comments 11 and 12: *Note that the temporary access and trail alignment that extends beyond Block 20 must be reviewed comprehensively and supported by an Environmental Impact Study in the future (for 220 Arkell Rd subdivision).* *The Provincially Significant Wetland boundary and 30m buffer should be shown in proximity to the proposed temporary access to the bulb of Dawes Ave.* Kevin: Noted.	None
Comment 13: *Please include proposed location of erosion and sediment control measures on future submissions.* Kevin: Will be provided at detailed design. FSR will have commentary but will not be provided on plans. Jim/Mary have seen this approach before but that was when site alt came first.	None
Comment 14: *All grading and other associated works must remain outside the 15m setback from the Provincially Significant Wetland. This must be demonstrated on the grading plan.* Kevin: Yes this is the case.	None
General Summary of Comments and Discussion Kevin summarized action items for each group.	Action items noted above.

Item:	Action:
Leah: Ecological Linkage no pipe proposed within, overland flow will cross linkage to be directed into SWM. Jyoti: Sketch of proposed storm easement for review. Note theoretical pipe with depths, etc. Nancy: Assume this layout works. Can all lots be developed too the farthest east location? Kevin: 150 m beyond the access road to end of temporary cul-de-sac. Looks like can accommodate. Would that allow the multi-family block development? City: Haven't looked at. Traffic considerations. Would be connecting those lots. Mary: Would have to be able to see if can finish side yard of homes. More chance can support if not recreate side yard. Jim: Length of road to be finishing beyond the temporary bulb, show and will consider. Nancy: Put a holding zone on lots temporary impacted by bulb? Katie: likely Easement for the bulb. Holding is fair. Leah to send Melissa an email re: studies to date on the property.	Leah to respond to email from Melissa regarding corridor studies completed to date on the property.

The meeting adjourned at 12:15 PM

The foregoing is considered to be a true and accurate record of all items discussed. If any discrepancies or inconsistencies are noted, please contact the writer immediately.

Stantec Consulting Ltd.

Melissa Straus

Melissa Straus M.Sc.
Terrestrial Ecologist

Phone: (519) 780-8103
Fax: (519) 836-2493
Melissa.Straus@stantec.com

APPENDIX B3

ADDITIONAL CONSULTATION

From:	Brousseau, Kevin
To:	Jim.Hall@guelph.ca; Mary.Angelo@guelph.ca; Katie Nasswetter; "Jyoti Pathak"; Leah.Lefler@guelph.ca
Cc:	Carson Reid (carson@carsonreidhomes.com); Spencer Reid; Nancy Shoemaker; Straus, Melissa
Subject:	220 Arkell Guelph - Sept 10, 2018 Meeting Notes & Actions.
Date:	Tuesday, November 06, 2018 5:10:27 PM
Attachments:	Final Meeting Minutes.pdf 161413338_C-FB-Model.pdf Section A-A.pdf Section B-B.pdf Dawes Avenue Profile.pdf let_20181024_161413338_letter_to_city_taf_v1_collated.pdf

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Folks – Further to the above noted meeting, please find attached the following:

- Meeting minutes summarizing the items discussed and actions
- Updated concept plan addressing the items requested during the meeting as well as reflecting the adjacent wetland limits provided by NRSI.
- Section A-A profile of the interim and ultimate trail connection to Dawes Ave
- Section B-B profile of the storm sewer such to justify the easement width requirement.
- Dawes Ave profile utilized to justify the Temporary road/trail connection elevation.
- Response to City Stormwater Management Comments from July 19, 2018

We note the attached plan also confirms that the park layout meets the City's 5% parkland size being 0.31 hectares.

With the above provided, please review and confirm your general acceptance of the temporary emergency access strategy so we may proceed with finalizing our submission documents in support of Draft Plan Approval.

Please confirm.

Thank you.

Kevin Brousseau C.E.T.
Discipline Leader - Community Development

Direct: 519 585-7417
Mobile: 519 501-9367
Fax: 519 579-6733
kevin.brousseau@stantec.com

Stantec
100-300 Hagey Boulevard
Waterloo ON N2L 0A4 CA

From:	Jim Hall
To:	Brousseau, Kevin; Straus, Melissa; nshoemaker@jdbarnes.com; carson@carsonreidhomes.com; spencer@carsonreidhomes.com
Cc:	Leah Lefler; Jyoti Pathak; Katie Nasswetter; Mary Angelo
Subject:	RE: 220 Arkell Guelph - Sept 10, 2018 Meeting Notes & Actions.
Date:	Wednesday, January 23, 2019 11:19:26 AM

Hello Kevin, et.al,

City staff have reviewed the resubmitted documents in support of the proposed temporary emergency access road south from the lands, through Block 20 (part of the Arkell Meadows subdivision) to Dawes Avenue. We want to thank you for the time taken to prepare the information, as it has helped us as we considered this request.

Although we feel we don't have all of the information necessary to decide (see outstanding comments below), we recommend that you proceed with an application for Draft Plan of Subdivision, should that be the course of action desired by Carson Reid Homes. We strongly feel that, based on the comments we provided and the information you have provided to date, this is the best course of action that will help move this forward and put us in a position to give you a definitive answer. Some of the information we are looking for is better suited to the more detailed reports and plans that would typically accompany a draft plan application, and some of the discussions around the proposed temporary emergency access road would benefit from some of the higher-level review and discussions for the proposed subdivision.

To that end, I have appended an updated version of the preliminary comments previously provided, updated to reflect the most recent submission. Please use these as the various documents and plans are prepared for the draft plan application. If you have any questions about the comments, please feel free to contact me directly.

I hope this approach is acceptable to all; if you wish to meet to discuss it we would be happy to accommodate.

Sincerely,
Jim

Jim Hall, P.Eng. | Development and Infrastructure Engineer
Engineering and Transportation Services | City of Guelph
519-822-1260 x3514
jim.hall@guelph.ca
guelph.ca

Following up on your resubmission dated November 6, 2018, City staff met to discuss the revised

concept, and we offer the following for your future consideration as you prepare your application for Draft Plan of Subdivision:

The following comments, originally sent December 2017, remain in effect:

1. Staff scoped our review/discussion to just the temporary emergency road connection to Dawes Avenue and your proposal to use the existing City-owned Open Space Block fronting Dawes Avenue. We did not review the remainder of the plan, the remainder of the trail alignment, and don't feel it appropriate to respond to questions outside of this scope. Those items will need to be reviewed comprehensively with supporting impact assessment(s) as part of a complete submission package. **Any comments provided outside of this scope are provided for your convenience, and are subject to further review during the application stage.**

2. Staff Support would increase if the road and grading was shifted to the east as much as possible, with leaving a 3 m buffer from lot 12 to the toe of the new slope. This allows the wetland/woodland buffer to be maximized while still considering a temporary road alignment. Please include the approved grading for the Open Space Block, and the adjacent lots of this subdivision, and design the grading/servicing so that the objectives of the adjacent subdivision are not disrupted, and the area (including the Open Space Block and the lands to the north) is adequately and appropriately designed. Please take special note that the current design shows the proposed temporary road crossing an infiltration gallery and related structures; this will have to be redesigned accordingly. **Latest proposal does not appear to design for the objectives of the adjacent subdivision (infiltration requirements, drainage patterns, etc.). Additional details are required before staff can support the proposed temporary emergency access road.**

3. It should be noted that it is our expectation that the 10 m wide temporary road allowance would be restored to a 3m wide trail surface, at your client's sole expense, once the temporary access is no longer required. The 7 m restoration area should be planned on the west side and closer to the NHS and the restoration should include consideration for an alley of trees along the trail as well as other vegetation to stabilize, etc. **Please include a restoration plan to show the ultimate state of these lands once the temporary emergency access has been removed. Keep City standards for pathways and tree planting in mind while completing this design, and ensure that the restoration plan provided for Block 20 should (at a minimum) reflect the street tree plan for Arkell Meadows Subdivision in terms of number and variety of deciduous/coniferous trees and shrubs. Note that preference is given to indigenous species.**

4. The design must include provision for the extension of Dawes Avenue; please show the design under existing conditions (Dawes Ave. cul-de-sac) and with the extension in place. Please note the location of the existing fire hydrant, and the potential relocation of the hydrant when extending Dawes Avenue. **This information has not been submitted to date; please include these details in the Draft Plan application package.**

5. Given the area constraints, the existing and proposed grades, and the existing design within the 246 Arkell subdivision, please provide additional information on the proposed stormwater management for this area. **Preliminary information has been provided, but further details are required before staff can support the proposed temporary emergency access road. Please provide these details in the Draft Plan application package.**

The following comments, originally sent July 2018, remain in effect:

6. Currently the plan shows a storm sewer pipe located within the proposed park block and within the wetland buffer. All major servicing and utilities must be located outside of the park block and wetland buffer. (Although this comment is on an element outside of our current review scope, we felt it important to note, for your future subdivision design work.) **Parks staff have reconfirmed that, in accordance with Section C (ii) of the Local**

Servicing Policy, the park block must be free and clear of all encumbrances, and Parks would not support including an easement within the park block.

7. The proposed temporary access road should be located outside of the proposed neighbourhood park block so as to not have any direct impact on construction timing of either the temporary road or park. To this end, please place the temporary emergency access road within a dedicated block, its width sized to accommodate the temporary road and offsets to adjacent private property (based on the current layout, the block would be a minimum of 13m wide). **Resubmitted plans show this; comment remains as a reminder as you prepare the draft plan.**

8. City standard fencing will be required adjacent to the proposed/existing private properties. Additional fencing will be required adjacent to the temporary emergency access road where the grade slopes away from the road greater than 7% (ie. where 3:1 terracing is currently proposed sloping away from the road surface). Details on the required fencing will be discussed at a later stage of your subdivision submission, however please note required fencing on the resubmitted concept plans. **Further details of the required fencing will be discussed during engineering review of the application package.**

9. Note that the temporary access and trail alignment that extends beyond Block 20 must be reviewed comprehensively and supported by an Environmental Impact Study in the future (for 220 Arkell Rd subdivision). **Note that the EIS must include a policy analysis to demonstrate conformity with Official Plan policies.**

10. All grading and other associated works must remain outside the 15m setback from the Provincially Significant Wetland. This must be demonstrated on the grading plan. **The level of detail provided in the conceptual grading plan is insufficient to determine whether or not the proposed temporary access road can be constructed without impinging upon the 15m buffer. For example, at the northwest corner of Lot 20, it appears that grading is proposed right up to the 15m buffer and possibly extends into the 15m buffer. It is essential that adequate detail be provided to enable a proper assessment. If it is not possible to achieve the temporary access road outside of the 15m buffer, an Official Plan Amendment would be required.**

11. Note that the temporary access and trail alignment that extends beyond Block 20 must be reviewed comprehensively and supported by an Environmental Impact Study in the future (for 220 Arkell Rd subdivision). **Environmental planning staff emphasize that the proposed temporary access and trail alignment extending beyond Block 20 must be reviewed comprehensively and supported by an Environmental Impact Study as part of a future 220 Arkell Road subdivision application. At a cursory level, environmental planning staff are concerned with the extent of development and site alteration proposed within the minimum buffer of the Provincially Significant Wetland. Please review permitted use policies 4.1.2.1 and 4.1.3.4.6 in the Official Plan.**

The following additional comments are provided based on our review of the resubmitted material:

12. Other Wetlands - City staff requested that the limit of the small wetland pocket located to the east of the existing driveway be shown on the plans (refer to Comment 4 of September 10, 2018 meeting notes). Please revise the plans to include this information

13. Future Road Connection to Dawes Avenue - Section B-B should include the Provincially Significant Wetland limit, minimum 30m buffer and 15m buffer to enable a preliminary assessment of potential environmental impacts.

14. Changes to Water Balance and Wetland Hydrology - The response to storm water management comments raised by City staff (July 19, 2018) states that a runoff increase of 1 mm/year (4%) is anticipated (i.e. increased from 24 mm/year under current conditions to 25 mm/year under proposed conditions). Environmental planning staff note

that the pre-development runoff rate was 17 mm/year. Therefore, a 47% increase in runoff from pre-development conditions is anticipated. Please provide an assessment of potential impacts to wetland hydrology. The response to stormwater management comments raised by City staff states that in the event of overflows from the Arkell Meadows Subdivision, a culvert under the temporary access road would convey water away from the existing subdivision and towards the wetland. Environmental planning are concerned that this may result in a negative impact to the natural heritage system and hydrologic function of the Provincially Significant Wetland. Additional information is required to enable a proper assessment.

15. The design and construction of the trail shall meet the accessibility criteria outlined in the City's Facility Accessibility Design Manual (FADM). The criteria includes maximum running slope on trails to be 5% and the maximum cross slope on trails to be 2%. The trails need to be designed to include minimum 0.6 m. wide mowed grass strips, having a cross slope of 2% away from the trail, longitudinally along both sides of the trail surface. Section 4.5.2 OUTDOOR RECREATIONAL FACILITIES of the FADM outlines the accessibility guidelines for trails. This document can be viewed at the following link: http://guelph.ca/wpcontent/uploads/Guelph_FADM_2015-06-30-FINAL.pdf

16. Conceptual Park Block Grading - Currently park block grades include slopes ranging between 3.6% – 4.9%. City's Official Plan Policy 7.3.2.4 (v) outlines a criterion that the neighbourhood park site contain sufficient table land (approximately 80 per cent of site). Park block layout and grading would need to be revised to be consistent with the policy 7.3.2.4 (v) of the Official Plan regarding table land for a neighbourhood park to be 80% of the site and the local service policy as mentioned above.

From: Leah.Lefler@guelph.ca
To: Straus, Melissa
Subject: RE: 220 Arkell Pitfall Studies - Spring Surveys Complete
Date: Tuesday, August 21, 2018 10:38:05 AM

Hi Melissa,

I have been assigned to the 220 Arkell Road file and will be your contact for environmental planning moving forward. I have had an opportunity to review background information provided in the EIS TOR and email correspondence. Corridor studies within the east-west hedgerow located along the northern property boundary were to occur in March/April of 2018. Based on your email sent to Adele on May 14, 2018, these surveys were completed between March and May, due to unusual spring conditions.

I note that the purpose of the corridor study is to inform wildlife culvert design by providing target species or faunal groups for passage (e.g., amphibians and/or small mammals). Do you feel that data collected through the corridor study is sufficient to inform the wildlife culvert design? Please clarify whether or not sufficient data have been collected to inform the wildlife culvert design by providing a data summary table (date, species, abundance). This can be done very informally in an email.

Once I have had the opportunity to review the data summary table, I will be in a better position to determine whether or not the intent of the corridor study has been met.

Regards,
Leah

Leah Lefler | Environmental Planner
Planning, Urban Design and Building Services | **Infrastructure, Development and Enterprise**
City of Guelph
T 519-822-1260 x 2362 | F 519-837-5640
leah.lefler@guelph.ca

From: Straus, Melissa <Melissa.Straus@stantec.com>
Sent: August 17, 2018 6:18 PM
To: April Nix <April.Nix@guelph.ca>
Cc: Vleeming, John <John.Vleeming@stantec.com>
Subject: 220 Arkell Pitfall Studies - Spring Surveys Complete

Good afternoon April,

I am emailing to see if you are taking over the file for 220 Arkell Road (Stantec project number 161413338). I am looking to follow up on some unanswered questions in Adele's absence, namely if we are required to do any additional pitfall surveys this fall. We conducted surveys last fall, but had some issues getting started due to permitting delays and weather. However, we were able to get a decent amount of data, which was enhanced by conducting surveys in the spring, which was not included in our approved Terms of Reference. I understand there will be a meeting with the City in September, but wanted to give a chance to whoever is taking the file over to get up to speed and think about what was presented to Adele but never finalized, which you can find below. It is our opinion we have met the corridor study requirements, but prior to removing the pitfall traps on site, which we would really like to do as it is preventing movement currently, we would like confirmation that no additional surveys are required.

Thank you very much for your time,

Melissa Straus M.Sc.
Terrestrial Ecologist

Direct: 519 780-8103
Mobile: 226 971-2704
Fax: 519 836-2493
Melissa.Straus@stantec.com

Stantec
1-70 Southgate Drive
Guelph ON N1G 4P5 CA

From: Straus, Melissa
Sent: Monday, May 14, 2018 2:37 PM
To: 'Adele.Labbe@guelph.ca' <Adele.Labbe@guelph.ca>
Cc: Vleeming, John <John.Vleeming@stantec.com>
Subject: 220 Arkell Pitfall Studies - Spring Surveys Complete

Good afternoon Adèle,

As requested by the City in fall 2017, Stantec has completed the spring 2018 corridor monitoring studies at 220 Arkell Road. We relied on local amphibian movement reports to trigger survey commencement. Protocol detailed, and approved, for the fall monitoring program in the Terms of Reference were followed, comprised of (generally) 2 surveys per week for 4 weeks, for a total of 8 surveys. Due to the fragmented spring (ice storm in mid-April), surveys were not conducted that week and instead surveys were conducted only under optimal weather conditions. Spring optimal weather conditions were defined as wet evenings with temperatures >5C, as use of the fall movement temperature is not appropriate. 5C is consistent with the Marsh Monitoring Protocol for the month of April. All surveys were conducted during suitable evenings.

Date	Weather Conditions
March 30, 2018	Temp: 0C Wind (Beaufort): 2 Cloud Cover: 100 Precipitation During Survey: 0 Precipitation in last 24 hours: Rain
April 4, 2018	Temp: 3C Wind (Beaufort): 5 Cloud Cover: 100 Precipitation During Survey: 0 Precipitation in last 24 hours: 15 mm rain
April 14 2018	Temp: 2C Wind (Beaufort): 1 Cloud Cover: 100% Precipitation During Survey: Light rain Precipitation in last 24 hours: Light rain
April 28, 2018	Temp: 5C Wind (Beaufort): 0-1 Cloud Cover: 100% Precipitation During Survey: 0

	Precipitation in last 24 hours: Rain
May 3, 2018	Temp: 17C Wind (Beaufort): 3 Cloud Cover: 90% Precipitation During Survey: 0 Precipitation in last 24 hours: Rain
May 4, 2018	Temp: 12C Wind (Beaufort): 4 Cloud Cover: 100% Precipitation During Survey: Rain Precipitation in last 24 hours: Rain
May 9, 2018	Temp: 24C Wind (Beaufort): 0-1 Cloud Cover: None Precipitation During Survey: 0 Precipitation in last 24 hours: Rain
May 10, 2018	Temp: 16C Wind (Beaufort): 2 Cloud Cover: 100% Precipitation During Survey: 0 Precipitation in last 24 hours: Rain

Based on our studies and local movement reports, amphibians began moving late March/early April then stalled due to the ice storm (April 14-15) then resumed with a flurry of activity after the snow/ice melted again and temperatures warmed up 1.5-2 weeks later. We are confident that our spring surveys adequately captured the 2018 spring amphibian movement period at 220 Arkell.

Please confirm that these spring movement surveys satisfy the last of the field surveys to be conducted in support of the 220 Arkell Road EIS.

Thank you very much,

Melissa Straus
M.Sc.
Terrestrial Ecologist

Direct: (519) 780-8103
Mobile: (226) 971-2704
Fax: (519) 836-2493

Stantec Consulting Ltd.
1-70 Southgate Drive
Guelph ON N1G 4P5 CA

From:	Leah.Lefler@guelph.ca
To:	Straus, Melissa
Cc:	Brousseau, Kevin; Vleeming, John
Subject:	RE: 220 Arkell Pitfall Studies - Spring Surveys Complete
Date:	Wednesday, September 12, 2018 12:13:50 PM

Hi Melissa,

Thank you very much for providing this description. I am confident that the studies completed to date adequately address field survey requirements for the corridor study.

Thanks for checking in about this. We are on the same page for sure.

Thanks,
Leah

Leah Lefler | Environmental Planner
Planning, Urban Design and Building Services | **Infrastructure, Development and Enterprise**
City of Guelph
T 519-822-1260 x 2362 | F 519-837-5640
leah.lefler@guelph.ca

From: Straus, Melissa [mailto:Melissa.Straus@stantec.com]
Sent: Wednesday, September 5, 2018 10:27 AM
To: Leah Lefler <Leah.Lefler@guelph.ca>
Cc: Brousseau, Kevin <kevin.brousseau@stantec.com>; Vleeming, John <John.Vleeming@stantec.com>
Subject: RE: 220 Arkell Pitfall Studies - Spring Surveys Complete

Good morning Leah,

Thank you for your response.

To provide a bit more background on the corridor studies at 220 Arkell Road, field surveys were completed in August/September of 2017, in accordance with the approved EIS Terms of Reference (attached for you). Due to a delay in securement of a Wildlife Scientific Collector's Permit from the Ministry of Natural Resources and Forestry (10 weeks total) we were unable to start the studies in mid-July (as per the ToR) but instead they began mid-August. We consulted with the City to confirm that the survey results with the later start dates would be accepted and obtained initial approval (phone call with Adele Labbe on August 1, 2017). However, subsequent comments from the City in the fall of 2017 requested additional spring 2018 surveys (correspondence attached).

Results in 2017 (attached) showed that amphibians (specifically frogs and toads) and small mammals are using the area. The 2018 results (attached) further support these results.

We also conducted corridor use studies with trail cameras, placed at the north and southern ends of the property. Although not relevant to wildlife culvert design, photos have captured a coyote and numerous white-tailed deer using the property. These results will also be incorporated into the EIS and inform at grade wildlife crossing(s).

Stantec does not recommend any additional corridor surveys at 220 Arkell to support the EIS and wildlife culvert design. Amphibians and small mammals are the typical target groups for wildlife culvert design on

developments in the City. The results of the 2017 and subsequent 2018 studies have confirmed these are the wildlife groups moving through the subject property and therefore the target wildlife groups for culvert design. Further studies are not expected to provide any additional insight. Furthermore, small mammals do not fair well during these studies. Despite approved animal care protocols and additional measures taken to avoid mortalities such as providing a food source in the buckets, small mammal mortality appears unavoidable when conducting such pitfall studies. With this in mind, we typically suggest pitfall studies be kept to the minimal effort required to confirm use of an area.

Thank you very much for your time and let me know if you have any questions.

Sincerely,

Melissa Straus M.Sc.
Terrestrial Ecologist

Direct: 519 780-8103
Mobile: 226 971-2704
Fax: 519 836-2493
Melissa.Straus@stantec.com

Stantec
1-70 Southgate Drive
Guelph ON N1G 4P5 CA

From: Leah.Lefler@guelph.ca <Leah.Lefler@guelph.ca>
Sent: Tuesday, August 21, 2018 10:37 AM
To: Straus, Melissa <Melissa.Straus@stantec.com>
Subject: RE: 220 Arkell Pitfall Studies - Spring Surveys Complete

Hi Melissa,

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Once I have had the opportunity to review the data summary table, I will be in a better position to determine whether or not the intent of the corridor study has been met.

Regards,

Leah

Leah Lefler | Environmental Planner
Planning, Urban Design and Building Services | **Infrastructure, Development and Enterprise**
City of Guelph
T 519-822-1260 x 2362 | F 519-837-5640
leah.lefler@guelph.ca

From: Straus, Melissa <Melissa.Straus@stantec.com>
Sent: August 17, 2018 6:18 PM
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Cc: Vleeming, John <John.Vleeming@stantec.com>
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Thank you very much for your time,

Melissa Straus M.Sc.
Terrestrial Ecologist

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Mobile: 226 971-2704
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Stantec
1-70 Southgate Drive
Guelph ON N1G 4P5 CA

From: Straus, Melissa
Sent: Monday, May 14, 2018 2:37 PM
To: 'Adele.Labbe@guelph.ca' <Adele.Labbe@guelph.ca>
Cc: Vleeming, John <John.Vleeming@stantec.com>
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Good afternoon Adèle,

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Please confirm that these spring movement surveys satisfy the last of the field surveys to be conducted in support of the 220 Arkell Road EIS.

Thank you very much,

Melissa Straus
M.Sc.
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APPENDIX B4

GRCA

From:	Straus, Melissa
To:	Nathan Garland <ngarland@grandriver.ca> (ngarland@grandriver.ca)
Cc:	Brousseau, Kevin
Subject:	220 Arkell
Date:	Monday, November 28, 2016 3:47:00 PM
Attachments:	161413338_EIS_Fig02_Natural_Env.pdf 20161005112847.pdf

---

Hello Nathan,

Just a follow-up to my voicemail.

Just wanted to touch base regarding the wetland delineation conducted on November 1 at 220 Arkell.

I have provided the concept for the property presented at the pre-consultation meeting, as well as the preliminary wetland boundary as was delineated onsite.

Please give me a call to discuss at your earliest convenience.

Sincerely,

Melissa Straus, M.Sc.
Terrestrial Ecologist
Stantec
1-70 Southgate Drive Guelph ON N1G 4P5
Phone: (519) 780-8103
Cell: (226) 971-2704
Fax: (519) 836-2493
Melissa.Straus@stantec.com

From:	Straus, Melissa
To:	Nathan Garland <ngarland@grandriver.ca> (ngarland@grandriver.ca)
Cc:	Brousseau, Kevin
Subject:	220 Arkell Road Wetland Boundary Layer
Date:	Wednesday, June 14, 2017 2:42:00 PM
Attachments:	Wetland_Delineation_2017.shx

Good afternoon Nathan,

Please find the wetland delineation for 220 Arkell Road attached for your records. If you need this in CAD please let me know.

Sincerely,

Melissa Straus, M.Sc.
Terrestrial Ecologist
Stantec
1-70 Southgate Drive, Guelph ON N1G 4P5
Phone: (519) 780-8103
Cell: (226) 971-2704
Melissa.Straus@stantec.com

From:	Nathan Garland
To:	Straus, Melissa; Chris.DeVriendt@guelph.ca; "Adele.Labbe@guelph.ca"
Cc:	Nancy; Brousseau, Kevin; Vleeming, John; Ball, Janice; Carson Reid
Subject:	RE: 220 Arkell revised ToR
Date:	Tuesday, July 18, 2017 4:24:24 PM

Hello Melissa,

GRCA has no concerns to the ToR supplied.

The only note we would add was the Wetland boundary review should be updated to reference the Spring 2017 date it doesn't affect the scope of work so this can be referenced in the EIS.

Regards,

Nathan Garland
Resource Planner
Grand River Conservation Authority
ngarland@grandriver.ca
Direct Line: 519.621.2763 x 2236
Office: 1.866.900.4722
Fax: 519.621.4945

From: Straus, Melissa [mailto:Melissa.Straus@stantec.com]
Sent: July 11, 2017 5:43 PM
To: Chris.DeVriendt@guelph.ca; 'Adele.Labbe@guelph.ca'; Nathan Garland
Cc: Nancy; Brousseau, Kevin; Vleeming, John; Ball, Janice; Carson Reid
Subject: 220 Arkell revised ToR

Good afternoon,

Please find attached the revised Terms of Reference for the proposed 220 Arkell Road development.

The development plan is continuing to evolve as we work through the process, but the field program is well underway with the exception of the corridor pit fall studies. We are currently waiting for a Wildlife Collector Permit from the Ministry of Natural Resources and Forestry.

Please contact me if you have any questions.

Sincerely,

Melissa Straus, M.Sc.
Terrestrial Ecologist
Stantec
1-70 Southgate Drive, Guelph ON N1G 4P5
Phone: (519) 780-8103
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Melissa.Straus@stantec.com

APPENDIX C
Terms of Reference

From: Adele.Labbe@guelph.ca
To: Straus, Melissa; Chris.DeVriendt@guelph.ca; ngarland@grandriver.ca
Cc: Nancy@bsrd.com; Brousseau, Kevin; Vleeming, John; Ball, Janice; carson@carsonreidhomes.com
Subject: RE: 220 Arkell revised ToR
Date: Thursday, August 17, 2017 11:00:40 AM

Hi Melissa,
3-6 surveys in the winter months would be satisfactory. Should stick nests be observed, they should be surveyed during early spring to confirm species use and breeding evidence. The policy that would apply would be under Habitat for Significant Species and would depend upon the species. Findings may also inform the mitigation recommendations.
I'm happy to discuss further. Thanks,
Adèle

From: Straus, Melissa [mailto:Melissa.Straus@stantec.com]
Sent: August 14, 2017 4:01 PM
To: Adele Labbe; Chris DeVriendt; ngarland@grandriver.ca
Cc: Nancy@bsrd.com; Brousseau, Kevin; Vleeming, John; Ball, Janice; carson@carsonreidhomes.com
Subject: RE: 220 Arkell revised ToR
Good afternoon Adèle,
I can confirm that we can add incorporate your comments detailed below.
My only question is regarding #3 below. It is not clear to me what criteria we should use to determine local significance for winter raptor habitat at 220 Arkell. The EIS guidelines for City of Guelph does not describe how to assess winter raptor habitat. From a field survey perspective, based on our experience with winter raptor habitat in general I would suggest 3-6 surveys December-February. Then the question becomes what results would then deem something to be locally significant? And if it was, what policy of the Official Plan would apply? It's not Significant Wildlife Habitat, it isn't Habitat for Significant Species (that's under the assumption Red-tailed Hawk would be the main species in the area), and the pasture is not a natural area. We can discuss this between now and December to finalize study design and criteria for designation and applicable policies.
Thank you very much for your input.
Sincerely,
Melissa Straus, M.Sc.
Terrestrial Ecologist
Stantec
1-70 Southgate Drive, Guelph ON N1G 4P5
Phone: (519) 780-8103
Cell: (226) 971-2704
Melissa.Straus@stantec.com

From: Adele.Labbe@guelph.ca [mailto:Adele.Labbe@guelph.ca]
Sent: Wednesday, August 02, 2017 10:05 AM
To: Straus, Melissa <Melissa.Straus@stantec.com>; Chris.DeVriendt@guelph.ca; ngarland@grandriver.ca
Cc: Nancy@bsrd.com; Brousseau, Kevin <kevin.brousseau@stantec.com>; Vleeming, John <John.Vleeming@stantec.com>; Ball, Janice <Janice.Ball@stantec.com>; carson@carsonreidhomes.com
Subject: RE: 220 Arkell revised ToR
HI Melissa,

I've reviewed the resubmitted EIS TOR in context of our previous comments and have the following comments:

1. The City's Guidelines for the Preparation of an EIS do speak to evaluating locally significant species as part of "Habitat for Significant Species", which is a Natural Area Designation specific to local species. However, based on your TOR I gather we could make that clearer in future versions.
2. The camera work for the corridor study –it seems the west side of the site (near the swamp) won't be covered by the cameras and as such we suggest additional cameras at that end of the site.
3. Raptor wintering areas: I understand that the patch sizes may not be large enough to meet provincial criteria, however there may be local significance should raptors be wintering in the area. There is evidence that suggests that raptors are using this feature in the winter and as such we would like to see winter surveys to assess raptor wintering as part of the EIS. Note that NRSI is undertaking similar surveys for their site which is next door.
4. Raptor nesting surveys: The nest surveys should be undertaken in leaf off conditions. Should stick nests be observed, confirmation of breeding activity would need to be undertaken earlier than the Forest breeding bird timing window as may raptors nest in early spring.
5. Trails: existing footpaths need be mapped (if any).
6. Buffer anlaysis: The EIS TOR indicates that a buffer analysis will involve consideration of expanded buffers, however I want to flag that the buffer analysis should also defend the recommended buffer even if it is in keeping with the policy directed minimum.
7. Add the Torrance Creek Subwatershed Study to the Background Review.

Please confirm by way of reply to this email that the above will be incorporated into the EIS so that I can sign off on the TOR.

Thanks,

Adèle

From: Straus, Melissa [mailto:Melissa.Straus@stantec.com]

Sent: July 11, 2017 5:43 PM

To: Chris DeVriendt; Adele Labbe; Nathan Garland <ngarland@grandriver.ca> (ngarland@grandriver.ca)

Cc: Nancy; Brousseau, Kevin; Vleeming, John; Ball, Janice; Carson Reid

Subject: 220 Arkell revised ToR

Good afternoon,

Please find attached the revised Terms of Reference for the proposed 220 Arkell Road development.

The development plan is continuing to evolve as we work through the process, but the field program is well underway with the exception of the corridor pit fall studies. We are currently waiting for a Wildlife Collector Permit from the Ministry of Natural Resources and Forestry.

Please contact me if you have any questions.

Sincerely,

Melissa Straus, M.Sc.
Terrestrial Ecologist
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Melissa.Straus@stantec.com

Stantec Consulting Ltd.
1-70 Southgate Dr., Guelph, ON N1G 4P5

July 11, 2017
File: 161413338

Attention: Adèle Labbé
Environmental Planner
City of Guleph
1 Carden Street
Guelph, ON N1H 3A1

Dear Ms. Labbé:

Reference: 220 Arkell Road, Guelph – Scoped Environmental Impact Study Terms of Reference

Stantec Consulting Ltd. has been retained by Carson Reid Homes to prepare an Environmental Impact Study (EIS) in support of a draft Plan of Subdivision application and a Zoning By-law Amendment application to permit the development of single-detached residential and townhouse dwellings at 220 Arkell Road. The Subject Property is approximately 7 ha, and is currently occupied by a single residence, manicured lawn, scattered planted trees, hedgerows, and a horse pasture, and surrounded by hedgerows and the Torrance Creek Swamp Provincially Significant Wetland (PSW). The Subject Property is located south of the Victoria Park Village (VPV) development currently under construction, north of the recently constructed 246 Arkell Road subdivision, east of the Torrance Creek Swamp PSW, and west of active agricultural lands.

The consolidated City of Guelph Official Plan identifies the Torrance Creek Swamp PSW and a portion of the adjacent hedgerows as Significant Natural Areas. The remainder of the hedgerows along the northern boundary of the Subject Property are identified as Ecological Linkages. Approximately half of the Subject Property is located within the GRCA regulation limit.

Based on a preliminary review of the proposed application at a Development Review Committee Meeting, on October 5, 2016, the City of Guelph requires the preparation of an EIS in support of a Draft Plan of Subdivision application and Zoning By-law Amendment application, since the Subject Property is within 120 m of a Significant Natural Area. EIS requirements are determined by Section 6A.7 of the City of Guelph's Official Plan as revised by OPA 42. Consistent with these requirements, the EIS will characterize the Study Area and assess the potential impacts of the proposed development on the natural heritage features and ecological functions of the Subject Property and adjacent lands, with particular consideration given to the Torrance Creek Swamp PSW. The EIS will also identify a monitoring program and adaptive management procedures.

A terrestrial site investigation was undertaken on September 23, 2016 to determine the extent of vegetation communities on site, and to conduct a fall botanical inventory and a wildlife habitat assessment. The boundary of the PSW was delineated with Robert Messier from the GRCA on November 1, 2016, but due to the lack of vegetation late in the season, it was revisited in June 2017.

A draft terms of reference was presented at the May 10, 2017 Environmental Advisory Committee (EAC) and was conditionally supported. The attached Terms of Reference (ToR) is a resubmission

Reference: 220 Arkell Road, Guelph – Scoped Environmental Impact Study Terms of Reference

of the original ToR and is based on our understanding of the work required to complete an EIS to address natural heritage policies of the City of Guelph official plan within the context of the current regulatory and policy framework. The proposed field program was developed with input from the City of Guelph during the Development Review meeting on October 5, 2016, follow up consultation on March 13, 2017 (meeting at City Hall) and May 31, 2017 (via phone) as well as comments received in the May 10, 2017 Staff report and at EAC.

Please circulate the following to the appropriate City of Guelph and Grand River Conservation Authority (GRCA) staff for their review and comment. In addition, please include consideration of the proposed ToR on the agenda of the Environmental Advisory Committee (EAC) at your earliest convenience.

Regards,

STANTEC CONSULTING LTD.

Janice Ball, B.Sc.
Terrestrial Ecologist
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Fax: (519) 836-2493
Melissa.Straus@stantec.com

Attachment: 220 Arkell, Guelph – Environmental Impact Study Terms of Reference

c. Chris DeVriendt, City of Guelph
Nathan Garland, Grand River Conservation Authority
Carson Reid, Carson Reid Homes
Nancy Shoemaker, BSRD
Kevin Brousseau, Stantec Consulting Ltd.
John Vleeming, Stantec Consulting Ltd.

220 Arkell Road, Guelph

Environmental Impact Study Terms of Reference

Prepared for:
Carson Reid Homes
183 Dufferin St.
Guelph, ON N1H 4B3

Prepared by:
Stantec Consulting Ltd.
1-70 Southgate Dr.
Guelph, ON N1G 4P5

File: 161413338

July 11, 2017

Version 2

Table of Contents

1 Introduction

The introduction will provide the location of the development, and describe the current and historical land uses for the Subject Property and surrounding landscape.

Draft Plan of Subdivision and Zoning By-Law Amendment applications are proposed for 220 Arkell Street, in the City of Guelph, Ontario. The Subject Property is approximately 7.05 ha that is currently occupied by a single residence, manicured lawn, scattered planted trees, hedgerows, and a horse pasture, and surrounded by hedgerows and the Torrance Creek Swamp Provincially Significant Wetland (PSW). The Subject Property is located south of the Victoria Park Village (VPV) development currently under construction, north of 246 Arkell Road subdivision, east of the Torrance Creek Swamp PSW, and west of active agricultural lands, as shown on **Figure 1** (attached).

The Study Area includes those lands within 120 m of the Subject Property, as shown on **Figure 2** (attached).

1.1 Proposed Development

This section will outline the proposed development concept including but not limited to details on density, land uses, servicing infrastructure, stormwater management (SWM) and public trails/parks.

While at this time the development proposal is being refined, generally, the client, Carson Reid Homes, proposes to develop single-detached residential and townhouse units as shown on **Figure 3** (attached).

1.2 Designated Natural Heritage Features

This section will describe the designated natural heritage features in the Study Area as defined in the City of Guelph Official Plan (OP), Ministry of Natural Resources and Forestry (MNRF) Land Information Ontario Mapping (LIO) and Grand River Conservation Authority (GRCA) mapping.

The City of Guelph Official Plan (No. 42) identifies components of the Natural Heritage System within the Study Area. Specifically, the Torrance Creek Swamp PSW, and a portion of the adjacent hedgerows are part of the City's Natural Heritage System and Significant Natural Areas on the Subject Property.

The Torrance Creek Swamp PSW is identified as a significant wetland, significant woodland and significant wildlife habitat (SWH). A portion of the northern (east-west) and north-south hedgerows are identified as significant woodlands. The remainder of the hedgerow along the northern boundary of the Subject Property are identified as Ecological Linkages.

The Subject Property is located within 120 m of a wetland that is regulated by the Grand River Conservation Authority Ont. Reg. 150/06, as shown on **Figure 2** (attached).

2 Planning Context

The subject site is designated as General Residential in the City of Guelph Official Plan and zoned under the Township of Puslinch by-law. The development proposal is for a mixed density residential development with a zone change that will include appropriate zoning for the residential forms included in the plan as well as park, open space, and stormwater management areas.

Plans and policies relating to natural heritage that will be considered include:

- Provincial Policy Statement (2014)
- City of Guelph Official Plan (consolidated 2014)
- City of Guelph Zoning By-law (1995, 2016)
- Township of Puslinch Zoning By-law (1985)
- City of Guelph Tree By-law (2010-19058)
- Guelph Trail Master Plan (City of Guelph, 2005)
- Urban Forest Management Plan (City of Guelph, 2016)
- Ontario Regulation 150/06 (Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation)
- Natural Heritage Reference Manual (MNRF, 2010)
- Significant Wildlife Habitat Technical Guide (MNRF, 2000)
- Significant Wildlife Habitat Criteria Schedules for EcoRegion 6E (MNRF, 2015)
- Endangered Species Act (2007).

3 Background Review

3.1 Background Data Collection

A background review of the following sources will be completed including, but not limited to:

- Current and Historical Aerial Photography
- Natural Heritage Information Centre (NHIC) database
- Guelph Natural Heritage Strategy (Dougan, 2009)
- GRCA mapping and additional background information
- Land Information Ontario (LIO) Mapping (2015)
- Ministry of Natural Resources and Forestry (MNRF) will be contacted to obtain additional information (where available), including potential records of Species at Risk (SAR)
- Atlas of Breeding Birds of Ontario (Cadman et al., 2007) and ebird
- Atlas of the Mammals of Ontario (Dobbyn, 1994)
- Ontario Reptile and Amphibian Atlas (Ontario Nature, 2016)
- The Physiography of Southern Ontario, 3rd Ed. (Chapman and Putnam, 1984)
- EIS reports from adjacent lands, if available.

4 Characterizing the Natural Environment – Approach and Methods

This section will describe the study area's biological and physical features and functions based on background review collected from secondary sources, consultation with agencies, and field investigations.

4.1 Physiography, Soils, Hydrology and Natural Hazards

A geotechnical study, hydrogeology report, stormwater report, and landscape plans will be completed for the Subject Property.

The following physical and hydrological features of the Study Area will be briefly described:

- identification of physiographic region, overburden and bedrock geology
- topography
- soil types and drainage characteristics
- areas of groundwater recharge and discharge
- surface water features
- catchment areas

4.2 Terrestrial Field Investigation Methods

The following site-specific field investigations are proposed to characterize the extent and function of the natural heritage features within the study area:

Field Investigation	Timing
Fall Botanical Inventory	Completed by J. Ball September 23, 2016
Spring Botanical Inventory	Completed by J. Ball May 9, 2017
Summer Botanical Inventory	July 2017
Woodland Delineation	To be determined with City of Guelph
Tree Inventory	Spring/Summer 2017
Wetland Delineation	Site visit conducted with GRCA November 1, 2016; to be revisited in Spring 2017
Ecological Lands Classification	Preliminary assessment September 23, 2016, to be confirmed in 2017
Amphibian Surveys	April/May/June 2017
Bat Roost Habitat Assessment	Completed by J. Ball April 25, 2017
Crepuscular Surveys	June 2017
Snake Area Searches	June and July 2017
Corridor Studies (pit fall traps)	mid-July to mid-August 2017
Breeding Bird Surveys	June 2017
Bat Exit Surveys	2018/2019
Raptor Nest Surveys	Completed by J. Ball May 9, 2017 (leaf-off), June 2017
Corridor Studies (fall deer movement)	November-January 2017-2018
Wildlife Habitat Assessment, including Habitat Assessment for Species at Risk (SAR), species of conservation concern	Preliminary assessment September 23, 2016, to be confirmed in 2017

Field Investigation	Timing
(S1-S3, Special Concern), and locally rare species.	
Incidental Wildlife Observations	During each site visit
Hazard Tree Assessment	During the Environmental Implementation Report Stage (2018/2019)

Field surveys will be conducted where access has been granted. Where access is not available, alternate site investigations will be conducted using observations recorded from the property boundary. The field information collected from review and approval agencies will be used to characterize the natural features and ecological functions within the Study Area.

4.2.1 VEGETATION

Vegetation surveys began in fall 2016 and will be updated and confirmed in 2017. Survey methods are detailed below.

4.2.1.1 Tree Preservation Plan

A detailed tree inventory of trees on site and will be completed, with details provided on:

- identifier
- tree species (common and scientific name)
- diameter at breast height
- condition and health,
- ownership, and
- fate (e.g., retain, transplant, or remove).

The tree inventory and preservation plan will include tree protection fencing details as per City Standard SD-90a Part B Contract Specifications 2016 and a preliminary hazard assessment within 30 m of future-City owned lands. The hazard tree assessment finalized during the Environmental Implementation Report (EIR) stage in 2018/2019 as tree status can change rapidly over time, particularly as new diseases occur.

4.2.1.2 Vegetation Communities

A terrestrial site investigation was undertaken on September 23, 2016 to determine the extent of vegetation communities on site, and to conduct a fall botanical inventory. The survey work included vegetation community classification as per the Ecological Land Classification system (ELC) for southern Ontario (Lee et at., 1998; updated 2008). Preliminary ELC mapping is shown on **Figure 4.**

ELC vegetation communities, including soils information, will be confirmed and refined to Ecosite during the spring and summer botanical inventories in May and July 2017. Provincial significance of vegetation communities will be based on rankings assigned by the NHIC, 2010.

4.2.1.3 Vascular Plants

A fall botanical inventory was completed on September 23, 2016. Two additional botanical inventories will be conducted in May 2017 (spring) and July 2017 (summer). Flora nomenclature will be generally based on the Ontario Plant List (Newmaster et al. 1998). The provincial status of

all plant species will be based on Newmaster et. al (1998). Identification of potentially sensitive native plant species will be based on their assigned coefficient of conservatism (C) value, as determined by Oldham et al. (1995).

Rarity will be based on provincial S-Ranks assigned by the NHIC as well as the City of Guelph Locally Significant Species List (2012).

4.2.1.4 Wetland Delineation

The onsite delineation of the eastern boundary of the Torrance Creek Swamp PSW occurred with City of Guelph, Stantec Consulting Ltd. and GRCA on November 1, 2016. The final wetland boundary delineation is undergoing consultation with the GRCA. A review of the wetland delineation will be completed with GRCA to revisit the boundary of the wetland in the southern portion of the property where it is coincident with an active pasture.

4.2.1.5 Woodland Delineation

The boundaries of the significant woodland will be staked onsite with the City of Guelph, following the applicable procedures outlined in the OP.

4.2.2 WILDLIFE AND WILDLIFE HABITAT

Wildlife and habitat assessment surveys are details below.

4.2.2.1 Amphibian Surveys

Amphibian call count surveys will be conducted in accordance with the guidelines provided by the Marsh Monitoring Program manual (Bird Studies Canada and Environment Canada, 2008). Survey stations will target the Torrance Creek Swamp PSW. Surveys will be conducted 30 minutes after sunset and no later than midnight on nights with light or no winds. Surveys will be at least 15 days apart and will take place on nights with the following nighttime air temperatures:

- April >5°C
- May > 10°C
- June > 17°C

Proposed survey locations are shown on **Figure 4** (attached).

4.2.2.2 Corridor Studies

Corridor studies are proposed within the east-west hedgerow located along the northern property boundary, as shown on **Figure 4** (attached). The purpose of the corridor study is to inform wildlife culvert design by providing target species or faunal groups for passage (e.g., amphibians or/and small mammals) as well as movement patterns for White-tailed Deer (*Odocoileus virginiana*) in proximity to significant overwintering habitat to the southwest. It will also provide baseline results to which post-construction wildlife culvert studies can be compared.

Studies are proposed to occur for two days a week mid-July to mid-August after warm (>17˚C) and wet evenings to capture juvenile amphibian dispersal. Silt fence will be installed end of June or early July dependent upon securing the appropriate permits in a timely manner (e.g., Wildlife Scientific Collector's Permit). Fencing will be installed perpendicular to the hedgerow and into the adjacent open areas. Pitfall traps will consist of19 L buckets sunk into the ground flush with the substrate surface on both sides of the silt fence and located approximately every 20 m. Each trap will have a lid that can be secured when the trap is not in use. The traps will have at least three equidistant drainage holes punched in the bottom to prevent filling and will be lined with leaf detritus.

Mammal tracks and trails along the hedgerow length will also be recorded.

Two wildlife cameras will be used to obtain information on larger mammals with a focus on deer activity on the property. Cameras will be installed in early November and will be deployed until the end of January on the north and south sides of the property to capture cross property movement. Camera deployment locations are shown on **Figure 4.**

4.2.2.3 Breeding Bird Surveys

4.2.2.4 Diurnal Surveys

Two breeding bird surveys will be conducted on the Subject Property in June 2017 in accordance with the parameters outlined in Environment Canada's Breeding Bird Survey Protocol and the Ontario Forest Bird Monitoring Program Protocol. Fieldwork will be conducted at, or within, half an hour of sunrise, and will be completed by 10:00 a.m. and under favorable weather conditions.

Surveys will consist of recording all species of birds that are seen or heard within each habitat while traversing the Subject Property. A conservative approach to determining breeding status will be taken; all birds seen or heard in appropriate habitat during the breeding season will be assumed to be breeding.

4.2.2.5 Crepuscular Surveys

Two crepuscular surveys for Common Nighthawk (*Chordeiles minor*) will be conducted within the 2017 MNRF recommended timing window of June 1 – 17, 2017 (personal communication with Graham Buck, May 25, 2017). Surveys will consist of 3-minute auditory and visual point counts as shown on **Figure 4** and will follow protocols established in *Eastern Whip-poor-will (Caprimulgus vociferous) and Common Nighthawk (Chordeiles minor)* Survey Protocol (MNR Guelph District, May 2013). Surveys will begin at sunset and will occur on calm, clear, and warm evenings (>10˚C).

4.2.2.6 Snake Surveys

Snake surveys will be conducted every two weeks in June and July, generally following *Milksnake Survey Protocol* (MNR Guelph District, July 2012).

Surveys will consist of area searches by traversing the property, as shown on **Figure 4.** Transects target suitable habitat on the property, including hedgerows, wetland, and the existing onsite residence. Weather conditions of the surveys should target sunny days where air temperatures between 8˚C and 25˚C or temperatures above 15˚C if overcast.

Active hand searches will be employed where appropriate and under the authorization of a Wildlife Scientific Collectors Permit granted under the *Ontario Fish and Wildlife Conservation Act*.

4.2.2.7 Wildlife Habitat Assessment

A preliminary wildlife habitat assessment was conducted during the September 23, 2016 visit for the purposes of scoping the 2017 field program. This included an Ecological Land Classification survey and botanical inventory, and searches for candidate habitat for species at risk, snake hibernacula, bat maternity roosts, stick nests, seepage areas, and vernal pools.

Additional assessment in 2017 will consider habitat suitability for odonates (dragonflies and damselflies) and species of conservation concern (i.e., locally rare in the City of Guelph, S1-S3, Special Concern) such as Monarch (*Danaus plexippus*) and Yellow-banded Bumble Bee (*Bombus terricola*).

4.2.2.8 Incidental Wildlife Observations

Incidental wildlife observations will be recorded during every site visit.

4.2.2.9 Habitat for Species at Risk

This section will combine a background records review of potential species at risk (i.e., designated Threatened and Endangered on the Species at Risk in Ontario List) potentially occurring in the Study Area, cross referenced with existing habitat to determine presence/absence. Field studies will occur where required and in consultation with the MNRF.

4.2.2.10 Significant Wildlife Habitat

Incidental wildlife observations will be recorded during every site visit and field investigation.

Where there is a potential for other wildlife habitat, determined through species at risk habitat screening, information provided by MNRF, and data collected from incidental wildlife surveys; targeted surveys will be completed following acceptable protocol.

The following table is the completed Significant Wildlife Habitat Screening Table as provided in the City of Guelph EIS Draft Guidelines (2014).

Table 1: City of Guelph Significant Wildlife Habitat Screening Table.

Significant Wildlife Habitat Type	Known Candidate SWH present within or adjacent to the subject property?	Rationale (habitat presence or absence)	Field Studies Required?
Seasonal Concentration Areas			
Deer Yarding Areas (as identified by MNRF)	Identified by MNRF in PSW	Habitat in the PSW, potential onsite travel corridor.	Yes - Deer movement assessment along east/west linkage to be assessed during corridor studies.
Deer Winter Concentration Areas (as identified by MNRF	Identified by MNRF in PSW	Habitat in the PSW, potential on site travel corridor.	Deer movement assessment along east/west linkage to be assessed during corridor studies.
Colonial Bird Nesting Habitat (tree/shrub, cliff/bank, ground)	None	No woodland, banks, pits, wetlands, rocky islands or other suitable habitat present	No
Waterfowl Stopover and Staging Areas (Aquatic, Terrestrial)	None	No fields with standing water in spring or wetlands suitable for waterfowl	No
Waterfowl Overwintering Areas (as identified by MNRF)	Identified by MNRF	No permanent water bodies in the Study Area.	No

Table 1: City of Guelph Significant Wildlife Habitat Screening Table.

Significant Wildlife Habitat Type	Known Candidate SWH present within or adjacent to the subject property?	Rationale (habitat presence or absence)	Field Studies Required?
Raptor Wintering (Feeding and Roosting) Areas	None	Woodland habitat identified in PSW but insufficient (<15 ha) upland habitat (e.g., cultural meadow, thicket, savannah, or woodland).	No
Turtle Wintering Areas	None	No permanent water bodies in the Study Area.	No
Reptile (Snake) Hibernacula	None	No deep crevices identified during preliminary surveys.	Yes – Habitat assessment of onsite building foundations and snake area searches to be conducted in 2017.
Bat Hibernacula	None	No caves, mine shafts, underground formations or Karsts.	No
Bat Maternity Colonies	None	Yes – potential bat maternity colony habitat in the deciduous swamp and buildings on site.	No – trees within the deciduous swamp are not proposed for removal. Bat activity at building to be removed to be assessed.
Rare Vegetation Communities			
Alvar	None	Habitat not present.	Yes - to be confirmed during ELC and botanical surveys.
Prairie			
Savannah			
Rare Forest Types			
Cliff/Talus			
Rock Barrens			
Sand Barrens			
Other Rare Vegetation Types			

Table 1: City of Guelph Significant Wildlife Habitat Screening Table.

Significant Wildlife Habitat Type	Known Candidate SWH present within or adjacent to the subject property?	Rationale (habitat presence or absence)	Field Studies Required?
Specialized Habitats for Wildlife			
Waterfowl Nesting Area	None	Upland habitat adjacent to the Torrance Creek Swamp PSW is highly disturbed (lawn, pasture) and therefore does not provide habitat for nesting waterfowl.	No
Bald Eagle and Osprey nesting, foraging and Perching Habitat	None	Habitat not present	No
Woodland Raptor Nesting Habitat	Potential habitat present in PSW and onsite hedgerows	Habitat not present	Yes – assessed in 2016 and to be confirmed during breeding bird surveys in 2017
Amphibian Breeding Habitat (Woodland, Wetland)	None	Potential habitat for woodland breeding amphibians.	Yes – amphibian surveys to be conducted in 2017.
Turtle Nesting Habitat	None	No permanent water bodies in the Study Area with adjacent gravel/sandy soils for nesting.	No
Woodland/Specialized Raptor Nesting	None	Habitat not present	No
Raptor Wintering Areas	None	Habitat not present	No
Seeps and Springs	None	Unknown	Yes - to be confirmed during ELC and botanical surveys.
Wildlife Movement Corridors			
Animal Movement Corridors (including ecological linkages)	No	Deer movement corridors absent (determined by the MNRF). No potential wetland amphibian breeding habitat in the Study	Yes - baseline studies are proposed to characterize existing conditions.

Table 1: City of Guelph Significant Wildlife Habitat Screening Table.

Significant Wildlife Habitat Type	Known Candidate SWH present within or adjacent to the subject property?	Rationale (habitat presence or absence)	Field Studies Required?
		Area that would require an amphibian movement corridor, as determined by previous studies (Dougan 2009). Designated ecological linkage by City of Guelph Official Plan.	
Habitats of Species of Conservation Concern			
Marsh Bird Breeding Habitat	None	Habitat not present	No
Woodland Area-Sensitive Breeding Habitat	Present in PSW	Torrance Creek Swamp PSW may provide habitat for woodland area-sensitive breeding birds.	Yes – breeding bird surveys will be conducted in June 2017.
Open Country Bird Breeding Habitat	None	Habitat not present	No
Shrub/Early Successional Breeding Bird Habitat	None	Habitat not present	No
Terrestrial Crayfish Habitat	None	Potential habitat in or directly adjacent to the PSW.	Yes – incidental observations of terrestrial crayfish will be recorded during all field investigations.
Global Species of Conservation Concern as identified by the NHIC	None identified by NHIC.	Potential habitat absent.	No.
Federal Species of Conservation Concern	Potential for Eastern Ribbonsnake and Northern Map Turtle as per NHIC, although neither have been observed recently.	Unknown	Yes - habitat assessment for species identified as potentially present in the Study Area.

Table 1: City of Guelph Significant Wildlife Habitat Screening Table.

Significant Wildlife Habitat Type	Known Candidate SWH present within or adjacent to the subject property?	Rationale (habitat presence or absence)	Field Studies Required?
	To be confirmed with MNRF/NHIC records, GRCA and DFO		
Provincial Species of Conservation Concern	Potential for Monarch, Yellow-banded Bumble Bee, and Common Nighthawk as per City of Guelph records. Potential for Eastern Ribbonsnake and Northern Map Turtle as per NHIC, although neither have been observed recently. To be confirmed with MNRF/NHIC records, GRCA and DFO	Unknown	Yes - habitat Assessment for species identified as potentially present in the Study Area.

4.2.3 LOCALLY SIGNIFICANT SPECIES

Although not included in the City's guidance document for the preparation of an EIS, the report will identify locally significant species and address potential mitigation opportunities to minimize impacts to their habitat where possible.

4.2.4 TRAILS AND PARK PLANNING

The development proposal design in the EIS will include a trail system and park block. The EIS will include a figure that shows the topography of the site with spot elevations on a 10 X 10 m grid along the proposed trail corridor. Seasonally high water areas will be superimposed on the figure to highlight areas to be avoided or where additional fill and grading may be required for trial design.

5 Data Analysis

5.1 Evaluation of Significance

The data obtained from the field investigations and review of background resources will be evaluated to determine sensitivity of features and functions. The criteria for determining significant features and functions will be evaluated according to the following documents:

- Provincial Policy Statement
- Natural Heritage Reference Manual
- Significant Wildlife Habitat Technical Guide

- Significant Wildlife Habitat Criteria Schedules for EcoRegion 6E
- City of Guelph Official Plan

This section will evaluate all identified natural heritage features and areas, and associated ecological functions within the Study Area. The areas/features identified will be screened against the applicable policies and guidelines to confirm their significance in the City of Guelph.

With respect to SWH features, the EIS will include an evaluation of significance for SWH and habitat of significant species. These will be considered and assessed in the impact section of the EIS.

5.2 Constraints and Opportunities

A constraints and opportunities figure will be derived from the evaluation of significance summary, illustrating the boundaries of natural features, areas for development, areas for protection, natural hazards and buffers/setbacks. The constraints and opportunities analysis will identify opportunities for development on the Subject Property that work within the limitations of the site-specific constraints, and opportunities to improve the existing conditions of the natural heritage system, where possible.

The buffer analysis will involve consideration of expanded buffers where natural feature attributes warrant a greater area of protection.

5.3 Impact Assessment

The significant natural features identified in the evaluation of significance will need to be protected from the proposed development. These features will be evaluated for potential impacts from construction and grading, stormwater management, erosion and sediment control, noise, and other development related impacts.

The EIS will incorporate the Hydrogeological study results with respect to pre and post water balance with a focus on the wetland feature and recharge function. In additional the EIS will, in concert with the hydrogeological information, provide rationale for the SWM location.

This section will also provide a summary of the direct, indirect, induced and cumulative impacts that could be experienced by the Torrance Creek Swamp PSW and associated ecological functions as a result of the proposed development activity.

The primary management approach to avoid impacts on significant and sensitive natural features is to identify and avoid site-specific constraints to the extent possible.

5.4 Mitigation

Avoiding negative impacts is preferred over mitigation. Where impacts are unavoidable, mitigation measures to reduce or minimize impacts on features will be recommended.

This section will include an analysis of buffers and setbacks, a description of proposed compensation for impacts that cannot be mitigated (if applicable), restoration plans for disturbed areas and measures proposed to reduce, eliminate or off-set impacts.

Where possible, processes for the restoration and enhancement of natural features will be recommended to encourage a net benefit. Mitigation measures considered for the Subject Property may include, but are not limited to the following:

- Low Impact Development measures
- Stormwater management best practices
- Educational signage

- Sediment and erosion controls
- Location of fill piles, construction access, machinery storage
- Tree protection fencing and signage
- Timing windows for vegetation removal
- Implementation of appropriate buffers and setback distances from natural hazards and heritage features
- Naturalization and tree planting in areas on the Subject Property
- Potential linkages between natural heritage features

6 Policy Conformity

The relevant provincial, regional, municipal and conservation authority natural heritage policies and regulations will be reviewed. The proposed development plan will adhere to and respect the relevant natural heritage policies.

7 Monitoring Plan

This section will describe the appropriate monitoring procedure to ensure the recommended mitigation measures have been implemented in accordance with approved development plans.

Monitoring plans may include a combination of compliance monitoring, performance monitoring and/or effectiveness monitoring. Monitoring protocols will be established to standardize the procedures to ensure findings can be compared over a set time.

To ensure the proposed mitigation measures have been implemented in accordance with the approved development plans, the following monitoring plans will be considered for the purposes of this development:

- Monitoring during all phases of construction to ensure compliance with grading, erosion and sediment controls and that no encroachment occurs outside the limits of the proposed development and that retained trees are protected.
- Submission of compliance monitoring reports to the City of Guelph while the site is being actively developed, including log of dates of inspections, condition of facilities and any recommended remedial actions.
- Qualitative vegetation monitoring plan following the implementation of any rehabilitation plans (if applicable) to ensure the survival of any plantings.
- During and post-construction monitoring for homeowner interference and encroachment into buffer areas.
- Post-construction invasive species monitoring in adjacent natural areas/buffers.
- Post-construction monitoring for breeding birds and amphibians (if deemed applicable through EIS evaluation of significance) for three years after completion of the development.
- Species at Risk monitoring (if deemed applicable through consultation with the MNRF).

8 Conclusion and Recommendations

The conclusion will include a summary of all recommendations emerging from the EIS, as well as whether or not there will be no negative impacts if the recommendations are implemented, and if the proposed development conforms to the relevant environmental policies.

Regards,

STANTEC CONSULTING LTD.

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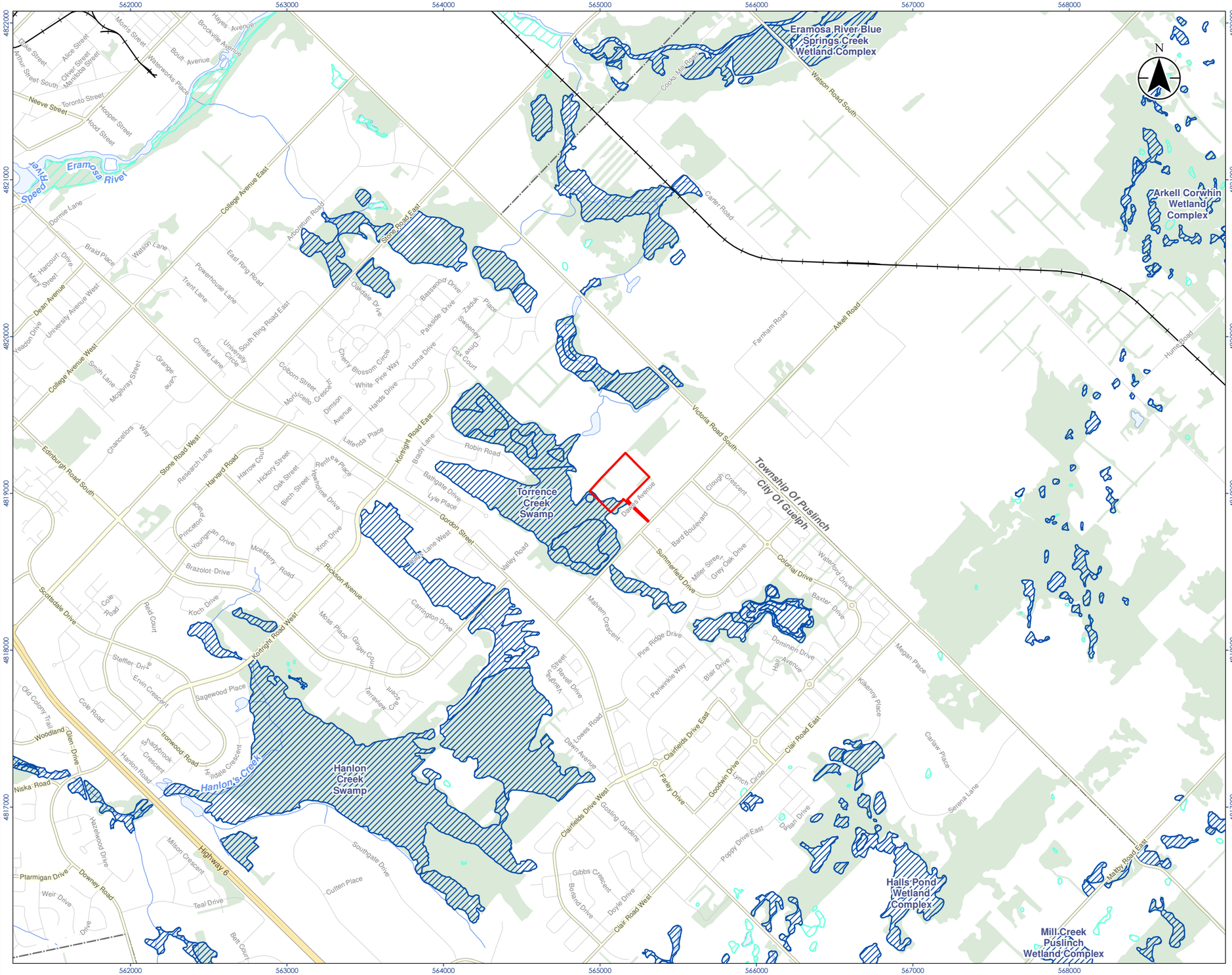
ATTACHMENT A: FIGURES



Stantec

- Property Boundary
- Expressway / Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Wetland - Evaluated (Provincial)
- Wetland - Not evaluated per OWES
- Wooded Area
- Municipal Boundary - Lower Tier

0 500 1,000 metres

1:25,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.

Project Location

Guelph, Ontario

161413338 REVA

Prepared by PRM on 2017-04-04

Technical Review by MS on 2017-04-04

Client/Project

CARSON REID HOMES LTD.

220 ARKELL ROAD, GUELPH, ONTARIO

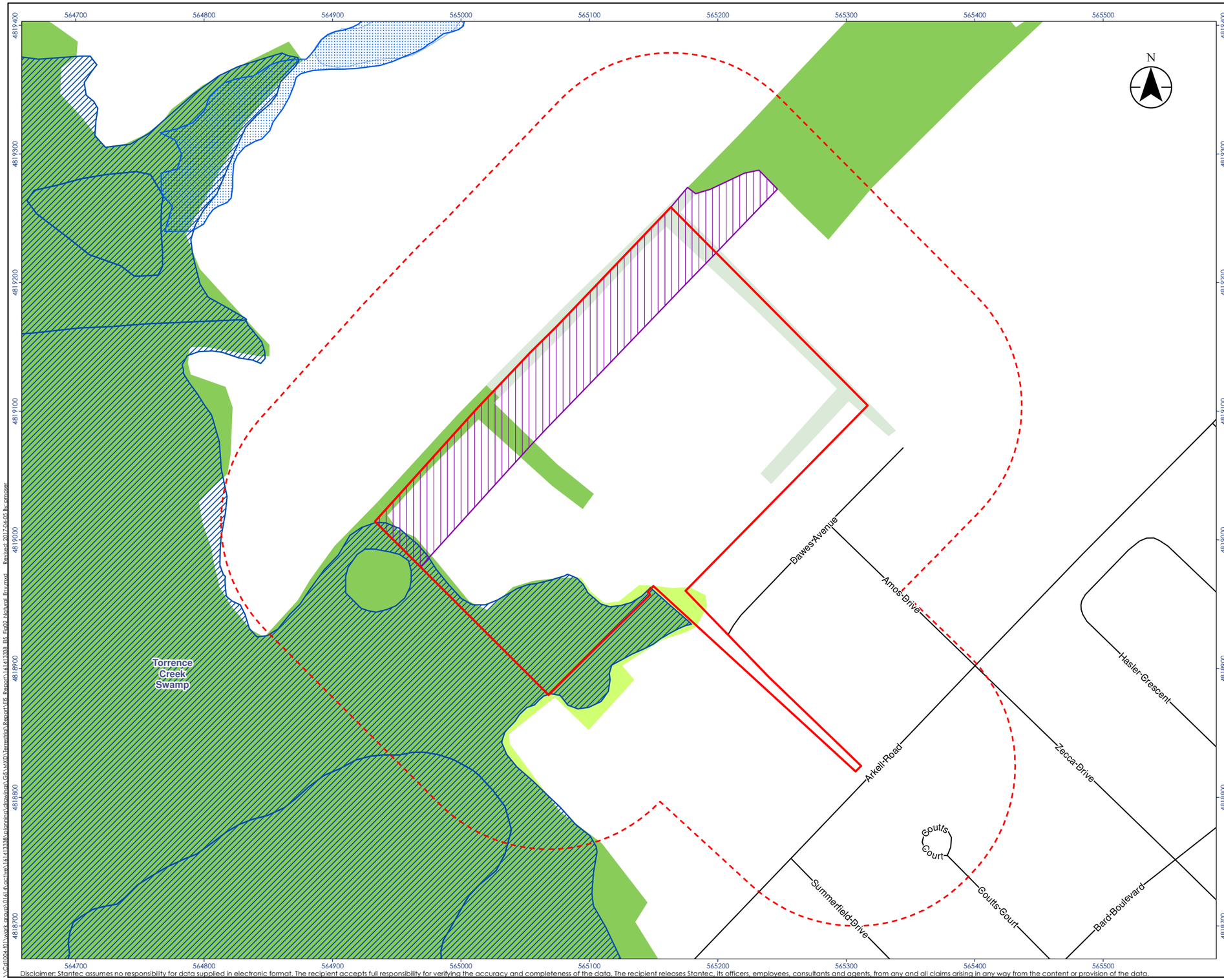
EIS TERMS OF REFERENCE

Figure No.

1

Title

Subject Property



Stantec

- Property Boundary
- Road
- Watercourse
- Waterbody

Natural Heritage System

- Wetland - Evaluated (Provincial)
- Regulatory Floodplain (GRCA)
- Significant Woodland (City of Guelph Official Plan)
- Woodland (LIO, 2015)
- Hedgerow
- Ecological Linkage (City of Guelph Official Plan)
- Study Area

0 50 100 metres
1:3,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.

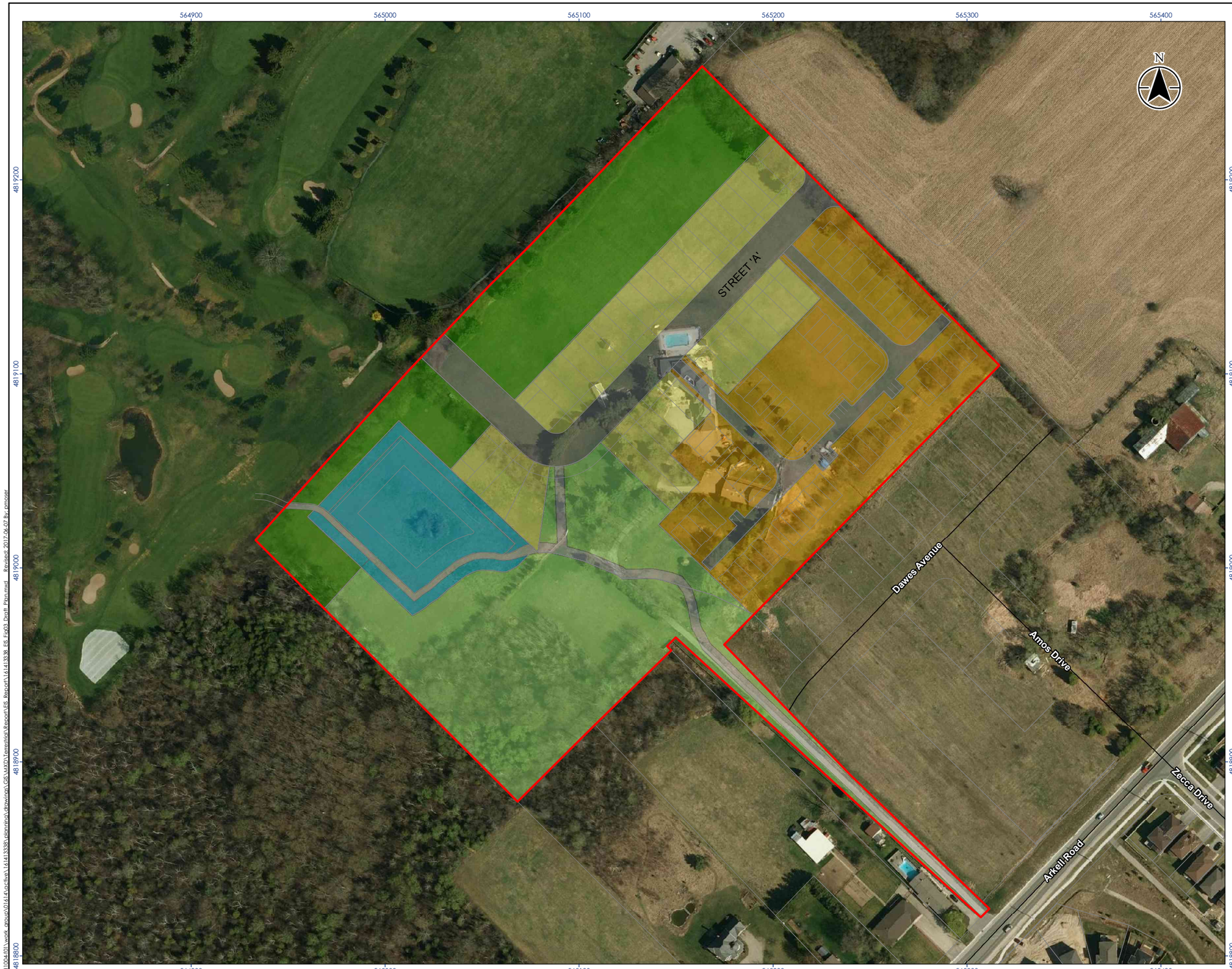
Project Location
Guelph, Ontario

161413338 REVA
Prepared by PRM on 2017-04-05
Technical Review by MS on 2017-04-05

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD, GUELPH, ONTARIO
EIS TERMS OF REFERENCE

Figure No.
2

Title
Natural Environment



Stantec

- Property Boundary
- Proposed Site Layout
- Road
- Single Detached
- Townhouses
- Open Space
- Ecological Linkage
- SWM Facility
- Public Trail

0 30 60 metres
1:2,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.
3. Orthoimagery © First Base Solutions, 2010.

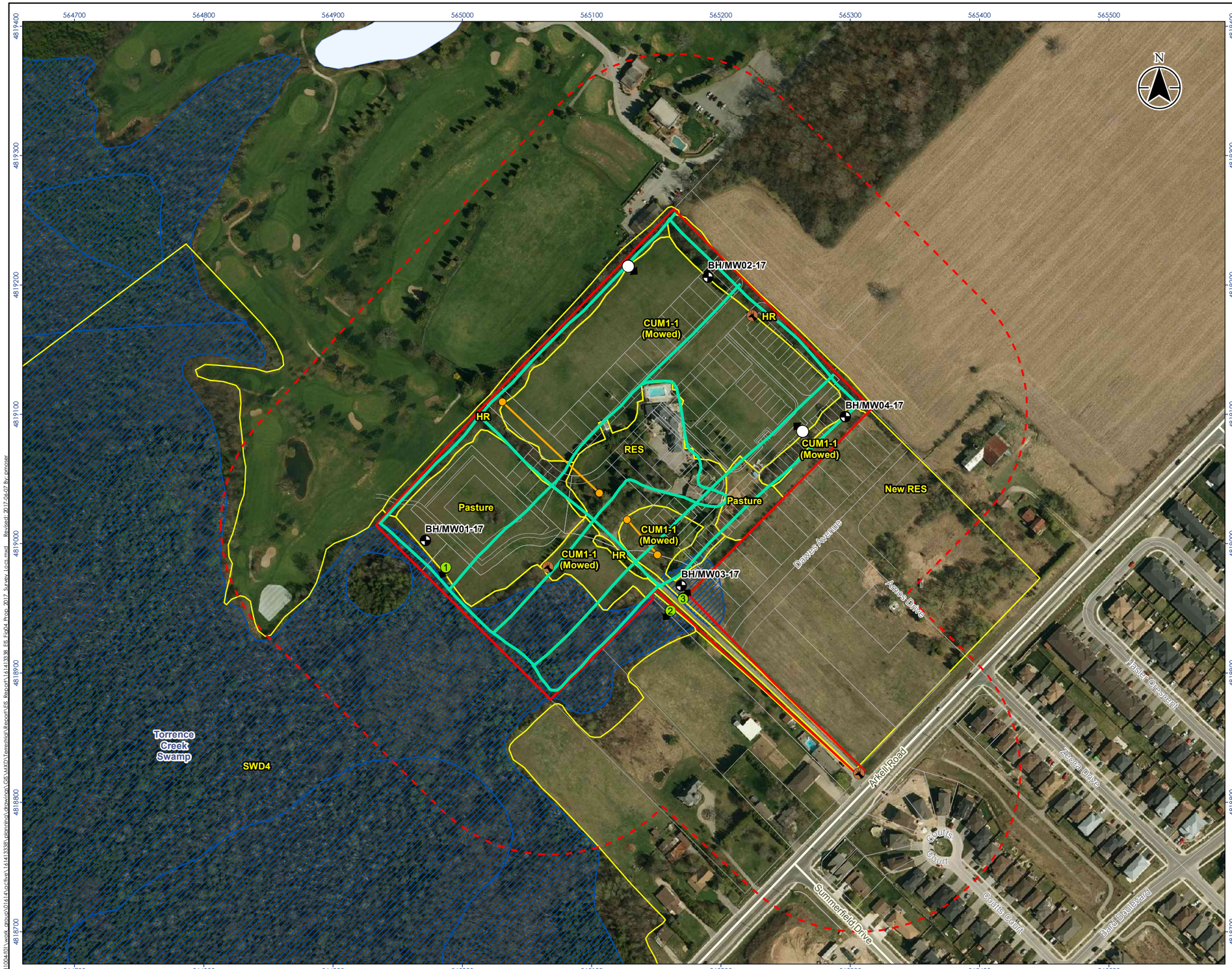
Project Location
Guelph, Ontario

161413338 REVA
Prepared by PRM on 2017-06-07
Technical Review by MS on 2017-06-07

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD, GUELPH, ONTARIO
EIS TERMS OF REFERENCE

Figure No.
3

Title
Conceptual Draft Plan



Stantec

- Proposed Borehole Location
- Proposed Amphibian Station
- Crepuscular Survey Location
- Wildlife Camera Location
- Proposed Corridor Study Location
- Snake Area Search Transect
- Proposed Site Layout
- Major Road
- Minor Road
- Waterbody
- Wetland - Evaluated (Provincial)
- Property Boundary
- Study Area (120m Buffer)
- ELC Boundary

CUM1-1: Dry-Moist Old Field Meadow Type
SWD4: Mineral Deciduous Swamp Ecosite
HR: Hedgerow
RES: Residential

0 50 100 metres
1:3,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.
3. Orthoimagery © First Base Solutions, 2010.

Project Location
Guelph,
Ontario

161413338 REVA
Prepared by PRM on 2017-06-07
Technical Review by MS on 2017-06-07

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD
GUELPH, ONTARIO

Figure No.
4

Title
Proposed 2017/2018 Survey Station Locations

ATTACHMENT B:
TOR CORRESPONDENCE

From:	Adele.Labbe@guelph.ca
To:	Straus, Melissa
Cc:	Chris.DeVriendt@guelph.ca; Eusebi, Daniel
Subject:	220 Arkel EIS TOR
Date:	Tuesday, May 23, 2017 2:43:10 PM
Attachments:	Staff Report EAC EIS TOR 220 Arkell.pdf 20170427 EIS TOR 220 Arkell Road - Parks comments.pdf May 10 2017 Draft EAC Motion.pdf

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Hello Melissa,

In follow up to the EAC meeting on May 10th, please find attached:

- the Staff report which contains comments from staff in relation to the proposed EIS TOR
- Comments from Parks Planning
- Draft motion passed on May 10th.

In addition to the above and in relation to our request asking for consideration of large mammal (deer) movement in the area, we request that the proposed wildlife corridor study location for amphibians (i.e., drift fence placement) as illustrated on Figure 4 of your submission be revised so to bisect the entire property.

Please resubmit the EIS TOR and provide an indication as to how the comments have been addressed.

Thanks,

Adèle Labbé | Environmental Planner
Infrastructure, Development and Enterprise | **Planning, Urban Design and Building Services**
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@cityofguelph

May 10, 2017
Environmental Advisory Committee

Item **220 Arkell Road EIS Terms of Reference**

Proposal The proposal is for the creation of a residential neighborhood. The EIS is being prepared to support a draft plan of subdivision and rezoning for residential development (single detached and townhouses) and including associated uses such as parks and stormwater management areas.

Location The site is located on the north side of Arkell Rd and is north of the recently constructed development along Dawes Ave and north of the proposal at 190-216 Arkell. It is south of the Victoria Park Village development. It is east of the Torrance Creek PSW (See attached map). The site is roughly 7ha in size.

Background

- The site is located in the Torrance Creek Subwatershed.
- The City's Official Plan designates the site as general residential and significant natural area
- The significant natural area designation is due to the known presence of significant woodland, wetland and wildlife habitat associated with the Torrance Creek PSW (see attached map).
- There is an Ecological Linkage on the property which is intended to provide a functional connection from the Torrance PSW eastward along existing hedgerows and woodlands to the City limit at Victoria Rd.
- The site also includes several hedgerows and individual trees that are part of the City's urban forest.
- The site is zoned Agriculture as per the 1985 Puslinch Zoning By-law
- GRCA has been circulated on the EIS TOR however no comments have been received at the time this report was prepared.
- Comments from Parks Planning staff have been integrated into this report.

Comments Staff have reviewed the proposed Environmental Impact Study Terms of Reference (EIS TOR) prepared by Stantec Consulting Ltd and dated April 5, 2017 and have the following comments:

1. Section 1.2 should refer to the City's current (2014) OP Consolidation and not OPA 42. The current consolidation includes the natural heritage system policies that are in place.
2. It is unclear why the 2016 zoning by-law for the Township of Puslinch is being referred to as a contextual document – the lands are within the City of Guelph and as such this zoning by-law is not applicable. The City's zoning by-law (for areas that were annexed into the City during the 90s) still utilizes the zoning that was in place at the time of annexation (so the 1985 Puslinch zoning by-law). This would be the correct reference.
3. Section 4.2.1 – staff note that ELC work should include an analysis to at least the ecosite level and should include soils in accordance with the ELC manual.
4. Section 4.2.3 – please clarify whether a further wetland staking is required.

Wildlife Studies, Significant Wildlife Habitat and Habitat for (Locally) Significant Species

5. With respect to the proposed field surveys (that will inform that analysis in regards

to Significant Wildlife Habitat and Habitat for (locally) Significant Species:

a. Section 4.2.6 –corridor studies – while the proposed method takes into consideration movement of smaller fauna (i.e. amphibian/ reptiles), it seems to miss that the ecological linkage provides a connection to a stratum 2 deer yard (and SWH as a deer overwintering area) as identified by MNRF. Part of the function of this linkage is to support movement at a broader scale (landscape/subwatershed) and as such this also warrants consideration through the EIS.

b. ELC work should also consider Lepidoptera implications and should identify areas with concentrations of milkweed for breeding feeding habitat associated with Monarch (Special Concern).

c. The Yellow-Banded Bumble Bee was recently listed as Special Concern – however it is not mentioned in the screening – given the potential for habitat on and adjacent to site should it not also be included? Recent guidance coming from MNRF Guelph District has been recommendation use of the methodology for the Rusty Patch Bumble Bee to assess for the species. The EIS should characterize any potential areas and assess any impacts. Please clarify.

6. In relation to the review of potential significant wildlife habitat as summarized in Table 1:

a. Per the comment above the Torrance Creek PSW is SWH for deer winter congregation as identified by MNRF and as shown in the City's Official Plan. The habitat should be characterized and impacts assessed through the EIS. Please clarify.

b. Winter raptor areas – Given the size of the Torrance PSW (which is also a woodland as it is a swamp) combined with the remnant edges/fallow fields in the area this could provide foraging opportunities. Red tailed hawks have been seen foraging along hedgerows to the south and east of the site as well throughout the winter. The habitat should be characterized and impacts assessed through the EIS. Please clarify.

c. It is unclear how there is no potential for snake hibernacula given existing building and fencerows onsite, in addition the adjacent swamp may also include suitable opportunities for over wintering. Area based surveys following the milksnake methodology developed by MNRF Guelph District should be utilized. The habitat should be characterized and impacts assessed through the EIS. Please clarify.

d. With respect to area sensitive breeding bird habitat – based on results from multiple EISs completed in this area of the City, it has been confirmed that the Torrance Creek PSW is SWH in regards to area sensitive breeding bird habitat. The proposed studies should characterize the edge habitat functions and assess the impacts of adjacent development on area sensitive habitat.

e. With regards to Woodland Raptor Nesting – why is the adjacent PSW (and significant woodland) not a potential habitat?

f. With respect to Animal Movement Corridors – these should be assessed and confirmed per the City's Ecological Linkage policies in the OP. Specifically staff note that the EIS will need to confirm the configuration of the linkage based on the scale that it is intended to function, the nature of adjacent land uses and its significance, sensitivity and ecological requirements in relation to

the species whose movements the linkage may facilitate both in the existing and future context. Baseline studies will assist in characterizing the existing conditions and informing the impact assessment.

g. Habitats for species of conservation concern (special concern and rare wildlife species) – it would be beneficial for the EIS to go through each potential habitat/species group in order to understand what is being assessed (such as monarch butterfly and yellow banded bumble bee as noted above).

h. Adjacent sites in the area are also completing crepuscular surveys due to potential habitat (i.e. common nighthawk) – how was this considered?

7. Pertaining to Habitats for (locally) Significant Species (HSS) – habitats that support locally significant species should be identified (similar to the SWH process) and assessed per the OP policies, including with respect to impacts.

Data and Impact Analysis

8. With respect to the data analysis - opportunities for protection, enhancement and restoration of trees within the Urban Forest should also be identified in accordance with the City's OP.

9. The site is also regulated under the tree by-law. A Tree Inventory and Preservation Plan is to be included in the EIS and should also include:

   a. Tree Protection Fencing locations and other associated mitigation/protection measures as recommended. Note that TPF is to follow City Standard SD-90a which can be found on the City's website under Part 'B' Contract Specifications 2016.

   b. A hazard assessment for all trees that would be within striking distance (generally 30m) of City owned lands/facilities including trails and consider removals where needed. Please note that this will need to include the edges of the woodland where trail connections are being assessed.

10. A buffer analysis should also be included within the constraints and opportunities and/or impacts assessment discussion. While the City's OP does include policies for minimum buffers – the establishment of larger buffers also warrants consideration in the EIS and is also reflected in the City's OP policies.

Water Resources and Hydrological Functions

11. Consideration should also be given to the protection of ground water functions including recharge in accordance with the City's Water Resource policies. On a related note a review and consideration of any recommendations or requirements from the Torrance Creek Subwatershed Study within the EIS should also be considered.

12. Related to the characterization of the hydrology and hydrogeology for the site. The site falls within the area identified in the Torrance Creek Subwatershed Study that provides recharge to Torrance Creek. Further it is also noted that groundwater monitoring associated with the 246 Arkell EIR found that groundwater levels along the northwest portion of the site (and to the south of this site) were within 1.5m to 2.3m of the existing grades, a high water table close to/at surface has also been documented on the VPV site to the north. In both cases this has resulted in parts of the site being raised in order to provide required separation for the development from the ground water table. It is anticipated that similar measures will need to be considered for this site and will need to be assessed through the impact analysis.

13. The EIS and supporting Hydrogeological study should include a wetland water

balance; in addition the site based water balance typically associated with the SWM report. The wetland water balance is to be broken down on a monthly basis.

14. The SWM design should include the targets for the Torrance Creek subwatershed (per the subwatershed study). In addition, opportunities to incorporate low impact design (LID) technologies utilizing a treatment train approach to assist with achieving a water balance for the site, and maintaining infiltration and recharge functions should be incorporated. The location of the SWMP should also be sited in the context of the hydrological and ecological functions of the site, and the EIS will need to provide support for its location.

Trails and Parks Planning

15. Parks Planning highlights that the Draft Schedule 8: Trail Network from OPA 48 (currently under appeal) identifies a proposed Secondary trail route through the subject property and has provided a sketch illustrating the desired trail locations (see attachment below). The environmental impact assessment must consider this proposed trail, recommend its location and alignment and provide mitigation recommendations. The trail corridor should be 6.5m minimum clear of any obstructions and include signage and rest areas in accordance with Guelph's Facility Accessibility Design Manual (2015) which will require additional space.

16. The EIS TOR should confirm that the EIS will include the following information to assist in the impact assessment of the trail:
    - Surveyed topography right up to the natural heritage feature limits (wetland, woodland, etc.) within the study area along the proposed trail corridor including spot elevations on a grid of 10 x 10m.
    - The surveyed locations of all existing foot paths within the study area.
    - Recent recorded seasonal high groundwater levels in the feature buffers and any other possible trail route areas – at locations to be agreed with City staff. The completed geotechnical work does not appear to cover this.

17. Parks Planning has identified the need for a public neighbourhood park block on the subject property. This should be integrated into the development proposal and sited in a suitable location in consultation with City staff.

Suggested Motion

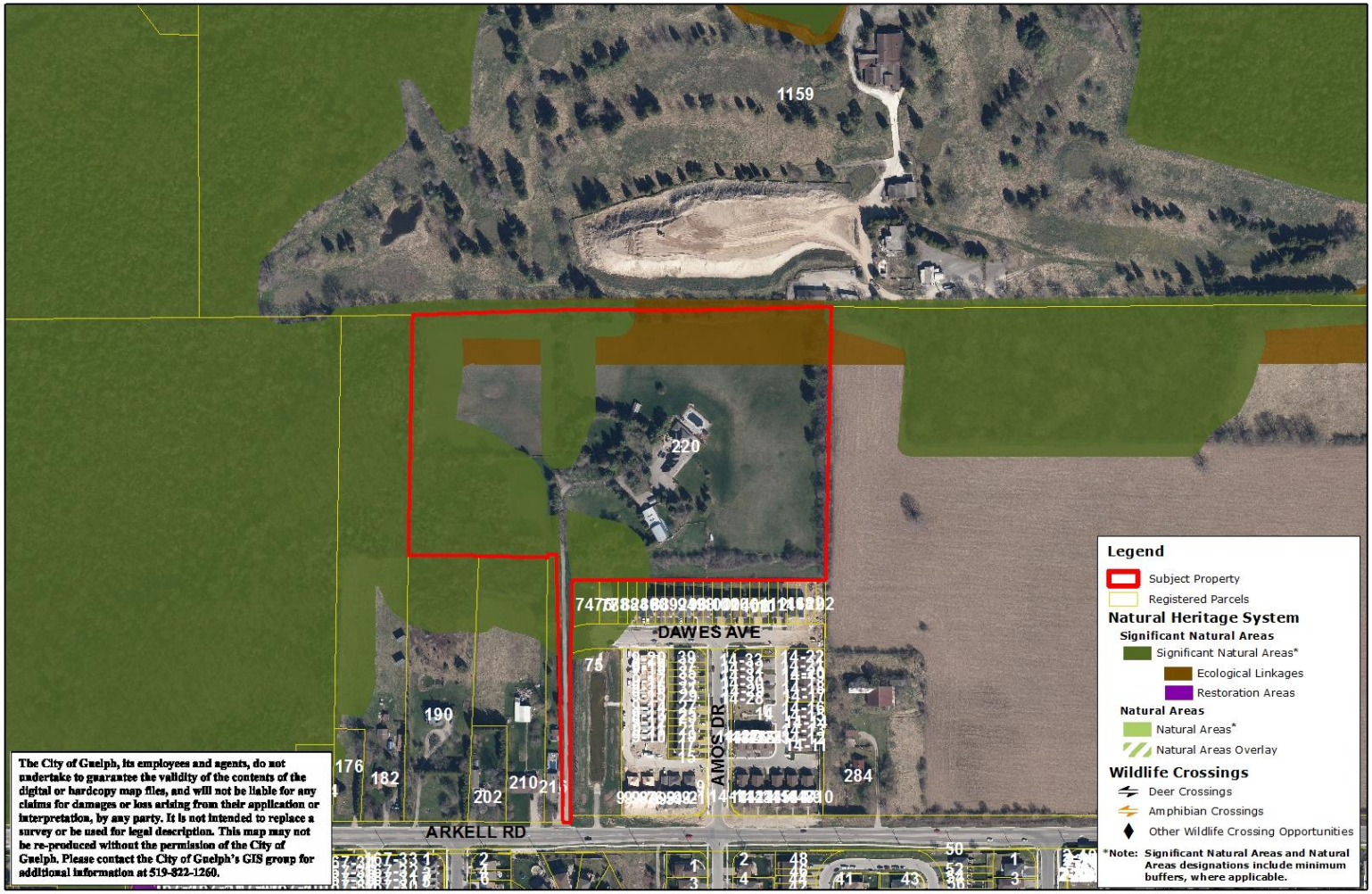
Staff recommends that the Environmental Advisory Committee conditionally support the EIS Terms of Reference for 220 Arkell Rd, prepared by Stantec Consulting Inc, providing a revised EIS TOR is provided which includes:

- Clarification as it relates to the field study program including information relating to raptors (wintering and nesting); habitats for species of conservation of concern (including monarch butterfly, yellow banded bumble bee and common nighthawk) and habitats for significant species;
- Clarification that the EIS will also include an evaluation of significance for Significant Wildlife Habitat and Habitat for Significant Species, as applicable and that this be carried into the impact assessment;
- Clarification that the EIS will also include a tree inventory and related analysis for protection enhancement and restoration of trees forming part of the City's urban forest;
- Consideration for the protection of ground water functions including recharge, as well as addressing recommendations or requirements from the Torrance Creek

Subwatershed Study within the EIS;

- Incorporates the development of a stormwater management approach that achieves a pre to post water balance for the site and surrounding natural areas as part of the EIS and supporting technical studies; and
- Incorporate a trail network and public neighbourhood park block into the proposed development.

Attachment 1 – Site Map and NHS limit (Official Plan Schedule 10)



50 25 0 50 m

Produced by the City of Guelph
Planning Services
Adopted: July 27, 2010, Consolidated: June 2014

Natural Heritage System

Natural Heritage System

As approved by the Ontario Municipal Board, June 4th, 2014.

220 Arkell Road

2016 Aerial Photography

I:\gis_staging\Planning\Environmental\Site Specific Mapping\NaturalHeritageStrategy-NHSSiteSpecificPublicMap.mxd

190 -216, 220 and 246 Arkell Road

Conceptual Trail Route

INTERNAL MEMO

DATE	April 27, 2017
TO	**Adele Labbe**
FROM	Jyoti Pathak
DIVISION	Parks and Recreation
DEPARTMENT	Public Services
SUBJECT	**220 Arkell Road – DRAFT Terms of Reference for a scoped Environmental Impact Study –(File # TBD)**

Parks Planning and Development has reviewed the Proposed Terms of Reference for a scoped Environmental Impact Study (EIS) prepared by Stantec Consulting Limited dated April 5, 2017 in support of the proposed residential development application at 220 Arkell Road property.

Site Location: The subject property is approximately 7.05 ha in area and is located south of the Victoria Park Village development currently under construction, north of the recently constructed 246 Arkell Road subdivision, east of the Torrance Creek Swamp Provincially Significant Wetland and west of active agricultural lands.

Proposed Development: The Conceptual Draft Plan (Figure 3) includes single residential and townhouse units and a public trail on the subject property.

Background:

Guelph Trail Network:

1. Schedule 7 - Trail Network of the Official Plan Amendment 48 (currently under appeal to OMB) identifies a proposed off-road trail on the subject property following the eastern edge of the natural heritage features located west of the property. The proposed off-road trail route connects the development on the subject property to the planned off-road 'Victoria Park Village subdivision' trail to the north and the proposed development at 190 -216 Arkell Road to the west and 246 Arkell Road subdivision to the east and Arkell Road to the south.

2. The trail is proposed to be 2.5 metre wide with 1.5 metre wide clearance along both edges to include mow strips and space for grading and drainage swales coordinated with the adjacent development and trail amenities (e.g. signage, rest areas) – in accordance with Guelph's Facility Accessibility Design Manual -2015, Accessibility Advisory Committee consultation, Guelph Trail master Plan and City' current standards, practices and policies.

Parkland Dedication:

3. Parkland conveyance is recommended for the subject development pursuant to s. 51.1 of the Planning Act and the conceptual draft plan would include a park block of appropriate shape and size under City's Official Plan policies.

Property Demarcation:

4. Property Demarcation would be designed and developed under City's property demarcation policy.

Parks Planning and Development offers the following comments:

Conceptual Draft plan:

1. Revise the conceptual draft plan to include a public neighbourhood park block on the subject property of appropriate shape and size in accordance with City's Official Plan policies and in consultation with Parks staff.

2. To ensure trees are preserved, avoid proposing new park block within an area where trees are proposed to be retained. The tree preservation on a new park block may impact the active recreational development potential of the new park and may result in eventual removal of some or all of the retained trees. Within a new development area, due to the proposed grading and drainage design the trees if preserved on a park block may impact its effective size (tableland), layout and sightlines within the park block.

3. A conceptual trail route was discussed and a sketch was shared with the applicant at the time of the pre-consultation meeting. See Attachment 1. Proposed north-south public trail alignment, as indicated on the Figure 3, from the southern edge of the Victoria Park Village development to the Arkell Road needs to be refined further. Add a trail link to the Street A along southern edge of the Victoria Park Village development. Add a trail connection to the west on 190 – 216 Arkell Road property and to the east to connect to an existing side walk on 246 Arkell Road subdivision.

4. The trail link to the Street A, south of the proposed storm water management pond, would need to be adjusted and refined further as the refinement of the development plan takes place and a location for the neighbourhood park block is determined in consultation with Parks staff.

Environmental impacts and mitigation:

5. Assess the impacts of the proposed trail development and recommend measures to mitigate these impacts through the EIS.

6. Recommend management of the natural heritage feature and the proposed buffer along the trail route including removal of invasive species and hazard trees through the EIS.

7. Recommend preparation of an Environmental Implementation Report, Trail and Landscape Drawings through EIS to detail design an appropriate trail, park and open space system and associated mitigation measures in accordance with the City's design and development standards.

Trail route alignment:

8. Identify the preferred trail alignment in consultation with City's environmental planning and parks staff and flag the trail route on site for City's review.

Grading and drainage:

9. Provide preliminary grading and drainage plans to demonstrate that the design of the public trail, including trail connections to the Arkell Road and existing and proposed development in the vicinity, and park block meets City's standards.

Open space restoration and enhancement:

10. The owner will be responsible for implementation of City approved landscape plans in accordance with the final approved EIR including, but not limited to, restoration, compensation and enhancement planting within the open space.

Demarcation of public open space:

11. Describe the recommended approach to demarcation of the public open spaces in accordance with the City's Property Demarcation Policy. City's standard 1.5 m high heavy duty black vinyl chain link fence along the proposed boundary is normally required.

Public education:

12. Recommend provision of public education through interpretive signage at the entry points to the trail and along the trail and open space system. Public education should address the environmental sensitivity of natural Heritage features and procedures residents can follow to protect and/or enhance these areas.

13. City will review and approve the design and locations of interpretive and educational signage, to be included on landscape plans at the EIR stage.

Attachment:

- Attachment - 1: Conceptual Public Trail Route

Summary:

Modify the Terms of Reference for a scoped Environmental Impact Study, to address Parks Planning and Development comments above as necessary, for further review.

Please contact me if you have any questions.

Sincerely,

Jyoti Pathak, Parks Planner
Parks and Recreation - **Public Services**
T 519-822-1260 x 2431
E Jyoti.pathak@guelph.ca

C. Janet Sperling, Manager of Open Space Planning

File Path: P:\CommunityServices\Riverside_Park Planning\PLANNING\SOUTH DISTRICT\Zoning By-Law & Official Plan Amendments\220 Arkell Road\EIS TOR\20170427 EIS TOR 220 Arkell Road.docx

190 -216, 220 and 246 Arkell Road

Conceptual Trail Route

220 Arkell EIS TOR
DRAFT motion from May 10, 2017 EAC Meeting
*note that this motion will remain draft until such time that the meeting minutes are voted upon

The Environmental Advisory Committee conditionally support the EIS Terms of Reference for 220 Arkell Rd, prepared by Stantec Consulting Inc, providing a revised EIS TOR is provided which includes:

- Clarification as it relates to the field study program including information relating to raptors (wintering and nesting); habitats for species of conservation of concern (including monarch butterfly, yellow banded bumble bee and common nighthawk) and habitats for significant species;
- Considers updated protocols for bat species-at-risk;
- Clarification that the EIS will also include an evaluation of significance for Significant Wildlife Habitat and Habitat for Significant Species, as applicable and that this be carried into the impact assessment;
- Clarification that the EIS will also include a tree inventory and related analysis for protection enhancement and restoration of trees forming part of the City's urban forest;
- Consideration for the protection of ground water functions including recharge, as well as addressing recommendations or requirements from the Torrance Creek Subwatershed Study within the EIS;
- Incorporates the development of an adaptive stormwater management approach that achieves a pre to post water balance for the site and surrounding natural areas to preserve the function of the natural heritage features as part of the EIS and supporting technical studies; and
- Incorporate a trail network and public neighbourhood park block into the proposed development.

From:	Adele.Labbe@guelph.ca
To:	Straus, Melissa
Cc:	bjones@fusionhomes.com
Subject:	RE: Bluewater Road Mortality Studies
Date:	Monday, May 15, 2017 2:42:23 PM
Attachments:	image001.png

HI Melissa,

The following points have been brought to the City's attention through monitoring of the Dallan lands:

Small (3.8 L paint cans) pit fall traps were replaced with large (19 L) buckets for pit fall traps as the smaller containers were ineffective in containing the frogs, and sphagnum moss and dried leaves were more effective at retaining moisture than sponges. Even the larger buckets were ineffective for Spring Peepers and Wood Frogs which are smaller and strong jumpers.

Road mortality (along with increased movement) occurred during warm nights (i.e., 17°C or above) when it was raining or was raining within two hours of the surveys.

With this information, I ask that for the Bluewater application road mortality surveys include at least two surveys undertaken during warm rainy nights (i.e., 17°C or above) when it was raining or was raining within two hours of the surveys.

For other applications, consider both these points (i.e., Arkell Road application).

Thanks,

Adèle Labbé | Environmental Planner
Infrastructure, Development and Enterprise | **Planning, Urban Design and Building Services**
City of Guelph
T (519) 822-1260 x 2563
E adele.labbe@guelph.ca

APPENDIX D
Geotechnical Investigation Report

Report

220 Arkell Road, Guelph, ON

June 11, 2019

Prepared for:

Rockpoint Properties Inc.
195 Hanlon Creek Blvd, Unit 100
Guelph, ON N1C 0A1

Prepared by:

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4

Project No. 161413338.801

Revision	Description	Author		Quality Check		Independent Review	
Rev0	Final	J.Dietz	20190611	P.Healy	20190611	--	--

This document entitled Geotechnical Investigation Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Rockpoint Properties Inc (the "Client") to support the permitting process for Client's application for a Draft Plan of Subdivision (the "Application") for 220 Arkell Road, Guelph, ON (the "Project"). In connection thereto, this document may be reviewed and used by the provincial and municipal government agencies participating in the permitting process in the normal course of their duties. Except as set forth in the previous sentence, any reliance on this document by any third party for any other purpose is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

LICENSED PROFESSIONAL ENGINEER
J.W. DIETZ
2019-06-11
PROVINCE OF ONTARIO

Prepared by _____
(signature)

Jeff Dietz, P.Eng.
Senior Geotechnical Engineer, Consulting Engineer
Geotechnical Engineering

Reviewed by _____
(signature)

Peter Healy, C.E.T.
Senior Associate,
Geotechnical Engineering

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LIST OF APPENDICES

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained to carry out a geotechnical investigation for a proposed residential subdivision development at an existing residential property located at 220 Arkell Road in Guelph, Ontario.

The work was carried out in accordance with Stantec's proposal under Project Number 161413338, dated March 23, 2017.

The information provided in this report is specific to the scope of the investigation and the scope of the proposed development as discussed herein and should not be used for any application or purpose other than that stated herein. The scope of this report includes focusing on the geotechnical aspects of the project and does not include hydrogeological or environmental components. However, a hydrogeological investigation was carried out by Stantec in conjunction with this geotechnical investigation. The hydrogeological investigation report is provided under a separate cover.

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**.

2.0 STUDY AREA DESCRIPTION

2.1 LOCATION AND CURRENT LAND USE

The site is situated in the City of Guelph, Ontario, and is set back to the north of Arkell Road, as shown on the Key Plan, Drawing 1, in **Appendix B**. The central part of the site has a large residential house and numerous associated outbuildings and a pool. The reminder of the property contains grassed areas and tree lines, with a forested area at the southwest corner. The plan area of the property is approximately 3 hectares, and the overall site is generally rectangular in shape. The site is bordered on the south by residential properties fronting on to Dawes Avenue, on the west by a forested area, on the north by a golf course, and on the east by an agricultural field. Historical air photos indicate that a pond was previously located in the south end of the property, immediately east of the entrance driveway connected to Arkell Road.

2.2 TOPOGRAPHY & DRAINAGE

The Site generally slopes from the east to the west, with a ground relief of 6.5 m at the borehole locations. Ground surface elevations at the borehole locations were surveyed by Stantec's geomatics team. The borehole elevations and locations are provided on the Borehole Locations Plan in **Appendix B** and on the Borehole Logs in **Appendix C**.

3.0 PROPOSED DEVELOPMENT

3.1 OVERVIEW

It is understood that the development will comprise the construction of lots for single detached homes, blocks for townhouses, and associated municipal servicing, driveways and parking spots. Construction of a stormwater management (SWM) facility is planned for the northwest corner of the site. The stormwater management strategy also incorporates a combination of lot level and centralized infiltration trenches to promote groundwater recharge.

4.0 METHOD OF INVESTIGATION

4.1 FIELD INVESTIGATION

As a component of our standard procedures, Stantec obtained ground clearances from public and private underground utility locators prior to commencing the field investigation.

The field drilling program was carried out on April 5, 2015. Four (4) boreholes (BH01-17 through BH04-17) were advanced to depths of 5.2 to 8.2 m below ground surface. The boreholes were advanced at the locations shown on Drawing 2, in **Appendix B**, using a track mounted Dietrich D–50 Turbo drill rig operated by a specialist drilling subcontractor.

The subsurface stratigraphy encountered in the boreholes was recorded in the field by Stantec personnel. Split spoon samples were collected at regular depth intervals in the boreholes via the completion of Standard Penetration Tests (SPTs) in accordance with ASTM Standard D1586-11. All soil samples recovered from the boreholes were placed in moisture-proof bags, appropriately labeled, and returned to the Stantec Kitchener laboratory for classification and testing.

Groundwater levels were measured (where present) in the open boreholes upon completion of drilling. Monitoring wells were installed in all boreholes. The monitoring wells comprised 50 mm PVC pipe with1.5 or 3.0 m long slotted and filtered screens. Water levels were measured in the monitoring wells on April 13 and September 15, 2017.

4.2 BOREHOLE LOCATION AND ELEVATION SURVEY

The ground surface elevations and UTM coordinates at the boreholes collected by the Stantec geomatics team are provided in Table 4.1 below.

Table 4.1 Borehole Elevations and Approximate Coordinates

Borehole Number	Elevation (m)	Easting (UTM)	Northing (UTM)
BH 01-16	333.48	564970	4819008
BH 02-16	337.19	565193	4819204
BH 03-16	334.30	565155	4818983
BH 04-16	339.95	565287	4819111

4.3 GEOTECHNICAL LABORATORY TESTING PROGRAM

All samples recovered from the geotechnical investigation were returned to Stantec's geotechnical laboratory and were visually examined by a geotechnical specialist.

The scope of the geotechnical laboratory testing program is outlined below in Table 4.2.

Table 4.2 Geotechnical Laboratory Testing Program

Laboratory Test	Number of Samples Tested
ASTM D2216-10 – Natural Moisture Content	Selected samples from the boreholes
ASTM D422-63 (2007) – Grain Size Distribution with/without Hydrometer	4
Corrosion Potential (subcontractor)	1

The results of the laboratory tests are discussed in the text of this report. The results of the moisture content tests are shown on the Borehole Records in **Appendix C**. The results of the grain size distribution tests and corrosion potential tests are provided in **Appendix D**.

Samples remaining after testing will be placed in storage for a period of three months after issue of this geotechnical report. After the storage period, the samples will be discarded.

5.0 RESULTS OF INVESTIGATION

5.1 SUBSURFACE CONDITIONS

5.1.1 Frame of Reference & Overview

The soils encountered in the boreholes and reported herein have been classified in accordance with the Unified Soil Classification System (USCS) as defined in ASTM D2487-11 and D2488-09a, with modifications consistent with the methods of the Ontario Ministry of Transportation (MTO). The modifications specifically include the removal of the descriptions "lean" and "fat" with reference to clay soils and include a "Medium" category with respect to plasticity.

The subsurface conditions encountered in the boreholes are presented in detail on the Borehole records provided in **Appendix C**. An explanation of the symbols and terms used to describe the Borehole Records is also included in **Appendix C**.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling and should be considered approximate only. Variations to the conditions reported and discussed herein must be anticipated.

5.1.2 General Subsurface Stratigraphy

In general, the subsurface stratigraphy encountered in the boreholes advanced on the subject property consisted of topsoil and a veneer of sand, or fill, overlying glacial till. The glacial till generally comprised silty sand and gravel till.

Bedrock was not encountered in the boreholes advanced for this investigation.

5.2 SUBSURFACE STRATIGRAPHY

5.2.1 Fill

Fill was encountered at borehole BH03-17 and extended to a depth of 2.4 m. A review of historical air photos indicates that borehole BH 03-17 is located in an area where a pond had previously been located. The upper 300 mm of the fill comprises topsoil. The remainder of the fill ranged from silty sand with some clay and trace gravel to sandy silty clay with gravel. SPT N-values of 6 to 8 blows per 300 mm penetration of a split spoon sampler indicate that the fill is loose. The fill was described as moist on the field logs.

5.2.2 Topsoil

Native topsoil was encountered surficially at boreholes BH01-17, BH02-17, and BH04-17. The topsoil is 280 to 300 mm thick at these locations and comprises dark brown silty topsoil.

5.2.3 Sand (SM)

A layer of sand was encountered below the topsoil in boreholes BH01-17, BH02-17, and BH04-17. This deposit comprises sand with trace gravel and silt and is 0.4 to 3.8 m thick at the borehole locations. The sand is thickest at the northwest end of the site (BH01-17). The upper 0.6 to 1.5 m of this deposit is loose based on SPT N-values of 5 to 9 blows per 300 mm. Below this upper loose portion, the sand deposit is typically compact with SPT N-values ranging from 11 to 21 blows per 300 mm. The sand is moist to wet, as indicated by moisture content results of 6 to 18%.

5.2.4 Silty Sand (SM) Till and Silty Sand with Gravel (SM) Till

A native deposit of glacial till was encountered beneath the topsoil, sand, and fill throughout the site. The silty sand till or silty sand with gravel glacial till extended to a depth of 7.2 m below ground surface in

borehole BH02-17; and, below the termination depths of the other boreholes. The results of particle size distribution tests performed on four samples of the glacial till are shown below in Table 5.1 and shown on Figure No. 1, provided in **Appendix D**.

Table 5.1 Grain Size Distribution – Glacial Till (SM)

Borehole	Sample	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH02-17	SS5	3.2	Silty Sand (SM) Till	6	38	42	14
BH03-17	SS5	3.4	Silty Sand with Gravel (SM) Till	23	28	41	8
BH04-17	SS4	2.6	Silty Sand with Gravel (SM) Till	18	36	37	9
BH04-17	SS6	4.7	Silty Sand with Gravel (SM) Till	27	32	32	9

SPT N-values typically ranging from 25 to greater than 50 blows per 300 mm indicate that the glacial till deposit has a compact to very dense relative density. Moisture content results of 6 to 12%, indicate that the glacial till is moist to wet.

5.2.5 Silty Clay (CL) Till

A deposit of silty clay till was encountered below the silty sand till at 7.2 m depth in borehole BH02-17. This deposit extended below the termination depth of the borehole and comprised grey silty clay with trace gravel. A SPT N-value of over 50 indicates the clay till is hard. A moisture content test result of 9% indicates that this deposit is moist.

5.3 GROUNDWATER CONDITIONS

Groundwater levels were measured in the wells installed in the boreholes on multiple occasions, and water level dataloggers were installed as part of the hydrogeological investigation. The initial groundwater measurement, and the high groundwater level from the datalogger results are summarized in the following Table 5.2.

Table 5.2 Groundwater Level Measurements

Borehole Number	Measurement	Groundwater Level	
		Depth (m)	Elevation (m)
BH01-17	April 13, 2017	0.29	333.19
	High datalogger result	0.12	333.36
BH02-17	April 17, 2017	0.40	336.79
	High datalogger result	-0.06	337.25
BH03-17	April 13, 2017	0.69	333.61
	High datalogger result	0.56	333.74
BH04-17	April 17, 2017	2.85	337.10
	High datalogger result	2.28	337.67

The water levels indicate that groundwater is either perched in the fill or sand above the glacial till, or contained in seams within the glacial till. The water level readings show significant variation between the April and September readings. Additional fluctuations in the above stabilized groundwater levels should be anticipated throughout the various seasons.

6.0 DESIGN DISCUSSION & RECOMMENDATIONS

It is proposed to develop the site as a residential subdivision. One L-shaped municipal road is planned from the north property line to the east property line, to connect to the proposed subdivisions on these sides of the site. Single family residential lots are planned to the north, south, and west of the municipal road. A townhouse development is planned in the south end of the site. A dry SWM facility is planned for the northwest end on the site. The proposed lot fabric is shown on the Borehole Location Plan.

6.1 SUBSURFACE CONDITIONS OVERVIEW

The subsurface conditions encountered in the boreholes advanced for the geotechnical investigation generally consisted of topsoil and a veneer of sand, or fill, overlying glacial till. The glacial till generally comprised silty sand and gravel till. Groundwater is perched in fill or sand deposits above the glacial till or contained in saturated seams within the glacial till.

Bedrock was not encountered in the boreholes advanced at the site for this investigation.

6.2 GEOTECHNICAL CONSIDERATIONS AND CONSTRAINTS

Based on the conditions encountered in the boreholes and the general details of the proposed development, the following considerations and constraints are anticipated for this site.

The existing buildings, surficial vegetation and topsoil and asphalt will require stripping and removal to facilitate construction.

Existing fill material, which was encountered in the area of a historical pond (BH03-17) is not considered a suitable founding stratum for the construction of the proposed building foundations and site pavements.

The undisturbed native soils are compact to dense and are considered a suitable founding stratum for the construction of the proposed development.

A combination of engineered fill, placed and compacted in accordance with the recommendations provided herein, overlying the undisturbed native soils will provide a suitable founding stratum for the construction of the buildings, site services and roads subject to completing the site preparation activities as described herein.

Groundwater was recorded perched in fill or sand deposits above the glacial till. Moderate to high seepage may be encountered in excavations through the saturated deposits of these soils. Excavations

for sewer installation will likely extend below seasonal high water level along a portion of the sewer route. Excavations below the groundwater table may require positive dewatering.

7.0 GEOTECHNICAL DESIGN

7.1 SITE PREPARATION AND GRADING

7.1.1 Grading Overview

The current grading plan indicates that up to about 3 m of fill will be required at the east and west ends of the site. A cut of up to about 3 m will be made in the central portion of the site. Up to about 1 m of soil will be cut from the bottom of the dry SWM facility, at the northwest end of the site. Areas of existing fill, such as at BH03-17 will require subexcavation as part of the area grading activities.

7.1.2 Erosion & Sediment Control and Regulatory Constraints

An erosion and sediment control plan should be developed and implemented prior to commencement of construction, to direct precipitation and ground surface runoff away from the areas of construction. Identification of an outfall/discharge location will be required for this purpose. All erosion sedimentation control should be conducted in accordance to the approved for construction design drawings.

7.1.3 Sub-Excavation and Proof Rolling

Subexcavation of existing fill will be required. Existing fill was found in a borehole positioned in an area previously occupied by a pond (BH03-17). The fill was 2.4 m thick at this location.

Groundwater may be perched in the fill depending on the time of year of the work. Moderate seepage may be expected from excavations in this area.

The areas of stripping and any areas of engineered fill are to be inspected by geotechnical personnel to ensure that all unsuitable materials are removed. Any soft zones or remaining unsuitable soil identified during site preparation or during general construction activities, are to be removed and replaced with approved Engineered Fill, as referenced below.

The exposed sub-grade surface should be proof rolled and compacted across the entire area of the planned development. The proof rolling program should be undertaken using large, vibratory compaction equipment having a minimum static weight of 10 tonnes.

7.1.4 Grading and Earthworks

Fill will be required in the east and west ends of the site; and, and in areas where existing fill is subexcavated. Fill required to backfill localized sub-excavations or for use as engineered fill to raise the site grades should consist of approved select portions of the native materials or imported granular soils

that conform to the requirements of Ontario Provincial Standard Specification (OPSS) Select Subgrade Material (SSM) or Granular 'B' Type I. Further comment in this regard are provided below in Section 8.3.

All engineered fill material should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

Fill below paved areas should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

7.2 FOUNDATIONS

7.2.1 General Foundation Overview

Given the conditions encountered in the boreholes, the use of conventional spread and strip footing foundations should provide a practical approach for the residential development.

7.2.2 Foundation Design Parameters

Subject to preparing the Study Area in accordance with the recommendations provided above, the preliminary Ultimate Limit States (ULS) and the geotechnical reaction at Serviceability Limit States (SLS) provided below in Table 7.1 may be considered for use in design of conventional shallow foundations founded on engineered fill and/or native soils.

Table 7.1 Geotechnical Bearing Reactions and Resistances for Design of Conventional Foundations

Ultimate Limit States (kPa)	Serviceability Limit States (kPa)
225	150

7.2.3 Foundation Design Commentary

The geotechnical bearing resistance, ULS incorporates a resistance factor of 0.5. The geotechnical reaction, SLS, is the bearing pressure that corresponds to 25 mm of total settlement.

In some cases, the design grades in combination with the prevailing soil conditions may result in foundations being placed on a combination of the native soils and engineered fill. Typically, placing foundations on a combination of soils is considered to pose a risk due to the different behaviors of native soils and fill materials. As such, it is preferred to place the foundations on only one soil/fill type.

If foundation excavations need to be deepened beyond the intended founding depth, either the height of the foundation walls will need to be increased or the excavation will need to be backfilled to the design

founding depth with lean mix concrete. The placement and material specifications for the lean mix concrete should be in accordance with OPSS 1359.

All perimeter footings for heated structures should be protected from frost action by a minimum soil cover of 1.2 m. Where footings have insufficient soil cover for frost protection, the use of manufactured insulation will be required.

7.2.4 Foundation Wall Backfill

The exteriors of foundation walls should be backfilled with free-draining granular material such as OPSS Granular B Type 1. If native soils are used for backfilling of foundations, then a manufactured drainage layer must be utilized on the outside face of the foundation wall.

The exterior (perimeter) wall backfill should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 95% of the material's SPMDD. Care should be taken immediately adjacent to existing foundation walls to avoid over-compaction of the soil which could result in damage to the walls

7.3 SEISMIC SITE CLASS

The selection of the seismic site classification is based on the soil conditions encountered in the upper 30 m of the stratigraphy. For this project, the boreholes were terminated at a maximum depth of 8.2 m. The stratigraphy below this depth has therefore been interpreted based on the conditions encountered, supplemented by the conditions described on the regional geological maps and from the Ontario MOE Water Well Records electronic database.

Based on the conditions encountered in the boreholes, the recommended site classification for seismic site response for this Study Area is Site Class D in accordance with Table 4.1.8.4.A of the 2010 National Building Code (NBC).

7.4 PAVEMENT DESIGN RECOMMENDATIONS

A public road and private roads for the multi-family block will be constructed as part of the development. Parking areas will also be constructed in the multi-family block. The sub-grade within the road right-of-way, driveway and parking areas should be prepared as outlined in Section 7.1.

It has been assumed that the pavement in the multi-family block will be used by both passenger vehicles and truck traffic. No traffic study or traffic counts were available at the time of this report. The following pavement designs are recommended based on the anticipated loading and subgrade conditions, and City of Guelph requirements for residential roads.

Table 7.2 Recommended Pavement Structure

Material	Design Pavement Structure Thicknesses (mm)		
	Public Roads	Private Roads	Parking Areas
Superpave 12.5 or HL3 PG 64-28 Top course	40	35	35
Superpave 19.0 or HL8 PG 64-28 Base course	50	50	50
OPSS Granular 'A' Base	175	150	150
OPSS Granular 'B' Sub-base	350	350	300

The design for the roadways should provide a pavement service life in the order of 15 years, although operation and maintenance efforts will be required during the life cycle of the pavements.

The finished sub-grade surface and the pavement surface should be crowned and graded to direct runoff water away from the development and associated infrastructure.

The base and sub-base materials should be compacted to a minimum of 100% SPMDD. The asphaltic concrete should be compacted to a minimum of 92.0% of Maximum Relative Density (MRD) for all asphalt types with the exception of SuperPave 19.0 which should be compacted to at a minimum of 91.0% of MRD.

Sub drains are recommended at the site, since the sub-grade soil anticipated will predominantly comprise silty glacial till soils. The pavement subdrains should comprise 100 mm or 150 mm perforated corrugated pipe in filter sock, bedded in concrete sand outletted to the catch basins. The subdrains should be positioned such that the top of subdrain bedding is at the lower limit of the Granular 'B' subbase. The subgrade below the Granular 'B' subbase should be sloped towards the subdrain locations. Because of this, along roads crowned at the centre, subdrains are typically installed below the curb line.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 TEMPORARY EXCAVATIONS

It is anticipated that the depth of excavations will vary for the proposed scope of work. Shallow excavations are likely to be required for foundations whereas deeper excavations may be required for servicing.

Temporary open cut excavations should be conducted in accordance with the requirements of the Occupational Health & Safety Act & Regulations (OH&S Act) for Construction Projects.

The undisturbed native soils at this site and engineered fill materials should be considered to be Type 3 soils in accordance with the OH&S Act. Temporary excavations in these soils should be sloped at 1H:1V (horizontal to vertical) from the base of the excavation or top of the trench box.

Where the native soils extend below the static groundwater level, these materials and soils must be considered to be Type 4 soils in accordance with the OHSA. Unsupported excavation sidewalls in Type 4 soils must be 3H: 1V or flatter, from the base of the excavation.

Some sloughing and caving must be anticipated for excavations in the silty sand, sand and gravel, and silt, particularly where excess moisture (precipitation, ground surface runoff and the groundwater table) is present.

Based on groundwater information from the Hydrogeological Investigation, and the proposed sewer inverts, some of the excavations for the sewers may extend below the seasonal high groundwater level, potentially requiring the use of positive dewatering.

8.2 DEWATERING

A hydrogeological Investigation was completed by Stantec in conjunction with the geotechnical investigation. Results of the hydrogeological investigation report are provided under separate cover for additional details related to groundwater and dewatering.

8.3 REUSE OF ONSITE SOILS

8.3.1 Existing Fill

The existing fill encountered at BH03-17 contained clay. This material may be considered for reuse below paved areas or in landscaped areas. Some moisture conditioning may be required, which could make use problematic during wet or cold weather.

8.3.2 Topsoil

Topsoil may be re-used in landscaped areas. Any excess topsoil should be removed from site.

8.3.3 Sand

These soils are generally considered suitable for reuse as bulk fill for paved areas, engineered fill below structures, and as backfill in excavations to the finished sub-grade level.

This material should be placed with moisture contents that are within +/- 2.0% of the optimum moisture content level. It is recommended that the material be approved at the time of placement by qualified geotechnical personnel.

This material is assessed as having low frost susceptibility in accordance in accordance to Section 3.1.5 of the MTO's Pavement Design and Rehabilitation Manual.

This material may have variable silt content. Additional testing would be needed if this material is to be considered for use in applications where free-draining soils are required, such as for drainage layers, or foundation wall backfill.

8.3.4 Glacial Till

These soils are generally considered suitable for reuse as bulk fill for paved areas, engineered fill below structures, and as backfill in excavations to the finished sub-grade level.

The results of the gradation analyses on these materials indicate that the glacial till has a high percentage of silt and clay size particles. The glacial till may be difficult to handle, place, and compact in “less-than-ideal” weather conditions. Disturbance and loss of strength in the presence of excess moisture and/or construction traffic is a concern. It is recommended that reuse of this soil be scheduled for times of year that are typically warm and dry.

This material should be placed with moisture contents that are within +/- 2.0% of the optimum moisture content level. It is recommended that the material be approved at the time of placement by qualified geotechnical personnel. Due to the high in-situ moisture content of the glacial till soils, scarifying and drying may be required prior to placement.

This material is assessed as having moderate to high frost susceptibility in accordance in accordance to Section 3.1.5 of the MTO’s Pavement Design and Rehabilitation Manual.

This material should not be considered as free-draining. Therefore, this soil should not be used as backfill in any application requiring the use of free draining material, such as for drainage layers, foundation wall backfill, service pipe bedding, or subbase and base layers in pavements.

8.4 IMPORTING AND EXPORTING SOIL MATERIALS

8.4.1 Overview

Excess soils intended for off-site disposal will be subject to environmental requirements as stated by the MOECC.

All fill materials imported to the site must meet all applicable municipal, provincial, and federal guidelines and requirements associated with environmental characterization of the materials.

Imported fill materials should contain no recycled materials such as concrete or asphalt. The imported fill material intended for this purpose should be tested and approved by the Geotechnical Engineer prior to delivery to the site.

8.4.2 Engineered Fill

It is presumed that this construction project may require some amount of imported fill material required to develop the design grades for the development depending on the usability of the excavated materials at the time of construction. It is recommended that imported fill material for the purpose of placement as

"engineered fill" comprise imported sand or sand and gravel, preferably meeting the requirements of OPSS 1010 Granular 'B' or OPSS 1010 Select Subgrade Material (SSM).

8.5 BEDDING AND BACKFILL

8.5.1 Service Pipe Bedding

Bedding for services should consist of OPSS Granular 'A' material. In general, a minimum of 150 mm of bedding and 300 mm of cover material is recommended.

The bedding and cover material should be compacted to achieve a minimum of 100% of the material's SPMDD.

These recommendations should be confirmed with the pipe manufacturer and care must be taken to avoid incurring damage to the services. Pipe manufactures may have additional/alternative requirements that should be reviewed by the Designer and Contractor prior to installation of the services.

8.5.2 Service Trench Backfill

Service trench backfill placed over the pipe bedding and cover material can consist of the excavated native soils, or approved imported backfill, subject to inspection and approval by the geotechnical consultant to confirm the condition at the time of backfilling. Any wet soils may not be suitable for use as backfill without first being allowed to dry. Due to this, some native soils may not be suitable for re-use as trench backfill during wet weather. The comments provided above with respect to the reuse of the native soils apply in this respect.

The trench backfill should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

8.5.3 Municipal Infrastructure Backfilling

Where manholes and catchbasins are required for the sewer or reinstatement of existing manholes and catch basins is required, these components should be constructed and backfilled in accordance with specifications outlined in OPSS 407: Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation.

Settlements around manholes are common, and the settlements can be reduced by backfilling immediately around the manhole structure using OPSS Granular B material.

8.6 SOIL CORROSIVITY POTENTIAL

One (1) soil sample was submitted to AGAT Laboratories in Mississauga, Ontario, for analysis of pH, soil conductivity and redox potential, and concentrations of sulphides. The purpose of the testing was to evaluate the potential for corrosion of ductile iron pipe in contact with the soil and groundwater at the site,

consistent with the methods described by ANSI/AWWA. The test results are summarized in the table below.

Table 8.1 Results of Chemical Analysis and ANSI/AWWA Soil Corrosivity Potential

Borehole No.	BH04-17	
Sample No.	SS2	
Median Depth (m)	1.1	
Parameter	**Measured Value**	**ANSI / ASSA Point Rating**
Resistivity (Ohm-cm)	10000	0
pH	8.60	3
Redox Potential (mV)	287	0
Sulphides (%)	<0.05	0
Moisture	Fair	1
Total ANSI / AWWA Points	**4**	

The ANSI/AWWA rating system considers a score of 10 points or more indicative of the potential for corrosion of buried steel (less than 10 points indicates no potential for corrosion of buried steel). Based on the ANSI/AWWA rating system, the soil samples tested have little potential for corrosion.

It is noted that other factors may influence the corrosion potential, such as the application of deicing salts that leach into the soil, or the presence of stray electrical currents.

8.7 FOUNDATIONS

The base of all footing excavations should be inspected by geotechnical personnel prior to placing concrete to confirm the founding conditions are consistent with the recommendations described herein, and to ensure that there is no disturbance of the soil at the founding surface. Any deleterious materials, organics, or loose/soft or wet conditions observed, should be sub-excavated and removed and the excavations backfilled with engineered fill in accordance with the recommendations provided herein.

Where construction is undertaken during winter conditions, the subgrade at the founding elevation and below, must be protected from freezing at all times.

8.8 SURFACE WATER MANAGEMENT

8.8.1 Storm Water Management Facility

A dry storm water management facility is proposed to be constructed at the northwest end of the site as part of the proposed development. The proposed bottom of pond elevation ranges from Elevation 333.0 to 333.5 m.

The soil conditions in the borehole closest to the proposed dry SWM facility comprises surficial topsoil overlying a native sand deposit to a depth of over 4 m below existing grade. Groundwater level measurements show the seasonal high groundwater level is around Elevation 333.3 m These conditions indicate that the facility will be suitable for infiltration of collected water, except during the time of year where groundwater levels are high.

8.8.2 Infiltration Galleries

Infiltration galleries will also be used at this site. The predominant glacial till soils at this site are silty. Infiltration galleries could still be designed and constructed as long as they are positioned above the groundwater table, sized using a suitably low infiltration rate, and provided with subsurface overflows connected to suitable frost-free outlets, such as a storm sewer.

Hydraulic conductivity for the predominant native materials on site is provided below in Table 8.2. These numbers were obtained from supplementary standard B-6 to the Ontario Building Code.

Table 8.2 Percolation Time and Coefficient of Permeability Estimates

Native Soil Type	Estimated Percolation Time (T) (minutes/cm)	Estimated Coefficient of Permeability (K) (cm/sec)
Glacial Till	8 to 50	$1x10^{-3}$ to $1x10^{-6}$
Sand	8 to 20	$1x10^{-3}$ to $1x10^{-5}$

As per City of Guelph guidelines, it is recommended that the infiltration rates be confirmed by in-situ tests methods, such as the double-ring infiltrometer.

We refer to the Stormwater Management Report, completed by Stantec under separate cover, for additional information on stormwater management for this site.

8.9 RADON GAS

Radon gas is a radioactive gas that is produced naturally. It is known that there are areas of Guelph where residential houses have recorded concentrations of radon gas over the Canadian Guidelines for indoor air. As the concentration of radon gas in a home is a result of a combination of factors, including the underlying soil conditions, air pressure differentials, and the air tightness of the house construction, it is recommended that basements in houses at this development be tested for radon gas concentration following construction. Any issues with radon concentrations above the Canadian Guidelines should be referred to a Radon Mitigation Professional.

9.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided on the following page. It is the responsibility of Rockpoint Properties Inc. who is identified as “the Client” within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report;
- Basis of the report;
- Standard of care;
- Interpretation of site conditions;
- Varying or unexpected site conditions; and,
- Planning, design or construction.

This report has been prepared by Jeff Dietz and reviewed by Peter Healy.

Respectfully submitted;

STANTEC CONSULTING LTD.

REPORT

Appendix A
June 12, 2019

APPENDICES

Appendix A

A.1 STATEMENT OF GENERAL CONDITIONS

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

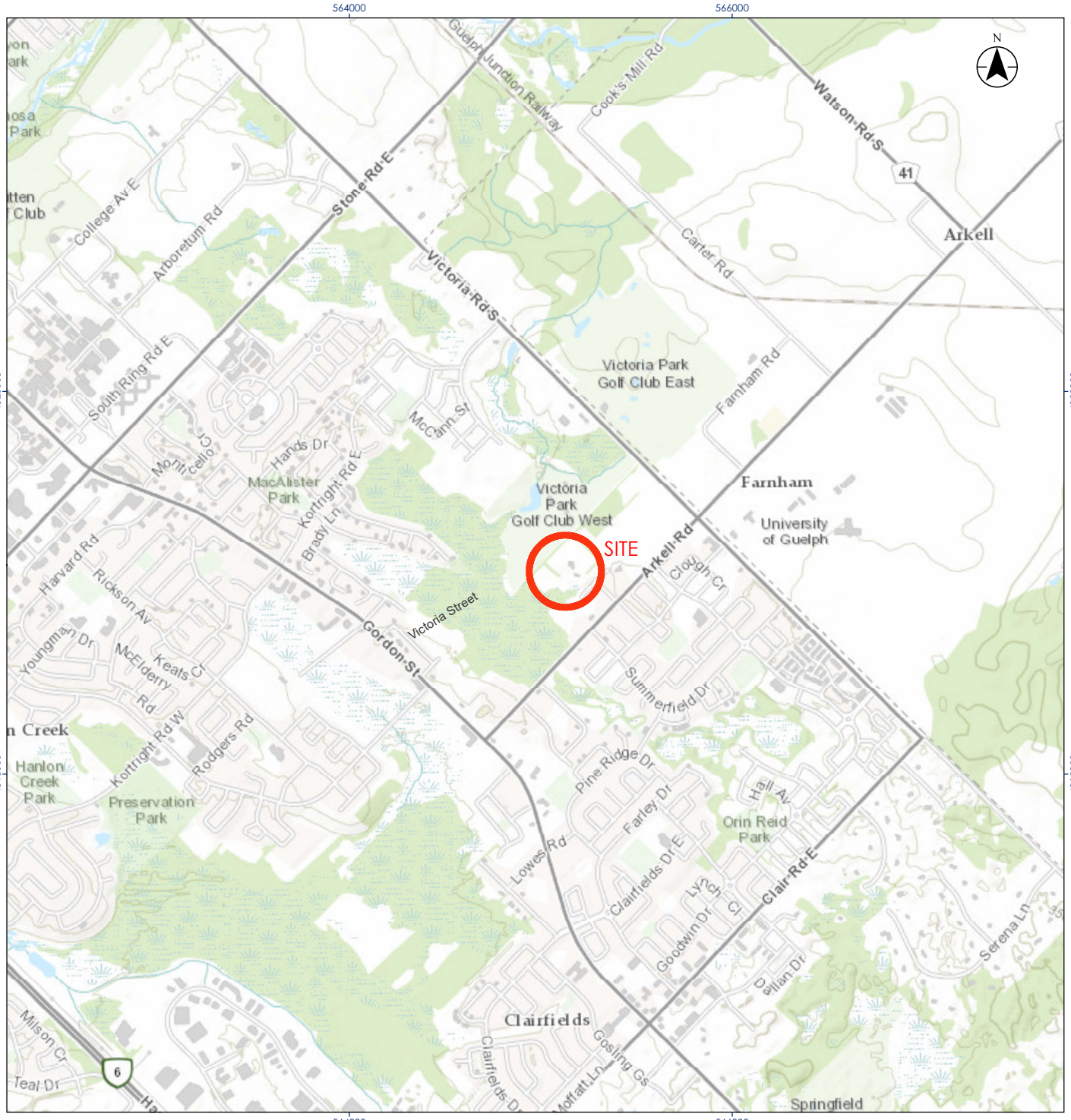
VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

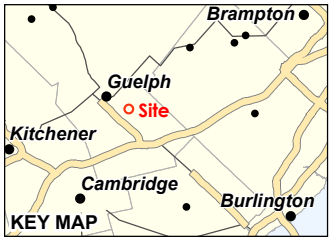
PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

Appendix B

B.1 DRAWINGS

T:\Autocad\Drawings\Project Drawings\2019\161413338\Key Plan (gis)\161413338_Keyplan.mxd Revised: 2019-06-12 By: gbriones





Legend

Site Location

0 500 1,000 metres

1:30,000 (at original document size of 8.5x11)

Stantec

Project Location
220 Arkell Road
Guelph, Ontario

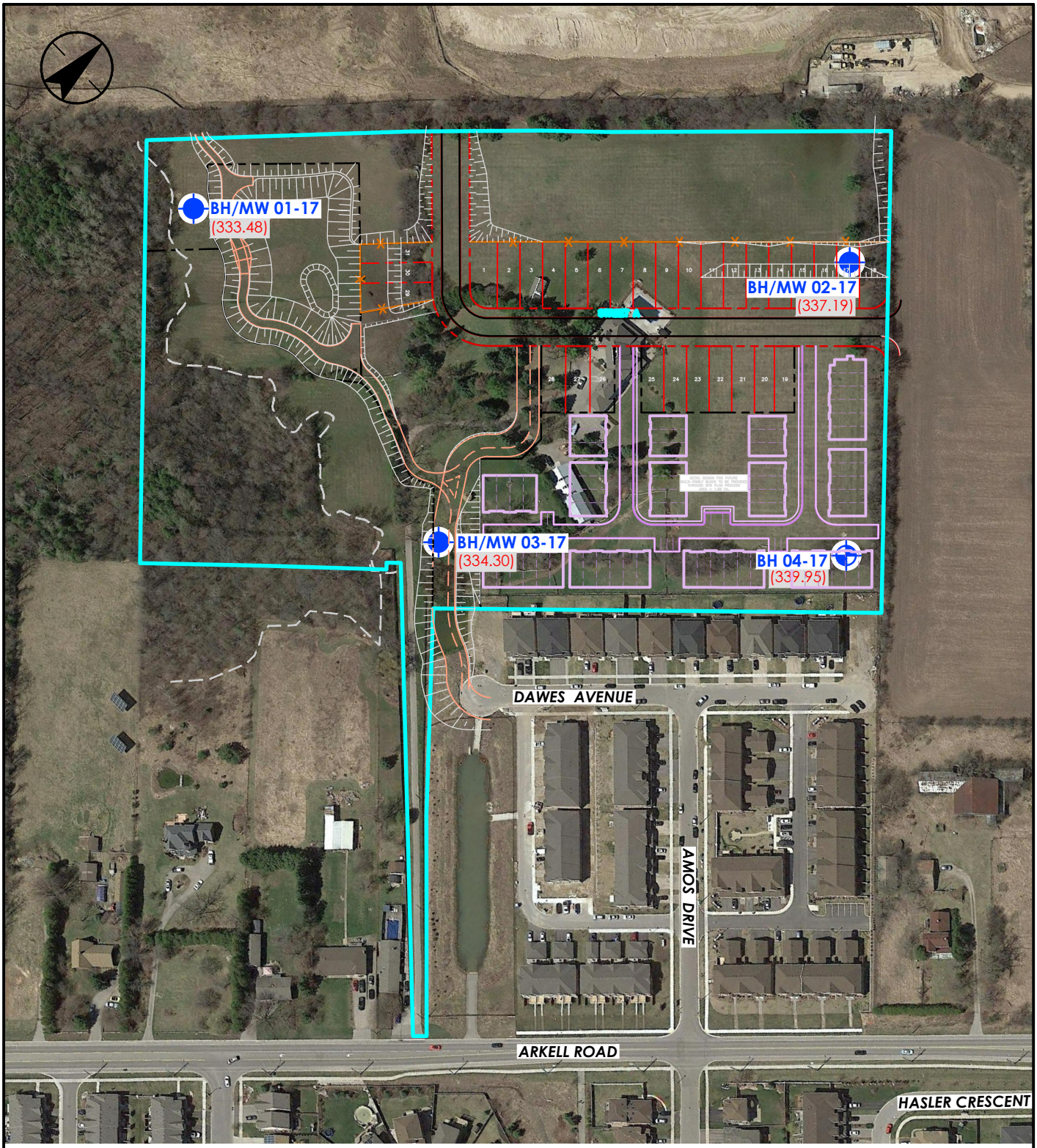
Project No. 121413338
Prepared by Gliceria Briones
on 2019-06-12

Client/Project
ROCKPOINT PROPERTIES INC.
GEOTECHNICAL INVESTIGATION

Drawing No.
1

Title
Key Plan

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Imagery provided by Esri ©2017.



25 m 0 25 50 m

1 : 2500

JUNE 2019
PROJECT No. 121613338

T:\Autocad\Drawings\Project Drawings\2019\161413338\161413338_Boreholes.dwg
2019/06/12 11:56 AM By: Briones, Gliceria

Stantec

400 - 1331 Clyde Avenue
Ottawa, ON, Canada K2C 3G4
www.stantec.com

LEGEND

APPROXIMATE BOREHOLE LOCATION

APPROXIMATE BOREHOLE WITH MONITORING WELL LOCATION

(337.19) GROUND SURFACE ELEVATION (m)

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17.
2. IMAGERY: SCREENSHOT FROM GOOGLE EARTH ©2017.

Client/Project

ROCKPOINT PROPERTIES INC.
GEOTECHNICAL INVESTIGATION
220 ARKELL ROAD, GUELPH, ONTARIO

Drawing No.

2

Title

BOREHOLE LOCATION PLAN

Appendix C

C.1 SYMBOLS & TERMS USED ON BOREHOLE RECORDS

C.2 BOREHOLE RECORDS

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization 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 successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

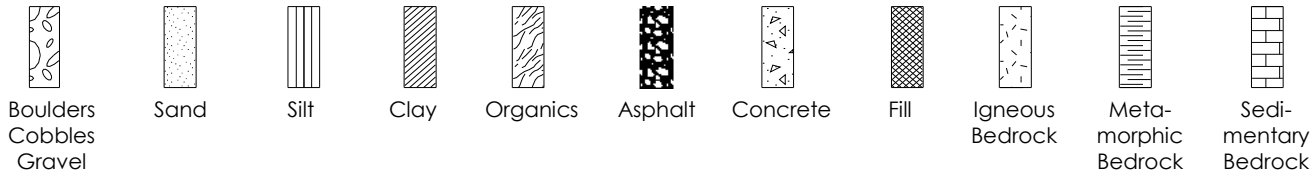
Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

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BOREHOLE RECORD

N: 4 819 008 E: 564 970

BH01-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 334.36

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	333.5	**Grass Field**
	333.2	300 mm TOPSOIL
1		Loose to compact, brown, SAND (SM) - trace gravel and silt - wet
2		
3		- grey, some silt
4	329.4	
		Very dense, grey, Silty Sand with Gravel (SM) TILL - wet
5	328.3	
		END OF BOREHOLE at approximately 5.2 m below existing grade. Water level measured at 2.1 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.
6		
7		
8		
9		
10		
11		
12		

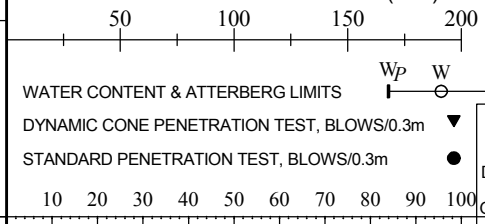
STRATA PLOT

WATER LEVEL

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	280/610	6
3	SS	2	250/610	9
6	SS	3	100/610	17
9	SS	4	230/610	21
11	SS	5	460/610	5
16	SS	6	380/610	54

SAMPLES

UNDRAINED SHEAR STRENGTH (kPa)



REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 819 204 E: 565 193

BH02-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 338.12

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
	337.2	**Grass Field**
	336.9	280 mm TOPSOIL
		Compact, brown, SAND (SM) - trace gravel and silt - moist
	335.8	
		Loose, brown, Silty Sand (SM) TILL - wet
		- very dense, moist
		- grey
		- auger grinding
		- auger grinding
		- moist to wet
	330.0	
		Hard, grey, Silty Clay (CL) TILL - trace gravel - moist
	329.3	
		END OF BOREHOLE at approximately 7.9 m below existing grade. Water level measured at 2.3 below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.

STRATA PLOT

WATER LEVEL: ▽

SAMPLES

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	200/610	5
3	SS	2	51/610	11
6	SS	3	100/610	7
8	SS	4	250/250	50/100
10	SS	5	230/230	50/76
15	SS	6	250/280	50/130
20	SS	7	76/76	50/76
25	SS	8	280/280	50/130

UNDRAINED SHEAR STRENGTH (kPa) 50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
	6	38	42	14

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 818 983 E: 565 155

BH03-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 335.26

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	**334.3**	**Grass Field**			0					
	334.0	FILL: 300 mm TOPSOIL			1	SS	1	460/610	8	
1	332.9	FILL: brown silty sand, some clay, trace gravel - moist			3	SS	2	200/610	8	
2	331.9	FILL: brown sandy silty clay, trace gravel - moist		▽	6	SS	3	250/610	6	
3		Compact, brown, Silty Sand with Gravel (SM) TILL - moist to saturated			9	SS	4	25/610	25	
					11	SS	5	300/610	26	23 28 41 8
5	329.1				16	SS	6	430/610	28	
6		END OF BOREHOLE at approximately 5.2 m below existing grade.								
7		Water level measured at 2.4 m below grade on completion of drilling.								
8		Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.								
9										
10										
11										
12										

UNDRAINED SHEAR STRENGTH (kPa): 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS: W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 819 111 E: 565 287

BH04-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 340.86

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	340.0	**Grass Field**
	339.7	280 mm TOPSOIL
	339.3	Loose, brown, SAND (SM) - some gravel, trace silt - wet
1		Compact to very dense, brown, Silty Sand with Gravel (SM) TILL - moist
2		
3		
4		
5		
6		- wet
7		
8	331.8	
		END OF BOREHOLE at approximately 8.2 m below existing grade. Water level measured at 6.4 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 4.6 m to 7.6 m below grade.
9		
10		
11		
12		

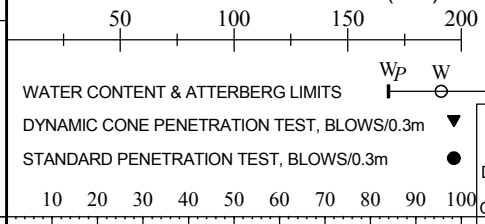
STRATA PLOT

WATER LEVEL

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	1	230/610	8	
3	SS	2	460/610	11	
6	SS	3	430/610	26	
8	SS	4	460/610	67	18 36 37 9
11	SS	5	460/610	87	
15	SS	6	250/250	50/100	27 32 32 9
20	SS	7	130/130	50/130	
26	SS	8	460/610	84	

SAMPLES

UNDRAINED SHEAR STRENGTH (kPa)



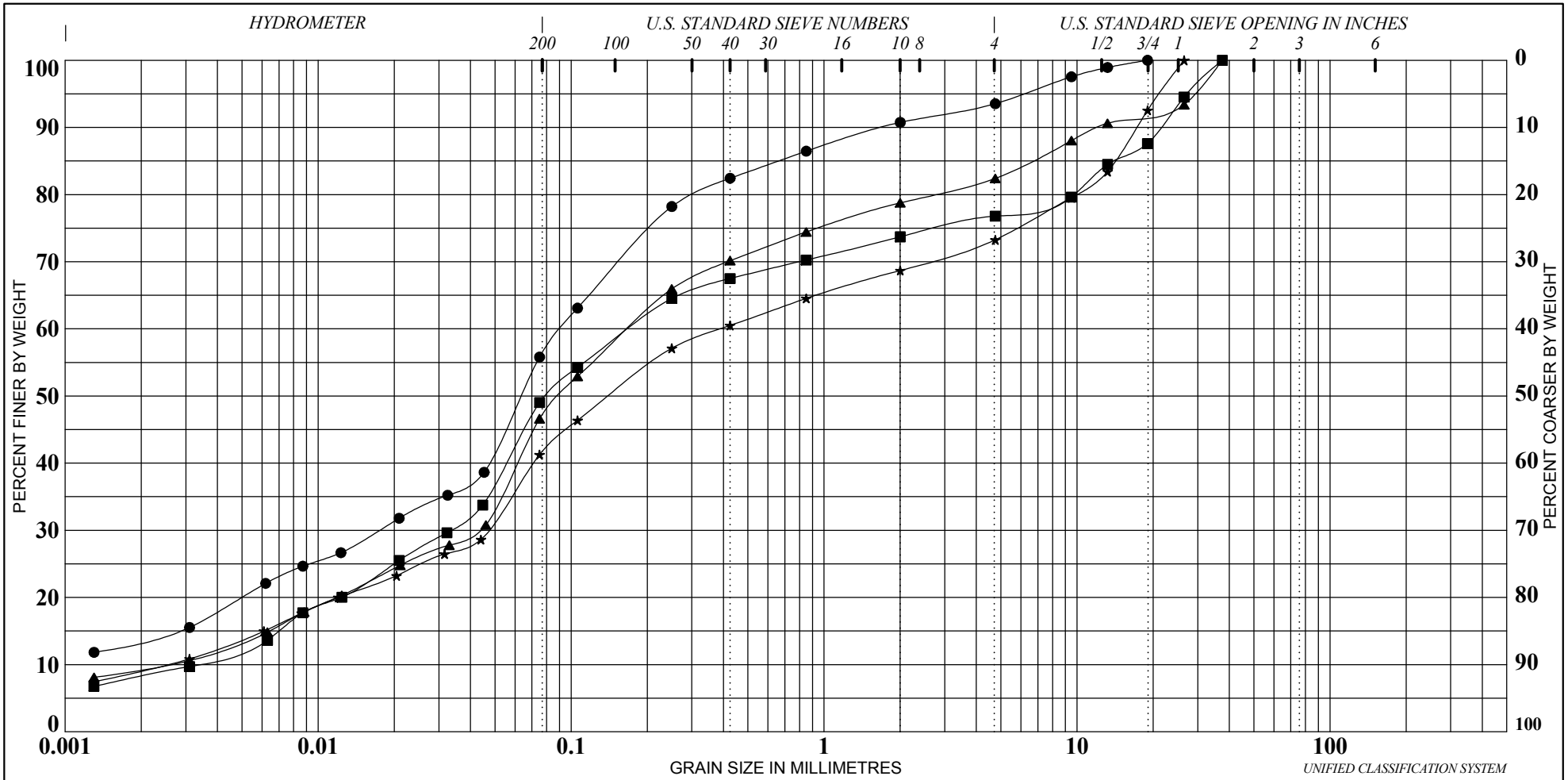
□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Appendix D

D.1 LABORATORY TEST RESULTS



SILT & CLAY		SAND			GRAVEL		COBBLES	BLDs
CLAY	SILT	fine	medium	coarse	fine	coarse		

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH02-17	3.2	Silty Sand (SM) TILL	8				6	38	42	14
■ BH03-17	3.4	Silty Sand with Gravel (SM) TILL					23	28	41	8
▲ BH04-17	2.6	Silty Sand with Gravel (SM) TILL	6				18	36	37	9
★ BH04-17	4.7	Silty Sand with Gravel (SM) TILL	6				27	32	32	9

Stantec

Project: Arkell Road

Location: 220 Arkell Road, Guelph, ON

Project No.: 161413338

GRADATION CURVE (ASTM D422)

Figure: 1

Remarks:

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD
100 - 300 HAGEY BOULEVARD
WATERLOO, ON N2L0A4
(519) 579-4410

ATTENTION TO: Jeff Dietz

PROJECT: 161413338-220 Arkell

AGAT WORK ORDER: 17W204004

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Apr 17, 2017

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17W204004

PROJECT: 161413338-220 Arkell

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Jeff Dietz

SAMPLING SITE:Guelph, ON

SAMPLED BY:RS

Corrosivity Package

DATE RECEIVED: 2017-04-07

DATE REPORTED: 2017-04-17

		SAMPLE DESCRIPTION:		BH04-17 2.5-4.5'
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2017-04-05
Parameter	Unit	G / S	RDL	8306282
*Sulphide	%		0.05	<0.05
Chloride (2:1)	µg/g		2	4
Sulphate (2:1)	µg/g		2	<2
pH (2:1)	pH Units		NA	8.60
Electrical Conductivity (2:1)	mS/cm		0.005	0.100
Resistivity (2:1)	ohm.cm		1	10000
Redox Potential (2:1)	mV		5	287

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8306282 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT Vancouver

Certified By: Amanjot Bhela

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

PROJECT: 161413338-220 Arkell

SAMPLING SITE:Guelph, ON

AGAT WORK ORDER: 17W204004

ATTENTION TO: Jeff Dietz

SAMPLED BY:RS

Soil Analysis

RPT Date: Apr 17, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
*Sulphide	8301141		<0.05	<0.05	NA	< 0.05	100%	80%	120%						
Chloride (2:1)	8306282	8306282	4	4	NA	< 2	99%	80%	120%	100%	80%	120%	102%	70%	130%
Sulphate (2:1)	8306282	8306282	<2	<2	NA	< 2	95%	80%	120%	105%	80%	120%	104%	70%	130%
pH (2:1)	8306282	8306282	8.60	8.57	0.3%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	8306282	8306282	0.100	0.100	0.0%	< 0.005	93%	90%	110%	NA			NA		
Redox Potential (2:1)	8306282	8306282	287	278	3.2%	< 5	105%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 17W204004

PROJECT: 161413338-220 Arkell

ATTENTION TO: Jeff Dietz

SAMPLING SITE:Guelph, ON

SAMPLED BY:RS

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
*Sulphide	INOR-181-6027	modified from ASTM E1915-11	COMBUSTION
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
www.agatlabs.com webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 17W204004

Cooler Quantity: 1 blk

Arrival Temperatures: 7.5 17.7 17.6 (ice pack)

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Stantec Consulting Ltd.
Contact: Jeff Dietz
Address: 100-300 Hagey Boulevard
Waterloo
Phone: 519 579 4410 Fax:
Reports to be sent to:
1. Email: jeff.dietz@stantec.com
2. Email:

Regulatory Requirements: ☑ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ (Indicate One)
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ (Indicate One)

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ (Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☑ No

Report Guideline on Certificate of Analysis ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 161413338 - 220 Arkell
Site Location: Guelph, ON
Sampled By: R Stroebel
AGAT Quote #: PO: 161413338
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company: Stantec Consulting Ltd.
Contact: Jeff Dietz
Address: 100-300 Hagey Blvd., Waterloo N2L 0A4
Email: jeff.dietz@stantec.com

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

(Check Applicable)

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cr ☐CN⁻ ☐Cr⁶⁺ ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	Corrosivity
BH 04-17 2.5-4.5'	Apr 5	N/A	1 bag	Soil																	X
		~~N/A~~	~~1 bag~~																		

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time	
B Frank	Apr 6/17		M. Verne M	2017/04/6	3:10 pm	Page 1 of 1
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time	Nº:
			Milan	Apr. 8/17	9:30 am	

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

APPENDIX E
Hydrogeological Assessment

Hydrogeological Assessment,
220 Arkell Road, Guelph, ON

FINAL REPORT

161413338

May 28, 2019

Prepared for:

Rockpoint Properties Inc.
195 Hanlon Creek Blvd.
Unit 100
Guelph ON N1C 0A1

Prepared by:

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4

This document entitled Hydrogeological Assessment, 220 Arkell Road, Guelph, ON was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Rockpoint Properties Inc. (the "Client") to support the permitting process for Client's application for a Draft Plan of Subdivision (the "Application") for 220 Arkell Road (the "Project"). In connection thereto, this document may be reviewed and used by the provincial and municipal government agencies participating in the permitting process in the normal course of their duties. Except as set forth in the previous sentence, any reliance on this document by any third party for any other purpose is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

PROFESSIONAL GEOSCIENTIST
TRACEY NICOLE SEMPER
PRACTISING MEMBER
0515
05/28/2019
ONTARIO

Prepared by _____
(signature)

T. Nicole Semper, B.Sc., P.Geo.
Senior Hydrogeologist

PROFESSIONAL GEOSCIENTIST
LIMITED MEMBER
GRANT S. WHITEHEAD
1774 MAY 28, 2019
ONTARIO

Reviewed by _____
(signature)

Grant Whitehead, MES, P.Geo. (Limited)
Senior Hydrogeologist

Table of Contents

LIST OF APPENDICES

Abbreviations

AMSL	above mean sea level
AO	Aesthetic Objectives
ASTM	American Society for Testing and Materials
BGS	below ground surface
EASR	Environmental Activity Sector Registry
GRCA	Grand River Conservation Area
GRIN	Grand River Information Network
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
GUDI	Groundwater Under the Direct Influence
HDPE	high-density polyethylene
HVA	Highly Vulnerable Aquifer
ID	inside diameter
IMAC	Interim Maximum Acceptable Criteria
IPZ	Intake Protection Zone
LID	Low Impact Development
LST	London Soil Test
MAC	Maximum Acceptable Criteria
Maxxam	Maxxam Analytics Inc.
MECP	Ontario Ministry of the Environment, Conservation and Parks

MNRF	Ministry of Natural Resources and Forestry
ODWS	Ontario Drinking Water Quality Standards
OG	Operational Guidelines
ORP	oxidation reduction potential
PSW	Provincially Significant Wetland
PTTW	Permit to Take Water
PVC	polyvinyl chloride
PWQOs	Provincial Water Quality Objectives
Site	220 Arkell Road, City of Guelph, Ontario
SGRA	Significant Groundwater Recharge Area
Stantec	Stantec Consulting Ltd.
SWM	stormwater management
WHPA	Well Head Protection Area
WWR	Water Well Record

1.0 INTRODUCTION

Rockpoint Properties Inc. retained Stantec Consulting Limited (Stantec) to complete a hydrogeological assessment for the lands located at 220 Arkell Road in the City of Guelph, Ontario (the Site) (Figure 1, Appendix A). The proposed Site development is to consist of single-family lots and a 1.72 hectare (ha) multiple-family residential block, which will be serviced by municipal sanitary sewer and water, utilities, storm drainage, and a stormwater management (SWM) facility. The Site covers an area of approximately 7.16 ha and is bounded by Victoria Park Village Subdivision to the north, existing woodlot and greenfield property to the east, Arkell Meadows Subdivision to the south, and the Torrance Creek Swamp to the west. A single-family residence and former horse pasture currently occupy the Site, which is accessed via a driveway connected to Arkell Road.

The information provided in this report is to support the Draft Plan Application. The objectives of the hydrogeological assessment are to:

- Characterize current geological and hydrogeological conditions at the Site, including a discussion of overburden and bedrock stratigraphy, hydrostratigraphic units, seasonal fluctuations in groundwater levels and hydraulic gradients, flow direction across the Site, soil infiltration potential, and groundwater quality conditions.
- Evaluate pre-development infiltration volumes at the Site and assess the impact that proposed land use changes could potentially have on these volumes under the post-development condition, including an evaluation of potential measures that could be employed throughout the Site under the post-development condition to mitigate these impacts.
- Assess whether proposed buildings, site servicing and associated construction activities will intercept the groundwater table and evaluate if any measures are required to mitigate potential disturbances to pre-development groundwater levels, flow patterns, and groundwater-surface water interactions.
- Evaluate whether proposed land use activities conform to Source Water Protection requirements as stipulated in the Clean Water Act, S.O. 2006, Chapter 22.

This report is arranged into eight sections, including this introduction (Section 1.0). Section 2.0 presents the Site's physical setting at a regional scale. Section 3.0 presents the methodology for investigations of site-specific hydrogeological conditions. Section 4.0 presents the result of the site-specific investigations. Section 5.0 presents a water balance analysis for the Site. Section 6.0 presents the potential impacts of the proposed development on the hydrogeological form and function of the Site and discusses potential mitigation measures for identified impacts. Report conclusions are provided in Section 7.0, with references listed in Section 8.0.

All figures and tables referenced in this report are presented in Appendices A and B, respectively. Appendices C to G include Regional Groundwater Flow Mapping, Vertical Hydraulic Gradient Mapping, Borehole Logs, Laboratory Certificates of Analysis, and Hydraulic Conductivity Testing Analytical Solutions, respectively.

2.0 PHYSICAL SETTING

2.1 PHYSIOGRAPHY AND TOPOGRAPHY

The Site is situated within the physiographic region referred to by Chapman and Putnam (1984) as the Guelph Drumlin Field. The Guelph Drumlin Field consists of a series of broad oval type hills with axes trending in a northwest to southeast direction (i.e., drumlins). The drumlins and associated till plain consist of stony, calcareous till derived from dolostone of the Goat Island and Gasport Formations (formerly referred to as the Amabel Formation) and consists of sand (50%; average content based on grain-size analysis completed on till samples), silt (35%) and clay (15%) (Chapman and Putnam, 1984). The drumlin groupings occur in swampy valleys that are flanked by terraced spillway channels of sand and gravel, which contain tributaries of the Grand River (e.g., Torrance Creek located north of the Site; Figure 2). Gravel ridges or eskers are also known to cut through the till plain in the same general direction of the drumlins.

The Site is located within the Torrance Creek subwatershed of the Grand River Watershed and within the boundary of the Grand River Conservation Authority (GRCA). The subwatershed is characterized by hummocky terrain associated with the drumlins and by the network of broad, relatively flat spillway channels that cut through the drumlin fields. As shown on in Figure 3, a topographic high point occurs within the southeastern portion of the Site at an elevation of 340 m AMSL (representing the peak of a drumlin), with the land sloping from this peak elevation to the north (337 m AMSL) and southwest (334 m AMSL) limits of the property. Surface water drainage from the Site follows two routes, with approximately 4.70 ha of the land draining to the southwest towards the Torrance Creek Swamp and the remaining land area (2.47 ha) flowing offsite via the northern corner of the property and discharging to an existing woodlot.

2.2 REGIONAL GEOLOGY AND HYDROSTRATIGRAPHY

Geological conditions within the region have been mapped and described by Matrix Solutions Inc. (2017), the Lake Erie Region Source Protection Committee (LERSPC, 2015a), Golder Associates Limited (2011), Totten Sims Hubicki Associates *et al.* (1998), and Jagger Hims Limited (1998). Based on these previous studies, overburden and bedrock geology near the Site is summarized as follows, listed from youngest to oldest:

Spillway Deposits: Glaciofluvial outwash and glaciolacustrine deposits of sand and gravel with minor silt and clay associated with the spillway channels (Figure 2; Unit 7).

Ice-Contact Deposits: Predominantly sand and gravel containing lenses of silt and clay left behind by the melting of enclosed ice blocks (i.e., eskers, kames) (Figure 2; Unit 6).

Port Stanley Till: An occasionally stony, silty sand to sandy silt till, forming the till plain and drumlins that characterize the region (Figure 2; Unit 5b). Some of the drumlins, however, can consist of an older clayey silt till core that is subsequently covered by a veneer of Port Stanley Till (Karrow, 1968). In areas south of the Speed River, the till plain is often covered by a layer of glaciofluvial and glaciolacustrine sediments (i.e., fine to silty sand, sandy silt, sand and gravel) deposited from melting glacier ice, with the till extending to the bedrock surface.

Bedrock: The Guelph Formation, representing the uppermost bedrock unit throughout the region is described as a light brown/beige coloured fossiliferous dolostone and an important aquifer in the Guelph area (Brunton, 2008).

2.3 REGIONAL HYDROGEOLOGY

Based on previous groundwater modeling work completed by Matrix Solutions Inc. (2017), the following aquifer and aquitard systems occur beneath the Site:

Upper Sand and Gravel Aquifer: an unconfined aquifer system consisting predominantly of outwash sand and gravel deposits. This unit is reported to have a horizontal hydraulic conductivity ranging from 7.0×10^{-4} m/s to 6.0×10^{-6} m/s, with the vertical hydraulic conductivity being one tenth (0.1) to an order (1.0) of magnitude lower than the horizontal hydraulic conductivity (Golder, 2011). Soil permeability testing using a Guelph Permeameter indicates that the sandy soils of this unit have vertical hydraulic conductivities in the range of 10^{-5} m/s (Totten Sims Hubicki Associates *et al.*, 1998).

Lower Till Aquitard: dense sandy to silty glacial till (i.e., Port Stanley Till) that is occasionally interbedded with discontinuous lenses of coarse sand and gravel. This unit is reported to have a horizontal hydraulic conductivity ranging from 1.0×10^{-4} m/s to 2.0×10^{-9} m/s, with the vertical hydraulic conductivity being one half (0.5) to an order (1.0) of magnitude lower than the horizontal hydraulic conductivity (Golder, 2011). Soil permeability testing using a Guelph Permeameter indicates that the silty to clayey soils of this unit have vertical hydraulic conductivities in the range of 10^{-5} m/s to 10^{-7} m/s (Totten Sims Hubicki Associates *et al.*, 1998).

Contact Zone Aquifer: coarse, unconsolidated granular deposits directly overlying, and hydraulically connected to, upper weathered/fractured bedrock. This unit typically forms a thin aquifer having an assumed thickness of four meters (two meters above and below bedrock surface) (Golder, 2011). This aquifer is reported to have a horizontal hydraulic conductivity ranging from 1.0×10^{-4} m/s to 1.0×10^{-5} m/s, with the vertical hydraulic conductivity being one half (0.5) to an order (1.0) of magnitude lower than the horizontal hydraulic conductivity (Golder, 2011).

Bedrock Aquifer: consisting of medium to thick bedded fossiliferous dolostone of the Guelph Formation. This unit is reported to have a horizontal hydraulic conductivity ranging from 8.0×10^{-3} m/s to 7.0×10^{-9} m/s, with the vertical hydraulic conductivity being one tenth (0.1) to an order (1.0) of magnitude lower than the horizontal hydraulic conductivity (Golder, 2011).

As presented in Figure 4.3 of Matrix Solutions Inc. (2017) (Appendix C), simulated water table surface elevations produced via a calibrated steady-state groundwater flow model suggests that groundwater moves to the northwest through the overburden aquifer located beneath the Site, eventually discharging to the Speed River.

Regionally, the lands containing the Site are characterized by groundwater recharge conditions. Mapping created using the Grand River Information Network (GRIN) (GRCA, 2018) indicates that downward vertical hydraulic gradients are present beneath the Site (Appendix D). According to the GRIN mapping, annual recharge rates across the Site range from 100 to 200 mm/year where surficial deposits of Port Stanley Till (silty sand to sandy silt till) are present and from 200 to 400 mm/year in those areas where spillway and/or ice-contact deposits of sand and gravel cover the property (Appendix D).

2.4 SOURCE WATER PROTECTION

As per the Approved Assessment Report for the Grand River Source Protection Area (LERSPC, 2015a), the Site is located within the Well Head Protection Area (WHPA) for the Burke Municipal Production Well (Burke Well), with this production well located approximately 200 m to the south of the Site (Figure 4; MECP, 2018). Specifically, the Site is intercepted by the Burke Well WHPA-B, representing an area where it takes two years or less for precipitation to infiltrate to the underlying aquifer system and flow through this aquifer to the production well intake. The WHPA-B has an assigned vulnerability score of eight (8), indicating that groundwater beneath the Site is at medium risk to contamination from drinking-water threats (i.e., an activity or existing condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water).

The western portion of the Site lies within the WHPA-E (vulnerability score of 7.2; MECP, 2018) of the Carter Municipal Production Wells (Carter Wells), with these wells being classified as Groundwater Under the Direct Influence (GUDI) of surface water (i.e., a surface water source has a direct connection to the groundwater system and is drawn into the production well during pumping). The extents of the WHPA-E are equivalent to the area of an Intake Protection Zone (IPZ); that is, a capture zone delineated for those drinking-water systems that obtain their potable water from surface water bodies. The WHPA-E is equivalent to an IPZ-2 and for the Carter Wells, represents the upstream length of Torrance Creek where surface water will take less than two hours to travel along this watercourse to the intake of these production wells.

The Site is also designated as a Significant Groundwater Recharge Area (SGRA) having a medium vulnerability score of four (4); however, the Site is not classified as Highly Vulnerable Aquifer (HVA) (MECP, 2018).

3.0 METHODOLOGY

The hydrogeological site investigation included the:

- drilling of boreholes
- installing of monitoring wells
- installing of drive-point piezometers
- monitoring of groundwater levels
- collecting groundwater samples for quality testing
- performing of hydraulic response (hydraulic conductivity) testing

The methodology for these tasks is described in Section 3.1 to 3.6 below.

3.1 BOREHOLE DRILLING

Four boreholes (BH01-17 to BH04-17) were advanced at the Site on April 5, 2017 as part of the geotechnical (Stantec, 2017) and hydrogeological investigations. The boreholes were strategically located to obtain spatially representative soil and groundwater samples beneath the property. Borehole locations are shown on Figure 1.

Drilling services were provided by London Soil Test Limited (LST) who used a Diedrich D50 drill rig equipped with a hollow stem auger drilling system to advance the boreholes. Boreholes were advanced to maximum depths of 5.2 m to 8.2 m BGS, and soil samples were collected using a 0.6 m long stainless steel split spoon sampler at intervals of 0.76 m from the existing grade to at least 3.0 m BGS, and intervals of 1.5 m thereafter.

Stantec personnel were onsite during drilling to log soil samples using the *American Society for Testing and Materials (ASTM) Standard D2488 00 - Guidelines for the Manual Description and Identification of Soils* (ASTM, 2000). Borehole logs were prepared for each drilling location, containing descriptions of type, texture, colour, structure, consistency, plasticity, and moisture content of soil samples. Soil samples were collected in field for subsequent grain size analysis. Copies of the borehole logs are provided in Appendix E.

3.2 MONITORING WELL INSTALLATIONS

A single monitoring well was installed at each borehole location in accordance with *Revised Regulations of Ontario (R.R.O) 1990*, *Regulation 903: Wells* (MOE, 1990). The monitoring wells (i.e. MW01-17, MW02-17, MW03-17 and MW04-17) were installed to confirm local water table elevations, groundwater flow direction, and seasonal trends in groundwater fluctuations.

Each monitoring well is constructed with a 51 mm inside diameter (ID), Schedule 40 polyvinyl chloride (PVC) pipe, with a No. 10 slot screen (0.01 inch slot) that was 3.0 m long. The annular space between the monitoring well pipe and surrounding soil was backfilled with No.2 grade silica sand to approximately 0.3 m above the top of screen. The annular space was then filled with granular bentonite to 0.3 m BGS to prevent a hydraulic connection from occurring between the screened formation and those above. The monitoring wells were completed with above ground lockable protective steel casings that were cemented into place to 0.3 m BGS. The elevation of the existing grade and top-of-pipe at each monitoring well was surveyed to a geodetic benchmark by the Geomatics division of Stantec. Well construction details and survey data are summarized in Table 1 (Appendix B).

3.3 DRIVE-POINT PIEZOMETER INSTALLATIONS

On April 13, 2017, Stantec personnel installed one multi-level drive-point piezometer nest, consisting of a shallow and a deep piezometer (i.e. DP1-17(S) and DP1-17(D)), within a section of the Torrance Creek Swamp extending into south-central portion of the Site (Figure 1). The piezometer nest was installed to evaluate whether this wetland area functions as a groundwater recharge feature (i.e., contributes water to subsurface), discharge feature (receives water from the subsurface), or a combination of both.

Each drive-point piezometer is constructed of a 0.42 m long steel screen (19 mm diameter) that is connected to 25 mm diameter steel riser pipes. Stantec personnel drove the drive-point piezometers into the substrate using a fence post driver, with shallow and deep pipes being constructed within one meter of each other and their screens being separated by a vertical distance of approximately 1.3 m. Construction details for the drive-point piezometers are summarized in Table 1.

3.4 GROUNDWATER LEVEL MONITORING

Groundwater levels were recorded at the monitoring well and piezometer locations from April 2017 to May 2018 using a combination of automated and manual measurement methods. Solinst® Edge Leveloggers® (Leveloggers) were installed at all monitoring well and piezometer locations in April 2017 to allow automatic measurement of water levels. The Leveloggers were suspended into the water column at each monitoring well and drive-point piezometer and set to record water levels at 60-minute intervals. Leveloggers are not vented to the atmosphere and therefore record total pressure (where total pressure is the sum of the atmospheric pressure and the height of water column). To obtain an accurate measurement of the groundwater level at each well, the water level data obtained from the Leveloggers were corrected for atmospheric pressure using data obtained from a Solinst® Edge Barologger® (Barologger), which was suspended in the air column at monitoring well MW03-17.

Groundwater levels were manually measured at the Site in April and September 2017, and in February and May 2018. The groundwater level measurements were recorded in metres to the nearest 0.01 m using a battery-operated water level indicator. Manual groundwater level measurements were used to verify data recorded by the Leveloggers. Manual water levels collected from the monitoring wells and drive-point piezometers are presented in Tables 2 and 3, respectively. Hydrographs presenting both the automatic and manually measured groundwater level data are provided in Figure 6.

3.5 GROUNDWATER SAMPLING AND TESTING

The monitoring wells were developed following well installation between April 12 and 13, 2017. The purpose of well development was to remove drilling fluids, solids or other particulates that may have been introduced during drilling. Each monitoring well was developed using dedicated high-density polyethylene (HDPE) tubing and a Delrin Waterra foot valve. Where possible, at least ten well volumes of water were removed from each well.

Groundwater quality samples were collected from the monitoring wells following well development. between April 12 and 13, 2017. The samples were collected to help evaluate pre-development groundwater quality conditions at the Site. Groundwater sampling was completed using dedicated HDPE tubing and foot valve. Prior to collecting the samples, wells were purged and field parameters including pH, temperature, electrical conductivity, oxidation reduction potential (ORP), and dissolved oxygen (DO) were monitored periodically during the purging process using a Horiba U-52 multi-parameter water quality meter and a flow through cell. The meter was calibrated prior to use according to the manufacturer's specifications with the appropriate calibration standards. Groundwater sampling occurred after these field parameter concentrations had stabilized, indicating that water being pumped from the monitoring wells was representative of groundwater flowing into the well from surrounding geological formations.

The groundwater sample collected from each monitoring well consisted of pouring water directly from the HDPE tubing into lab supplied sample bottles. Groundwater samples collected for metals analysis were field-filtered using disposable in-line 0.45 µm (micron) filters attached to the HDPE tubing. The groundwater samples were carefully packed into coolers with ice, which was added to maintain sample temperatures below 10ºC during transport to the analytical laboratory. Samples were delivered to Maxxam Analytics Inc. (Maxxam) for analysis of general inorganic parameters and dissolved metals. Chain of custody forms were completed and included with the samples.

The results of the groundwater quality testing are summarized in Table 4 and illustrated in a piper diagram on Figure 8. A copy of the Laboratory Certificate of Analysis is presented in Appendix F.

3.6 HYDRAULIC RESPONSE TESTING

Stantec performed in-situ hydraulic response testing at each monitoring well between April 12 and 17, 2017 to estimate the horizontal hydraulic conductivity of the deposits beneath the Site. The testing consisted of creating an instantaneous change in the well water level by removing a known volume of water followed by recording the time taken for the water level to return to static conditions (i.e., a rising head or bail test). Data were analyzed using the Bouwer and Rice (1976) solution for a slug test in an unconfined aquifer as provided in the software package AQTESOLV ™ Pro Version 4.5 (Duffield, 2014). Testing provided an estimate of the horizontal hydraulic conductivity of the sediments within the screened interval for each monitoring well. Table 1 provides a summary of the calculated horizontal hydraulic conductivities, with the analytical solutions for the data being presented in Appendix G.

4.0 Local Geology and Hydrogeology

4.1 GEOLOGY

As shown in Figure 2, surficial geology mapping suggests the Site is covered by glaciofluvial sand and gravel, and stone-poor, silty to sandy till deposits representing the Port Stanley Till. These deposits are consistent with the subsurface materials encountered in the onsite boreholes BH01-17 through BH04-17 (Appendix E).

Cross-section A-A' (Figure 5), which traverses the Site from southwest to northeast, provides an interpretation of the subsurface stratigraphy based on onsite borehole data and nearby Ontario Ministry of the Environment, Conservation and Parks (MECP) water well records. The subsurface conditions at the borehole locations generally consist of a 0.4 m to 3.8 m thick layer of sand with trace to some gravel, overlying the Port Stanley Till (Figure 5). The till unit is encountered at depths ranging from approximately 0.7 m to at least 8.2 m BGS (the maximum depth of investigation), or elevations ranging from 339.3 m to 328.3 m AMSL. Surficial silty sand to sandy silty fill was encountered at BH03-17 and extended to a depth of 2.4 m BGS.

MECP Well No. 6712543 and No. 6702582, located approximately 20 m and 120 m to the south and north of the Site, respectively, indicate that the bedrock surface beneath the Site is found at an elevation ranging from 317.8 m to 322.8 m AMSL. Subsequently, overburden beneath the Site is estimated to range from 12 m to 17 m in thickness.

4.2 HYDROGEOLOGY

4.2.1 Groundwater Levels

Figure 6 and Table 2 present continuous and manual water level data measured within the onsite monitoring wells from April 2017 to May 2018, respectively. Available data indicate the depth to groundwater across the Site ranges from being positioned at ground surface (BH01-17, BH02-17) to 2.3 m BGS (BH04-17) under high water table conditions, with about 1.9 m to 3.5 m of seasonal fluctuation occurring based on the data collected throughout the monitoring period (Figure 6). Groundwater levels were highest in the spring, gradually declining over the summer and fall, after which water levels started to gradually increase again (Figure 6). This pattern in fluctuations is common within shallow groundwater systems throughout southern Ontario, where high water table conditions occur in the spring due to lower evapotranspiration losses and the infiltration of a melting snowpack and provide a greater volume of water for recharge. Low water table conditions occur in the late summer to fall as more water is drawn from the subsurface over this period to meet evapotranspiration demands.

4.2.2 Groundwater Flow

Groundwater elevations over the monitoring period ranged from a high of approximately 337.7 m AMSL at BH04-17 in the northeastern corner of the Site to lows of approximately 331.4 m AMSL at BH03-17 near the south-central property boundary (Figures 6 and 7). Groundwater elevation contours for May 2017, representing the period of highest groundwater levels measured at the Site, are shown on Figure 7. Based on the May 2017 data, the interpreted direction of groundwater flow through the overburden is to the south and southwest at an estimated average horizontal hydraulic gradient of approximately 0.017 m/m. A review of the groundwater level data shows no seasonal change in the groundwater flow direction throughout the monitoring period.

Figure 6 and Table 3 present continuous and manual water groundwater and surface water level data measured within drive-point piezometers DP1-17(S) (shallow) and DP1-17(D) (deep) installed within the wetland area from April 2017 to February 2018, respectively (Figure 1). Groundwater levels within DP1-17(D) remained lower than the observed levels recorded at DP1-17(S) throughout the monitoring period, with measured vertical hydraulic gradients being consistently downward and ranging from -0.61 m/m to -1.00 m/m (Table 3). These downward gradients indicate that the wetland functions as a groundwater recharge feature, which is consistent with GRCA (2017) mapping that shows downward hydraulic gradients to be present beneath the entire Site (Appendix D).

The hydraulic conductivities estimated from the single well hydraulic response testing are summarized in Table 1, with the solutions being provided in Appendix G. Calculated horizontal hydraulic conductivities range from 1.6×10^{-6} m/s to 2.8×10^{-5} m/s for wells screened within the silty sand deposits that characterize the subsurface of the Site (i.e., from depths of 1.3 m to 7.4 m BGS). The geometric mean of the hydraulic conductivity across the Site is estimated at 6.2×10^{-6} m/s.

Assuming a soil porosity of 0.3, an average horizontal hydraulic gradient of 0.017 m/m, and geometric mean hydraulic conductivity of 6.2×10^{-6} m/s, the estimated velocity of horizontal groundwater flow through the shallow overburden beneath the Site is calculated to be approximately 11 m/year.

4.2.3 Groundwater Quality

Results of the groundwater quality testing are summarized in Table 4. Groundwater quality data have been assessed against the Ontario Drinking Water Quality Standards (O. Reg 169/03) (ODWS) for health-related [i.e., Maximum Acceptable Criteria (MAC) and Interim Maximum Acceptable Criteria (IMAC)] and non-health related [i.e., Aesthetic Objectives (AO) and Operational Guidelines (OG)] parameters. Technical documentation of the ODWS is provided in Ministry of the Environment (2006)

The shallow groundwater system is characterized by calcium-bicarbonate type water (Figure 8).

No tested parameters were detected above applicable health-related criteria. The ODWS for hardness was exceeded in samples collected at all monitoring wells, with values ranging from 290 mg/L to 410 mg/L; and higher than the OG of 80 mg/L to 100 mg/L. ODWS OG exceedances are provided primarily for operators of drinking water systems to identify parameter levels that can lead to poor system performance and affect the appearance and taste of drinking water. The presence of elevated hardness concentrations is typical of groundwater in southern Ontario.

5.0 WATER BALANCE

Water balance calculations were completed to quantify infiltration volumes at the Site and confirm the recharge function. A comparison of water balance data under pre- and post-development conditions was completed to determine the potential impacts of development on the Site's recharge function. The methodology for the water balance calculations is provided in Section 5.1. Results of the pre-development water balance analysis are presented in Section 5.2. The comparison of pre- and post-development conditions is presented in Section 6.1.

5.1 METHODOLOGY

Within the hydrologic cycle, the flow of water into and out of system can be described through a simplified water balance equation as follows:

$$P = ET + S + R + I$$ **Equation 1**

Where:

P = precipitation
ET = evapotranspiration
S = change in groundwater storage
R = runoff
I = infiltration (groundwater recharge)

Equation 1 may be further simplified by ignoring the change in groundwater storage (S), which trends over time to zero. The various components of the hydrologic cycle may be estimated through calculations or based on measurements made in the field. Precipitation (P) is typically a measured value. Evapo-transpiration (ET) is calculated based on measured air temperatures. Infiltration (I) and Runoff (R) are calculated based on P and ET, where the difference between P and ET is the water surplus (WS) available for Infiltration (I) and Recharge (R) as follows:

$$WS = P - ET$$ **Equation 2**

Where WS is used to calculate I after applying an infiltration factor (IF),

$$I = WS \times IF$$ **Equation 3**

And R is estimated by subtracting I from WS,

$$R = WS - I$$ **Equation 4**

For this assessment, ET was calculated using the soil moisture balance model by Thornthwaite and Mather (1955). In the Thornthwaite and Mather model monthly potential evapotranspiration (PET) is calculated based on the measured average monthly daily temperature (T_a) and a heat index (H_i) value assuming 12 hours of daylight in a day and 30 days in a month, as follows:

$$PET = 16 \times \left(\frac{10T_a}{H_i}\right)^{\alpha}$$ **Equation 5**

Where T_a is taken as 0 degrees Celsius for months with negative temperatures, and H_i, the heat index is estimated as,

$$H_i = \sum_{i=1}^{12} \left(\frac{10T_a}{5}\right)^{1.514}$$ **Equation 6**

For α

$$\alpha = 0.49 + (0.0179 \times H_i) - \left(0.0000771 \times H_i^2\right) + \left(0.000000675 \times H_i^3\right)$$ **Equation 7**

PET values are then multiplied by an adjustment factor, after Thornthwaite and Mather (1957), which represents the average number of daylight hours per month at the latitude of the subject property to give the Adjusted Potential Evapotranspiration (PET_{adj}).

Actual Evapotranspiration (AET) is derived as,

$$AET = PET_{adj} - \Delta S$$ **Equation 8**

Where ΔS is the change in storage for the month, calculated as,

$$\Delta S = S_{mc} \times e^{\left(\frac{APWL}{S_{mc}}\right)}$$ **Equation 9**

Where:

S_{mc} = soil moisture capacity
APWL = accumulated potential water loss, calculated for $\Delta P < 0$ as $APWL = -\sum_{i=0}^{12} PET_i$, and for $\Delta P > 0$ by rearranging equation 8; with ΔP= net precipitation = P - PET_{adj}

WS is derived by subtracting AET from the monthly precipitation,

$$WS = P - AET$$ **Equation 10**

And the infiltration and runoff calculated per Equations 3 and 4 above.

The infiltration factor shown in Equation 3 is estimated based on the topography, soil type and land cover after MOE (2003) and the Ministry of the Environment and Energy (MOEE) (1995). To define appropriate infiltration factors, the Site was divided into three Sub-Areas based on similarities in soil type, topography and vegetation cover as follows:

Sub-Area A (0.83 ha)	Sand to silty sand, flat topography, woodland cover (wetland)
Sub-Area B (2.31 ha)	Sand to silty sand, flat to gently rolling topography, pasture and shrubs land cover
Sub-Area C (4.01 ha)	Sand to silty sand, rolling topography, cultivated land cover

The delineated Sub-Areas are shown on Figure 9 and the infiltration factors assigned for each Sub-Area pre- and post-development is presented in Tables 5 and 6, respectively.

Soil moisture capacity was set between 150 mm to 300 mm among the Sub-Areas depending on the soil type and land cover as specified under MOE (2003). In Sub-Area A, where sand to silty sand and woodland/wetland cover is present, soil moisture was set at 300 mm corresponding to the soil moisture content for fine sandy loam in a mature forest. For Sub-Area B, where sand to silty sand soil and cultivated land cover is present, soil moisture content was set at 150 mm corresponding to a fine sandy loam with pasture and shrubs. For Sub-Area C, where sand to silty sand soil and cultivated land cover is present, soil moisture content was set at 150 mm corresponding to fine sandy loam with moderately rooted crops.

Under pre-development conditions, the Site (7.16 ha) is either covered by wetland/woodland, or cultivated fields and is deemed 92% pervious, with 8% impervious cover associated with the existing residential structures and driveways. Lands planned for residential use under the post-development condition is expected to have 80% of its area converted to impervious surfaces. Similarly, the land area being used for stormwater management purposes (i.e., pond) or roadways will have an impervious cover of 100% (i.e., no pervious area). Overall, the calculated percent imperviousness value assigned for each Sub-Area was based on the proportion of each previously mentioned land use area expected to occur in each Sub-Area under the post-development condition. Percent imperviousness values for the various land uses are consistent with those presented in the in the City of Guelph and Township of Guelph/Eramosa Tier Three Water Budget and Local Area Risk Assessment (Matrix Solutions Inc., 2017).

For this water balance assessment, climate normals (1981 to 2010) as recorded at the Waterloo Wellington A Climate Station were used to obtain monthly values of precipitation and temperature. The climate data were obtained from Environment Canada (2018) and are summarized in Table 7. The Waterloo Wellington A Climate Station is located approximately 15 km to the southwest of the Site. Although the Guelph Arboretum Climate Station is located approximately 1.5 km to the northwest of the Site, climate normals from 1971 to 2000 are only available from this station.

Water balance calculations were completed for each Sub-Area and then summed to provide results for the entire Site. The water balance calculations shown in Tables 5 and 6 generate a rounding error of less than 1%.

5.2 PRE-DEVELOPMENT WATER BALANCE

The average annual precipitation at the Site is estimated at 916 mm based on data obtained from the Waterloo Wellington A Climate Station (Environment Canada, 2018). In comparison, Matrix Solutions Inc. (2017) reported average annual precipitation in the Upper Speed Assessment Area is 923 mm/year as measured at the Guelph Arboretum Climate Station. In Sub-Areas A, B, and C, annual actual evapotranspiration is estimated as 620 mm, 592 mm and 592 mm, respectively. This means that 296 mm of surplus water is available for runoff and infiltration across Sub-Area A on an annual basis, with an annual surplus of 324 mm being available across both Sub-Areas B and C. Applying the estimated infiltration factors of 0.90 for Sub-Area A, 0.80 for Sub-Area B and 0.70 for Sub-Area C, the calculated annual infiltration for these sub-areas is 267 mm, 259 mm and 227 mm, respectively.

Overall, the average annual volume of infiltration to the Site under pre-development conditions is estimated at 15,946 m^3/year for a rate of 223 mm/year (Table 5). This infiltration rate falls within the 100 mm/year to 400 mm/year groundwater recharge rate range for the Site area as estimated by Matrix Solutions Inc. (2017) and GRIN mapping (Appendix D). The average annual volume of runoff under pre-development conditions at the Site is estimated to be 10,027 m^3/year (140 mm/year) (Table 5).

6.0 IMPACT ASSESSMENT AND MITIGATION MEASURES

6.1 GROUNDWATER RECHARGE

As per the proposed Draft Plan (Figure 9) the Site development is to include the construction of internal roadways, single-family lots and a multiple-family residential block, and a SWM facility. In the areas of the Site where this development is to occur, there will also be the introduction of impervious surfaces (e.g., rooftops, concrete/asphalt roadways and walkways) and, subsequently, a corresponding reduction in the volume of water infiltrating to the subsurface. The potential impacts associated with the introduction of impervious surfaces on the recharge function of the Site are discussed below.

Under the post-development condition, impervious surfaces are expected to cover 39% of the Site (2.82 ha of 7.16 ha), resulting in a projected infiltration volume deficit of 4,908 m^3/year (i.e., from 15,946 m^3/year to 11,038 m^3/year) (Table 6).

Low impact development (LID) is a stormwater management strategy that seeks to mitigate the impacts of increased stormwater runoff by managing this runoff as close to source as possible, with the implementation of such strategies also providing the residual benefit of offsetting potential infiltration losses associated with the increase in impervious surfaces associated with a given development. Infiltration augmentation options (as described in CVC-TRCA *Low Impact Development Stormwater Management Planning and Design Guide*, 2010) that could potentially be available for use across the Site to assist in maximizing infiltration under the post-development condition include:

- roof downspout disconnection
- soakaways / infiltration trenches
- bioretention cells
- vegetated filter strips
- grass swales or enhanced grassed swales

A key constraint in using several of the mentioned infiltration augmentation measures (i.e., soakaways / infiltration trenches, bioretention, vegetated filter strips, grass swales) is the positioning of the seasonally high groundwater table. As per CVC-TRCA (2010), the recommended vertical separation between the base of the given infiltration augmentation option and the high groundwater table is at least one meter; however, distances of less than one meter of separation in soils having higher infiltration potential may still be effective. At the Site, the seasonally high groundwater table is deepest at the northeastern limits of the property (e.g., BH04-17), with the groundwater table becoming shallower moving to the southwest across the property towards the Torrance Creek Swamp (e.g., BH01-17 and BH03-17). As shown in Figure 6, the high groundwater table occurs at depths ranging from 0.1 m to 0.6 m BGS in the southwestern portion of the Site, whereas in the northeastern portion of the Site the high groundwater

table is in the range of 2.3 m BGS. As such, the use of post-development infiltration augmentation measures in the southwestern areas of the Site may be limited.

The suitability of using the previously mentioned infiltration augmentation options within the Site will be evaluated at the detailed design stage of the project. Overall, it is reasonable to conclude that the application of some or all the previously mentioned infiltration augmentation measures in those areas of the Site where the seasonal groundwater table is greater than one meter below final grades will assist in achieving the maximum groundwater recharge possible throughout the property under the post-development condition.

6.2 GROUNDWATER DEWATERING

The proposed development is to consist of residential housing that will be connected to underground utility infrastructure (e.g., watermain, storm and sanitary sewers). Invert levels of the site servicing are expected to be up to three to four meters below grade but could be as much as eight meters below grade. Groundwater levels measured in the onsite monitoring wells ranged from at ground surface to 2.3 m BGS under high water table conditions across the Site, with about 1.9 m to 3.5 m of seasonal fluctuation (Section 4.2.1). Subsequently, groundwater levels are expected to occur above the servicing invert levels throughout the Site and, consequently, construction dewatering will likely be required.

Under Ontario Regulation (O. Reg.) 64/16 and O. Reg. 63/16A, if construction dewatering volumes are projected to exceed 50,000 L/day, registration of an MECP Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW) will be required for dewatering to occur. A PTTW is required when daily dewatering volumes are expected to exceed 400,000 L, whereas an EASR is required for daily dewatering volumes ranging between 50,000 L and 400,000 L. A dewatering assessment can be completed during the detailed design phase of the project to determine dewatering and water taking permitting requirements.

If site servicing infrastructure is installed below the groundwater table, mitigation measures may be required to minimize the disturbance that this site servicing could have on pre-development groundwater flow patterns. Typically, the most common mitigation measure is the installation of anti-seepage (cut-off) collars to prevent the preferential movement of groundwater along the servicing alignments. An assessment for the need, total number and exact placements of anti-seepage collars along the servicing alignments can be explored in more detail during the detailed design phase of the project.

6.3 WETLAND ALTERATION

As per the proposed Draft Plan, the proposed development is expected to encroach into the wetland area located to the east of the existing access driveway to the Site, where DP1-17(S/D) is installed (Figure 1). However, as discussed in the Stantec (2019) *Environmental Impact Study*, existing Grand River Conservation Authority (GRCA) and Ministry of Natural Resources and Forestry (MNRF) wetland mapping for the Site does not appear to reflect recent updates to the Torrance Creek Swamp boundary in

this area of the property. In 2010, a portion of this wetland area was approved for removal and, subsequently, removed as part of the Arkell Meadows Subdivision development.

Pursuant to Ontario Regulation 150/06, the GRCA must first provide permission for any proposed alteration of a wetland to occur as part of a land development project. The GRCA will permit development to occur within, or result in the removal of, a naturally occurring wetland of less than 0.5 ha or an anthropogenic wetland covering an area less than 2.0 ha, if the wetland is not:

1. part of a Provincially Significant Wetland
2. located within a floodplain or riparian community
3. part of a Provincially or municipally designated natural heritage feature, a significant woodland, or hazard land
4. a bog or fen
5. fish habitat
6. significant wildlife habitat
7. confirmed habitat for a Provincially or regionally significant species as determined by the Ministry of Natural Resources and Forestry or as determined by the municipality
8. part of an ecologically functional corridor or linkage between larger wetlands or natural areas
9. part of a groundwater recharge area
10. a groundwater discharge area associated with any of the above

The hydrogeological information previously presented in this report will be used to address GRCA Criteria 9) and 10), with the remaining criteria being addressed in Stantec's accompanying *Environmental Impact Study* (Stantec, 2019) report.

Although it appears that wetland area located to the east of the access driveway has already been approved for removal by the GRCA, if additional permissions are required to remove the remaining portion of this wetland area, Stantec is of the opinion that this can occur for the reasons presented below.

9) The onsite wetland is not a notable groundwater recharge area

Under the pre-development condition, the predicted annual volume of infiltration provided to the shallow groundwater system by the onsite wetland only represents approximately 3% of the total annual volume of infiltration that occurs across the Site, noting that the subsurface deposits found beneath this wetland area are also present throughout the entire Site (i.e., the soils underlying the wetland are not unique to the Site) (Appendix E). Overall, it is reasonable to conclude that the loss of recharge function associated with the onsite wetland will not detrimentally impact the overall groundwater recharge function provided by the Site.

10) The onsite wetland is not a groundwater discharge feature

As discussed in Section 4.2.2, consistent downward vertical hydraulic gradients are present beneath the wetland area, indicating that the wetland functions as a groundwater recharge feature.

6.4 SOURCE WATER PROTECTION

A drinking-water threat is an activity or condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water. The following activities are prescribed by the province of Ontario under O. Reg. 287/07 to be drinking water threats (i.e., Significant Drinking Water Threat Policy Categories):

1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
3. The application of agricultural source material to land.
4. The storage of agricultural source material.
5. The management of agricultural source material.
6. The application of non-agricultural source material to land.
7. The handling and storage of non-agricultural source material.
8. The application of commercial fertilizer to land.
9. The handling and storage of commercial fertilizer.
10. The application of pesticide to land.
11. The handling and storage of pesticide.
12. The application of road salt.
13. The handling and storage of road salt.
14. The storage of snow.
15. The handling and storage of fuel.
16. The handling and storage of a dense non-aqueous phase liquid (DNAPL).
17. The handling and storage of an organic solvent.
18. The management of runoff that contains chemicals used in the de-icing of aircraft.

19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.

20. An activity that reduces the recharge of an aquifer.

21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.

The Site is intercepted by the Burke Well WHPA-B, with this area having an assigned vulnerability score of eight (8), indicating that groundwater beneath the Site is at medium risk to contamination from drinking-water threats (i.e., an activity or existing condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water). As per the Approved Source Protection Plan (LERSPC, 2015b), the Site is subject to the protection policies specified under Significant Drinking Water Threat Policy Categories 1 (Waste Disposal), 2 (Sewage Systems), and 16 (DNAPLs). Since the planned use for the Site does not involve the operation or maintenance of a waste disposal facility or the onsite handling and storage of a DNAPL, the policies under Categories 1 and 16 do not apply.

Given that the Site will be serviced by municipal sanitary sewers and a SWM facility, the following protection policies under Category 2 (Sewage Systems) will apply and require discussion with the City of Guelph at the detailed design stage of the project:

Policy No. CG-MC-14 (Sanitary Sewers and Related Pipes): For existing and future sanitary sewers and pipes within vulnerable areas where this activity is or would be a significant drinking water threat, the MECP shall ensure that the Environmental Compliance Approval that governs sanitary sewer and related pipes includes appropriate terms and conditions to ensure the activity ceases to be and/or never becomes a significant drinking water threat.

Policy No. CG-MC-15 (Discharge of Stormwater from a Stormwater Management Facility): For existing and future discharge of stormwater from a stormwater management facility within vulnerable areas where this activity is or would be a significant drinking water threat, the MECP shall ensure that the Environmental Compliance Approval that governs the stormwater management facility includes appropriate terms and conditions to ensure the activity ceases to be and/or never becomes a significant drinking water threat.

No protection policies are specified in the *Approved Source Protection Plan* (LERSPC, 2015b) that apply to the Site's designation as a SGRA or WHPA-E (intercepts the western portion of the property).

6.5 SPILL CONTAINMENT AND RESPONSE

The potential exists for spills during any construction activity, with the most probable type of spill occurring being attributable to the refuelling of major construction equipment that cannot readily leave the Site (e.g., earth movers). The potential impacts of a spill could be the contamination of soils, groundwater and/or surface water. By implementing proper protocols for the handling of fuels and lubricants during

construction, the risk of a spill occurring will be greatly reduced. The procedures to be implemented to prevent onsite spills are as follows:

- all trucks or other road vehicles would be refuelled and maintained offsite, where practicable
- refuelling and lubrication of other construction equipment would not be allowed within 30 m of a drainage system or dewatering excavation
- regular inspections of hydraulic and fuel systems on machinery, with leaks being repaired immediately upon detection or the equipment being removed from Site
- spill kits containing absorbent materials would be kept on hand
- implement best management practices and develop an emergency spill response plan

Given that anticipated construction activities at the Site are not expected to involve the storage or use of bulk chemicals or fuels, any potential spill that does occur would be localized and involve a small volume of material. Standard containment facilities and emergency response materials are to be maintained onsite as required, with refuelling, equipment maintenance, and other potentially contaminating activities being confined to designated areas. As appropriate, spills are to be reported immediately to the MECP Spills Action Centre.

7.0 CONCLUSIONS

Based on the hydrogeological assessment, using the existing data collected at the Site and information obtained from a background review of regional data, the following conclusions are provided:

1. Subsurface conditions across the Site consist of 0.4 m to 3.8 m thick layer of sand with trace to some gravel, overlying stone-poor, silty to sandy till deposits representing the Port Stanley Till. The till unit is encountered at depths ranging from approximately 0.7 m to at least 8.2 m BGS (339.3 m to 328.3 m AMSL). Bedrock appears to be encountered at elevations ranging from 317.8 m to 322.8 m AMSL.

2. Groundwater depths across the Site range from being positioned at ground surface (BH01-17, BH02-17) to 2.3 m BGS (BH04-17) under high water table conditions, with about 1.9 m to 3.5 m of seasonal fluctuation occurring based on the data collected during the monitoring period (i.e., April 2017 to May 2018). The groundwater table is deepest in the northeastern corner of the Site, with groundwater levels becoming shallower moving to the southwest towards the Torrance Creek Swamp.

3. Groundwater flows horizontally through the subsurface overburden deposits to the south and southwest towards the Torrance Creek Swamp at an average rate of 11.1 m/year.

4. Downward vertical hydraulic gradients are consistently observed beneath the wetland area located in the future footprint of the development, indicating that this wetland is a groundwater recharge feature. Under the pre-development condition, the predicted annual volume of infiltration provided to the shallow groundwater system by this wetland area represents approximately 3% of the total annual volume of infiltration that occurs across the Site.

5. Groundwater in the shallow groundwater system is calcium-bicarbonate type water. No tested parameters having health-related ODWS were detected above their applicable standards. The ODWS for hardness was exceeded in samples collected at all wells. The presence of elevated hardness concentrations is typical of groundwater in southern Ontario.

6. The Site is located within the WHPA-B for the Burke Municipal Well. Given that the Site will be serviced by municipal sanitary sewers and a SWM facility, Policies CG-MC-14 (Sanitary Sewers and Related Pipes) and CG-MC-15 (Discharge of Stormwater from a Stormwater Management Facility) will apply to the Site as per the *Approved Source Protection Plan* (LERSPC, 2015b) and require discussion with the City of Guelph at the detailed design stage of the project.

7. A calculated 15,946 m^3 (223 mm) of annual infiltration occurs under pre-development conditions at the Site. Under post-development conditions, Stantec estimates that 39% of the land surface will be converted to impervious cover, reducing annual infiltration to 11,038 m^3 (154 mm), and resulting in an annual infiltration deficit of approximately 4,908 m^3.

8. The future development of the Site will increase the overall imperviousness of these lands, resulting in an overall reduction in infiltration under the post-development condition. The proposed development will require strategies to infiltrate as much stormwater as possible post-development to mimic the existing recharge function provided by these lands. Potential LID infiltration augmentation options available to the Site are roof downspout disconnection, soakaways / infiltration trenches, bioretention cells, vegetated filter strips and/or grassed swale or enhanced grassed swales. High

water table conditions may present a constraint for the using of LIDs in certain areas of the Site. The suitability of using these infiltration augmentation options will be evaluated further at the detailed design stage of the project.

9. Underground utility infrastructure (e.g., watermain, storm and sanitary sewers) is expected to occur below the groundwater table in certain areas of the Site and, consequently, groundwater dewatering will likely be required. A dewatering assessment should be completed during the detailed design phase of the project to determine dewatering and water taking permitting requirements.

10. Servicing (e.g., watermain, storm and sanitary sewers) is likely to occur below the groundwater table at the Site. Efforts may be required to minimize the disturbance that this servicing could have on pre-development groundwater flow patterns. Typically, the most common mitigation measure is the installation of anti-seepage (cut-off) collars to prevent the preferential movement of groundwater along the servicing alignments. An assessment for the need, total number and exact placements of anti-seepage collars along the servicing alignments can be explored in more detail during the detailed design phase of the project.

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APPENDIX A:
FIGURES

Stantec

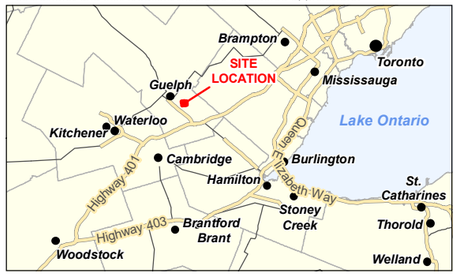
- Site Boundary
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2017)
- MECP Water Well Record
- Proposed Subdivision
- Wetland Boundary (Stantec, June 2017)
- Wetland - Evaluated (Provincial)
- Wetland Boundary (GRCA)

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
4. MECP water well record locations have been positioned based on published UTM coordinates and their locations should be considered approximate.



Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
1

Title
Site Plan

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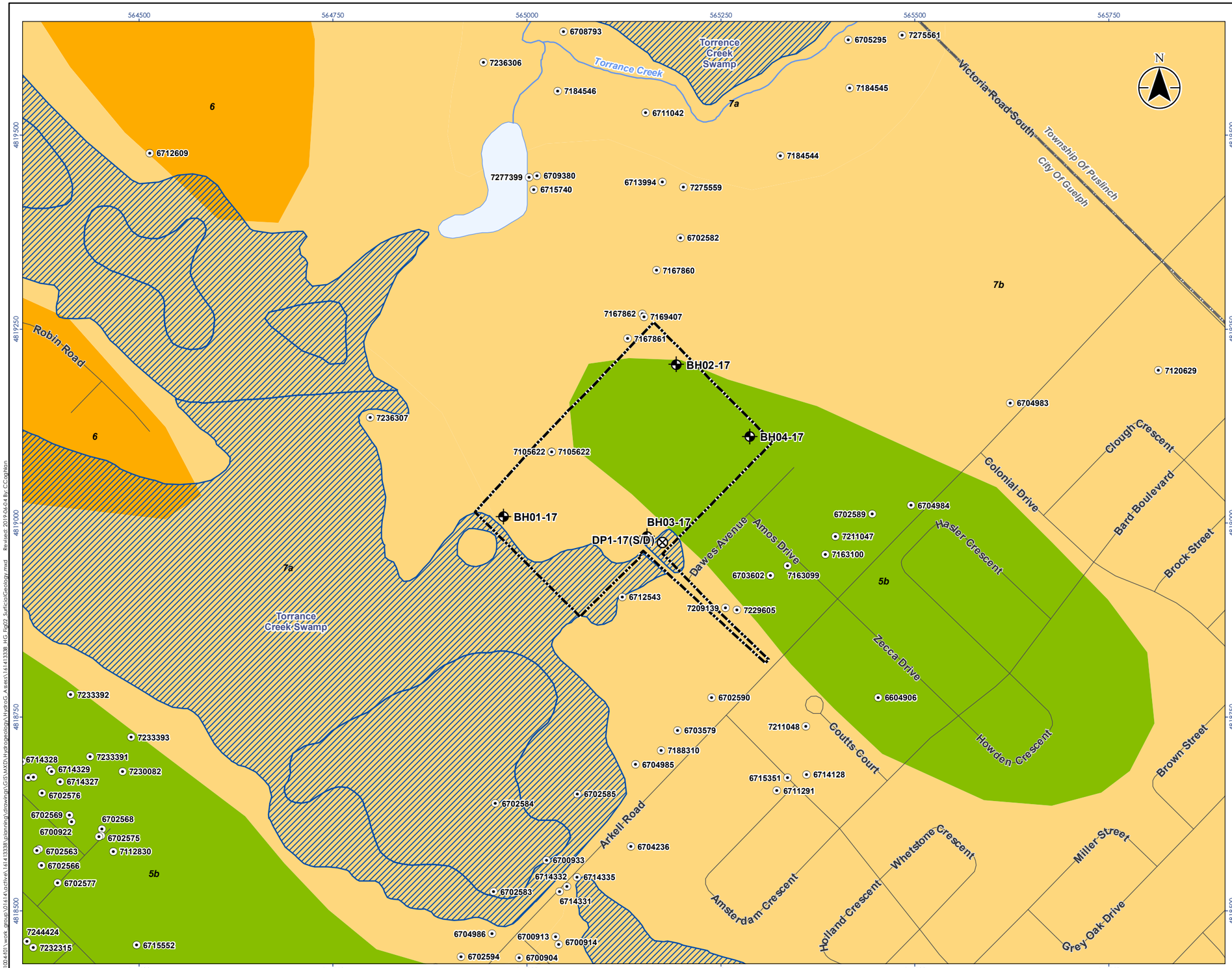


Stantec

- Site Boundary
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2017)
- MOECC Water Well Record
- Road
- Watercourse
- Municipal Boundary - Lower Tier
- Waterbody
- Wetland - Evaluated (Provincial)

Surficial Geology

- 7a: Glaciofluvial deposits (Sandy deposits)
- 7b: Glaciofluvial deposits (Gravelly deposits)
- 6: Ice-contact stratified deposits
- 5b: Stone-poor, carbonate-derived silty to sandy till (Port Stanley Till)

0 100 200 metres

1:5,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Ontario Geological Survey 2010. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV ISBN 978-1-4435-2483-4
4. MECP water well record locations have been positioned based on published UTM coordinates and their locations should be considered approximate.

Project Location
Guelph, Ontario

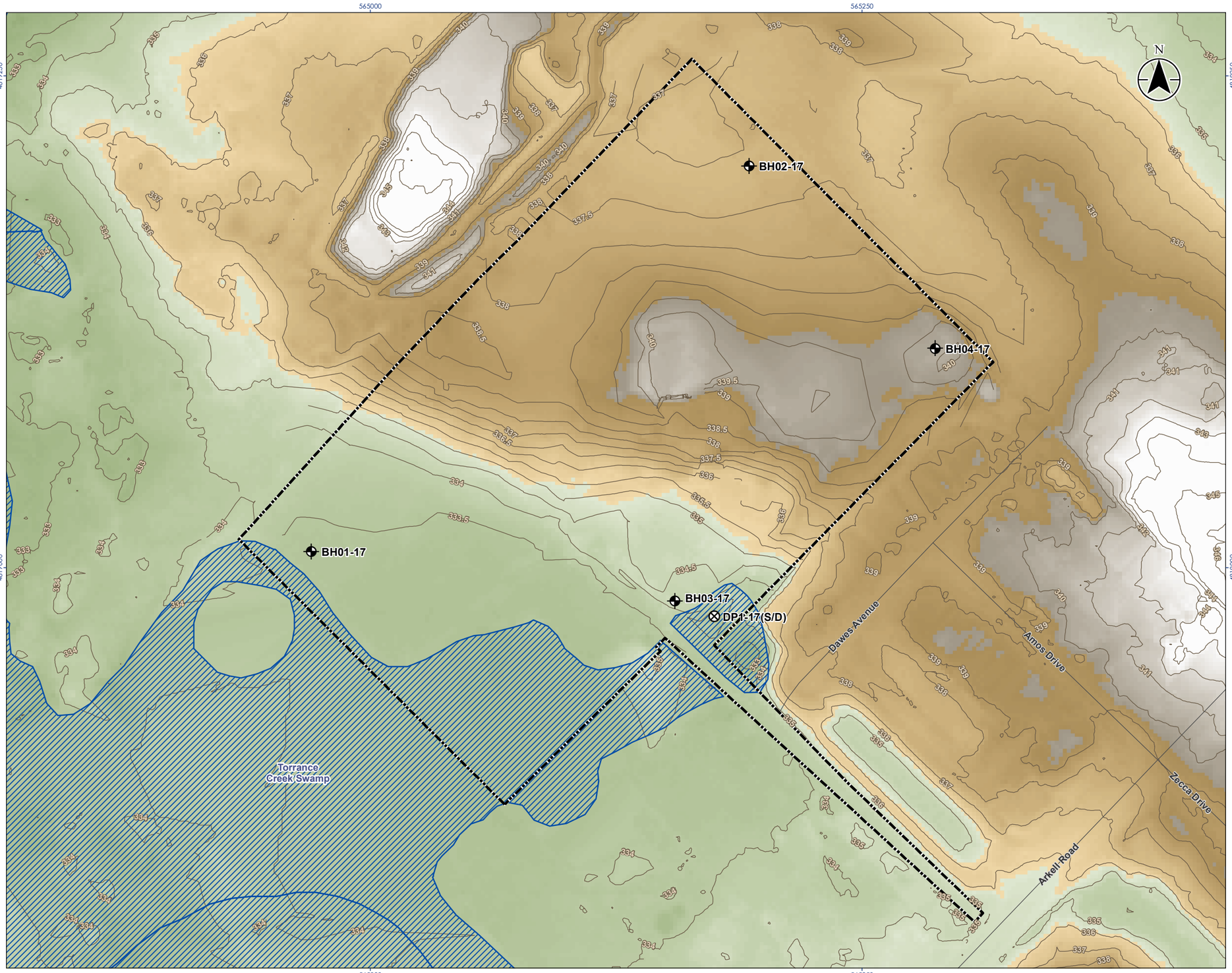
161413338 REVA
Prepared by CMC on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
2

Title
Surficial Geology

\\ca1061401\work_group\03614\active\161413338\planning\drawings\GIS\WATER\Hydrogeology\HydroG_Assess\161413338_HG_Fig02_SurficialGeology.mxd Revised: 2019-06-04 By: CCoghlan



Stantec

Legend

- Site Boundary
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2017)
- Road
- Topographic Contour (mAMSL)
- Wetland - Evaluated (Provincial)

Value

High : 346.46

Low : 332.05

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Topographic contours presented on site as surveyed by Stantec (2017). Topographic data beyond the site boundaries should be considered approximate and for illustrative purposes only.
4. DEM from the Southwestern Ontario Orthophotography Project 2015 Digital Elevation Model (DEM) © Queen's Printer for Ontario, 2015. This product is a generalized representation of groud surface features and should be considered approximate.

Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
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HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
3

Title
Topography

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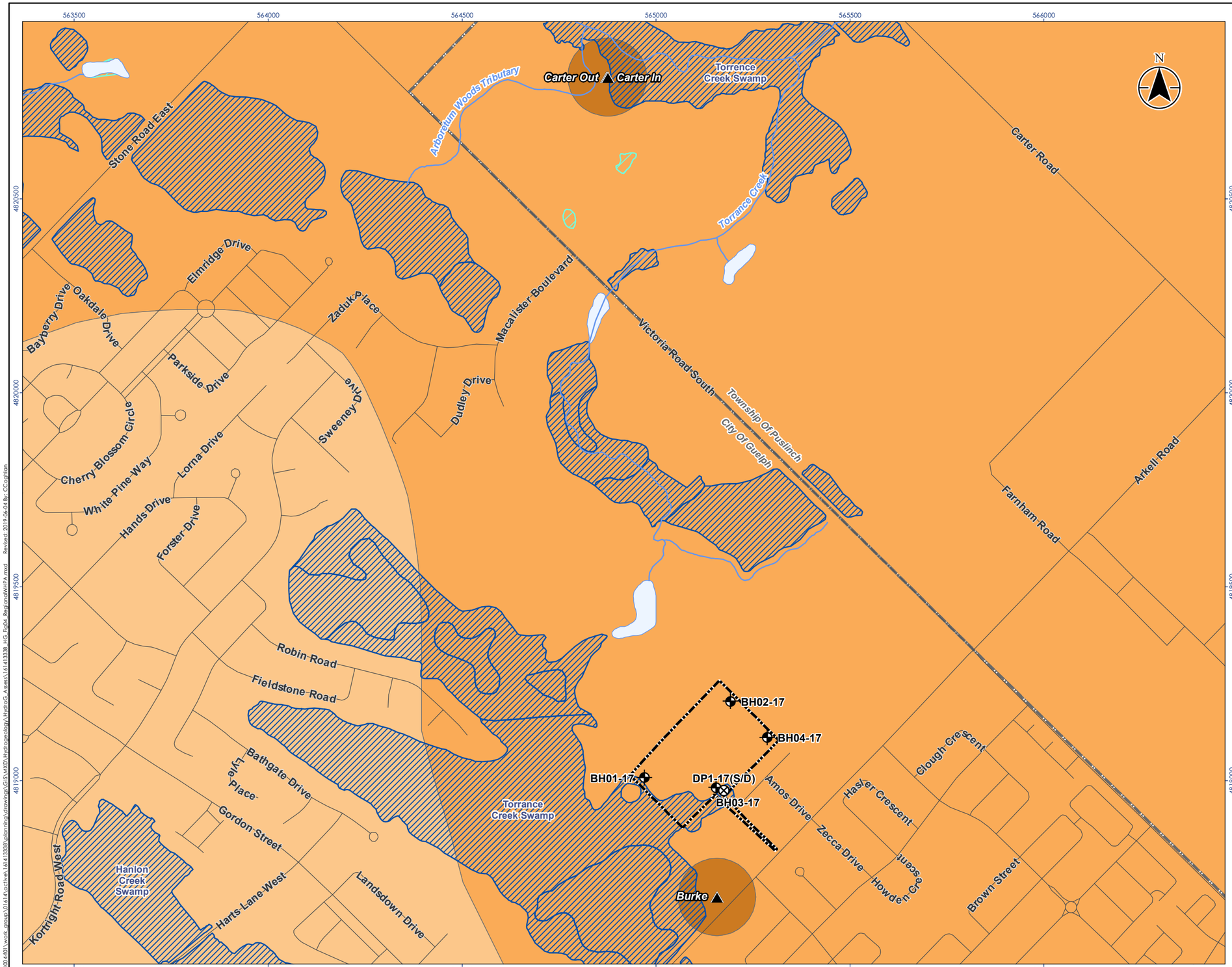

Stantec

- Site Boundary
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2017)
- Municipal Production Well
- Road
- Watercourse
- Municipal Boundary - Lower Tier
- Waterbody
- Wetland - Evaluated (Provincial)
- Wetland - Not evaluated per Ontario Wetland Evaluation System

WHPA - Wellhead Protection Area (GRCA)

- WHPA-A
- WHPA-B
- WHPA-C

0 200 400 metres

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Regional WHPA zones and Production well locations © Grand River Conservation, 2017.

Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
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HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
4

Title
Regional Wellhead Protection Zones

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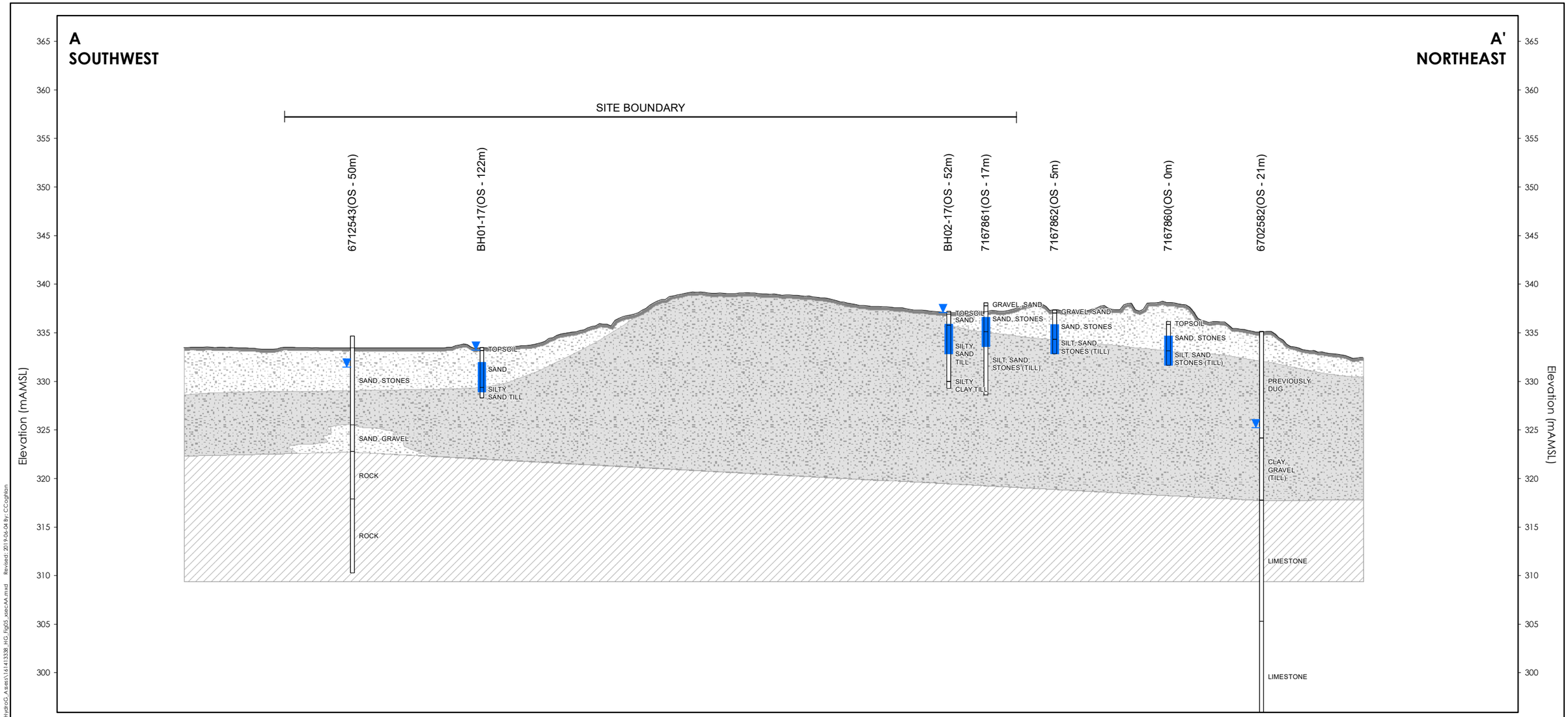

MW1-15 (OS m)

Well ID (Offset)

Sand Stratigraphy

Water Level

Well Screen

Topsoil and/or Fill

Glaciofluvial/Glaciolacustrine Deposit (Sand and Gravel, Silty Sand and Sandy Silt)

Port Stanley Till (Silty Sand to Sandy Silt Till)

Bedrock

5x Vertical Exaggeration

0 30 60 metres

1:2,000 (At original document size of 11x17)

Notes

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

2. Groundwater elevations for Stantec monitoring wells from May 2017. All other water levels were taken at time of well drilling.

Stantec

Project Location
Guelph, Ontario

161413338 REVA
Prepared by CCoghlan on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
5

Title
Cross-Section A-A'

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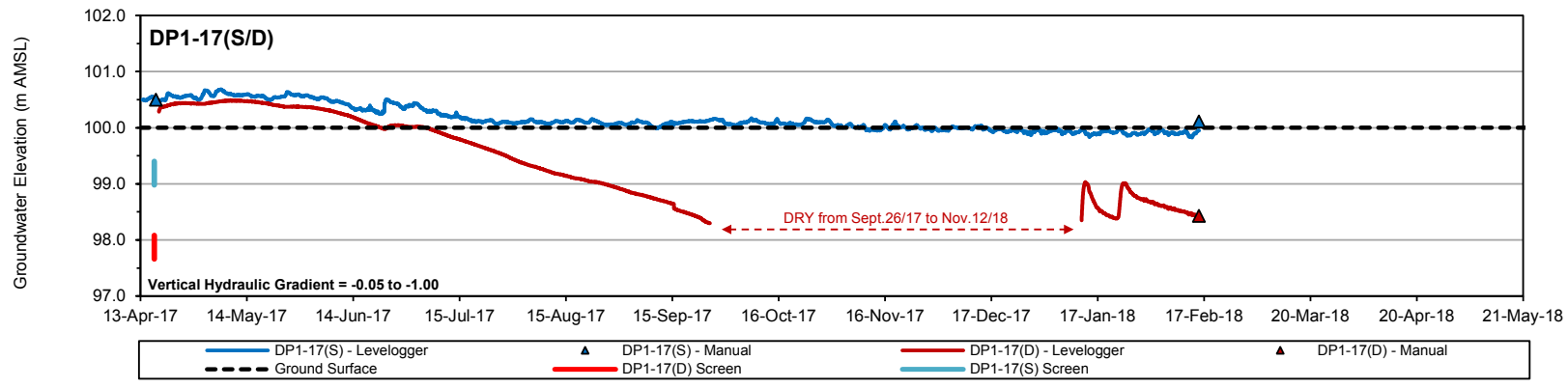

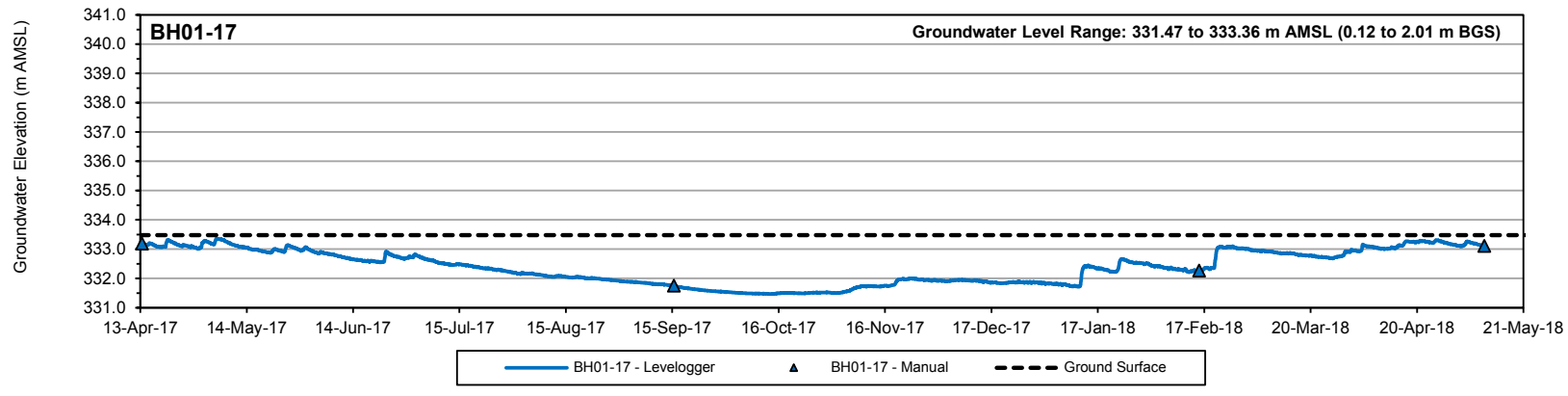

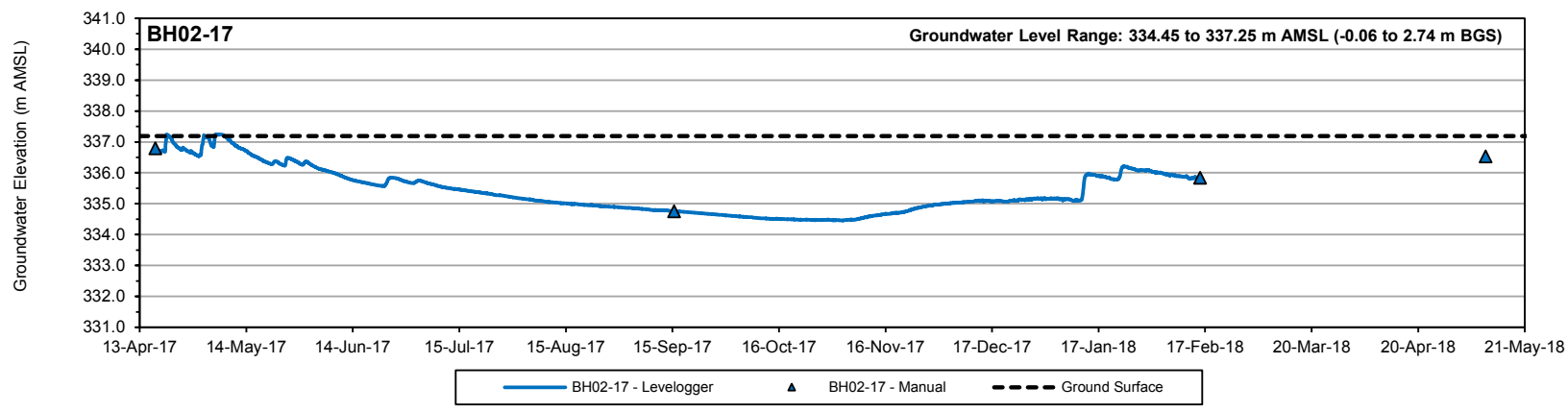

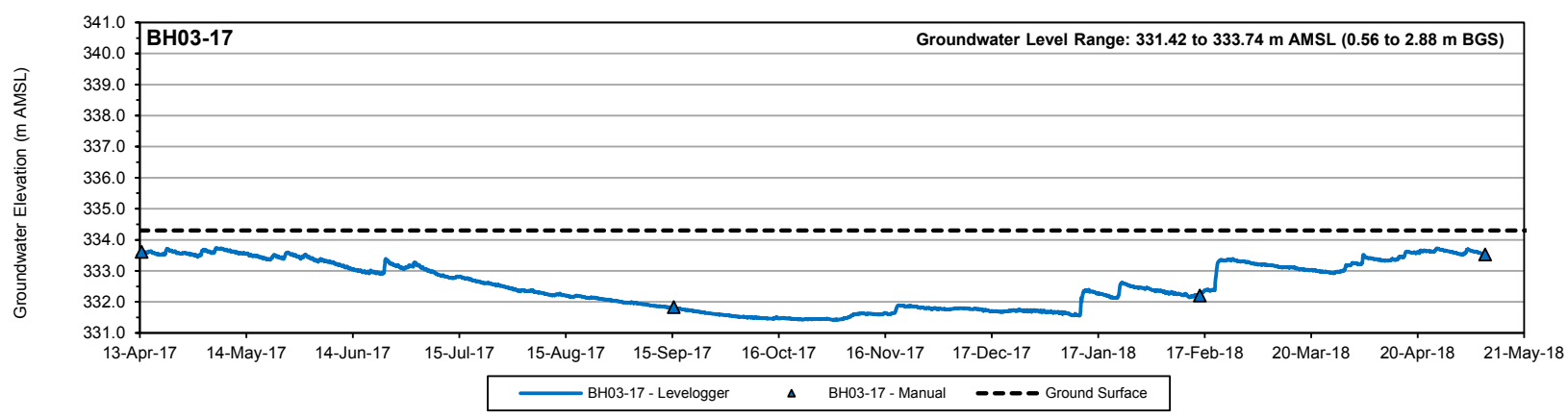

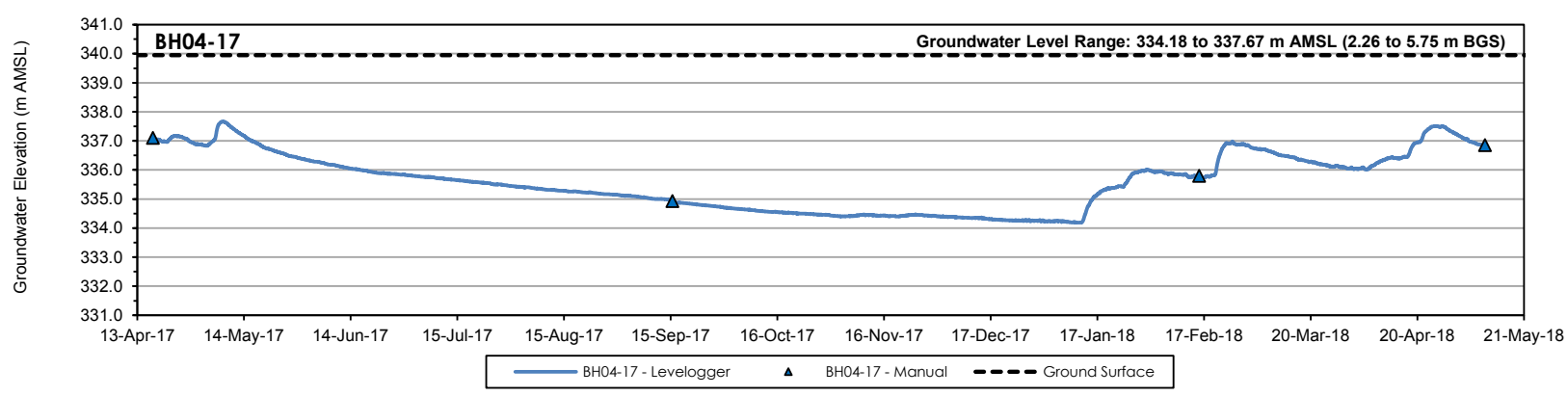

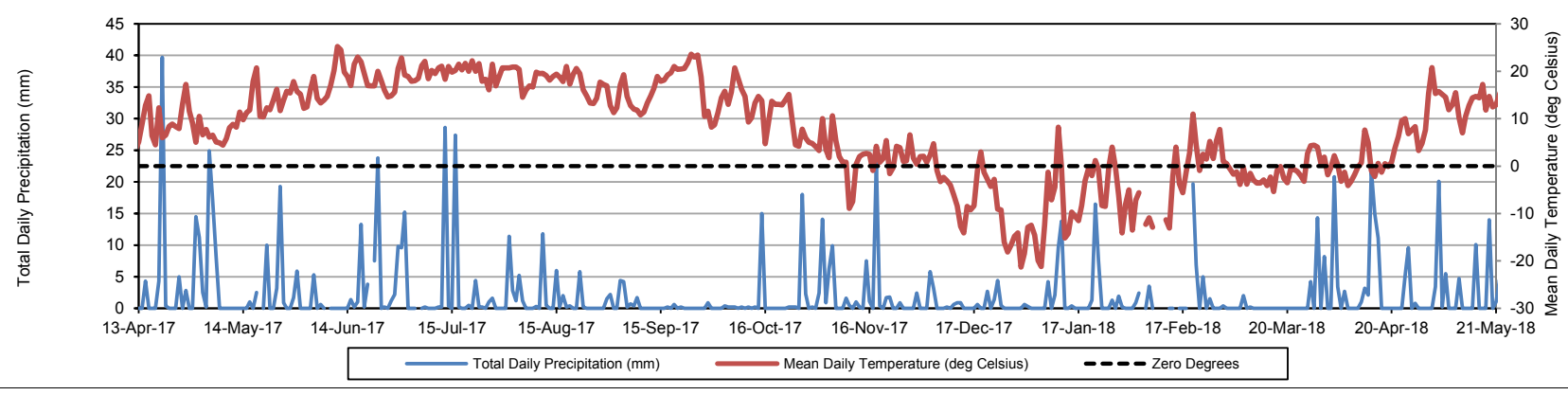

Stantec

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
6

Title **HYDROGRAPHS**
BH01-17 to BH04-17 and DP1-17(S/D)

Stantec

- Site Boundary
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2017)
- Proposed Subdivision
- 337.10 Groundwater Elevation (mAMSL)
- Groundwater Contour (mAMSL)
- Interpreted Direction of Groundwater Flow

0 50 100 metres

1:2,000 (At original document size of 11x17)

Notes

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

Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
7

Title
Groundwater Flow - May 2017

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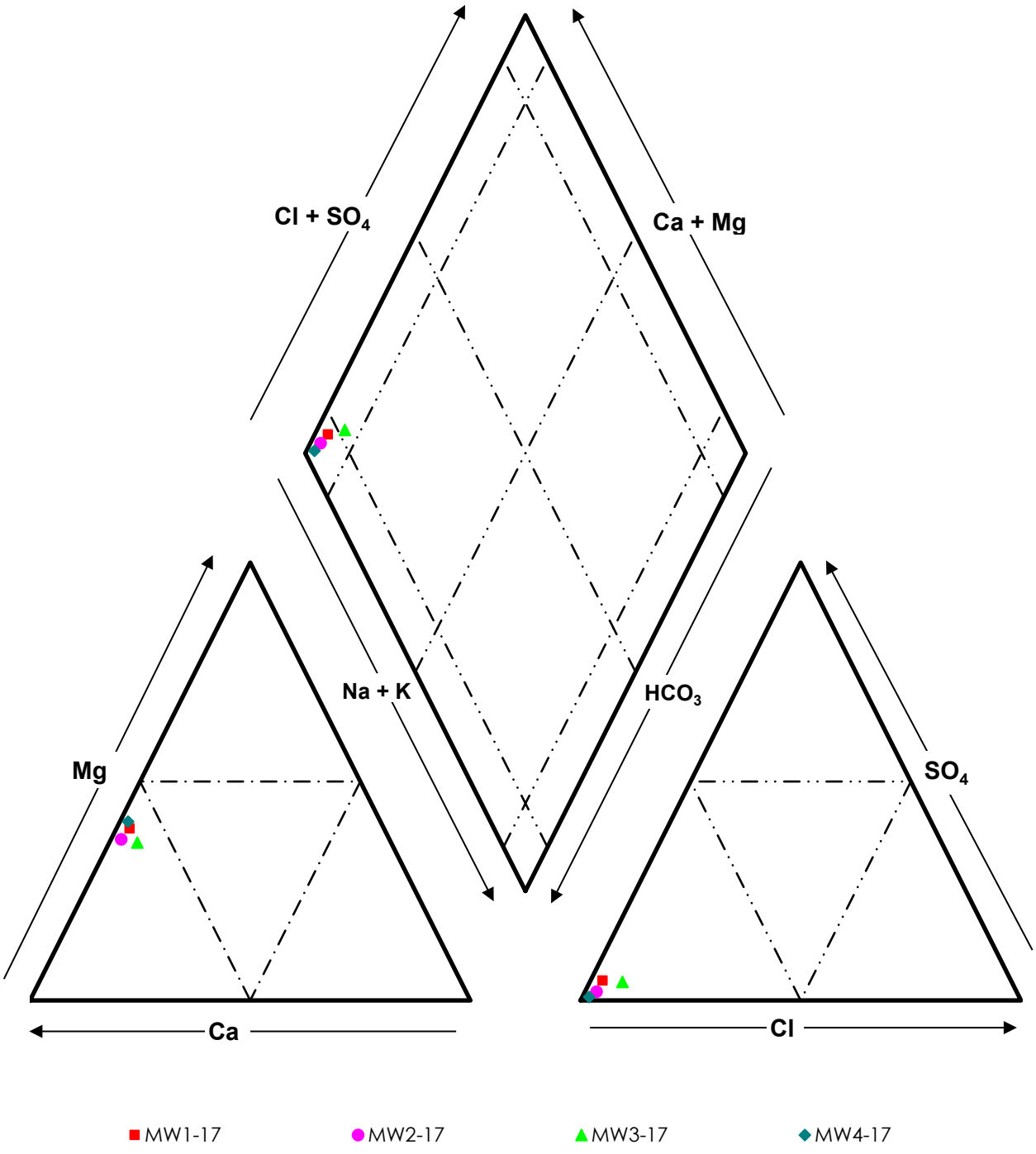


Stantec

ROCKPOINT PROPERTIES INC., 220 ARKELL RD, GUELPH
HYDROGEOLOGICAL ASSESSMENT

PIPER DIAGRAM

DATE:	SCALE:	PROJECT No.	FIGURE No.
		161413338	8

Stantec

Site Boundary
Monitoring Well (Stantec, 2017)
Drive-Point Piezometer (Stantec, 2017)
Proposed Subdivision
Wetland Boundary (Stantec, June 2017)

Proposed Land Use

Community Trail
Ecological Linkage
Open Space
Park
Residential
Road
SWM Pond
Wetland

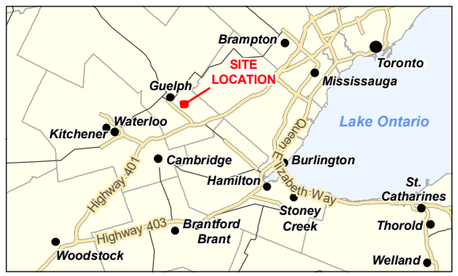
Water Balance Sub-Areas

Sub-Area A (0.83 ha)
Sub-Area B (2.31 ha)
Sub-Area C (4.02 ha)

0 50 100 metres
1:2,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Project Location
Guelph, Ontario

161413338 REVA
Prepared by CMC on 2019-06-04
Technical Review by GW on 2018-12-03

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
9

Title
Water Balance Sub-Areas

\\cal0240\1\work_group\01614\active\161413338\planning\drawings\GIS\MXD\HydroGeology\HydroG_Assess\161413338_HG_Fig09_WaterBalanceAreas.mxd Revised: 2019-06-04 By: CCrighton

APPENDIX B:
TABLES

TABLE 1
WELL CONSTRUCTION DETAILS

Well ID	UTM Coordinates		Elevations		Well Stick-up (m)	Well Depth (m BTOC)	Well Depth (m BGS)	Well Base Elevation (m AMSL)	Screened Interval				Screened Material Description [(a)]	Hydraulic Conductivity [(b)] (m/s)
	Northing	Easting	Top of Casing (m AMSL)	Ground Surface (m AMSL)					Top Elevation (m BGS)	Top Elevation (m AMSL)	Bottom Elevation (m BGS)	Bottom Elevation (m AMSL)		
MONITORING WELLS														
BH01-17	4819008	564970	334.36	333.48	0.88	5.45	4.57	328.91	1.52	331.96	4.57	328.91	Sand / Silty Sand with Gravel TILL	2.8E-05
BH02-17	4819204	565193	338.12	337.19	0.93	5.30	4.37	332.82	1.32	335.87	4.37	332.82	Silty Sand TILL	2.4E-06
BH03-17	4818983	565155	335.26	334.30	0.96	5.28	4.32	329.98	1.27	333.03	4.32	329.98	Sandy Silty Clay FILL / Silty Sand with Gravel TILL	1.6E-06
BH04-17	4819111	565287	340.86	339.95	0.91	8.30	7.39	332.56	4.34	335.61	7.39	332.56	Silty Sand with Gravel TILL	1.4E-05
													GEOMEAN =	**6.2E-06**
DRIVE-POINT PIEZOMETERS														
DP1-17(S)	4818975	565175	-	-	1.15	1.75	0.60	-	0.18	-	0.60	-	-	-
DP1-17(D)	4818974	565169	-	-	1.14	3.06	1.92	-	1.50	-	1.92	-	-	-

Notes:

(a) Refer to **Appendix E** for borehole and well construction logs
(b) Refer to **Appendix G** hydraulic conductivity analytical solutions

m AMSL = meters above mean sea level
m BGS = meters below ground surface
m BTOC = meters below top of well casing
\- = data not available

TABLE 2
GROUNDWATER LEVEL DATA - MONITORING WELLS

Well ID	Date	Time	Well Depth			Screen Length	Top of Casing Elevation	Ground Surface Elevation	Pipe Stick-up	Groundwater Level		
			(m BTOC)	(m BGS)	(m AMSL)	(m)	(m AMSL)	(m AMSL)	(m)	(m BGS) (1)	(m BTOC)	(m AMSL)
BH01-17	13-Apr-17	11:38 AM	5.45	4.57	328.91	3.05	334.36	333.48	0.88	0.29	1.17	333.19
	15-Sep-17	11:33 AM								1.72	2.60	331.76
	15-Feb-18	12:30 PM								1.21	2.09	332.27
	9-May-18	3:09 PM								0.37	1.25	333.11
BH02-17	17-Apr-17	1:02 PM	5.30	4.37	332.82	3.05	338.12	337.19	0.93	0.40	1.33	336.79
	15-Sep-17	12:08 PM								2.44	3.37	334.75
	15-Feb-18	1:00 PM								1.35	2.28	335.84
	9-May-18	3:24 PM								0.66	1.59	336.53
BH03-17	13-Apr-17	1:12 PM	5.28	4.32	329.98	3.05	335.26	334.30	0.96	0.69	1.65	333.61
	15-Sep-17	11:18 AM								2.47	3.43	331.83
	15-Feb-18	1:30 PM								2.09	3.05	332.21
	9-May-18	4:03 PM								0.77	1.73	333.53
BH04-17	17-Apr-17	12:06 PM	8.30	7.39	332.56	3.05	340.86	339.95	0.91	2.85	3.76	337.10
	15-Sep-17	12:03 PM								5.02	5.93	334.93
	15-Feb-18	1:15 PM								4.16	5.07	335.79
	9-May-18	3:42 PM								3.10	4.01	336.85

Notes:

(1) A negative value indicates that the water level measured within the pipe is located above ground surface

m BGS = meters below ground surface
m BTOC = meters below top of casing
DRY = no groundwater or surface water was observed in the piezometer or watercourse, respectively
- = measurement not available

TABLE 3
GROUNDWATER LEVELS - DRIVE-POINT PIEZOMETERS

Piezometer ID	Depth (m BTOC)	Depth (m BGS)	Screen Length (m)	Screen Separation [1] (m)	Pipe Stick-up (m)	Ground Surface Elevation (m AMSL)	Top of Casing Elevation (m AMSL)	Date	Time	Groundwater Level (m BGS) [2]	Groundwater Level (m BTOC)	Groundwater Level (m AMSL)	Surface Water Level (m BTOC) [3]	Surface Water Level (m AMSL)	Vertical Hydraulic Gradient[4] (+) = Upward (-) = Downward
DP1-17(S)	1.75	0.60	0.42		1.15	100.00	101.15	17-Apr-17	-	-0.50	0.65	100.50	0.67	100.48	
								15-Sep-17	11:49 AM	-	DRY	-	DRY	-	
								15-Feb-18	12:00 PM	-0.11	1.04	100.11	DRY	-	
DP1-17(D)	3.06	1.92	0.42	1.32	1.14	100.00	101.14	17-Apr-17	-	0.30	1.44	99.70	0.72	100.42	-0.61
								15-Sep-17	11:48 AM	-	DRY	-	DRY	-	-
								15-Feb-18	12:02 PM	1.57	2.71	98.43	DRY	-	-1.00

Notes:
(1) Distance between the mid-point of the screened intervals of the shallow and deep piezometer.
(2) A negative value indicates that the water level measured within the pipe is located above ground surface
(3) A negative value indicates that the surface water level is above the top of the piezometer
(4) Vertical hydraulic gradient between the mid-points of the shallow and deep piezometer screen.
(5) Ground surface elevation set to an arbitrary elevation of 100 m AMSL.

m BGS = meters below ground surface
m BTOC = meters below top of casing
DRY = no groundwater or surface water was observed in the piezometer or watercourse, respectively
- = measurement not available

TABLE 4
GROUNDWATER QUALITY RESULTS

Sample Location			MW01-17	MW02-17	MW03-17	MW04-17
Sample Date			13-Apr-17	12-Apr-17	12-Apr-17	12-Apr-17
Sample ID			WG-161413338-20170413-AH04	WG-161413338-20170412-AH03	WG-161413338-20170412-AH01	WG-161413338-20170412-AH02
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			MAXX	MAXX	MAXX	MAXX
Laboratory Work Order			B774848	B774848	B774848	B774848
Laboratory Sample ID	Units	ODWS	EFF795	EFF794	EFF792	EFF793
Calculated Parameters						
Anion Sum	me/L	n/v	6.88	5.66	8.51	7.25
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	310	270	370	350
Total Dissolved Solids (Calculated)	mg/L	500[C]	340	280	430	360
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	2.9	2.7	2.9	3.2
Cation Sum	me/L	n/v	6.91	5.84	8.7	7.68
Hardness (as CaCO3)	mg/L	80-100[E]	**340[E]**	**290[E]**	**410[E]**	**380[E]**
Ion Balance	%	n/v	0.17	1.58	1.08	2.89
Langelier Index (at 20 C)	none	n/v	0.972	0.892	1.03	1.05
Langelier Index (at 4 C)	none	n/v	0.723	0.642	0.784	0.798
Saturation pH (at 20 C)	none	n/v	7.03	7.13	6.88	6.94
Saturation pH (at 4 C)	none	n/v	7.27	7.38	7.13	7.19
Inorganics						
Total Ammonia-N	mg/L	n/v	<0.050	<0.050	<0.050	<0.050
Electrical Conductivity, Lab	µmhos/cm	n/v	610	520	740	640
Dissolved Organic Carbon (DOC)	mg/L	5[C]	1.3	1.2	1.8	1.4
Orthophosphate(as P)	mg/L	n/v	<0.010	<0.010	<0.010	<0.010
pH	S.U.	6.5-8.5[E]	8	8.02	7.91	7.99
Sulfate	mg/L	500[C] h	15	5.4	17	2.7
Alkalinity, Total (as CaCO3)	mg/L	30-500[E]	320	270	370	350
Chloride	mg/L	250[C]	6.8	5.3	22	4
Nitrite (as N)	mg/L	1.0 d[B]	<0.010	<0.010	<0.010	<0.010
Nitrate (as N)	mg/L	10.0 d[B]	0.73	<0.10	0.98	0.26
Nitrate + Nitrite (as N)	mg/L	10.0 d[B]	0.73	<0.10	0.98	0.26
Metals						
Aluminum	mg/L	0.1[E]	<0.0050	0.014	<0.0050	0.045
Antimony	mg/L	0.006[A]	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	mg/L	0.025[A]	<0.0010	<0.0010	<0.0010	<0.0010
Barium	mg/L	1[B]	0.044	0.022	0.042	0.025
Beryllium	mg/L	n/v	<0.00050	<0.00050	<0.00050	<0.00050
Boron	mg/L	5[A]	0.021	0.01	0.019	0.015
Cadmium	mg/L	0.005[B]	<0.00010	<0.00010	<0.00010	<0.00010
Calcium	mg/L	n/v	80	71	100	88
Chromium	mg/L	0.05[B]	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt	mg/L	n/v	<0.00050	<0.00050	<0.00050	<0.00050
Copper	mg/L	1[C]	0.0013	0.0012	0.0013	0.0012
Iron	mg/L	0.3[C]	<0.10	<0.10	<0.10	<0.10
Lead	mg/L	0.01 c[B]	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium	mg/L	n/v	33	26	38	38
Manganese	mg/L	0.05[C]	0.0054	0.017	0.014	0.03
Molybdenum	mg/L	n/v	0.00068	<0.00050	<0.00050	<0.00050
Nickel	mg/L	n/v	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	mg/L	n/v	<0.10	<0.10	<0.10	<0.10
Potassium	mg/L	n/v	0.9	0.8	1.1	1.1
Selenium	mg/L	0.01[B]	<0.0020	<0.0020	<0.0020	<0.0020
Silicon	mg/L	n/v	4.7	4.6	6.4	5.8
Silver	mg/L	n/v	<0.00010	<0.00010	<0.00010	<0.00010
Sodium	mg/L	200 g[C] 20 g[D]	4.3	2.6	12	2.6
Strontium	mg/L	n/v	0.15	0.097	0.13	0.1
Thallium	mg/L	n/v	<0.000050	<0.000050	<0.000050	<0.000050
Titanium	mg/L	n/v	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	mg/L	0.02[B]	0.00069	0.00062	0.00048	0.00038
Vanadium	mg/L	n/v	<0.00050	<0.00050	<0.00050	<0.00050
Zinc	mg/L	5[C]	0.012	<0.0050	0.016	0.0056

Notes:

ODWS	Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (MOE, 2006, revised January 2017)
A	ODWS Table 2 - Chemical Standards, Interim Maximum Acceptable Concentration
B	ODWS Table 2 - Chemical Standards, Maximum Acceptable Concentration
C	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Aesthetic Objectives
D	ODWS Table 4 - Medical Officer of Health Reporting Limit
E	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Operational Guidelines
6.5[A]	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.50	Laboratory reporting limit was greater than the applicable standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
c	This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes.
d	Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).
CD g	The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.
h	When sulfate levels exceed 500 mg/L, water may have a laxative effect on some people.

TABLE 5
PRE-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A (pre)	flat, silty sand, woodland (Wetland)
Sub-Area B (pre)	flat to gently rolling, silty sand, pastures and shrubs
Sub-Area C (pre)	rolling, silty sand, cultivated

Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Properties Inc.
Total Site Area (ha) 7.16

Land Description Factors	Sub-Area A (pre)	Sub-Area B (pre)	Sub-Area C (pre)											Total
Topography	0.30	0.25	0.20											
Soils	0.40	0.40	0.40											
Cover	0.20	0.15	0.10											
Sum (Infiltration Factor)†	0.90	0.80	0.70											
Soil Moisture Capacity (mm)	300	150	150											
Site area (ha)	0.83	2.31	4.01											7.16
Imperviousness Coefficient	0.00	0.00	0.15											
Impervious Area (ha)	0.00	0.00	0.60											0.60
Percentage of Total Site Area	0.0%	0.0%	8.4%											8%
Remaining Pervious Area (ha)	0.83	2.31	3.41											6.56
Total Pervious Site Area (ha)	0.83	2.31	3.41											6.56
Percentage of Total Site Area	11.6%	32.3%	47.7%											92%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data ‡													
Average Daily Temperature (°C)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3	**7.0**
Precipitation (mm)	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2	**916**

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.4	4.0	6.7	8.2	7.5	5.0	2.1	0.4	0.0	**35**
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.0	60.8	87.2	99.8	94.0	71.1	39.0	11.1	0.0	**492**
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	32	75	112	126	110	74	36	9	0	**573**
Precipitation - PET (mm)	65	55	61	42	8	-30	-27	-26	14	32	78	71	**343**

Evapotranspiration Analysis													
Sub-Area A (pre)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Precipitation (m^3)													**7,605**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	300	300	300	300	300	272	225	171	185	216	300	300	
Change in Storage	0	0	0	0	0	-28	-47	-54	14	32	84	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	111	145	138	74	36	9	0	**620**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	-6	71	**296**
Potential Infiltration (I)	59	49	55	38	7	0	0	0	0	0	-5	64	267
Potential Direct Surface Water Runoff (R)	7	5	6	4	1	0	0	0	0	0	-1	7	30
Potential Infiltration (mm)	0	0	0	265	7	0	0	0	0	0	-5	0	267
Pervious Evapotranspiration (m^3)	0	0	0	270	620	919	1207	1144	615	297	75	0	5,147
Pervious Runoff (m^3)	54	46	51	35	6	0	0	0	0	0	-5	59	**246**
Pervious Infiltration (m^3)	0	0	0	2199	57	0	0	0	0	0	-43	0	**2,213**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

TABLE 5
PRE-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Evapotranspiration Analysis													
Sub-Area B (pre)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Precipitation (m^3)													**21,191**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	150	150	150	150	150	123	84	49	62	94	150	150	
Change in Storage	0	0	0	0	0	-27	-39	-36	14	32	56	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	109	137	120	74	36	9	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	22	71	**324**
Potential Infiltration (I)	52	44	49	34	6	0	0	0	0	0	18	57	259
Potential Direct Surface Water Runoff (R)	13	11	12	8	2	0	0	0	0	0	4	14	65
Potential Infiltration (mm)	0	0	0	235	6	0	0	0	0	0	18	0	259
Pervious Evapotranspiration (m^3)	0	0	0	751	1728	2529	3177	2764	1714	828	208	0	13,699
Pervious Runoff (m^3)	302	254	282	194	35	0	0	0	0	0	102	329	**1,499**
Pervious Infiltration (m^3)	0	0	0	5445	140	0	0	0	0	0	408	0	**5,994**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Evapotranspiration Analysis													
Sub-Area C (pre)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Precipitation (m^3)													**36,787**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	150	150	150	150	150	123	84	49	62	94	150	150	
Change in Storage	0	0	0	0	0	-27	-39	-36	14	32	56	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	109	137	120	74	36	9	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	22	71	**324**
Potential Infiltration (I)	46	38	43	29	5	0	0	0	0	0	15	50	227
Potential Direct Surface Water Runoff (R)	20	16	18	13	2	0	0	0	0	0	7	21	97
Potential Infiltration (mm)	0	0	0	206	5	0	0	0	0	0	15	0	227
Pervious Evapotranspiration (m^3)	0	0	0	1108	2549	3732	4687	4078	2529	1222	307	0	20,213
Pervious Runoff (m^3)	667	562	624	430	78	0	0	0	0	0	226	729	**3,317**
Pervious Infiltration (m^3)	0	0	0	7031	181	0	0	0	0	0	527	0	**7,739**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Evaporation (m^3)	39	33	37	45	50	50	59	51	53	41	52	43	**552**
Impervious Runoff (m^3)	353	298	331	404	446	447	534	455	476	365	472	386	**4,966**

Pre-Development Infiltration	**15,946**	**(m^3/yr)**	**223**	**mm/yr**	**0.5**	**L/s**
Pre-Development Runoff	10,027	(m^3/yr)	140	mm/yr	0.3	L/s

Notes:
† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2018. Canadian Climate Normals 1981-2010, Waterloo Wellington A Climate Station, Climate ID 6149387. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html

Assumptions:
[1] The monthly average precipitation collected at the Waterloo-Wellington A climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

TABLE 6
POST-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A (post)	flat, silty sand, woodland (Wetland)
Sub-Area B (post)	rolling, silty sand, cultivated
Sub-Area C (post)	rolling, silty sand, cultivated

Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Properties Inc.
Total Site Area (ha) 7.16

Land Description Factors	Sub-Area A (post)	Sub-Area B (post)	Sub-Area C (post)											Total
Topography	0.30	0.25	0.20											
Soils	0.40	0.40	0.40											
Cover	0.20	0.15	0.10											
Sum (Infiltration Factor)†	0.90	0.80	0.70											
Soil Moisture Capacity (mm)	300	150	100											
Site area (ha)	0.83	2.31	4.01											7.16
Imperviousness Coefficient	0.00	0.10	0.65											
Impervious Area (ha)	0.00	0.22	2.60											2.82
Percentage of Total Site Area	0.0%	3.1%	36.3%											39%
Remaining Pervious Area (ha)	0.83	2.09	1.42											4.34
Total Pervious Site Area (ha)	0.83	2.09	1.42											4.34
Percentage of Total Site Area	11.6%	29.2%	19.8%											61%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data ‡													
Average Daily Temperature (°C)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3	**7.0**
Precipitation (mm)	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2	**916**

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.4	4.0	6.7	8.2	7.5	5.0	2.1	0.4	0.0	**35**
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.0	60.8	87.2	99.8	94.0	71.1	39.0	11.1	0.0	**492**
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	32	75	112	126	110	74	36	9	0	**573**
Precipitation - PET (mm)	65	55	61	42	8	-30	-27	-26	14	32	78	71	**343**

Evapotranspiration Analysis													
Sub-Area A (post)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	300	300	300	300	300	272	225	171	185	216	300	300	
Change in Storage	0	0	0	0	0	-28	-47	-54	14	32	84	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	111	145	138	74	36	9	0	**620**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	-6	71	**296**
Potential Infiltration (I)	59	49	55	38	7	0	0	0	0	0	-5	64	267
Potential Direct Surface Water Runoff (R)	7	5	6	4	1	0	0	0	0	0	-1	7	30
Potential Infiltration (mm)	0	0	0	265	7	0	0	0	0	0	-5	0	267
Pervious Evapotranspiration (m^3)	0	0	0	270	620	919	1207	1144	615	297	75	0	5,147
Pervious Runoff (m^3)	54	46	51	35	6	0	0	0	0	0	-5	59	**246**
Pervious Infiltration (m^3)	0	0	0	2199	57	0	0	0	0	0	-43	0	**2,213**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

TABLE 6
POST-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Evapotranspiration Analysis													
Sub-Area B (post)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	150	150	150	150	150	123	84	49	62	94	150	150	
Change in Storage	0	0	0	0	0	-27	-39	-36	14	32	56	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	109	137	120	74	36	9	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	22	71	**324**
Potential Infiltration (I)	52	44	49	34	6	0	0	0	0	0	18	57	259
Potential Direct Surface Water Runoff (R)	13	11	12	8	2	0	0	0	0	0	4	14	65
Potential Infiltration (mm)	0	0	0	235	6	0	0	0	0	0	18	0	259
Pervious Evapotranspiration (m^3)	0	0	0	679	1562	2287	2872	2499	1549	749	188	0	12,384
Pervious Runoff (m^3)	273	230	255	176	32	0	0	0	0	0	92	298	**1,355**
Pervious Infiltration (m^3)	0	0	0	4923	127	0	0	0	0	0	369	0	**5,419**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	130	110	122	149	164	165	197	168	175	135	174	142	**1,831**

Evapotranspiration Analysis													
Sub-Area C (post)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	100	100	100	100	100	74	42	18	32	64	100	100	
Change in Storage	0	0	0	0	0	-26	-32	-24	14	32	36	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	108	131	108	74	36	9	0	**573**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	42	71	**344**
Potential Infiltration (I)	46	38	43	29	5	0	0	0	0	0	29	50	241
Potential Direct Surface Water Runoff (R)	20	16	18	13	2	0	0	0	0	0	13	21	103
Potential Infiltration (mm)	0	0	0	206	5	0	0	0	0	0	29	0	241
Pervious Evapotranspiration (m^3)	0	0	0	460	1057	1530	1851	1522	1049	507	127	0	8,104
Pervious Runoff (m^3)	277	233	259	178	32	0	0	0	0	0	178	302	**1,460**
Pervious Infiltration (m^3)	0	0	0	2916	75	0	0	0	0	0	415	0	**3,406**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	1525	1284	1427	1743	1925	1928	2307	1963	2054	1577	2038	1666	**21,435**

Post-Development Infiltration	**11,038**	**(m^3/yr)**	**154**	**mm/yr**	**0.3**	**L/s**
Post-Development Runoff	26,327	(m^3/yr)	368	mm/yr	0.8	L/s
Infiltration Deficit	**4,908**	**(m^3/yr)**	**69**	**mm/yr**	**0.2**	**L/s**

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A (post)	flat, silty sand, woodland (Wetland)
Sub-Area B (post)	rolling, silty sand, cultivated
Sub-Area C (post)	rolling, silty sand, cultivated

Notes:
† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2018. Canadian Climate Normals 1981-2010, Waterloo Wellington A Climate Station, Climate ID 6149387. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html

Assumptions:
[1] The monthly average precipitation collected at the Waterloo-Wellington A climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

TABLE 7
1981 TO 2010 CANADIAN CLIMATE NORMALS (WATERLOO WELLINGTON A)
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Climate Normals 1981-2010 Station Data
Metadata including Station Name, Province, Latitude, Longitude, Elevation, Climate ID, WMO ID, TC ID

STATION_NAME	PROVINCE	LATITUDE	LONGITUDE	ELEVATION	CLIMATE_ID	WMO_ID	TC_ID
WATERLOO WELLINGTON A	ON	43°27'00.000" N	80°23'00.000" W	317.0 m	6149387		

Legend
A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)
B = At least 25 years
C = At least 20 years
D = At least 15 years

1981 to 2010 Canadian Climate Normals Station Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Temperature														
Daily Average (°C)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3	7	C
Standard Deviation	2.9	2.5	2	1.4	2.1	1.3	1.3	1.3	1.2	1.4	1.5	2.9	0.9	C
Daily Maximum (°C)	-2.6	-1.2	3.6	11.5	18.5	23.6	26	24.8	20.4	13.5	6.3	0.2	12	C
Daily Minimum (°C)	-10.3	-9.7	-5.6	0.8	6.4	11.5	14	12.9	8.6	2.9	-1.4	-6.8	2	C
Extreme Maximum (°C)	14.2	13.7	24.4	29.2	32	36.1	36	36.5	33.3	29.4	21.7	18.7		
Date (yyyy/dd)	1995/14	2000/26	2000/08	1990/25	1987/28	1988/25	1988/07	2001/08	1973/03	1971/02	1974/01	1982/03		
Extreme Minimum (°C)	-31.9	-29.2	-25.4	-16.1	-3.9	-0.6	5	1.1	-3.7	-8.3	-15.4	-27.2		
Date (yyyy/dd)	1984/16	1979/18	1980/02	1972/08	1970/07	1972/11	1971/03	1982/29	1989/27	1976/27	2000/23	1980/25		
Precipitation														
Rainfall (mm)	28.7	29.7	36.8	68	81.8	82.4	98.6	83.9	87.8	66.1	75	38	776.8	C
Snowfall (cm)	43.7	30.3	26.5	7.3	0.4	0	0	0	0	1.4	13	37.2	159.7	C
Precipitation (mm)	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2	916.5	C
Average Snow Depth (cm)	11	11	6	0	0	0	0	0	0	0	1	5	3	C
Median Snow Depth (cm)	11	11	4	0	0	0	0	0	0	0	0	3	3	C
Snow Depth at Month-end (cm)	12	9	1	0	0	0	0	0	0	0	1	9	3	C
Extreme Daily Rainfall (mm)	43	47	36.8	53.4	51.8	54.2	89.8	73.7	74.4	39.2	56	36.8		
Date (yyyy/dd)	1995/15	2001/09	1991/27	1992/16	1996/20	1984/17	1985/15	1975/24	1986/10	1977/08	1992/12	1990/29		
Extreme Daily Snowfall (cm)	16.8	17.8	21.2	22.9	6	0	0	0	0	6	16.6	22.4		
Date (yyyy/dd)	1992/14	1985/12	1980/08	2002/02	1984/13	1970/01	1970/01	1970/01	1970/01	1997/26	1986/20	1971/30		
Extreme Daily Precipitation (mm)	43	47	53.8	53.4	51.8	54.2	89.8	73.7	74.4	39.2	56	36.8		
Date (yyyy/dd)	1995/15	2001/09	1976/02	1992/16	1996/20	1984/17	1985/15	1975/24	1986/10	1977/08	1992/12	1990/29		
Extreme Snow Depth (cm)	58	74	77	18	0	0	0	0	0	2	19	50		
Date (yyyy/dd)	1976/24	1982/14	1982/10	1975/04	1970/01	1970/01	1970/01	1970/01	1970/01	1989/21	1986/21	2000/31		
Days with Maximum Temperature														
<= 0 °C	20.7	15.7	9.2	0.64	0	0	0	0	0	0	3.2	14	63.5	C
> 0 °C	10.3	12.5	21.8	29.4	31	30	31	31	30	31	26.8	17	301.7	C
> 10 °C	0.45	0.5	4.9	17.3	29.3	29.9	31	31	29.6	22.5	7.4	1.6	205.4	C
> 20 °C	0	0	0.29	2.9	11.6	23.5	29.7	28.1	15.9	3.6	0.15	0	115.7	C
> 30 °C	0	0	0	0	0.32	2.1	3.6	1.9	0.45	0	0	0	8.4	C
> 35 °C	0	0	0	0	0	0.05	0.23	0.05	0	0	0	0	0.33	C
Days with Minimum Temperature														
> 0 °C	1.5	1.9	4	15.5	28.9	30	31	31	29.2	21.7	10.4	2.5	207.6	C
<= 2 °C	30.5	27.9	29.2	19.6	6.1	0.23	0	0.09	2.6	14.6	24.2	29.8	184.7	C
<= 0 °C	29.5	26.4	27	14.5	2.1	0	0	0	0.77	9.3	19.7	28.5	157.6	C
< -2 °C	27.2	23.6	21.9	8.3	0.18	0	0	0	0.18	3.8	13.1	23.1	121.3	C
< -10 °C	15.1	13.4	6.7	0.18	0	0	0	0	0	0	0.85	9.1	45.4	C
< -20 °C	2.9	2	0.41	0	0	0	0	0	0	0	0	0.67	6	C
< - 30 °C	0.05	0	0	0	0	0	0	0	0	0	0	0	0.05	C
Days with Rainfall														
>= 0.2 mm	5.6	5	6.9	11.5	12.4	12	10.6	10.7	12.2	13.7	11.6	6.9	118.7	C
>= 5 mm	1.8	1.8	2.5	4.1	5.1	5.2	5.1	4.4	5	4.4	4.7	2.8	46.9	C
>= 10 mm	0.95	1	1.4	2.1	2.9	3.1	3.4	2.8	2.8	2.4	2.4	1.2	26.4	C
>= 25 mm	0.09	0.14	0.09	0.32	0.45	0.36	0.95	0.77	0.68	0.14	0.48	0.14	4.6	C
Days With Snowfall														
>= 0.2 cm	16.1	11.9	9	3.3	0.18	0	0	0	0	0.91	6.5	14.4	62.2	C
>= 5 cm	2.5	1.8	1.9	0.36	0.05	0	0	0	0	0.05	0.67	2.3	9.6	C
>= 10 cm	0.64	0.5	0.64	0.09	0	0	0	0	0	0	0.05	0.57	2.5	C
>= 25 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	C
Days with Precipitation														
>= 0.2 mm	18.2	14.2	13.8	13.7	12.4	12	10.6	10.7	12.2	13.9	16.4	18.1	166	C
>= 5 mm	4.3	3.2	4	4.5	5.2	5.2	5.1	4.4	5	4.5	5.3	4.5	55.1	C
>= 10 mm	1.5	1.6	1.8	2.3	2.9	3.1	3.4	2.8	2.8	2.4	2.5	2.1	29.2	C
>= 25 mm	0.09	0.18	0.27	0.32	0.45	0.36	0.95	0.77	0.68	0.14	0.48	0.38	5.1	C
Days with Snow Depth														
>= 1 cm	26.9	24.3	17.2	1.7	0	0	0	0	0	0.18	5.6	19.4	95.3	C
>= 5 cm	20.6	17.5	9.7	0.41	0	0	0	0	0	0	1.1	10.5	59.8	C
>= 10 cm	13.7	11.2	6.5	0.05	0	0	0	0	0	0	0.33	4.5	36.2	C
>= 20 cm	6.8	5.1	1.5	0	0	0	0	0	0	0	0	1.4	14.7	C

TABLE 7
1981 TO 2010 CANADIAN CLIMATE NORMALS (WATERLOO WELLINGTON A)
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Climate Normals 1981-2010 Station Data
Metadata including Station Name, Province, Latitude, Longitude, Elevation, Climate ID, WMO ID, TC ID

STATION_NAME	PROVINCE	LATITUDE	LONGITUDE	ELEVATION	CLIMATE_ID	WMO_ID	TC_ID
WATERLOO WELLINGTON A	ON	43°27'00.000" N	80°23'00.000" W	317.0 m	6149387		

Legend
A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)
B = At least 25 years
C = At least 20 years
D = At least 15 years

1981 to 2010 Canadian Climate Normals Station Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Wind														
Speed (km/h)	15.2	14.3	14.9	14.6	12.3	10.4	9.6	8.5	9.8	11.7	14.5	14.8	12.6	C
Most Frequent Direction	W	W	W	NW	NW	NW	NW	NW	NW	W	W	SW	W	C
Maximum Hourly Speed (km/h)	70	67	74	72	71	52	52	45	53	63	66	61	74	
Date (yyyy/dd)	1982/04	2002/01	2002/09	1984/30	1976/05	1998/02	2001/01	1966/09	1967/26	2001/26	1975/10	1972/13	2002/09	
Direction of Maximum Hourly Speed	SW	W	W	S	SW	W	NW	W	S	SW	SW	SW	W	
Maximum Gust Speed (km/h)	113	113	120	98	106	89	111	98	89	96	100	96	120	
Date (yyyy/dd)	1978/26	2002/01	1981/30	1984/30	1976/05	1998/02	1997/14	1990/27	1997/29	2001/25	1998/11	1982/28	1981/30	
Direction of Maximum Gust	S	W	SW	SW	SW	W	W	N	W	SW	SW	SW	SW	
Days with Winds >= 52 km/h														
Days with Winds >= 63 km/h														
Degree Days														
Above 24 °C	0	0	0	0	0.1	1.6	5.2	2.5	0.3	0	0	0	9.8	C
Above 18 °C	0	0	0	1	10.2	40.9	77.2	54.7	16.6	0.7	0	0	201.4	C
Above 15 °C	0	0	0.1	3.7	30.2	94.1	157.3	125	46.3	4.5	0	0	461.2	C
Above 10 °C	0	0	2.3	20.3	103.6	227.6	310.8	275.6	145.8	33	3.8	0.6	1123.2	C
Above 5 °C	1.2	0.9	13.4	75.1	234.7	376.8	465.8	430.5	286.4	115.6	28.1	5	2033.3	C
Above 0 °C	11	13.9	55.4	190.6	388.6	526.8	620.8	585.5	436.2	255.6	100.1	26.1	3210.6	C
Below 0 °C	211.7	168	89.7	6.1	0	0	0	0	0	0.2	23.6	129.4	628.8	C
Below 5 °C	356.8	296.1	202.7	40.7	1.1	0	0	0	0.1	15.2	101.7	263.3	1277.6	C
Below 10 °C	510.7	436.4	346.7	135.8	25	0.8	0	0.2	9.6	87.5	227.3	413.8	2193.7	C
Below 15 °C	665.7	577.5	499.4	269.3	106.6	17.2	1.5	4.6	60.1	214.1	373.6	568.3	3357.8	C
Below 18 °C	758.7	662.2	592.4	356.6	179.7	54	14.4	27.2	120.4	303.3	463.6	661.3	4193.6	C
Humidex														
Extreme Humidex	13.4	13	28	33.7	39.6	43.2	47.7	48.3	41.2	34.5	24.4	22.1		
Date (yyyy/dd)	1995/14	1997/21	1998/30	2002/16	1987/30	1988/25	1995/14	1988/02	1983/10	1971/02	1987/03	1982/03		
Wind Chill														
Extreme Wind Chill	-40.5	-37.1	-30.2	-20.6	-8.1	0	0	0	-4.1	-11.9	-22.2	-31.2		
Date (yyyy/dd)	1982/17	1979/17	1989/07	1982/04	1978/01	1966/13	1966/01	1966/01	1989/27	1969/23	1976/29	1983/26		
Humidity														
Average Relative Humidity - 0600LST (%)	86.4	83.4	84.8	84.4	84.7	87	90.1	93.6	94.3	90.6	87.6	87.1	87.8	D
Average Relative Humidity - 1500LST (%)	78.2	75.4							66.5	69.7		81.7		

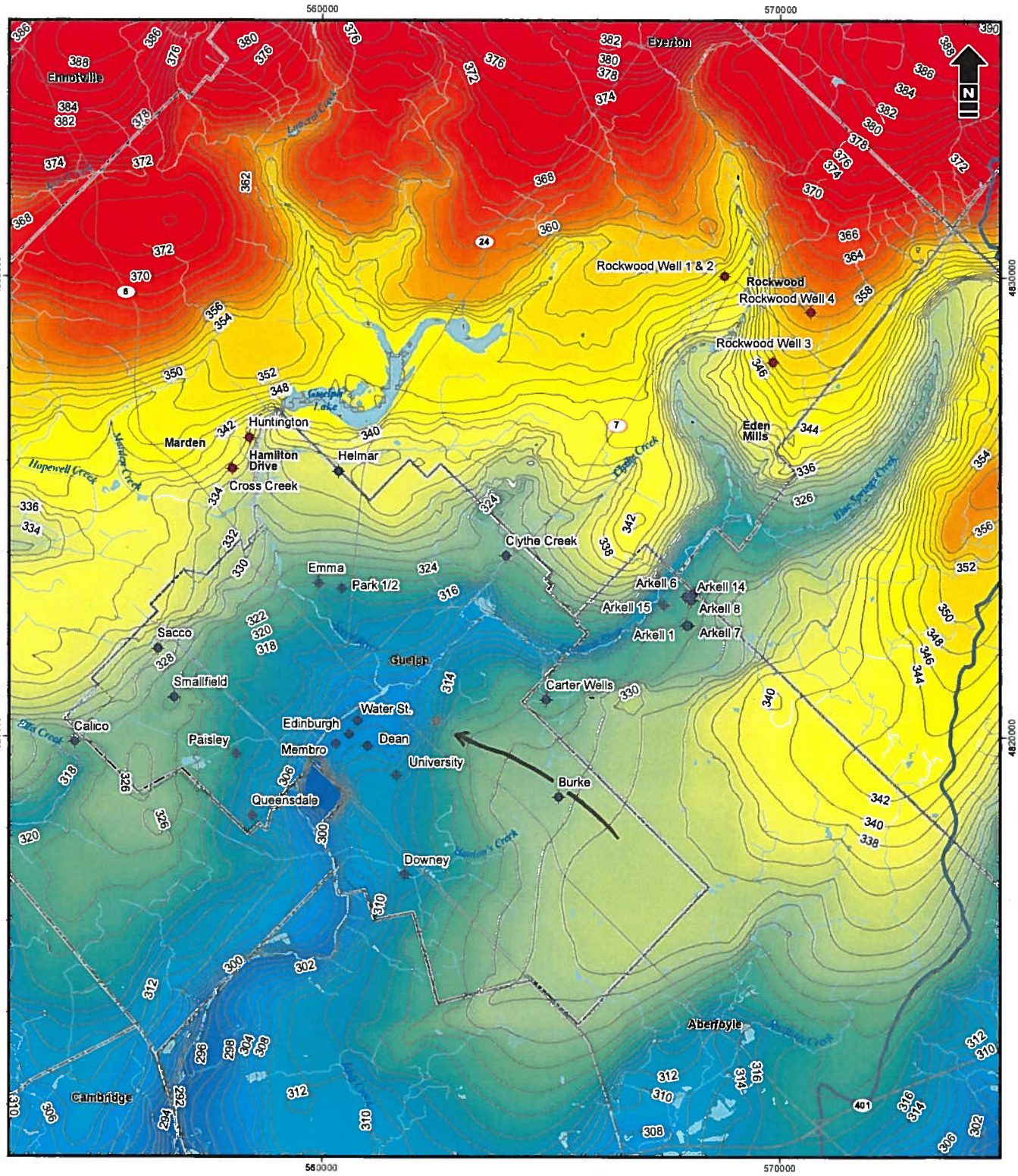
1981 to 2010 Canadian Climate Normals station data (Frost-Free)

	Frost-Free:	Code
Average Date of Last Spring Frost	7-May	D
Average Date of First Fall Frost	2-Oct	D
Average Length of Frost-Free Period	147 Days	D

Probability of last temperature in spring of 0 °C or lower on or after indicated dates	10%	25%	33%	50%	66%	75%	90%
Date	18-May	15-May	13-May	8-May	4-May	30-Apr	28-Apr
Probability of first temperature in fall of 0 °C or lower on or after indicated dates	10%	25%	33%	50%	66%	75%	90%
Date	19-Sep	24-Sep	25-Sep	30-Sep	3-Oct	8-Oct	16-Oct
Probability of frost-free period equal to or less than indicated period (Days)	10%	25%	33%	50%	66%	75%	90%
Days	128	135	136	144	152	157	169

Source: Environment Canada, 2018. Canadian Climate Normals 1981-2010. Online [http://climate.weather.gc.ca/climate_normals/index_e.html] Last Accessed February 2018

APPENDIX C:
REGIONAL GROUNDWATER FLOW MAPPING



Reference: Base Data - City of Guelph, 2009; GRCA, 2008; CVC, 2008; Ministry of Natural Resources, 2008. Produced using information provided by the Grand River Conservation Authority. Copyright © Grand River Conservation Authority, 2013. Produced using information provided by the Ministry of Natural Resource. Copyright © Ministry of Natural

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph and Township of Guelph/Eramosa
Tier 3 Water Budget and Local Area Risk Assessment

Model Predicted Water Table Elevation (Area of Interest)

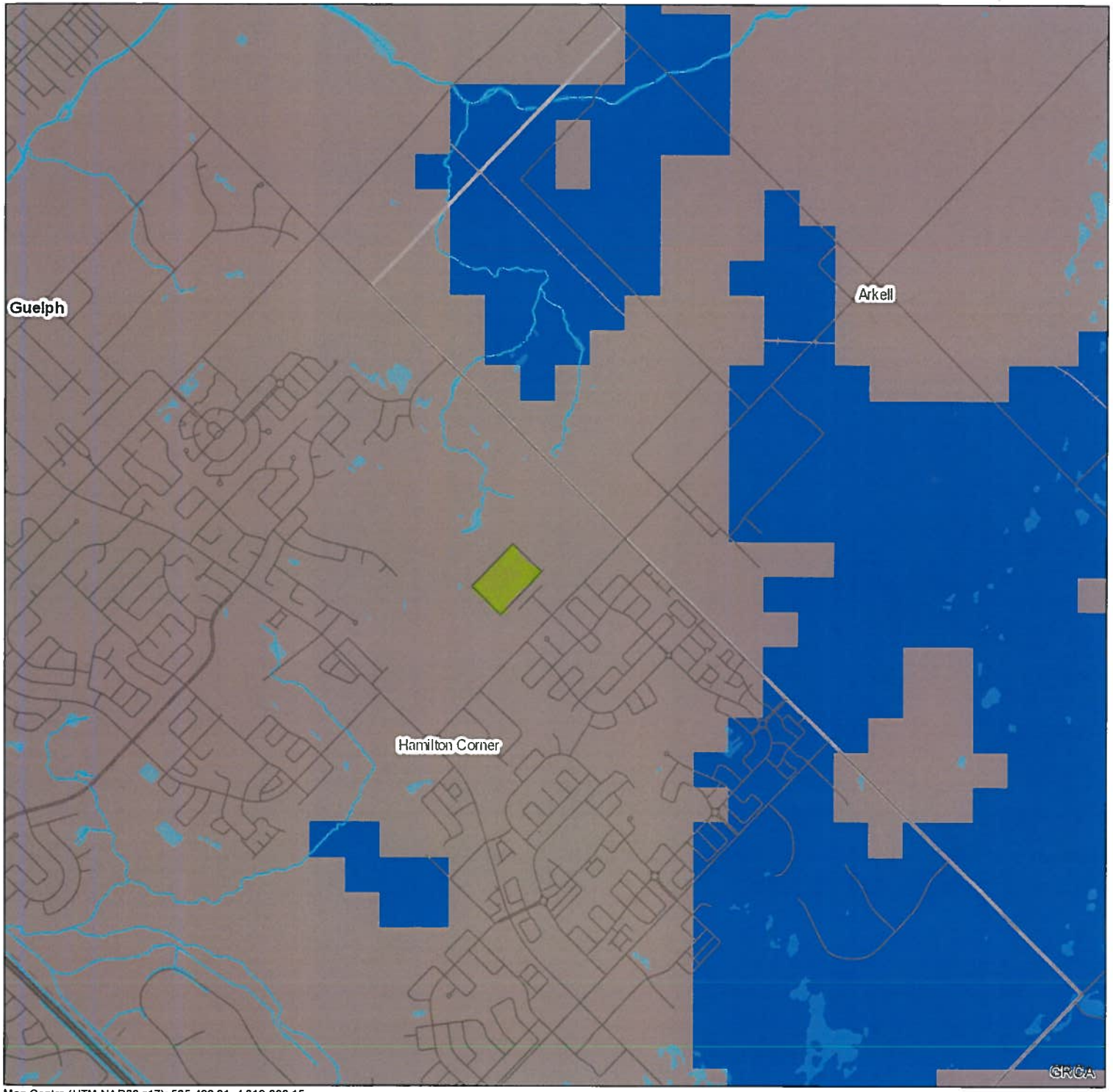
Date	Project	Technical	Reviewer	Drawn
23 Mar 2017	15072-527	P. Chin	D. VanVliet	M. Urtheil

Disclaimer: Prepared solely for the use of City of Guelph as specified in the accompanying report. No representation of any kind is made to other parties with which City of Guelph has not entered into contract.

Figure 4-3

I:\CityofGuelph\15072\Figures\Tables\QH\2013\Report\RiskAssessment\Figure_4-3_Model_Predicted_Water_Table_Elevation_CityofGuelph.mxd

APPENDIX D:
VERTICAL HYDRAULIC GRADIENT MAPPING



Grand River Conservation Authority

Date: Mar 23, 2017

Legend

- Municipal Boundary (GRCA)
- Watercourse - Local (GRCA)
- Park - Local (GRCA)
- Waterbody - Local (GRCA)
- Great Lakes - Local (GRCA)
- Upward
- Downward

0 190 380 760 1,140 Metres

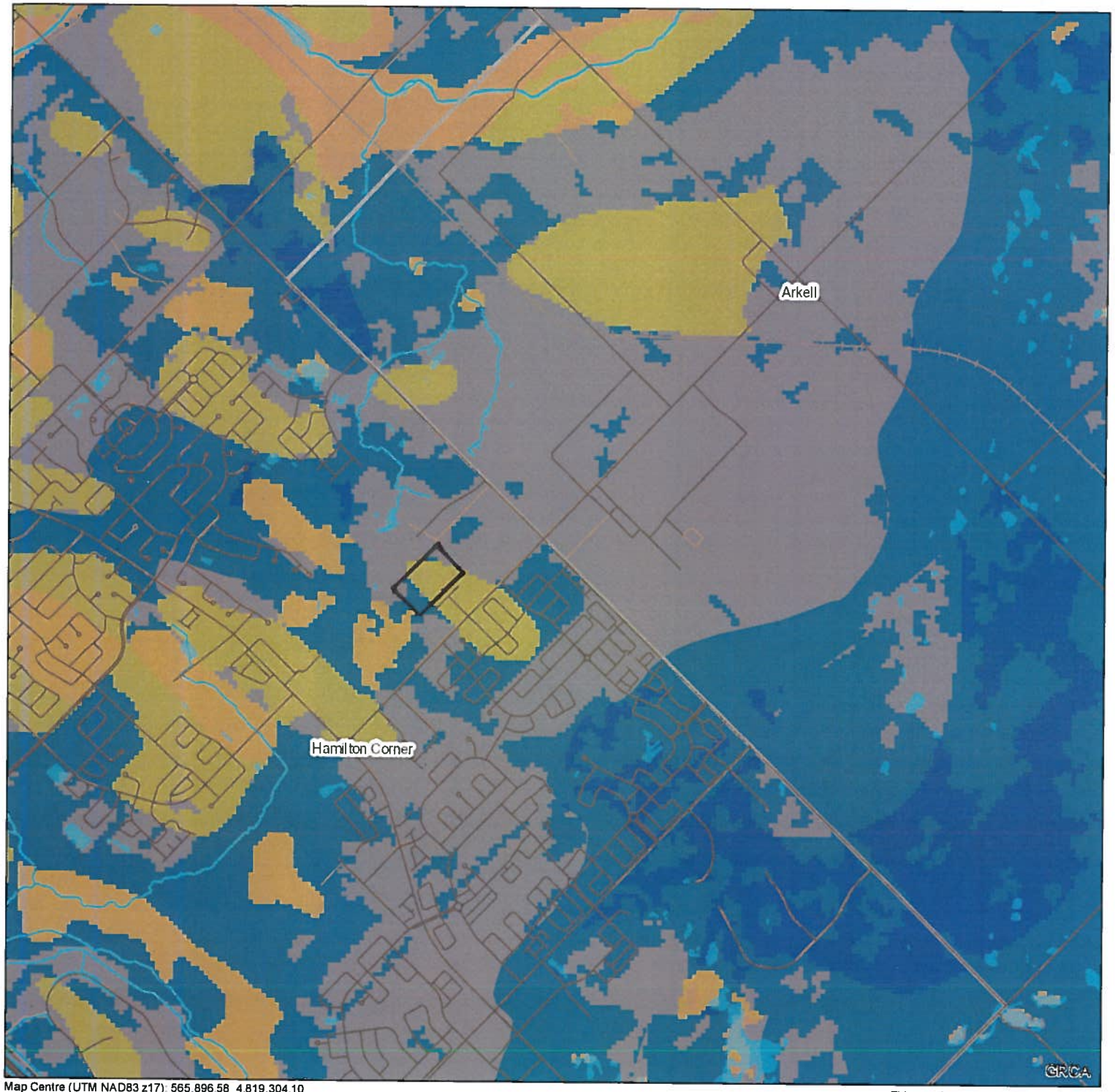
N

Map Centre (UTM NAD83 z17): 565,422.01 4,819,298.15

This map is not to be used for navigation

NAD 1983 UTM Zone 17N

Scale: 31,728



Map Centre (UTM NAD83 z17): 565,896.58 4,819,304.10

This map is not to be used for navigation

Grand River Conservation Authority

Date: Nov 21, 2018

Legend

- Municipal Boundary (GRCA)
- Watercourse - Local (GRCA)
- Park - Local (GRCA)
- Waterbody - Local (GRCA)

Average Annual Recharge (GRCA)

- less than 50 mm/yr
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- > 400
- Great Lakes - Local (GRCA)

The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 187.5 375 750 1,125 Metres

N

NAD 1983 UTM Zone 17N

Scale: 31,000

APPENDIX E:
BOREHOLE LOGS

Stantec

BOREHOLE RECORD

N: 4 819 008 E: 564 970

BH01-17

CLIENT Carson Reid Homes Ltd. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 334.36

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	333.5	**Grass Field**
	333.2	300 mm TOPSOIL
1, 2		Loose to compact, brown, SAND (SM) - trace gravel and silt - wet
3		- grey, some silt
4	329.4	Very dense, grey, Silty Sand with Gravel (SM) TILL - wet
5	328.3	END OF BOREHOLE at approximately 5.2 m below existing grade. Water level measured at 2.1 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.
6, 7, 8, 9, 10, 11, 12		

STRATA PLOT

WATER LEVEL

SAMPLES

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	280/610	6
4	SS	2	250/610	9
6	SS	3	100/610	17
9	SS	4	230/610	21
11	SS	5	460/610	5
16	SS	6	380/610	54

UNDRAINED SHEAR STRENGTH (kPa) 50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 819 204 E: 565 193

BH02-17

CLIENT Carson Reid Homes Ltd. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 338.12

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	337.2	**Grass Field**
	336.9	280 mm TOPSOIL
1		Compact, brown, SAND (SM) - trace gravel and silt - moist
	335.8	
2		Loose, brown, Silty Sand (SM) TILL - wet
		- very dense, moist
3		- grey
4		- auger grinding
5		- auger grinding
6		- moist to wet
7	330.0	
		Hard, grey, Silty Clay (CL) TILL - trace gravel
8	329.3	- moist
		END OF BOREHOLE at approximately 7.9 m below existing grade. Water level measured at 2.3 below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.
9		
10		
11		
12		

STRATA PLOT

WATER LEVEL

DEPTH (ft): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

SAMPLES

TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
SS	1	200/610	5
SS	2	51/610	11
SS	3	100/610	7
SS	4	250/250	50/100
SS	5	230/230	50/76
SS	6	250/280	50/130
SS	7	76/76	50/76
SS	8	280/280	50/130

UNDRAINED SHEAR STRENGTH (kPa) 50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
6	38	42	14

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 818 983 E: 565 155

BH03-17

CLIENT Carson Reid Homes Ltd.

LOCATION 220 Arkell Road, Guelph, ON

DATES: BORING April 5, 2017

WATER LEVEL

PROJECT No. 161413338

DATUM Geodetic

TPC ELEVATION 335.26

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	UNDRAINED SHEAR STRENGTH (kPa) 50 100 150 200 / WATER CONTENT & ATTERBERG LIMITS W_P W W_L / DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼ / STANDARD PENETRATION TEST, BLOWS/0.3m ●	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	334.3	**Grass Field**			0						
	334.0	FILL: 300 mm TOPSOIL			1	SS	1	460/610	8	●	
1	332.9	FILL: brown silty sand, some clay, trace gravel - moist			3	SS	2	200/610	8	●	
2	331.9	FILL: brown sandy silty clay, trace gravel - moist			6	SS	3	250/610	6	●	
3		Compact, brown, Silty Sand with Gravel (SM) TILL - moist to saturated		▽	8	SS	4	25/610	25	●	
					11	SS	5	300/610	26	●	23 28 41 8
5	329.1				16	SS	6	430/610	28	●	
6		END OF BOREHOLE at approximately 5.2 m below existing grade.									
7		Water level measured at 2.4 m below grade on completion of drilling.									
8		Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.									
9											
10											
11											
12											

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 819 111 E: 565 287

BH04-17

CLIENT Carson Reid Homes Ltd.

LOCATION 220 Arkell Road, Guelph, ON

DATES: BORING April 5, 2017

WATER LEVEL

PROJECT No. 161413338

DATUM Geodetic

TPC ELEVATION 340.86

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	340.0	**Grass Field**
	339.7	280 mm TOPSOIL
	339.3	Loose, brown, SAND (SM) - some gravel, trace silt - wet
1		Compact to very dense, brown, Silty Sand with Gravel (SM) TILL - moist
2		
3		
4		
5		
6		- wet
7		
8	331.8	
		END OF BOREHOLE at approximately 8.2 m below existing grade. Water level measured at 6.4 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 4.6 m to 7.6 m below grade.
9		
10		
11		
12		

STRATA PLOT

WATER LEVEL

DEPTH (ft): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39

SAMPLES

TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
SS	1	230/610	8
SS	2	460/610	11
SS	3	430/610	26
SS	4	460/610	67
SS	5	460/610	87
SS	6	250/250	50/100
SS	7	130/130	50/130
SS	8	460/610	84

UNDRAINED SHEAR STRENGTH (kPa)

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
18	36	37	9
27	32	32	9

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

APPENDIX F:
LABORATORY CERTIFICATES OF ANALYSIS

Maxxam
A Bureau Veritas Group Company

Your Project #: 161413338
Your C.O.C. #: 606049-01-01

Attention:Grant Whitehead

Stantec Consulting Ltd
300 Hagey Blvd
Suite 100
Waterloo, ON
N2L 0A4

Report Date: 2017/04/24
Report #: R4436105
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B774848
Received: 2017/04/13, 16:00

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	4	N/A	2017/04/21	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2017/04/21	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2017/04/19	CAM SOP-00463	EPA 325.2 m
Conductivity	4	N/A	2017/04/21	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	4	N/A	2017/04/18	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	4	N/A	2017/04/19	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	4	N/A	2017/04/19	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	4	N/A	2017/04/21		
Anion and Cation Sum	4	N/A	2017/04/21		
Total Ammonia-N	4	N/A	2017/04/20	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	4	N/A	2017/04/19	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	4	N/A	2017/04/21	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	4	N/A	2017/04/19	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	4	N/A	2017/04/21		
Sat. pH and Langelier Index (@ 4C)	4	N/A	2017/04/21		
Sulphate by Automated Colourimetry	4	N/A	2017/04/19	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	4	N/A	2017/04/21		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel (905) 817-5700 Toll Free 800 563 6266 Fax (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Your Project #: 161413338
Your C.O.C. #: 606049-01-01

Attention:Grant Whitehead

Stantec Consulting Ltd
300 Hagey Blvd
Suite 100
Waterloo, ON
N2L 0A4

Report Date: 2017/04/24
Report #: R4436105
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B774848
Received: 2017/04/13, 16:00

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Augustyna Dobosz
Project Manager
24 Apr 2017 14:46:56

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Augustyna Dobosz, Project Manager
Email: ADobosz@maxxam.ca
Phone# (905)817-5700 Ext:5798
==========
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel (905) 817-5700 Toll Free 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EFF792	EFF793	EFF794		
Sampling Date		2017/04/12 13:43	2017/04/12 16:17	2017/04/12 17:14		
COC Number		606049-01-01	606049-01-01	606049-01-01		
	UNITS	WG-161413338-20170412-AH01	WG-161413338-20170412-AH02	WG-161413338-20170412-AH03	RDL	QC Batch
Calculated Parameters						
Anion Sum	me/L	8.51	7.25	5.66	N/A	4941389
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	370	350	270	1.0	4941386
Calculated TDS	mg/L	430	360	280	1.0	4941392
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.9	3.2	2.7	1.0	4941386
Cation Sum	me/L	8.70	7.68	5.84	N/A	4941389
Hardness (CaCO3)	mg/L	410	380	290	1.0	4941387
Ion Balance (% Difference)	%	1.08	2.89	1.58	N/A	4941388
Langelier Index (@ 20C)	N/A	1.03	1.05	0.892		4941390
Langelier Index (@ 4C)	N/A	0.784	0.798	0.642		4941391
Saturation pH (@ 20C)	N/A	6.88	6.94	7.13		4941390
Saturation pH (@ 4C)	N/A	7.13	7.19	7.38		4941391
Inorganics						
Total Ammonia-N	mg/L	<0.050	<0.050	<0.050	0.050	4945156
Conductivity	umho/cm	740	640	520	1.0	4945858
Dissolved Organic Carbon	mg/L	1.8	1.4	1.2	0.20	4941671
Orthophosphate (P)	mg/L	<0.010	<0.010	<0.010	0.010	4944394
pH	pH	7.91	7.99	8.02		4945861
Dissolved Sulphate (SO4)	mg/L	17	2.7	5.4	1.0	4944392
Alkalinity (Total as CaCO3)	mg/L	370	350	270	1.0	4945849
Dissolved Chloride (Cl)	mg/L	22	4.0	5.3	1.0	4944387
Nitrite (N)	mg/L	<0.010	<0.010	<0.010	0.010	4943872
Nitrate (N)	mg/L	0.98	0.26	<0.10	0.10	4943872
Nitrate + Nitrite (N)	mg/L	0.98	0.26	<0.10	0.10	4943872
Metals						
Dissolved Aluminum (Al)	mg/L	<0.0050	0.045	0.014	0.0050	4942980
Dissolved Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	4942980
Dissolved Arsenic (As)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	4942980
Dissolved Barium (Ba)	mg/L	0.042	0.025	0.022	0.0020	4942980
Dissolved Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	4942980
Dissolved Boron (B)	mg/L	0.019	0.015	0.010	0.010	4942980
Dissolved Cadmium (Cd)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	4942980
Dissolved Calcium (Ca)	mg/L	100	88	71	0.20	4942980
Dissolved Chromium (Cr)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	4942980
Dissolved Cobalt (Co)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	4942980

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll Free: 800 563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EFF792	EFF793	EFF794		
Sampling Date		2017/04/12 13:43	2017/04/12 16:17	2017/04/12 17:14		
COC Number		606049-01-01	606049-01-01	606049-01-01		
	UNITS	WG-161413338-20170412-AH01	WG-161413338-20170412-AH02	WG-161413338-20170412-AH03	RDL	QC Batch
Dissolved Copper (Cu)	mg/L	0.0013	0.0012	0.0012	0.0010	4942980
Dissolved Iron (Fe)	mg/L	<0.10	<0.10	<0.10	0.10	4942980
Dissolved Lead (Pb)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	4942980
Dissolved Magnesium (Mg)	mg/L	38	38	26	0.050	4942980
Dissolved Manganese (Mn)	mg/L	0.014	0.030	0.017	0.0020	4942980
Dissolved Molybdenum (Mo)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	4942980
Dissolved Nickel (Ni)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	4942980
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	4942980
Dissolved Potassium (K)	mg/L	1.1	1.1	0.80	0.20	4942980
Dissolved Selenium (Se)	mg/L	<0.0020	<0.0020	<0.0020	0.0020	4942980
Dissolved Silicon (Si)	mg/L	6.4	5.8	4.6	0.050	4942980
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	4942980
Dissolved Sodium (Na)	mg/L	12	2.6	2.6	0.10	4942980
Dissolved Strontium (Sr)	mg/L	0.13	0.10	0.097	0.0010	4942980
Dissolved Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.000050	0.000050	4942980
Dissolved Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	4942980
Dissolved Uranium (U)	mg/L	0.00048	0.00038	0.00062	0.00010	4942980
Dissolved Vanadium (V)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	4942980
Dissolved Zinc (Zn)	mg/L	0.016	0.0056	<0.0050	0.0050	4942980

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EFF795		
Sampling Date		2017/04/13 10:55		
COC Number		606049-01-01		
	UNITS	WG-161413338-20170413-AH04	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	6.88	N/A	4941389
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	310	1.0	4941386
Calculated TDS	mg/L	340	1.0	4941392
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.9	1.0	4941386
Cation Sum	me/L	6.91	N/A	4941389
Hardness (CaCO3)	mg/L	340	1.0	4941387
Ion Balance (% Difference)	%	0.170	N/A	4941388
Langelier Index (@ 20C)	N/A	0.972		4941390
Langelier Index (@ 4C)	N/A	0.723		4941391
Saturation pH (@ 20C)	N/A	7.03		4941390
Saturation pH (@ 4C)	N/A	7.27		4941391
Inorganics				
Total Ammonia-N	mg/L	<0.050	0.050	4945156
Conductivity	umho/cm	610	1.0	4945858
Dissolved Organic Carbon	mg/L	1.3	0.20	4941671
Orthophosphate (P)	mg/L	<0.010	0.010	4944394
pH	pH	8.00		4945861
Dissolved Sulphate (SO4)	mg/L	15	1.0	4944392
Alkalinity (Total as CaCO3)	mg/L	320	1.0	4945849
Dissolved Chloride (Cl)	mg/L	6.8	1.0	4944387
Nitrite (N)	mg/L	<0.010	0.010	4943872
Nitrate (N)	mg/L	0.73	0.10	4943872
Nitrate + Nitrite (N)	mg/L	0.73	0.10	4943872
Metals				
Dissolved Aluminum (Al)	mg/L	<0.0050	0.0050	4942980
Dissolved Antimony (Sb)	mg/L	<0.00050	0.00050	4942980
Dissolved Arsenic (As)	mg/L	<0.0010	0.0010	4942980
Dissolved Barium (Ba)	mg/L	0.044	0.0020	4942980
Dissolved Beryllium (Be)	mg/L	<0.00050	0.00050	4942980
Dissolved Boron (B)	mg/L	0.021	0.010	4942980
Dissolved Cadmium (Cd)	mg/L	<0.00010	0.00010	4942980
Dissolved Calcium (Ca)	mg/L	80	0.20	4942980
Dissolved Chromium (Cr)	mg/L	<0.0050	0.0050	4942980
Dissolved Cobalt (Co)	mg/L	<0.00050	0.00050	4942980

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800 563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		EFF795		
Sampling Date		2017/04/13 10:55		
COC Number		606049-01-01		
	UNITS	WG-161413338-20170413-AH04	RDL	QC Batch
Dissolved Copper (Cu)	mg/L	0.0013	0.0010	4942980
Dissolved Iron (Fe)	mg/L	<0.10	0.10	4942980
Dissolved Lead (Pb)	mg/L	<0.00050	0.00050	4942980
Dissolved Magnesium (Mg)	mg/L	33	0.050	4942980
Dissolved Manganese (Mn)	mg/L	0.0054	0.0020	4942980
Dissolved Molybdenum (Mo)	mg/L	0.00068	0.00050	4942980
Dissolved Nickel (Ni)	mg/L	<0.0010	0.0010	4942980
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	4942980
Dissolved Potassium (K)	mg/L	0.90	0.20	4942980
Dissolved Selenium (Se)	mg/L	<0.0020	0.0020	4942980
Dissolved Silicon (Si)	mg/L	4.7	0.050	4942980
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	4942980
Dissolved Sodium (Na)	mg/L	4.3	0.10	4942980
Dissolved Strontium (Sr)	mg/L	0.15	0.0010	4942980
Dissolved Thallium (Tl)	mg/L	<0.000050	0.000050	4942980
Dissolved Titanium (Ti)	mg/L	<0.0050	0.0050	4942980
Dissolved Uranium (U)	mg/L	0.00069	0.00010	4942980
Dissolved Vanadium (V)	mg/L	<0.00050	0.00050	4942980
Dissolved Zinc (Zn)	mg/L	0.012	0.0050	4942980

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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A Bureau Veritas Group Company

Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

TEST SUMMARY

Maxxam ID: EFF792
Sample ID: WG-161413338-20170412-AH01
Matrix: Water

Collected: 2017/04/12
Shipped:
Received: 2017/04/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4945849	N/A	2017/04/21	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	4941386	N/A	2017/04/21	Automated Statchk
Chloride by Automated Colourimetry	KONE	4944387	N/A	2017/04/19	Alina Dobreanu
Conductivity	AT	4945858	N/A	2017/04/21	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4941671	N/A	2017/04/18	Anastasia Hamanov
Hardness (calculated as CaCO3)		4941387	N/A	2017/04/19	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4942980	N/A	2017/04/19	Cristina Petran
Ion Balance (% Difference)	CALC	4941388	N/A	2017/04/21	Automated Statchk
Anion and Cation Sum	CALC	4941389	N/A	2017/04/21	Automated Statchk
Total Ammonia-N	LACH/NH4	4945156	N/A	2017/04/20	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4943872	N/A	2017/04/19	Chandra Nandlal
pH	AT	4945861	N/A	2017/04/21	Surinder Rai
Orthophosphate	KONE	4944394	N/A	2017/04/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4941390	N/A	2017/04/21	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4941391	N/A	2017/04/21	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4944392	N/A	2017/04/19	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	4941392	N/A	2017/04/21	Automated Statchk

Maxxam ID: EFF793
Sample ID: WG-161413338-20170412-AH02
Matrix: Water

Collected: 2017/04/12
Shipped:
Received: 2017/04/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4945849	N/A	2017/04/21	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	4941386	N/A	2017/04/21	Automated Statchk
Chloride by Automated Colourimetry	KONE	4944387	N/A	2017/04/19	Alina Dobreanu
Conductivity	AT	4945858	N/A	2017/04/21	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4941671	N/A	2017/04/18	Anastasia Hamanov
Hardness (calculated as CaCO3)		4941387	N/A	2017/04/19	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4942980	N/A	2017/04/19	Cristina Petran
Ion Balance (% Difference)	CALC	4941388	N/A	2017/04/21	Automated Statchk
Anion and Cation Sum	CALC	4941389	N/A	2017/04/21	Automated Statchk
Total Ammonia-N	LACH/NH4	4945156	N/A	2017/04/20	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4943872	N/A	2017/04/19	Chandra Nandlal
pH	AT	4945861	N/A	2017/04/21	Surinder Rai
Orthophosphate	KONE	4944394	N/A	2017/04/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4941390	N/A	2017/04/21	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4941391	N/A	2017/04/21	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4944392	N/A	2017/04/19	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	4941392	N/A	2017/04/21	Automated Statchk

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Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

TEST SUMMARY

Maxxam ID: EFF794
Sample ID: WG-161413338-20170412-AH03
Matrix: Water

Collected: 2017/04/12
Shipped:
Received: 2017/04/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4945849	N/A	2017/04/21	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	4941386	N/A	2017/04/21	Automated Statchk
Chloride by Automated Colourimetry	KONE	4944387	N/A	2017/04/19	Alina Dobreanu
Conductivity	AT	4945858	N/A	2017/04/21	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4941671	N/A	2017/04/18	Anastasia Hamanov
Hardness (calculated as CaCO3)		4941387	N/A	2017/04/19	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4942980	N/A	2017/04/19	Cristina Petran
Ion Balance (% Difference)	CALC	4941388	N/A	2017/04/21	Automated Statchk
Anion and Cation Sum	CALC	4941389	N/A	2017/04/21	Automated Statchk
Total Ammonia-N	LACH/NH4	4945156	N/A	2017/04/20	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4943872	N/A	2017/04/19	Chandra Nandlal
pH	AT	4945861	N/A	2017/04/21	Surinder Rai
Orthophosphate	KONE	4944394	N/A	2017/04/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4941390	N/A	2017/04/21	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4941391	N/A	2017/04/21	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4944392	N/A	2017/04/19	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	4941392	N/A	2017/04/21	Automated Statchk

Maxxam ID: EFF795
Sample ID: WG-161413338-20170413-AH04
Matrix: Water

Collected: 2017/04/13
Shipped:
Received: 2017/04/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4945849	N/A	2017/04/21	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	4941386	N/A	2017/04/21	Automated Statchk
Chloride by Automated Colourimetry	KONE	4944387	N/A	2017/04/19	Alina Dobreanu
Conductivity	AT	4945858	N/A	2017/04/21	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	4941671	N/A	2017/04/18	Anastasia Hamanov
Hardness (calculated as CaCO3)		4941387	N/A	2017/04/19	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	4942980	N/A	2017/04/19	Cristina Petran
Ion Balance (% Difference)	CALC	4941388	N/A	2017/04/21	Automated Statchk
Anion and Cation Sum	CALC	4941389	N/A	2017/04/21	Automated Statchk
Total Ammonia-N	LACH/NH4	4945156	N/A	2017/04/20	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4943872	N/A	2017/04/19	Chandra Nandlal
pH	AT	4945861	N/A	2017/04/21	Surinder Rai
Orthophosphate	KONE	4944394	N/A	2017/04/19	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	4941390	N/A	2017/04/21	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	4941391	N/A	2017/04/21	Automated Statchk
Sulphate by Automated Colourimetry	KONE	4944392	N/A	2017/04/19	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	4941392	N/A	2017/04/21	Automated Statchk

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Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C

Results relate only to the items tested.

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Maxxam Job #: B774848
Report Date: 2017/04/24

QUALITY ASSURANCE REPORT

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4941671	Dissolved Organic Carbon	2017/04/17	94	80 - 120	98	80 - 120	<0.20	mg/L	0.24	20
4942980	Dissolved Aluminum (Al)	2017/04/19	101	80 - 120	101	80 - 120	<0.0050	mg/L		
4942980	Dissolved Antimony (Sb)	2017/04/19	102	80 - 120	100	80 - 120	<0.00050	mg/L		
4942980	Dissolved Arsenic (As)	2017/04/19	101	80 - 120	98	80 - 120	<0.0010	mg/L		
4942980	Dissolved Barium (Ba)	2017/04/19	101	80 - 120	100	80 - 120	<0.0020	mg/L		
4942980	Dissolved Beryllium (Be)	2017/04/19	104	80 - 120	102	80 - 120	<0.00050	mg/L		
4942980	Dissolved Boron (B)	2017/04/19	104	80 - 120	103	80 - 120	<0.010	mg/L	1.5	20
4942980	Dissolved Cadmium (Cd)	2017/04/19	101	80 - 120	97	80 - 120	<0.00010	mg/L		
4942980	Dissolved Calcium (Ca)	2017/04/19	98	80 - 120	97	80 - 120	<0.20	mg/L	0.47	20
4942980	Dissolved Chromium (Cr)	2017/04/19	99	80 - 120	97	80 - 120	<0.0050	mg/L		
4942980	Dissolved Cobalt (Co)	2017/04/19	98	80 - 120	96	80 - 120	<0.00050	mg/L		
4942980	Dissolved Copper (Cu)	2017/04/19	102	80 - 120	99	80 - 120	<0.0010	mg/L		
4942980	Dissolved Iron (Fe)	2017/04/19	101	80 - 120	98	80 - 120	<0.10	mg/L	NC	20
4942980	Dissolved Lead (Pb)	2017/04/19	94	80 - 120	94	80 - 120	<0.00050	mg/L		
4942980	Dissolved Magnesium (Mg)	2017/04/19	99	80 - 120	99	80 - 120	<0.050	mg/L	1.2	20
4942980	Dissolved Manganese (Mn)	2017/04/19	NC	80 - 120	98	80 - 120	<0.0020	mg/L		
4942980	Dissolved Molybdenum (Mo)	2017/04/19	102	80 - 120	99	80 - 120	<0.00050	mg/L		
4942980	Dissolved Nickel (Ni)	2017/04/19	98	80 - 120	96	80 - 120	<0.0010	mg/L		
4942980	Dissolved Phosphorus (P)	2017/04/19	108	80 - 120	115	80 - 120	<0.10	mg/L		
4942980	Dissolved Potassium (K)	2017/04/19	102	80 - 120	101	80 - 120	<0.20	mg/L		
4942980	Dissolved Selenium (Se)	2017/04/19	100	80 - 120	98	80 - 120	<0.0020	mg/L		
4942980	Dissolved Silicon (Si)	2017/04/19	101	80 - 120	101	80 - 120	<0.050	mg/L		
4942980	Dissolved Silver (Ag)	2017/04/19	84	80 - 120	95	80 - 120	<0.00010	mg/L		
4942980	Dissolved Sodium (Na)	2017/04/19	100	80 - 120	99	80 - 120	<0.10	mg/L		
4942980	Dissolved Strontium (Sr)	2017/04/19	100	80 - 120	97	80 - 120	<0.0010	mg/L		
4942980	Dissolved Thallium (Tl)	2017/04/19	94	80 - 120	94	80 - 120	<0.000050	mg/L		
4942980	Dissolved Titanium (Ti)	2017/04/19	101	80 - 120	102	80 - 120	<0.0050	mg/L		
4942980	Dissolved Uranium (U)	2017/04/19	99	80 - 120	96	80 - 120	<0.00010	mg/L		
4942980	Dissolved Vanadium (V)	2017/04/19	99	80 - 120	97	80 - 120	<0.00050	mg/L		
4942980	Dissolved Zinc (Zn)	2017/04/19	99	80 - 120	96	80 - 120	<0.0050	mg/L		
4943872	Nitrate (N)	2017/04/19	108	80 - 120	104	80 - 120	<0.10	mg/L	3.1	20

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Maxxam Job #: B774848
Report Date: 2017/04/24

QUALITY ASSURANCE REPORT(CONT'D)

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4943872	Nitrite (N)	2017/04/19	100	80 - 120	94	80 - 120	<0.010	mg/L	NC	20
4944387	Dissolved Chloride (Cl)	2017/04/19	NC	80 - 120	103	80 - 120	<1.0	mg/L	0.82	20
4944392	Dissolved Sulphate (SO4)	2017/04/19	119	75 - 125	104	80 - 120	<1.0	mg/L	1.7	20
4944394	Orthophosphate (P)	2017/04/19	115	75 - 125	100	80 - 120	<0.010	mg/L	NC	25
4945156	Total Ammonia-N	2017/04/20	NC	80 - 120	98	85 - 115	<0.050	mg/L	3.8	20
4945849	Alkalinity (Total as CaCO3)	2017/04/21			97	85 - 115	<1.0	mg/L	1.5	20
4945858	Conductivity	2017/04/21			100	85 - 115	<1.0	umho/cm	0.23	25
4945861	pH	2017/04/21			101	98 - 103			0.86	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam
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Maxxam Job #: B774848
Report Date: 2017/04/24

Stantec Consulting Ltd
Client Project #: 161413338
Sampler Initials: AW

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Services

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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STANTEC CHAIN OF CUSTODY RECORD

Page 1 of 1

IMMEDIATE

INVOICE INFORMATION:

Company Name: #9197 Stantec Consulting Ltd
Contact Name: Accounts Payable
Address: 300 Hagey Blvd Suite 100, Waterloo ON N2L 0A4
Phone: (519) 579-4410 x Fax: (519) 579-6733 x
Email: accounts.payable.invoices@stantec.com

REPORT INFORMATION (if differs from invoice):

Company Name:
Contact Name: Grant Whitehead
Address:
Phone: (519) 585-7400 x Fax:
Email: grant.whitehead@stantec.com

PROJECT INFORMATION:

Quotation #: 851646
Task #:
Project #: 161413338
Profit Centre: 1614
Site #:
Sampled By: Allison Healey

Laboratory Use Only:

Maxxam Job #:
Bottle Order #: 606049
COC #: C606049-01-01
Project Manager: Augustyna Dobosz

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agr/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☒ Other ODWS

Special Instructions: gw samples non-reportable

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC): Field Filtered (please circle): Metals / Hg / Cr VI; RCAp - Comprehensive

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (Metals / Hg / Cr VI)	RCAp - Comprehensive	# of Bottles	Comments
1	WG-161413338-	20170412-AH01	12-Apr-17	3:43	GW	Y	X	4	
2	↓	-AH02	↓	16:17	GW	Y	X	4	
3	↓	-AH03	↓	17:14	GW	Y	X	4	
4	WG-161413338-	20170413-AH04	13 Apr-17	10:55	GW	Y	X	4	
5					GW			4	
6									
7									
8									
9									
10									

13-Apr-17 16:00
Augustyna Dobosz
B774848
AKP FXV-1159

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Allison Healey	17/04/13	16:10	[illegible]	2017/04/13	16:00	
			Matthew Taylor	2017/04/13	16:42	

Time Sensitive

Laboratory Use Only

Temperature (°C) on Receipt	Custody Seal Present	Yes	No
7 7 7	Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF

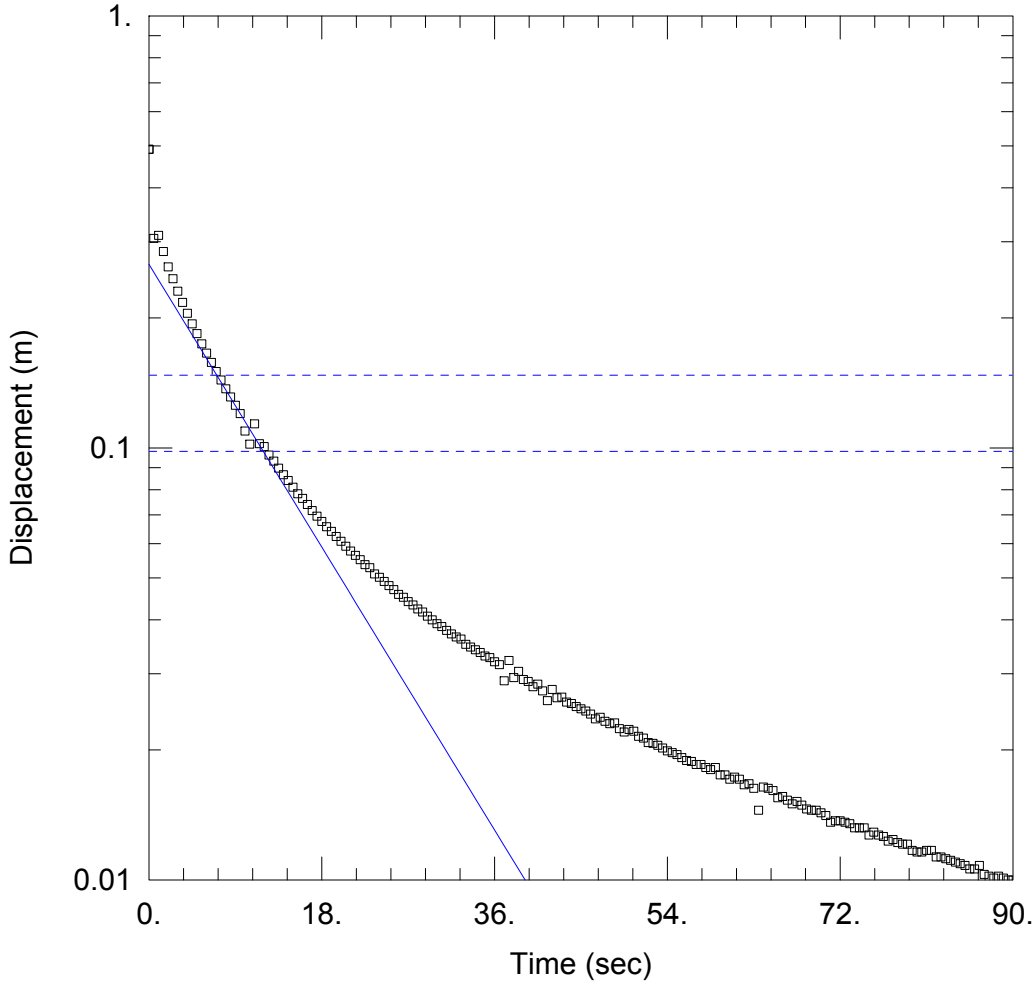
SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxam Yellow: Client

3/12

Maxxam Analytics International Corporation o/a Maxxam Analytics

APPENDIX G:
HYDRAULIC CONDUCTIVITY TESTING ANALYTICAL SOLUTIONS



TEST 1

Data Set: \...\MW01-17test1_ah_JK.aqt
Date: 04/21/17 Time: 09:31:06

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW01-17
Test Date: 13-Apr-17

AQUIFER DATA

Saturated Thickness: 4.28 m Anisotropy Ratio (Kz/Kr): 0.5

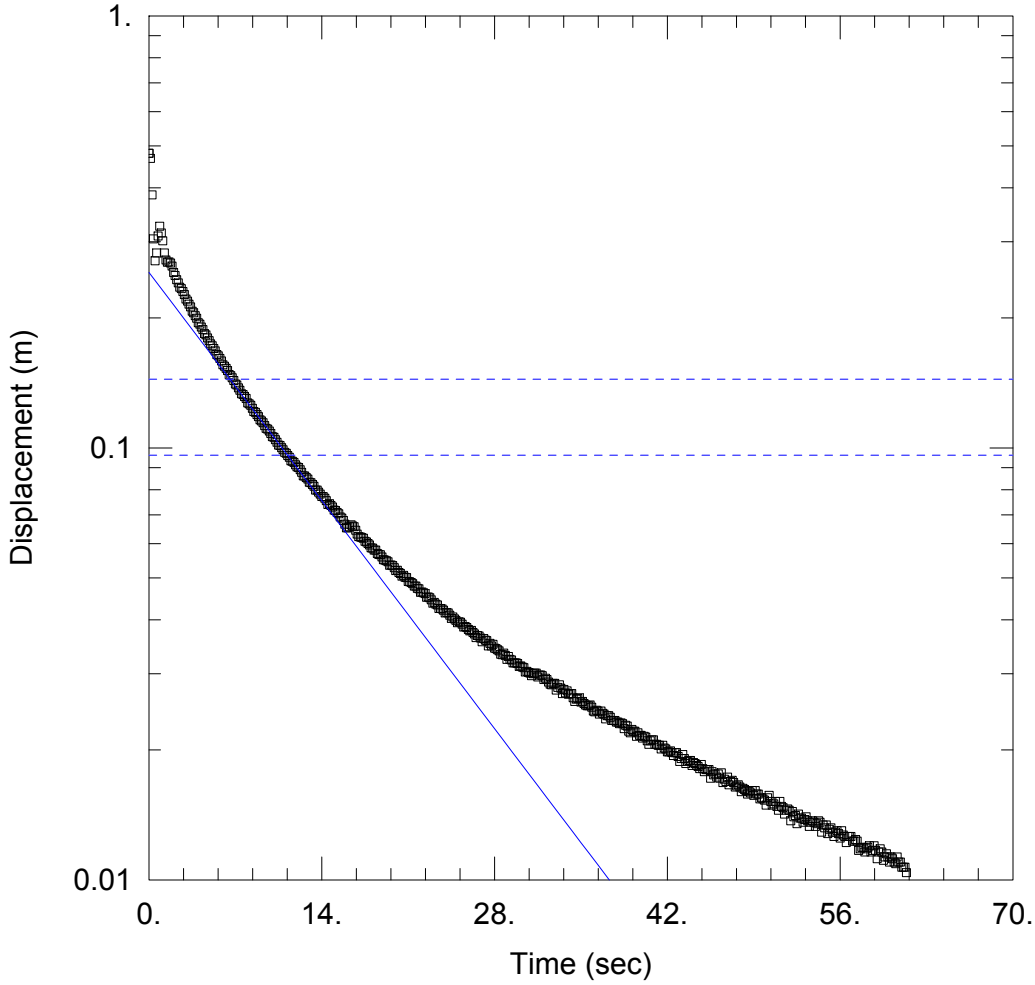
WELL DATA (MW01-17)

Initial Displacement: 0.4911 m Static Water Column Height: 4.28 m
Total Well Penetration Depth: 4.28 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.7E-5 m/sec y0 = 0.266 m



TEST 2

Data Set: \...\MW01-17test2_ah_JK.aqt
Date: 04/21/17 Time: 09:38:52

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW01-17
Test Date: 13-Apr-17

AQUIFER DATA

Saturated Thickness: 4.28 m Anisotropy Ratio (Kz/Kr): 0.5

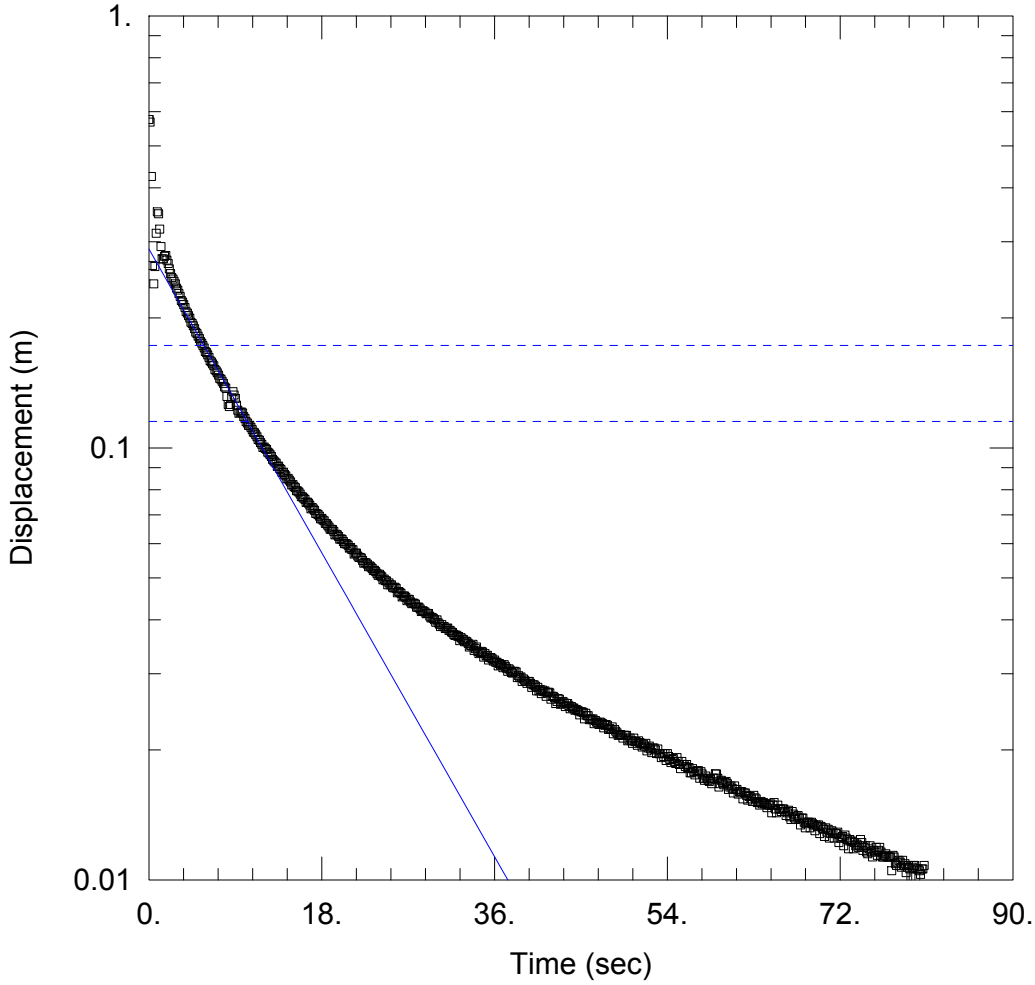
WELL DATA (MW01-17)

Initial Displacement: 0.4808 m Static Water Column Height: 4.28 m
Total Well Penetration Depth: 4.28 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.8E-5 m/sec y0 = 0.2548 m



TEST 3

Data Set: \...\MW01-17test3_ah_JK.aqt
Date: 04/21/17 Time: 09:42:15

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW01-17
Test Date: 13-Apr-17

AQUIFER DATA

Saturated Thickness: 4.28 m Anisotropy Ratio (Kz/Kr): 0.5

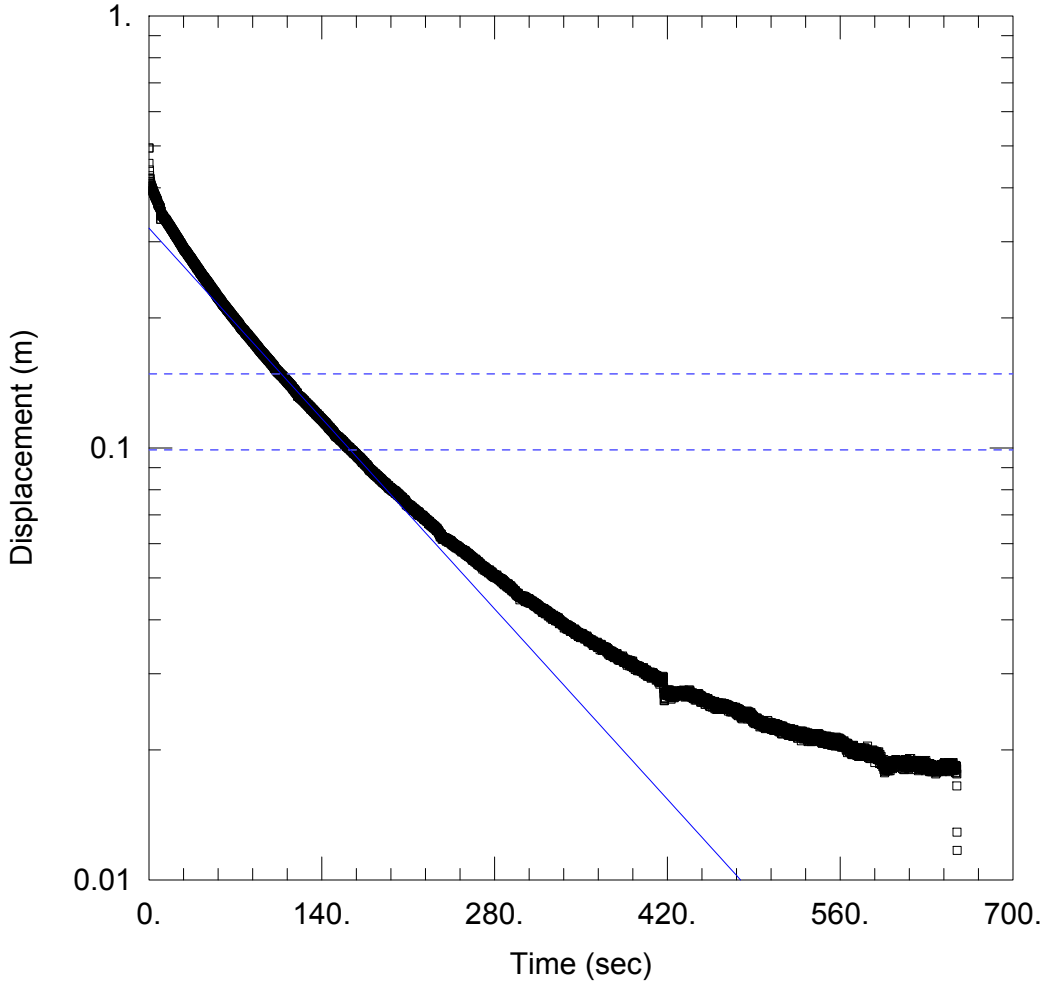
WELL DATA (MW01-17)

Initial Displacement: 0.5757 m Static Water Column Height: 4.28 m
Total Well Penetration Depth: 4.28 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.9E-5 m/sec y0 = 0.2886 m



TEST 1

Data Set: \...\MW02-17test1_ah_JK.aqt
Date: 04/21/17 Time: 09:53:11

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW02-17
Test Date: 17-Apr-17

AQUIFER DATA

Saturated Thickness: 3.96 m Anisotropy Ratio (Kz/Kr): 0.5

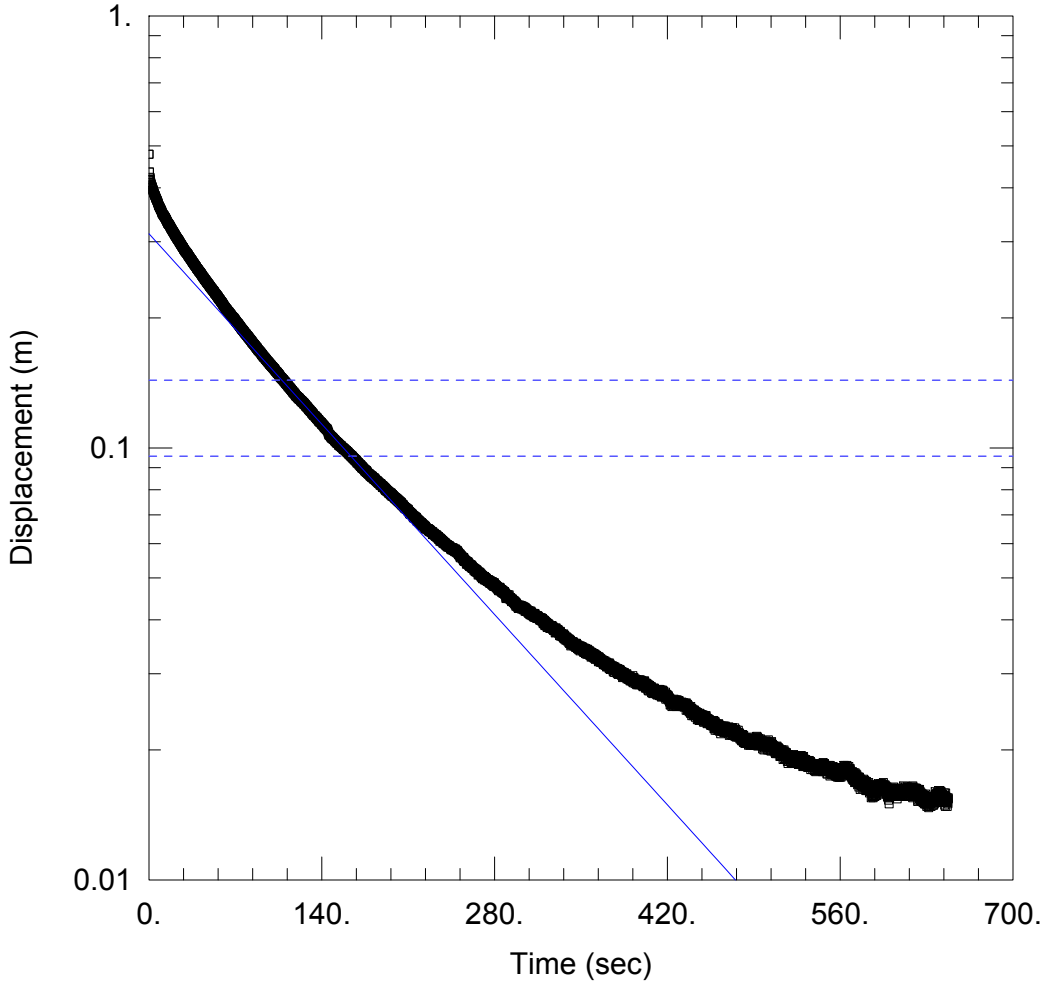
WELL DATA (MW02-17)

Initial Displacement: 0.4945 m Static Water Column Height: 3.96 m
Total Well Penetration Depth: 3.96 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.3E-6 m/sec y0 = 0.3226 m



TEST 2

Data Set: \...\MW02-17test2_ah_JK.aqt
Date: 04/21/17 Time: 10:00:17

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW02-17
Test Date: 17-Apr-17

AQUIFER DATA

Saturated Thickness: 3.96 m Anisotropy Ratio (Kz/Kr): 0.5

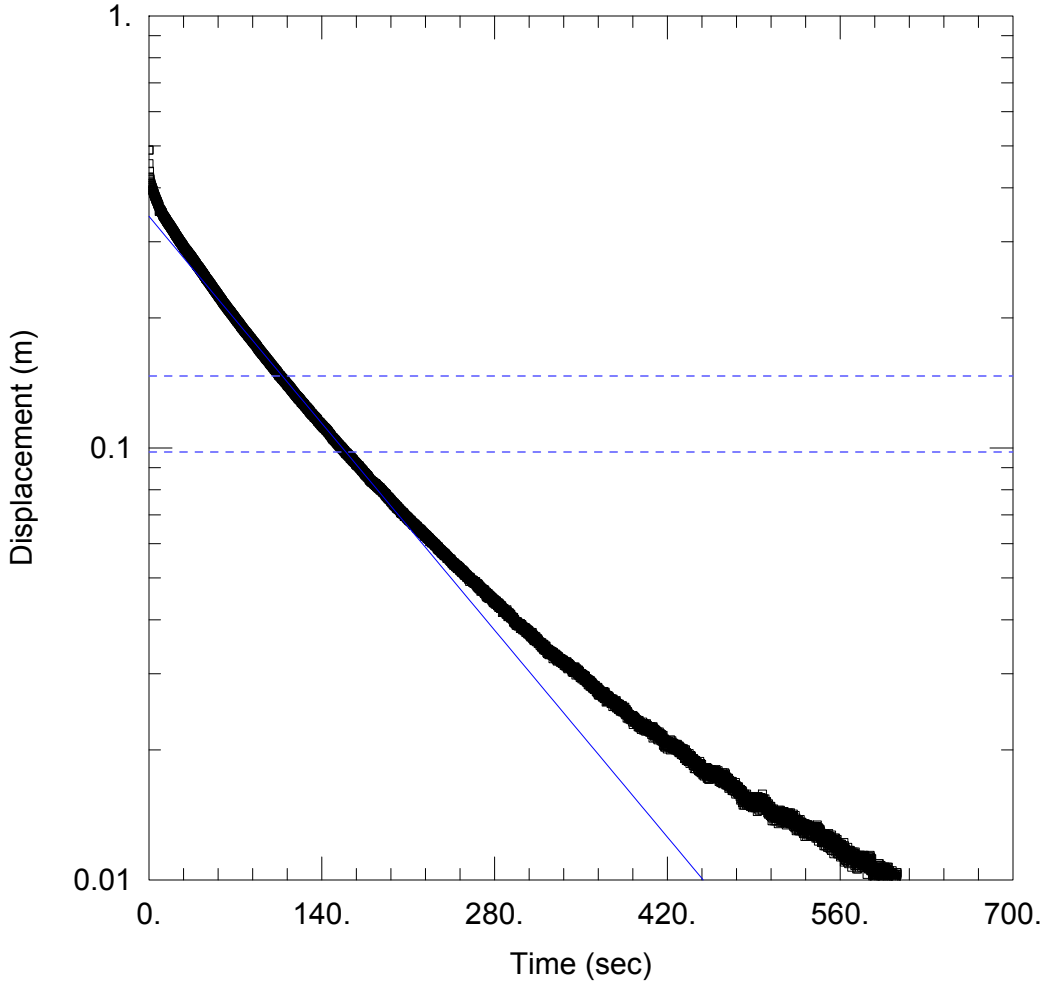
WELL DATA (MW02-17)

Initial Displacement: 0.4785 m Static Water Column Height: 3.96 m
Total Well Penetration Depth: 3.96 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.3E-6 m/sec y0 = 0.313 m



TEST 3

Data Set: \...\MW02-17test3_ah_JK.aqt
Date: 04/21/17 Time: 10:05:53

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW02-17
Test Date: 17-Apr-17

AQUIFER DATA

Saturated Thickness: 3.96 m Anisotropy Ratio (Kz/Kr): 0.5

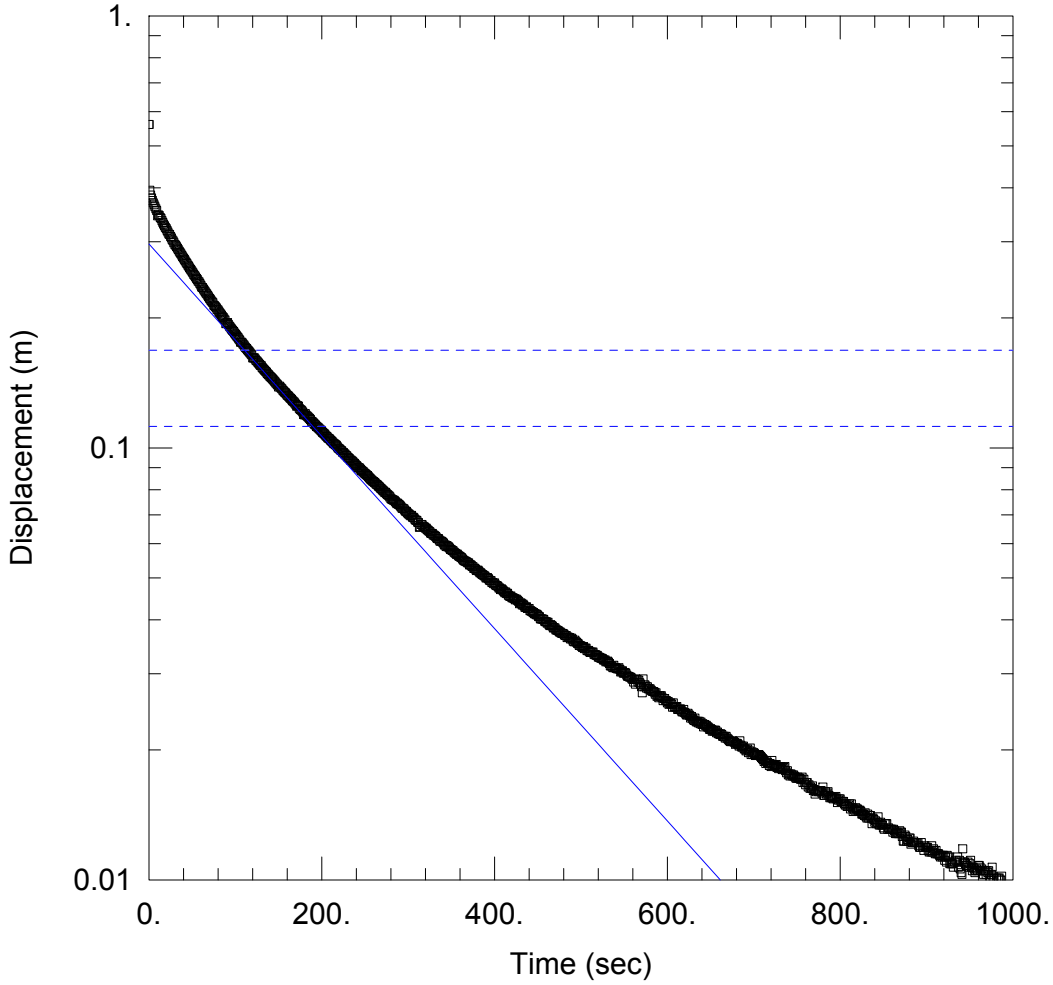
WELL DATA (MW02-17)

Initial Displacement: 0.4892 m Static Water Column Height: 3.96 m
Total Well Penetration Depth: 3.96 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.5E-6 m/sec y0 = 0.3435 m



TEST 1

Data Set: \...\MW03-17test1_ah_JK.aqt
Date: 04/21/17 Time: 10:19:45

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW03-17
Test Date: 13-Apr-17

AQUIFER DATA

Saturated Thickness: 3.66 m Anisotropy Ratio (Kz/Kr): 0.5

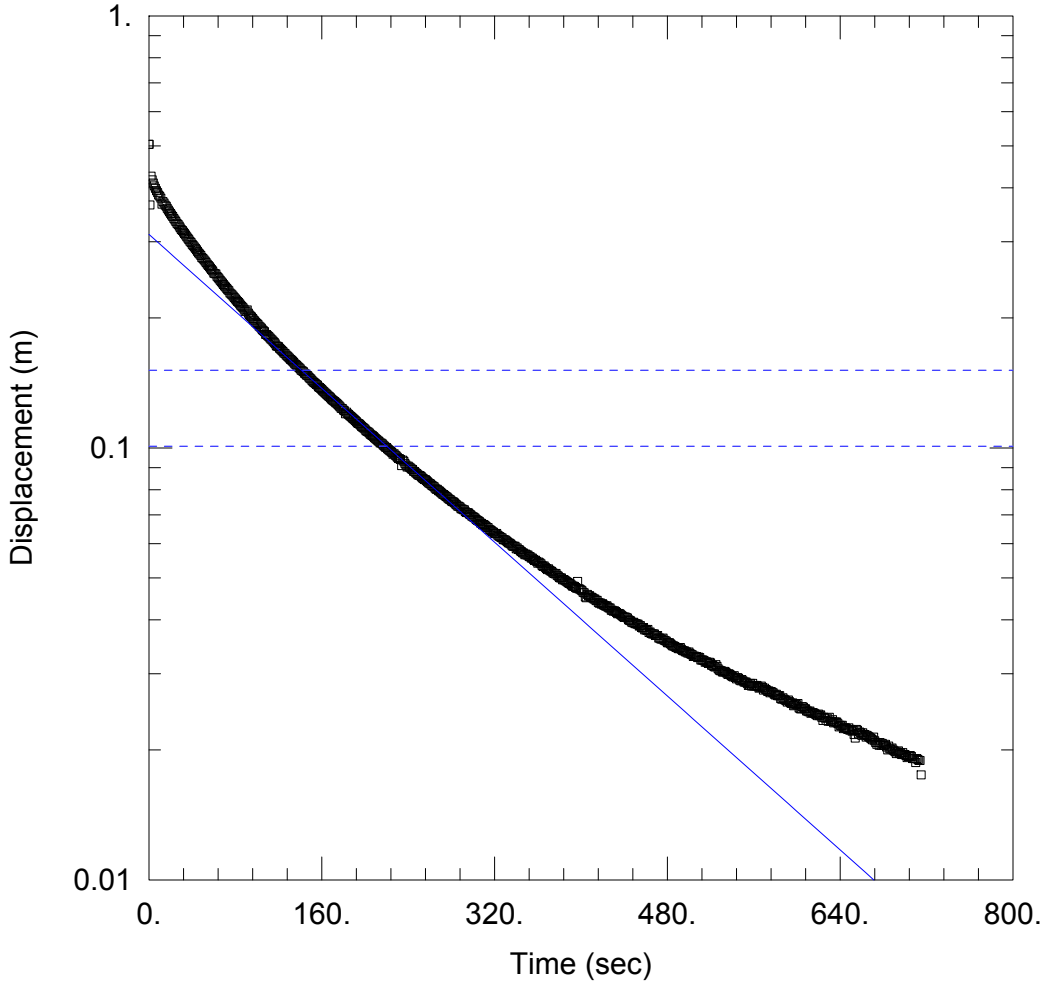
WELL DATA (MW03-17)

Initial Displacement: 0.5608 m Static Water Column Height: 3.66 m
Total Well Penetration Depth: 3.66 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.6E-6 m/sec y0 = 0.2965 m



TEST 2

Data Set: \...\MW03-17test2_ah_JK.aqt
Date: 04/21/17 Time: 10:21:46

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW03-17
Test Date: 13-Apr-17

AQUIFER DATA

Saturated Thickness: 3.66 m Anisotropy Ratio (Kz/Kr): 0.5

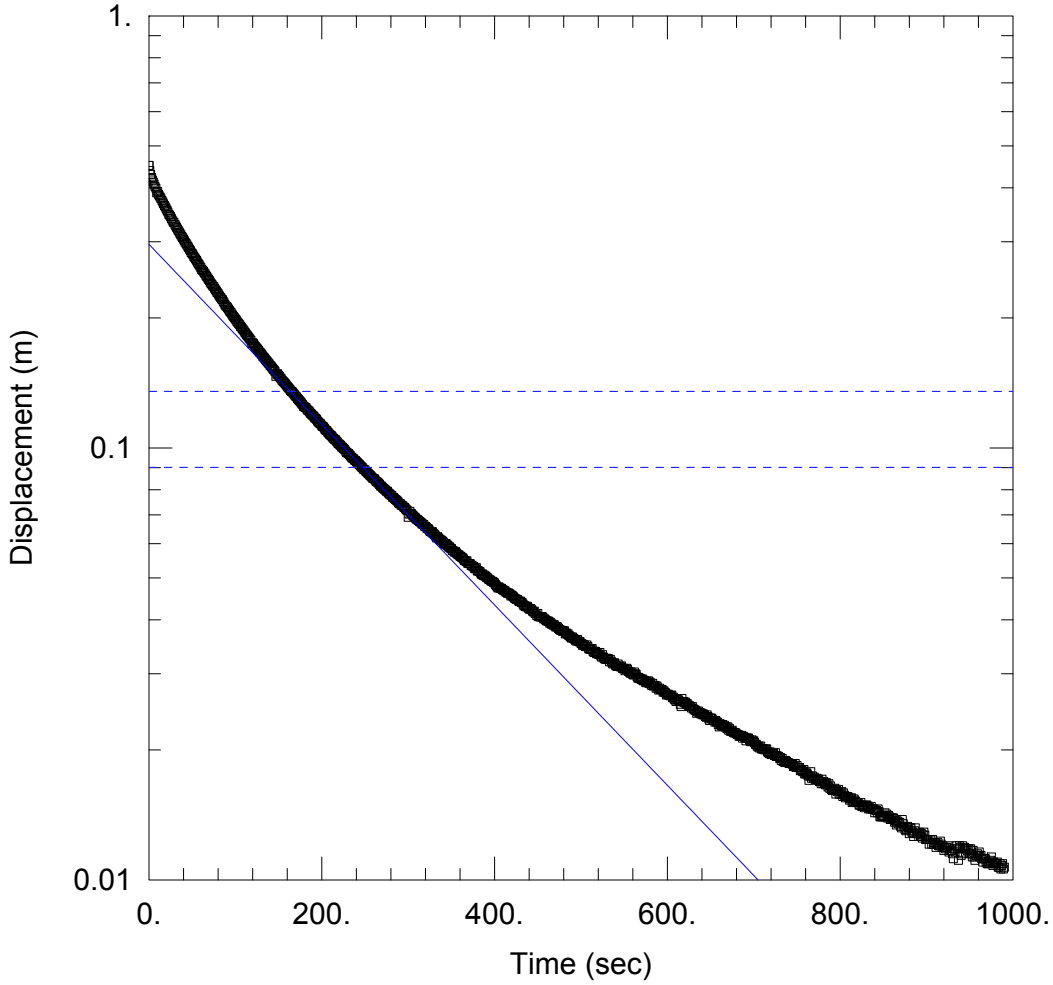
WELL DATA (MW03-17)

Initial Displacement: 0.5044 m Static Water Column Height: 3.66 m
Total Well Penetration Depth: 3.66 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.6E-6 m/sec y0 = 0.312 m



TEST 3

Data Set: \...\MW03-17test3_ah_JK.aqt
Date: 04/21/17 Time: 10:23:46

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW03-17
Test Date: 13-Apr-17

AQUIFER DATA

Saturated Thickness: 3.66 m Anisotropy Ratio (Kz/Kr): 0.5

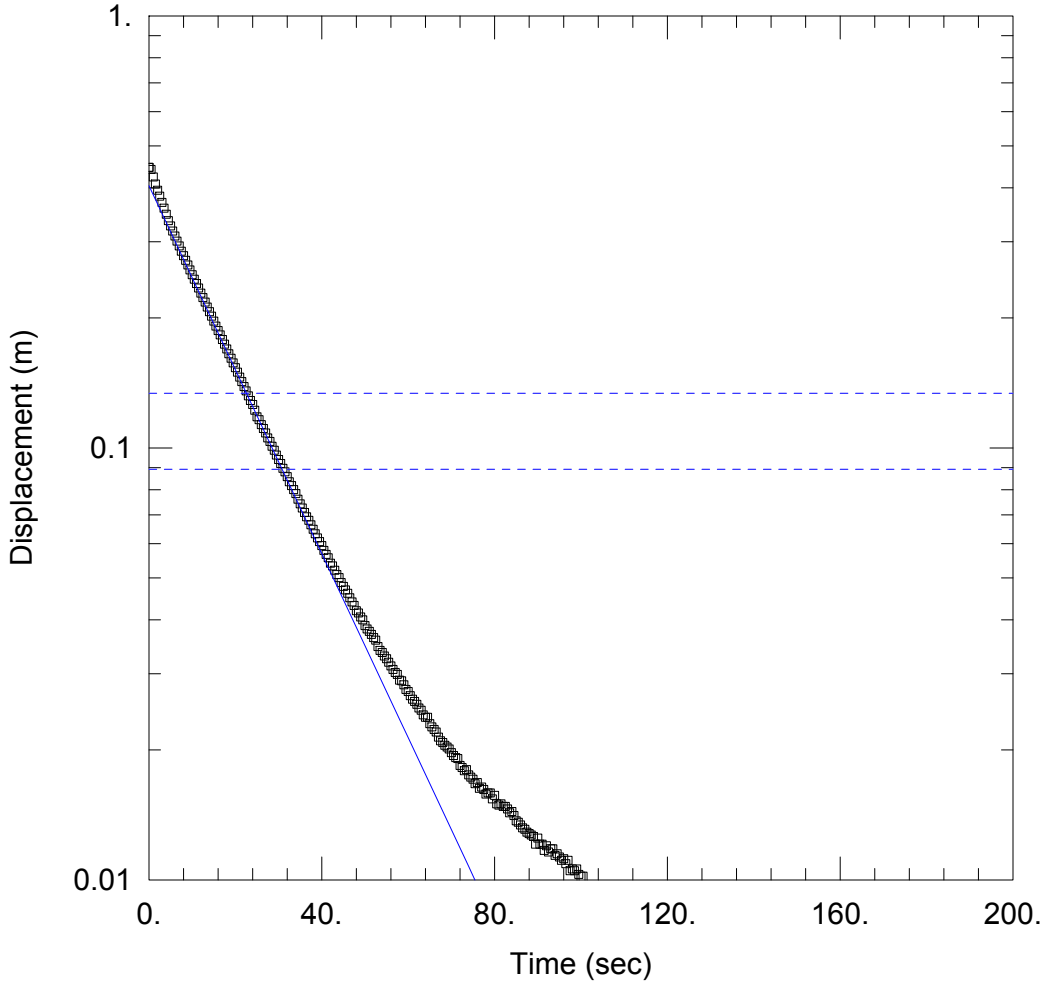
WELL DATA (MW03-17)

Initial Displacement: 0.4507 m Static Water Column Height: 3.66 m
Total Well Penetration Depth: 3.66 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.5E-6 m/sec y0 = 0.2959 m



TEST 1

Data Set: \...\MW04-17test1_ah_JK.aqt
Date: 04/21/17 Time: 10:39:03

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW04-17
Test Date: 17-Apr-17

AQUIFER DATA

Saturated Thickness: 4.54 m Anisotropy Ratio (Kz/Kr): 0.5

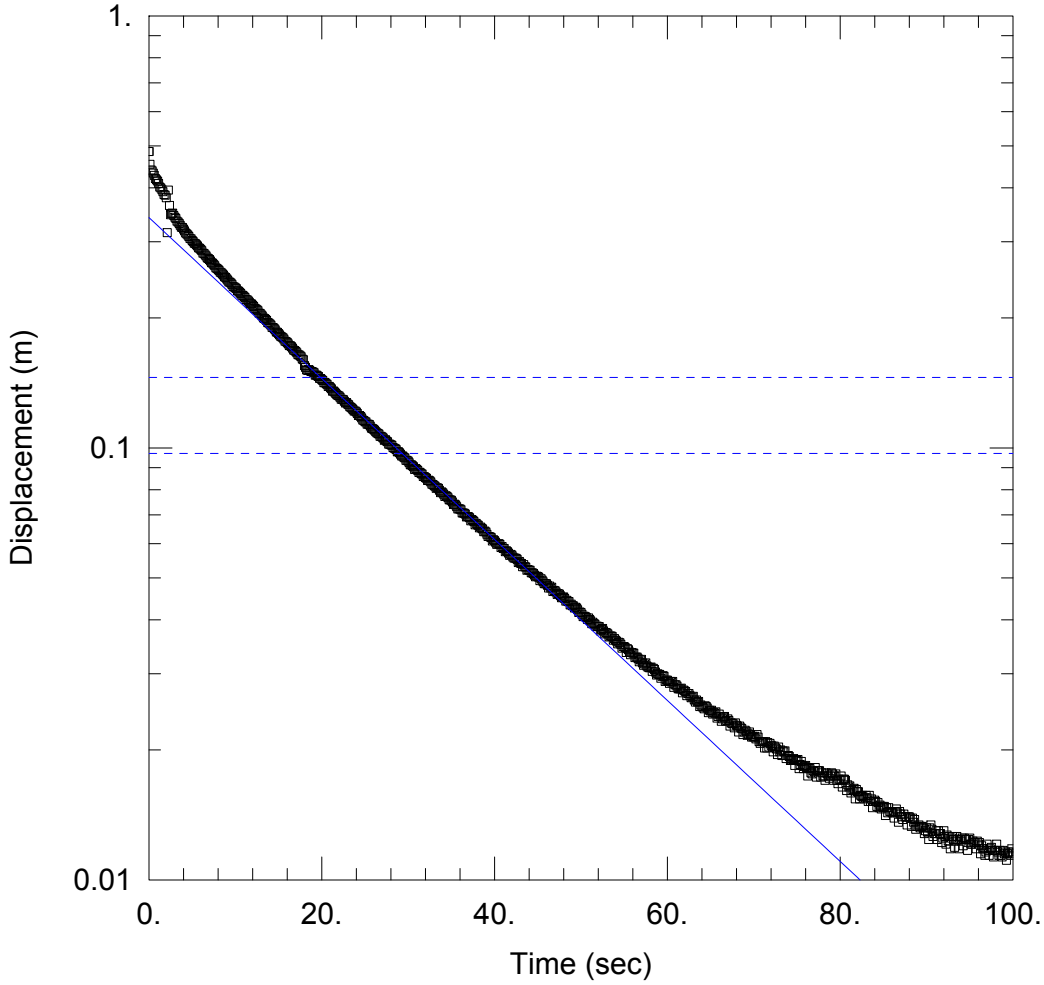
WELL DATA (MW04-17)

Initial Displacement: 0.4462 m Static Water Column Height: 4.54 m
Total Well Penetration Depth: 4.54 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.6E-5 m/sec y0 = 0.4043 m



TEST 2

Data Set: \...\MW04-17test2_ah_JK.aqt
Date: 04/21/17 Time: 10:42:17

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW04-17
Test Date: 17-Apr-17

AQUIFER DATA

Saturated Thickness: 4.54 m Anisotropy Ratio (Kz/Kr): 0.5

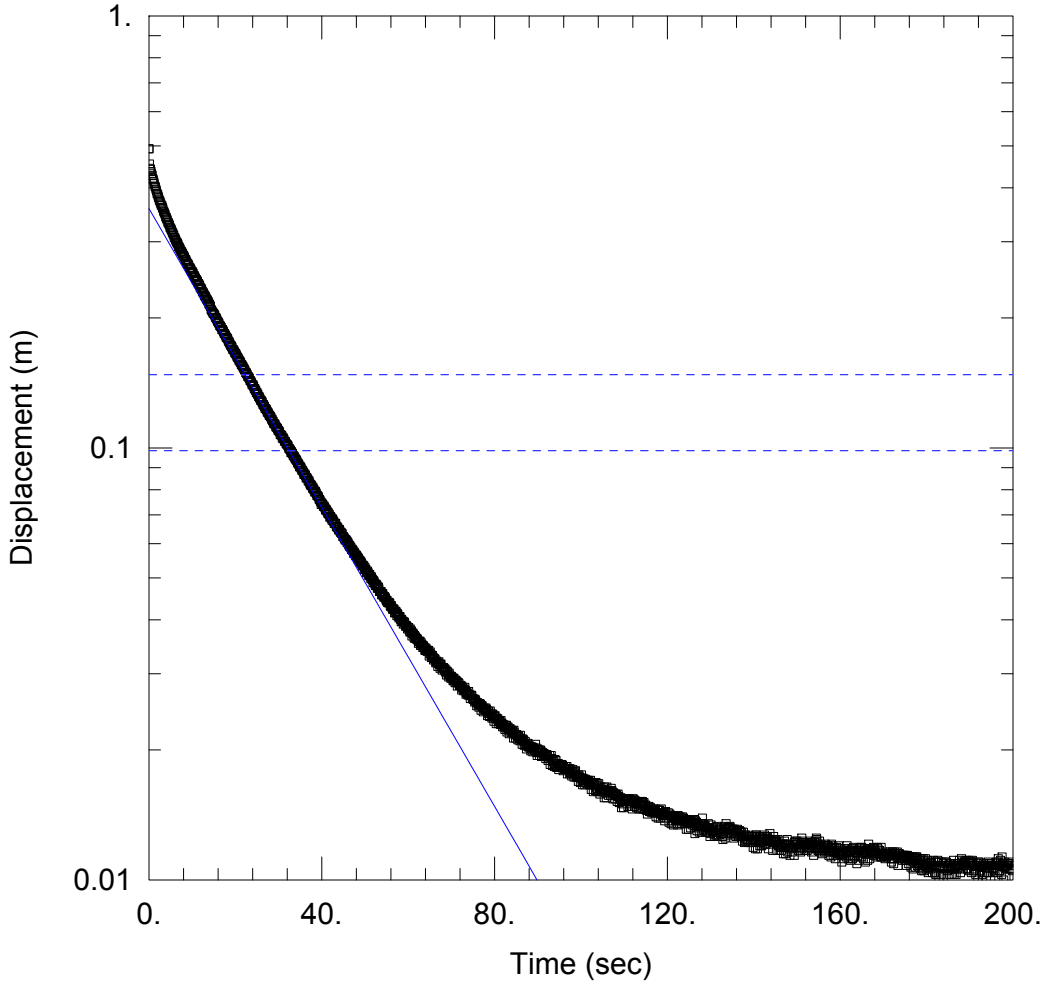
WELL DATA (MW04-17)

Initial Displacement: 0.4854 m Static Water Column Height: 4.54 m
Total Well Penetration Depth: 4.54 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.4E-5 m/sec y0 = 0.3413 m



TEST 3

Data Set: \...\MW04-17test3_ah_JK.aqt
Date: 04/21/17 Time: 10:54:42

PROJECT INFORMATION

Company: Stantec Consulting
Client: Carson Reid Homes
Project: 161413339
Test Well: MW04-17
Test Date: 17-Apr-17

AQUIFER DATA

Saturated Thickness: 4.54 m Anisotropy Ratio (Kz/Kr): 0.5

WELL DATA (MW04-17)

Initial Displacement: 0.4926 m Static Water Column Height: 4.54 m
Total Well Penetration Depth: 4.54 m Screen Length: 3.05 m
Casing Radius: 0.0254 m Well Radius: 0.1048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.3E-5 m/sec y0 = 0.3581 m

APPENDIX F
Tree Preservation Plan

220 Arkell Road, Guelph, Ontario, Tree Preservation Plan

May 28, 2019

Prepared for:

Rockpoint Properties Inc.
195 Hanlon Creek Boulevard, Unit 100
Guelph, ON N1C 0A1

Prepared by:

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4
Tel.: (519) 579-4410
Fax: (519) 579-6733

161413338

This document entitled 220 Arkell Road, Guelph, Ontario, Tree Preservation Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Rockpoint Properties Inc. (the "Client") to support the permitting process for Client's application for a Draft Plan Application (the "Application") for the development at 220 Arkell Road, in Guelph, ON (the "Project"). In connection thereto, this document may be reviewed and used by the provincial and municipal government agencies participating in the permitting process in the normal course of their duties. Except as set forth in the previous sentence, any reliance on this document by any third party for any other purpose is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document

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(signature)

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Reviewed by _____
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LIST OF APPENDICES

1.0 INTRODUCTION

Stantec Consulting Limited (Stantec) has been retained by Rockpoint Properties Inc. to prepare a Tree Preservation Plan (TPP) for the proposed future development at 220 Arkell Road in Guelph, Ontario. The TPP has been prepared to support the Draft Plan Approval.

1.1 EXISITING SITE

The development site is located in southeast Guelph on Arkell Road between Victoria Road South and Gordon Street. The property is approximately 7.16ha (17.69 acres).

2.0 METHODOLOGY

The tree inventory and assessment was conducted by Ms. Jennifer Koskinen, HBESfcon, Certified Arborist, and Ms. Ashley Hosker, Landscape Architect Student on May 8, 2017. Our inventory and assessment include the trees located within the property boundary, and trees on adjacent lands that may be impacted by the development or proposed grading work.

The detailed inventory data was collected for any trees 10 cm diameter at breast height (DBH) and greater. Inventory data includes tree species, general health condition, DBH, and dripline radius. Trees located within the property area were tagged with a numbered steel tree tag (i.e., trees #1, #2, #3 etc.). Trees located in dense planted vegetation units have been grouped in a vegetation unit identified with a letter ID, i.e. '1', 2', '3' etc. Trees within the vegetation units have been included in the detailed inventory. Trees that could not be physically tagged were provided a tree identification of 'A', 'B', 'B' etc. Tree data has been compiled in the Table 1, Detailed Tree Inventory, located in Appendix A.

Tree locations have been identified on the Tree Management Plan Drawings L-900 to L-905, located in Appendix 'A'.

2.1 TREE CONDITION RATING

Outlined below are the detailed guidelines utilized for the classification of condition rating:

Excellent: (Vigour Class 6: Healthy)
No major branch mortality: crown is reasonably normal with less than 10% branch or twig mortality; no signs of decay.

Good: (Vigour Class 5: Light Decline)
Branch mortality, twig dieback in 11-25% of the crown: broken branches or crown missing based on presence of old snags is less than 26%; minor evidence of decay.

Fair: (Vigour Class 4: Moderate Decline)
Branch mortality, twig dieback in 26-50% of the crown: broken branches or crown area missing based on presence of old snags is 50% or less; decay evident.

Poor: (Vigour Class 3: Severe Decline)
Branch mortality, 50% or more of the crown dead: broken branches or crown area missing based on presence of old snags in more than 50%; decay resulting in high hazard assessment.

Dead: (Vigour Class 2: Dead due to Natural Causes)
Tree is dead, either standing or down: phloem under bark has brown streaks: few epicormic shoots may be present.

Dead: (Vigour Class 1: Dead due to Human Causes)
Tree removed: tree has been sawed or girdled by human activity.

3.0 OBSERVATIONS AND ANALYSIS

3.1 OBSERVATIONS

The project site was a mix of landscaped trees surrounding the existing home with naturalized areas occurring along the perimeter of the site. Tree species included in the inventory are:

> Manitoba Maple (*Acer negundo*), Red Maple (*Acer rubrum*), White Birch (*Betula papyrifera*), Sugar Maple (*Acer saccharum*), Silver Maple (*Acer saccharinum*), Hawthorn sp. (*Crataegus sp.*), Ash sp.(*Fraxinus sp.*), Honeylocust (*Gleditsia triacanthos*), Tamarack (*Larix laricina*), Apple sp. (*Malus sp.*), White Spruce (*Picea glauca*), Colorado Spruce (*Picea pungens*), White Pine (*Pinus strobus*), Scots Pine (*Pinus sylvestris*), Balsam Poplar (*Populus balsamifera*), Trembling Aspen (*Populus tremuloides*), Black Cherry (*Prunus serotina*), Buckthorn (*Rhamnus cathartica*), Staghorn Sumac (*Rhus typhina*), Willow sp. (*Salix sp.),* Basswood (*Tilia americana*), and Eastern White Cedar (*Thuja occidentalis*).

The following provides general observations of specific tree groupings within the project site.

Edge 1, 2, and 3
These sections were included to provide a general information for trees located along the edge of the significant woodland that abuts the site to the west. Species were young trees including Balsam Poplar, Manitoba Maple, and White Birch. There were no rare or endangered species observed 25 metres from the edge.

North Edge
Trees within this hedgerow are a mix of planted evergreens to typical naturalized farm edge type species such as Black Cherry, Buckthorn, and Apple. There were also mature Sugar Maple and White Elm. Several of the Sugar Maple and Black Cherry were located on the adjacent property.

East Edge
The east property line includes native trees and dense buckthorn (*Rhamnus sp.*). There were several buckthorn trees that were greater than 10cm DBH, and even 20cm DBH, buckthorn was not tagged as they are invasive, and the removal does not require compensation by the City of Guelph.

3.2 ANALYSIS

3.2.1 Trees to be Removed

Based on the proposed Draft Plan identified on Drawings L-900 and L-904, and associated proposed grades, the development has been designed to maximize the development area which has resulted in minimal opportunity for tree preservation within the interior of the site. Tree preservation will occur to the along the perimeter most of the north, east, and all the west as this area is part of the significant woodland.

It is important to note that as this analysis supports Draft Plan Application, during detailed design of Site Plan grading and servicing may affect the current preservation areas. As such during detailed design this report is to be used as a guide to mitigate impacts to preservation areas. Trees identified for preservation in this report may require removal due to grading or servicing upon review of detailed grading for the Site Plan submission.

Tree Removal Summary

The following is a summary of the total inventoried trees located within the subject property; trees to be retained; trees to be removed; and trees that require compensation:

- Total trees inventoried in area = 389
- Trees to be retained = 137
- Trees to be removed = 252
- Removals that are invasive species or trees in poor condition (with greater than 70% dead crown), or dead trees, without compensation = 26
- Trees to be removed with compensation = 226*

*excluding invasive species and trees in poor condition (with greater than 70% dead crown) or dead trees.

3.2.2 Tree Protection Fencing

Proposed Tree Protection Fencing (TPF) has been recommended for the trees to be retained along the property edge to the north, east, and 10m off the tree edge of the significant woodland to the west.

The TPF details conform to the current City of Guelph standard details and have been provided on the TPP, drawing L-904. Detailed information for TPF maintenance, installation and tree protection recommendations has been identified in Section 4.0 of this report. Refer to TPP, Drawing L-900 to L-904 in Appendix 'A' for the individual locations of the trees to be retained and proposed locations of Tree Protection Fencing.

3.3 COMPENSATION

The City of Guelph requires compensation for the loss of canopy cover for trees in fair to excellent condition, exempted from this are trees that fall under the listed conditions in section 3.2.1. The City requires a replacement ration of 3:1, or $500 cash in lieu for each tree removed.

There will be 226 trees that removed will require compensation. As such that represents 678 native trees planted for compensation, or cash in lieu of as mentioned above.

4.0 CONSTRUCTION MITIGATION AND MANAGEMENT

4.1 CONSTRUCTION IMPACT

4.1.1 Potential Construction Impacts to Trees

Trees are living organisms that react to changes in their environment. Trees can be damaged during construction without showing signs of damage until several years later. Most of the impacts relate to the removal of roots that results in the slow death of the tree because of its inability to absorb sufficient water and nutrients. Contained within this section are descriptions of the potential impacts this project may have on the trees, and impact mitigation methods that are intended to aid in the design and construction process.

4.1.2 Soil Compaction and Root Damage

The leading cause of construction damage to trees is compaction of the soil around the roots or within the Tree Protection Zone (TPZ). The TPZ is the area around the tree or group of trees in which no grading or construction activity may occur (Harris 1992). Equipment entering a TPZ compresses the air pockets around the roots inhibiting the tree from absorbing nutrients and water. This damage ultimately reduces the health of the tree. Accordingly, during the removal stage, equipment use within the preservation zones should be restricted to ensure that the tree's roots are not disturbed, thereby, assisting in maintaining their continued health. The TPZ is protected and delineated by the TPF.

4.1.3 Mechanical Damage

Equipment can physically damage the trees through striking the trunk, limbs and/or roots. Felled trees can also cause damage during the tree removal stage of construction. Some damage is unavoidable due the proximity of adjacent trees; however, using proper equipment and Best Management Practices (BMP) the damage can be minimized. The Contractor should be held responsible for all avoidable damage to the trees during all stages of development. Note: trees shall be felled away from adjacent trees to be retained to prevent damage to their stems, branches and crown.

4.1.4 Root Damage

The success of tree preservation is dependent not only on protecting the root zone from compaction and damage, it is also contingent upon the ability to ensure that the structural roots within the root plate are not disturbed. Impacts to this area may result in the structural failure of these trees.

Excavating soil within the dripline of a tree can damage roots by tearing and splitting. This damage can later lead to rot, which can kill the tree. When excavating the top 30-60 cm of soil adjacent to trees, care must be taken to minimize ripping or tearing of roots. Excavation should cleanly sever the roots prior to stripping and removal of soil. Exposed roots, greater than 2.5 cm diameter, shall be pruned back to the

soil face to prevent damage to the tree. No work should be completed within the dripline of preservation trees without the approval of the Project Arborist.

4.2 PROTECTING AND MANAGING TREES DURING CONSTRUCTION

The following recommendations are presented to provide appropriate tree protection and management during the construction for this project.

1. Tree protection fencing shall be installed to protect trees identified for preservation. TPF installation must conform to details and City of Guelph standards identified on the Tree Management Plan drawings located in Appendix 'B'. Upon installation of the tree protection fencing, the Contractor shall contact the Project Arborist to review and approve the fencing and its location prior to commencement of any site work. This shall be coordinated with City staff for approval. The protection fencing shall remain intact throughout the entire protection. The fencing will be inspected weekly and, if required, repaired. The fencing shall be removed at the completion of all site works.

2. Upon receiving the necessary project approvals and prior to the commencement of tree removals, all trees designated for preservation must be flagged in the field. All designated preservation areas must be left standing and undamaged during site works. Removals are to be completed outside of migratory bird nesting season from **April 10 to August 9**. Removals may take place during this restricted time only if the requirements of the Migratory Birds Convention Act are met and nesting activity is routinely monitored by qualified individuals (i.e., Wildlife Biologists).

3. The TPZ is the area around a retained tree that is to be protected by tree protection fencing. The TPZ is not to be used for any type of storage (e.g. storage of debris, construction material, surplus soils, and construction equipment). No trenching or tunneling for underground services shall be located within the TPZ. Construction equipment shall not be allowed to idle or exhaust within the TPZ.

4. Trees shall not have any rigging cables or hardware of any sort attached or wrapped around them, nor shall any contaminants be dumped within the protective areas. Furthermore, no contaminants shall be dumped or flushed where they may meet the feeder roots of the trees. If roots from retained trees are exposed, or if it is necessary to remove limbs or portions of trees after construction has commenced, the Project Arborist shall be informed and the proper actions conforming to City Policies and By-laws shall be carried out.

5. Upon completion of the tree removals, all felled trees are to be removed from the site. No lumber or brush from the clearing is to be stored on the site. Any chipping, cutting or brush cleanup are to be completed outside of the bird nesting season. These works may take place during this restricted time only if the requirements of the Migratory Birds Convention Act are met and nesting activity is routinely monitored by qualified individuals (i.e., Wildlife Biologists.

6. The following is the process that shall be carried out if tree removals are requested during the restricted time indicated in the Migratory Birds Convention Act:

    - Contact a qualified individual (i.e., Wildlife Biologist) to determine if nesting birds are within the tree removal disturbance area. Stantec has a qualified bird specialist on staff that can be contacted

    - If the bird specialist has determined that there are nesting birds onsite, there will be no tree removals/chipping conducted within the boundary set out by the specialist. Tree removals can resume within this area at the end of the nesting season, August 9, or if the migratory bird specialist has determined the birds have left

    - If the bird specialist determines there are no migratory birds nesting within the disturbance area, the contractor has 7 days to conduct removals. At the end of 7 days, if removals and chipping is not complete, the bird specialist will return to the site and proceed with another assessment. If there are still no birds, work can resume for another 7 days. This process will continue until all removals and chipping is complete.

5.0 DISCLAIMER

The assessment of the trees presented within this report has been made using accepted arboricultural techniques. These include a visual examination of the above-ground parts of each tree for structural defects, scars, external indications of decay, evidence of insect presence, discolored foliage, the general condition of the trees and the surrounding site, as well as the proximity of property and people. None of the trees examined were dissected, cored, probed, or climbed, and detailed root crown examinations involving excavation were not undertaken.

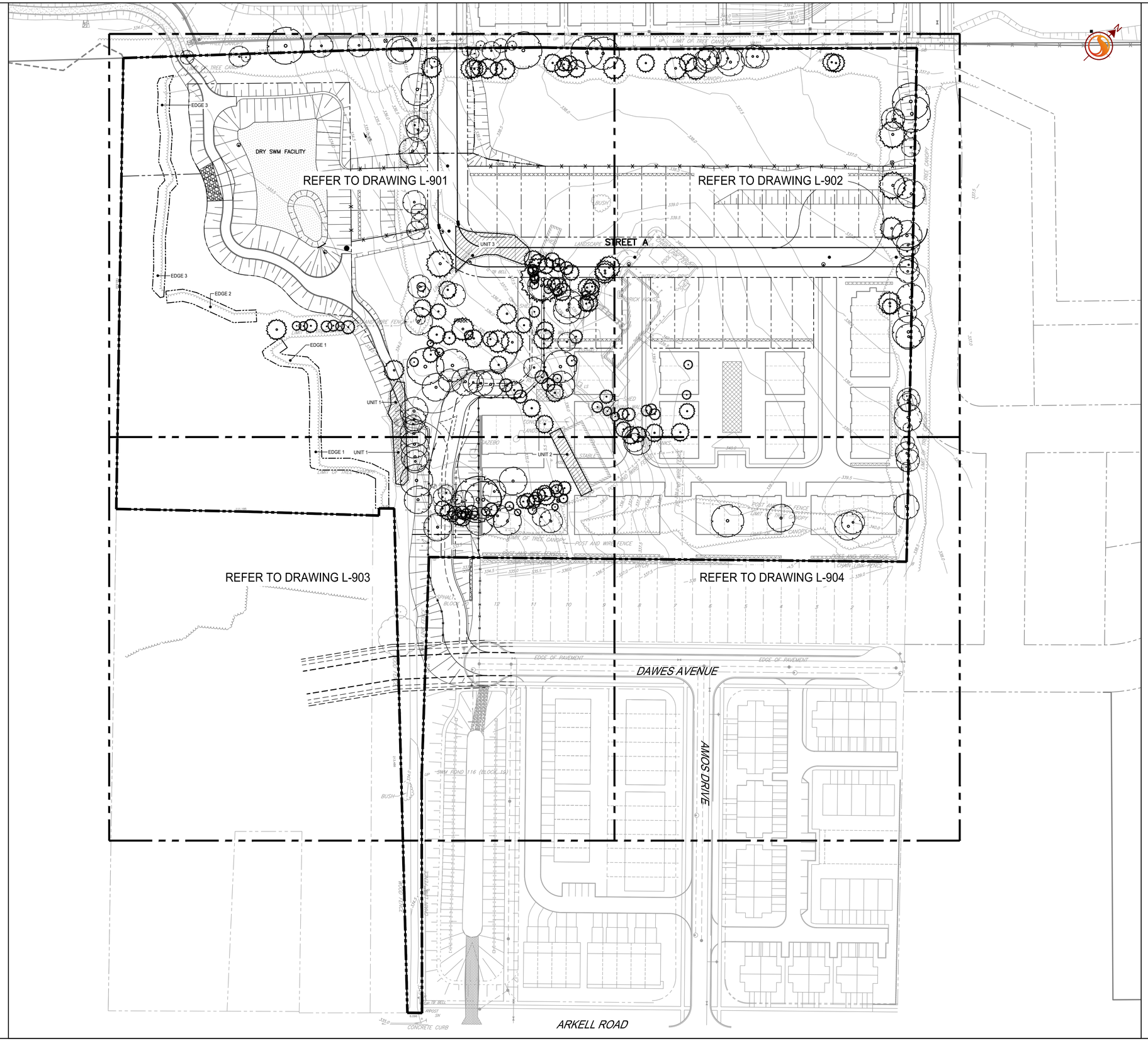
Notwithstanding the recommendations and conclusions made in this report, it must be realized that trees are living organisms and their health and vigor is constantly changing. They are not immune to changes in site conditions or seasonal variations in the weather.

While reasonable efforts have been made to ensure the trees recommended for retention are healthy, no guarantees are offered or implied, that these trees or any part of them will remain standing. It is both professionally and practically impossible to predict with absolute certainty the behavior of any single tree or group of trees in all circumstances. Inevitably, a standing tree will always pose some risk. Most trees have the potential for failure if provided with the necessary combinations of stresses and elements. This risk can only be eliminated if the tree is removed.

Every effort has been made to ensure that this assessment is reasonably accurate, and the trees should be re-assessed periodically. The assessment presented in this report is valid at the time of inspection.

APPENDIX A

Tree Management Plan
Drawings L-900 to L-905



Stantec

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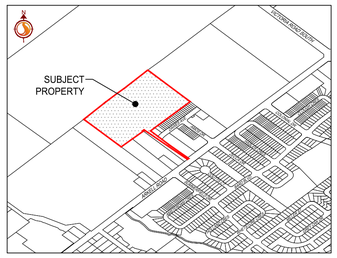
Key Map NTS.



Legend

- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- 0000 — TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG
- 0000* — TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG *APPROXIMATE LOCATION
- 0000 — TREE TO BE REMOVED IDENTIFICATION TAG
- 0000* — TREE TO BE REMOVED IDENTIFICATION TAG *APPROXIMATE LOCATION
- PROPOSED TREE PROTECTION FENCING
- EXISTING VEGETATION UNIT TO BE RETAINED AND PROTECTED
- EXISTING VEGETATION UNIT TO BE REMOVED
- 349.00 — EXISTING CONTOUR
- 352.92 — PROPOSED ELEVATION

Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	JJ	JK	19.05.30

File Name: 161413338_L-TM.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	JJ	JK		18.01.30

Permit-Seal

CERTIFIED ARBORIST ISA
JENNIFER KOSKINEN
ON-1234A

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

GUELPH, ON

Title

OVERALL TREE MANAGEMENT PLAN

Project No.	Scale	
161413338	1:750 (0 7.5 22.5 37.5m)	
Drawing No.	Sheet	Revision
L-900	1 of 6	0

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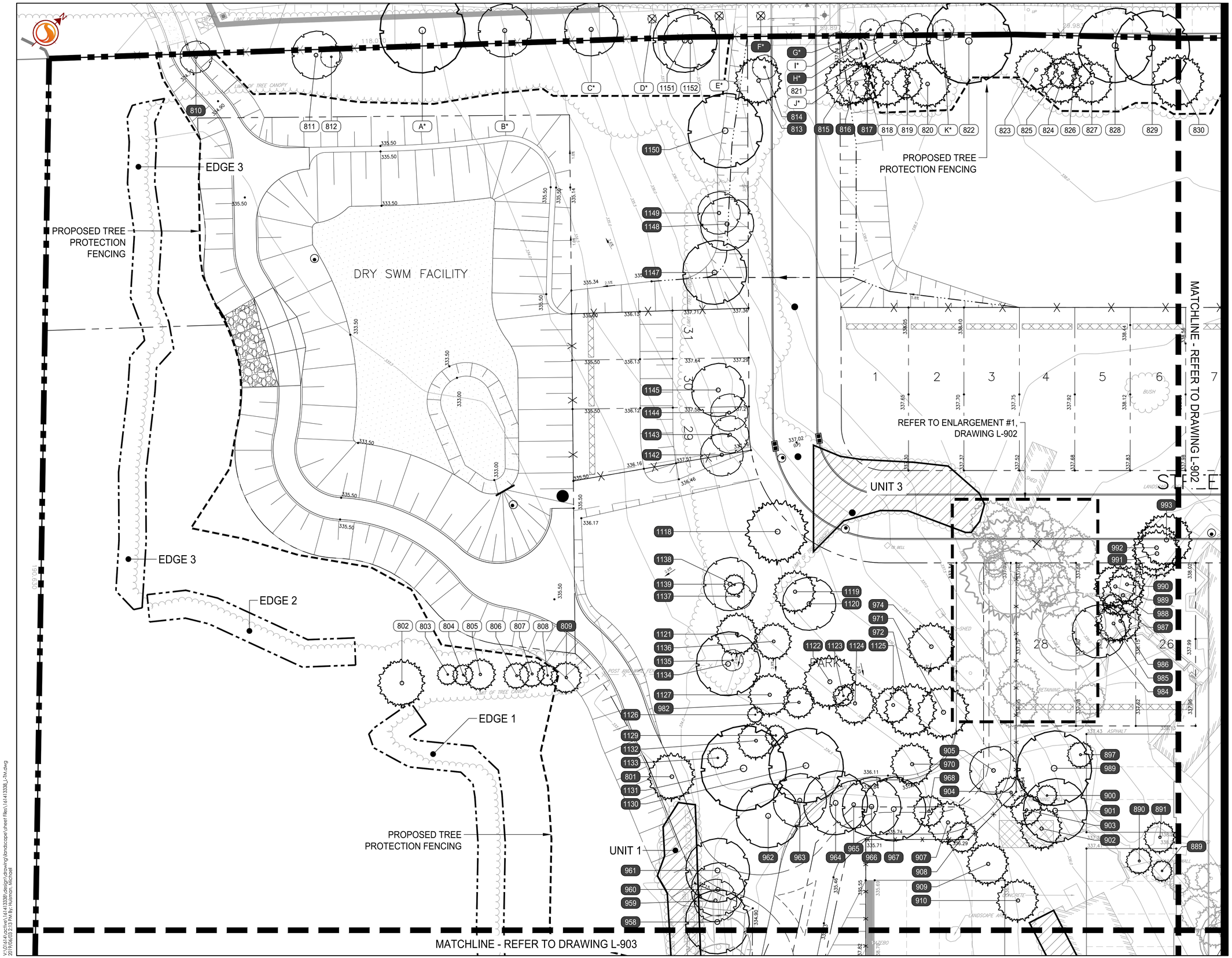
2019/06/03 2:12 PM By: Husman, Michael

ORIGINAL SHEET - ARCH D



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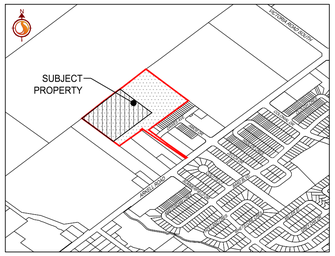
Tel. 519.579.4410
www.stantec.com

Key Map NTS.



Legend

- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- 0000 TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG
- 0000* TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG *APPROXIMATE LOCATION
- 0000 TREE TO BE REMOVED IDENTIFICATION TAG
- 0000* TREE TO BE REMOVED IDENTIFICATION TAG *APPROXIMATE LOCATION
- PROPOSED TREE PROTECTION FENCING
- EXISTING VEGETATION UNIT TO BE RETAINED AND PROTECTED
- EXISTING VEGETATION UNIT TO BE REMOVED
- 349.00 EXISTING CONTOUR
- • 352.92 PROPOSED ELEVATION

Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	JJ	JK	19.05.30

File Name: 161413338_L-TM.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	JJ	JK		18.01.30

Permit-Seal

CERTIFIED ARBORIST ISA
JENNIFER KOSKINEN
ON-1234A

Client/Project
ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

GUELPH, ON

Title
TREE MANAGEMENT PLAN

Project No.	Scale	
161413338	1:300 (0 3 9 15m)	
Drawing No.	Sheet	Revision
L-901	2 of 6	0

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2019/06/03 2:13 PM By: Husman, Michael

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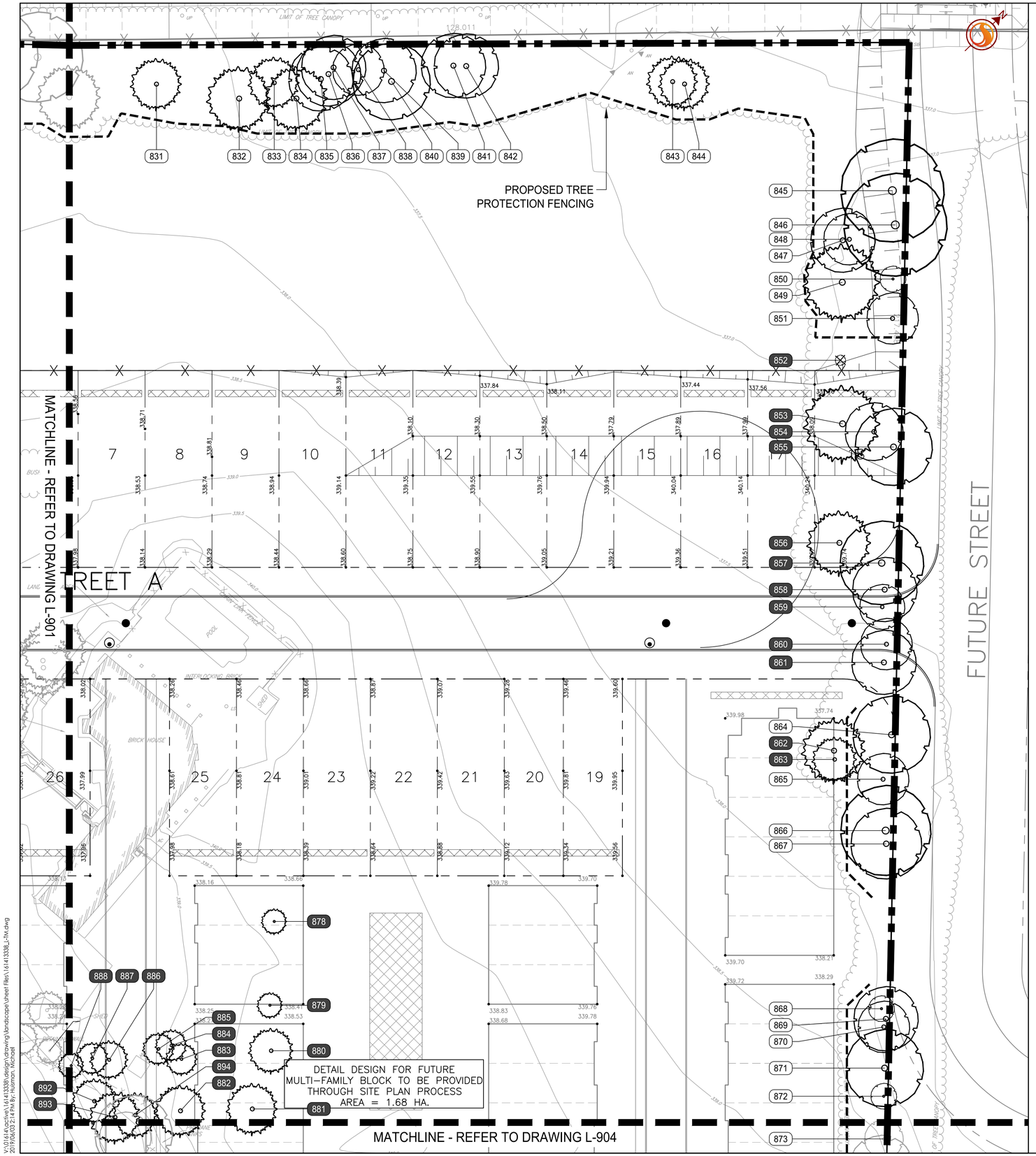

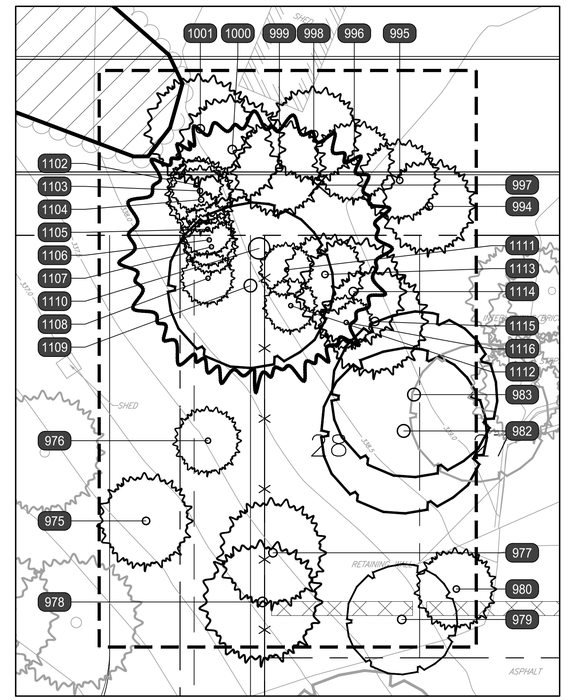

ENLARGEMENT #1
(REFER TO DRAWING L-901)

1:200 0 2 6 10m

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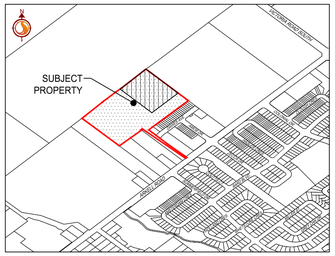
Key Map NTS.



Legend

- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- 0000 — TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG
- 0000* — TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG *APPROXIMATE LOCATION
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- 0000* — TREE TO BE REMOVED IDENTIFICATION TAG *APPROXIMATE LOCATION
- PROPOSED TREE PROTECTION FENCING
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- EXISTING VEGETATION UNIT TO BE REMOVED
- 349.00 — EXISTING CONTOUR
- 352.92 — PROPOSED ELEVATION

Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	JJ	JK	19.05.30

File Name: 161413338_L-TM.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	JJ	JK		18.01.30

Permit-Seal

CERTIFIED ARBORIST ISA
JENNIFER KOSKINEN
0N-1234A

Client/Project
ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

GUELPH, ON

Title
TREE MANAGEMENT PLAN

Project No. 161413338

Scale 1:300 0 3 9 15m

Drawing No. L-902

Sheet 3 of 6

Revision 0

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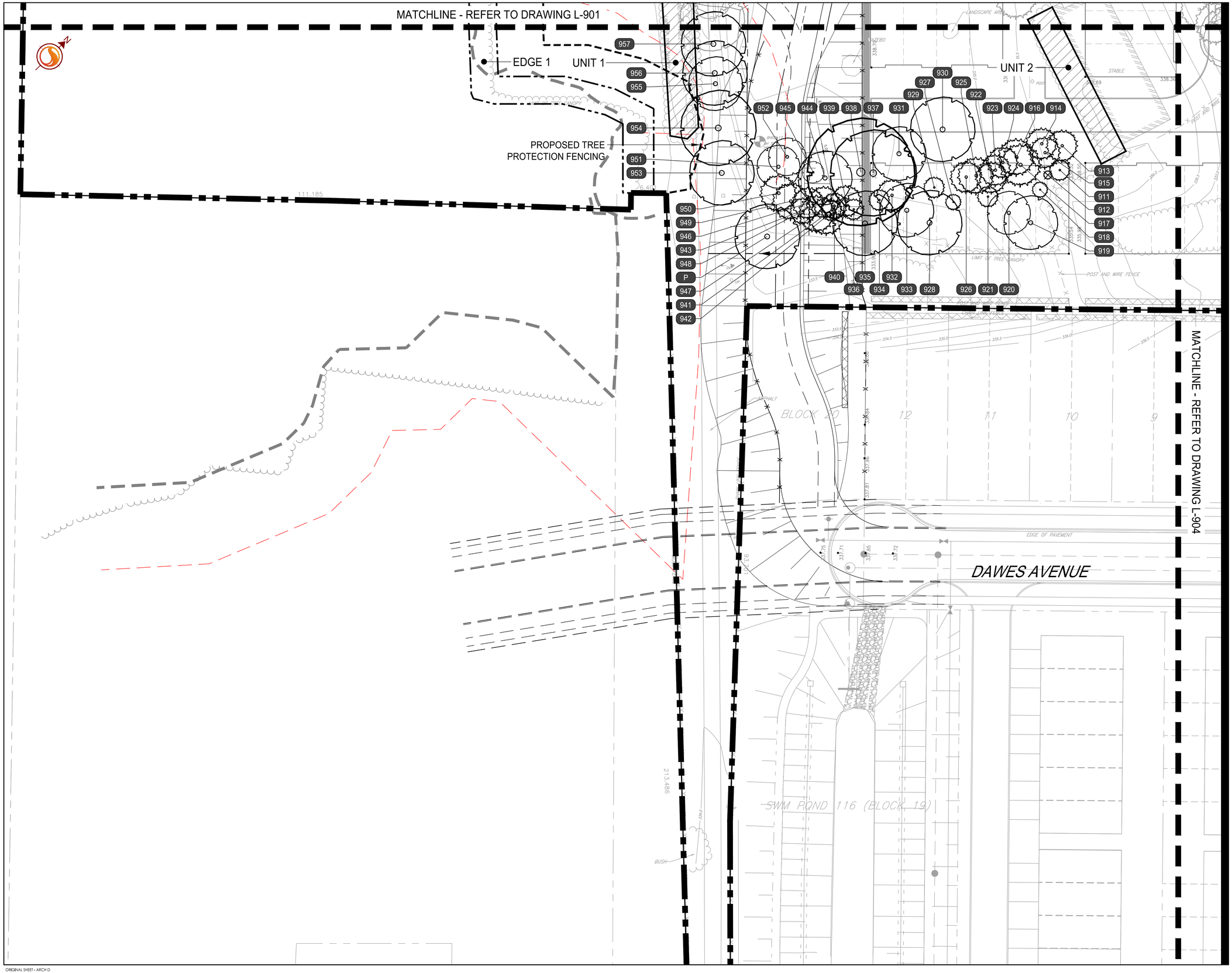
2019/06/03 2:14 PM By: Huisman, Michael

ORIGINAL SHEET - ARCH D



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Key Map NTS.

Legend

- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- 0000 — TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG
- 0000* — TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG *APPROXIMATE LOCATION
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- PROPOSED TREE PROTECTION FENCING
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Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	JJ	JK	19.05.30

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Permit-Seal

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Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

GUELPH, ON

Title

TREE MANAGEMENT PLAN

Project No. 161413338

Scale 1:750 (0, 7.5, 22.5, 37.5m)

Drawing No. L-903

Sheet 4 of 6

Revision 0

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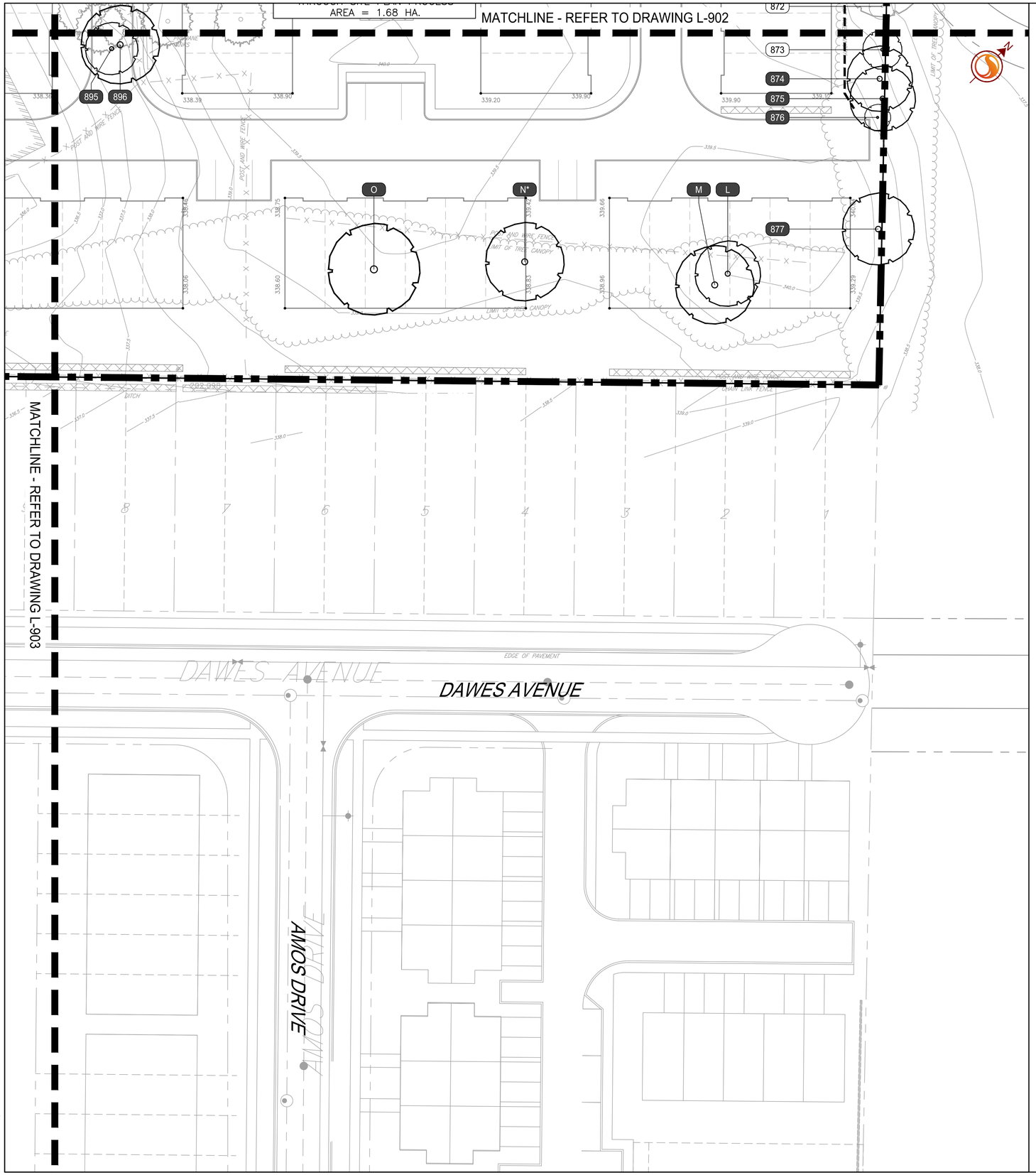
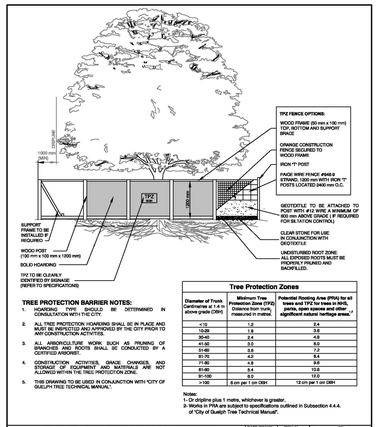
2019/06/03 2:14 PM By: Huisman, Michael

ORIGINAL SHEET - ARCH D





TREE PROTECTION BARRIER NOTES:

1. HOARDING TYPE SHOULD BE DETERMINED IN CONSULTATION WITH THE CITY.
2. ALL TREE PROTECTION HOARDING SHALL BE IN PLACE AND INSPECTED AND APPROVED BY THE CITY PRIOR TO ANY CONSTRUCTION ACTIVITIES.
3. ALL ARBORICULTURE WORK SUCH AS PRUNING OF BRANCHES AND ROOTS SHALL BE CONDUCTED BY A CERTIFICED ARBORIST.
4. CONSTRUCTION ACTIVITIES, GRADE CHANGES, AND STORAGE OF EQUIPMENT AND MATERIALS ARE NOT ALLOWED WITHIN THE TREE PROTECTION ZONE.
5. THIS DRAWING TO BE USED IN CONJUNCTION WITH "CITY OF GUELPH TREE TECHNICAL MANUAL".

Tree Protection Zones

Diameter of Trunk Centimeter at 1.4 m above grade (DBH)	Minimum Tree Protection Zone (TPZ) Distance from trunk, measured in metres	Potential Rooting Area (PRA) for all trees and TPZ for trees in lots, parks, open spaces and other significant natural heritage areas[1]
<10	1.2	3.4
10-20	1.8	5.6
30-40	2.4	4.0
41-50	3.0	6.0
51-60	3.6	7.2
61-70	4.2	8.4
71-80	4.8	9.6
81-90	5.4	10.8
91-100	6.0	12.0
> 100	6 cm per 1 cm DBH	12 cm per 1 cm DBH

Notes:
1- Or dripline plus 1 metre, whichever is greater.
2- Works in PRA are subject to specifications outlined in Subsection 4.4.4. of "City of Guelph Tree Technical Manual".

CITY OF GUELPH STANDARD DRAWING

TREE PROTECTION ZONE FENCE DETAIL

DATE DRAWN: JAN/11 | REV. No.: | DESCRIPTION: | REV. DATE: | REV. BY: G.F./C.M.C. | APPROVED BY: | CITY ENGINEER | ENGINEERING

SD - 90a

Schedule A: Tree Protection Zone (TPZ) Information Signage

Sign Design, Installation and Maintenance: TPZ information signs shall be constructed from metal, corrugated plastic, Gatorboard or wood, and shall be installed in an appropriate manner such that it will be able to withstand inclement weather conditions. Signage shall be maintained in good condition and in the original location throughout the duration of site development works. Signage shall be clearly legible, with black text on a white background being the preferred design.

Sign Content: The TPZ information sign shall, at minimum, provide a list of activities prohibited within the TPZ. Such activities shall include, but not be limited to: grade change, dumping, storage of equipment and materials, unauthorized entry by personnel, tree injury or removal, or other disturbance of any kind. The signage shall also note that TPZ fencing shall not be damaged or removed. The signage shall also provide the contact information for the City of Guelph Planning, Building, Engineering and Environmental Services Department. A City of Guelph corporate logo shall be displayed on the TPZ information sign.

Sign Placement: TPZ information signs shall be affixed no more than 20 m apart on each side of tree protection fencing, at a height of no less than 100 cm.

Sign Size: TPZ information signs shall be a minimum of 40 cm × 60 cm in size

CITY OF GUELPH STANDARD DRAWING

TREE PROTECTION ZONE INFORMATION SIGNAGE DETAIL

DATE DRAWN: JAN/11 | REV. No.: | DESCRIPTION: | REV. DATE: | REV. BY: G.F./C.M.C. | APPROVED BY: | CITY ENGINEER | ENGINEERING

SD - 90c

TREE PROTECTION AND REMOVAL NOTES:

1. REMOVALS ARE TO BE COMPLETED OUTSIDE OF MIGRATORY BIRD NESTING SEASON FROM APRIL 1 TO AUGUST 31. REMOVALS MAY TAKE PLACE DURING THIS RESTRICTED TIME ONLY IF THE REQUIREMENTS OF THE MIGRATORY BIRDS CONVENTION ACT ARE MET AND NESTING ACTIVITY IS ROUTINELY MONITORED BY QUALIFIED INDIVIDUALS (I.E.,WILDLIFE BIOLOGISTS).
2. TREE PROTECTION FENCE TO BE INSTALLED PRIOR TO THE REMOVAL OF TREES.
3. CITY STAFF TO INSPECT AND APPROVE TREE PROTECTION PRIOR TO ANY WORKS (INCLUDING TREE REMOVAL AND/OR GRADING) OCCURRING ON SITE. CONTACT ADELE LABBE AT 519-822-1260 EXT. 2563 OR ADELE.LABBE@GUELPH.CA.
4. CITY STAFF TO BE NOTIFIED AT LEAST 2 WEEKS PRIOR TO ANY TREE REMOVALS OCCURRING ONSITE. CONTACT ADELE LABBE AT 519-822-1260 EXT. 2563 OR ADELE.LABBE@GUELPH.CA.

ACCEPTANCE OF RETAINED TREES:

TREE PRESERVATION AREAS WILL BE ACCEPTED BY THE CITY PROVIDED THAT:

5. PRESERVED LIMBS ARE HEALTHY AND VIGOROUS;
6. DEAD LIMBS HAVE BEEN REMOVED IN CONSULTATION WITH AN ARBORIST AND DISPOSED OF OFF-SITE;
7. TEMPORARY FENCING HAS BEEN REMOVED OFF-SITE;
8. EXISTING EDGE GRADES AROUND THE TREES HAVE BEEN BLENDED WITH CONSTRUCTED GRADES AND SURFACES;
9. ENTIRE EDGE AND AREA AROUND THE PRESERVED TREES HAS BEEN CLEARED OF DEBRIS AND INVASIVE PLANTS;
10. ENTIRE AREA AROUND PRESERVED TREES HAS HEALTHY, ESTABLISHED NATIVE GROUND COVER.

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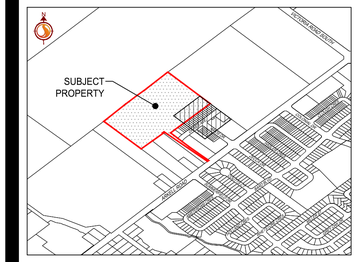
Key Map NTS.



Legend

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- 0000 TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG
- 0000* TREE TO BE RETAINED AND PROTECTED IDENTIFICATION TAG -APPROXIMATE LOCATION
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Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	JJ	JK	19.05.30

File Name: 161413338_L-TM.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	JJ	JK		18.01.30

Permit-Seal

CERTIFIED ARBORIST ISA

JENNIFER KOSKINEN
0N-1234A

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

GUELPH, ON

Title

TREE MANAGEMENT PLAN
DETAILS AND NOTES

Project No. 161413338

Scale 1:750 (0 7.5 22.5 37.5m)

Drawing No. L-904

Sheet 5 of 6

Revision 0

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2019/06/03 2:15 PM By: Husiman, Michael

ORIGINAL SHEET - ARCH D

TABLE 1. General Tree Inventory

Date: May 08, 2017

Unit	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
1	*Thuja occidentalis*	Eastern White Cedar	10, 12, 14	2.5	G	G	G	G	Some trees are <10cm DBH.	Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 12, 13	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 10	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10, (2) 12	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 10	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	2 (10), (3) 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 10	2.5	G	G	G	G		Remove
	Acer negundo	Manitoba Maple	20	5	F	G	G	F	Growing Directly adjacent to cedar trunk.	Remove
	Thuja occidentalis	Eastern White Cedar	10, 13, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 12	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 10, 12, 13	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	13	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10, 14, 15	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 10, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 12	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 12, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 15	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 12	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10, 12	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10, 12, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10, 13	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10, (2) 14	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 16	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 11, 12, 13, 16	2.5	G	G	G	G		Remove

Unit	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
2	*Thuja occidentalis*	Eastern White Cedar	19, 23	2.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23, 25	3.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	24	4.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20, 23	5.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10, (2) 14, 16	6.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 10, 12, 14	7.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, (2) 10, 14, 20	8.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18, 24	9.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	10.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	11.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	14	12.5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	12	13.5	G	G	G	G		Remove

Unit	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
	Acer saccharum	Sugar Maple	25	5	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	<10, 10	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	26	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23	NA		G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 10, 20, 21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	15	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(3) 10, 20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	10	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 15, 20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	15	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	16	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	14	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	25	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	13	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	25	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23, (2) 25	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	23	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	14	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 10	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	(2) 10	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	21	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	20	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove
	Thuja occidentalis	Eastern White Cedar	18	NA	G	G	G	G		Remove

Edge	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
1	*Populus balsamifera*	Balsam Poplar	(5) 20-30	G	G	G	G	G	Edge is lined with Buckthorn, Red Osier Dogwood, <10 Blasam Poplar	Retain
	Populus balsamifera	Balsam Poplar	20-30	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	30-40	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	10-20	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	20-30	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	30-40	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	10-20	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	20-30	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	(5) 20-30	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	10-20	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	20-30	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	30-40	G	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	20-30	G	G	G	G	G		Retain
	Acer negundo	Manitoba Maple	30-40	G	G	G	G	G		Retain

Edge	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
2	*Rhamnus*	Buckthorn	<10	NA	G	G	G	G		Retain
	Cornus sericea	Red Osier Dogwood	<10	NA	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	<10	NA	G	G	G	G		Retain
	Acer negundo	Manitoba Maple	<10	NA	G	G	G	G		Retain
	Salix	Willow	<10	NA	G	G	G	G		Retain
	Acer negundo	Manitoba Maple	10-20	NA	G	G	G	G		Retain
	Populus tremuloides	Trembling Aspen	10-20	NA	G	G	G	G		Retain

Edge	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
3	*Rhamnus*	Buckthorn	<10	NA	G	G	G	G		Retain
	Populus tremuloides	Trembling Aspen	(4) 30-40	NA	G	G	G	G		Retain
	Thuja occidentalis	Eastern White Cedar	<10	NA	G	G	G	G		Retain
	Betula papyrifera	White Birch	10-20	NA	G	G	G	G		Retain
	Betula papyrifera	White Birch	10-20	NA	G	G	G	G		Retain
	Betula papyrifera	White Birch	10-20	NA	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	30-40	NA	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	10-20	NA	G	G	G	G	Few dead standing trees.	Retain
	Populus balsamifera	Balsam Poplar	30-40	NA	G	G	G	G		Retain
	Populus balsamifera	Balsam Poplar	20-30	NA	G	G	G	G		Retain
	Rhus typhina	Sumac Clump	<10	NA	G	G	G	G	NW corner of edge.	Retain

TABLE 2. Detailed Tree Inventory

Date: May 08, 2017

Tag #	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Conditions				Comments	Action
					Trunk Integrity	Canopy Structure	Crown Vigour	Overall Condition		
A	*Acer saccharum*	Sugar Maple	(2) 50-60	8	G	G	G	G	Tree tag #1217; just off property line.	Retain
B	*Acer saccharum*	Sugar Maple	30-40	5	G	G	G	G	Along fence line.	Retain
C	*Prunus serotina*	Black Cherry	40-50		P	P	P	P	Tree tag #1216.	Retain
D	*Prunus serotina*	Black Cherry	30-40	NA	Dead	Dead	Dead	Dead	Tree tag #1215; leaning into client property.	Retain
E	*Prunus serotina*	Black Cherry	30-40	NA	Dead	Dead	Dead	Dead	Approximately 1.5m off property line.	Retain
F	*Prunus serotina*	Black Cherry	(2) 40-50	NA	Dead	Dead	Dead	Dead	1 stem over client property.	Remove
G	*Acer saccharum*	Sugar Maple	40-50	6	G	G	G	G	Tree tag #1213.	Remove
H	*Prunus serotina*	Black Cherry	(4)20-30	NA	P	P	P	P	Tree tag #1212.	Remove
I	*Prunus serotina*	Black Cherry	(3) 30-40	NA	P	P	P	P	Tree tag #1210; 2 stems dead, 1 poor; 25% live crown.	Retain
J	*Fraxinus sp.*	Ash sp.	15	3	G	G	F	F	Tree tag #1209.	Retain
K	*Prunus serotina*	Black Cherry	(2) 40-50	NA	G	F	G	F	Tree tag #1208; 1 stem dead; less than 50% live crown.	Retain
L	*Malus sp.*	Apple sp.	30	5	G	F	G	F	Canopy extends onto property.	Remove
M	*Prunus serotina*	Black Cherry	45	6	G	G	G	G	Extends approximately 3m onto property from property line.	Remove
N	*Malus sp.*	Apple sp.	(2) 35	6	F	F	F	F	Located beside M (approximately 1m apart) 3m over property line.	Remove
O	*Tilia americana*	Basswood	Multi 30-40	7	G	G	G	G	Extends approximately 2m over property line.	Remove
P	*Fraxinus grandidentata*	Green Ash	39	6	G	G	G	G	Just off driveway; surrounded by <10 trees.	Remove
801	*Picea glauca*	White Spruce	40	4.5	G	G	G	G		Remove
802	*Acer rubrum*	Red Maple	12, 55	4.5	G	G	G	G	Vines growing up trunk.	Retain
803	*Thuja occidentalis*	Eastern White Cedar	12	2	G	G	G	G	Trees between #802-803: <10 Buckthorn, Red Osier Dogwood, Eastern White Cedar.	Retain
804	*Thuja occidentalis*	Eastern White Cedar	16	2	G	G	G	G		Retain
805	*Thuja occidentalis*	Eastern White Cedar	17	3	G	G	G	G		Retain
806	*Thuja occidentalis*	Eastern White Cedar	16	2.5	G	G	G	G		Retain
807	*Thuja occidentalis*	Eastern White Cedar	16	2.5	F	G	G	F	Buckthorn clump growing against tree trunk.	Retain
808	*Thuja occidentalis*	Eastern White Cedar	16	2	F	G	G	F		Retain
809	*Thuja occidentalis*	Eastern White Cedar	22	3	G	G	G	G		Remove
810	*Fraxinus grandidentata*	Green Ash	10	3	P	P	P	P	Area includes dense buckthorn.	Remove
811	*Malus sp.*	Apple sp.	17, 22	4.5	F	F	G	F	Manitoba Maple growing on ground around # 811 and A.	Retain
812	*Acer saccharum*	Sugar Maple	59		P	G	G	P	Adjacent fence; tree tag #1219.	Retain
813	*Picea glauca*	White Spruce	35	4.5	G	G	G	G		Remove
814	*Acer negundo*	Manitoba Maple	20, (2) 23	2.3	P	P	P	P	2 stems are leaning parallel to ground; 1 straight up.	Remove
815	*Picea glauca*	White Spruce	32	4.5	G	G	G	G		Remove
816	*Picea glauca*	White Spruce	17	4	G	G	G	G		Remove
817	*Picea glauca*	White Spruce	14	3.5	G	G	G	G		Remove
818	*Picea glauca*	White Spruce	30	4.5	G	G	G	G		Retain
819	*Picea glauca*	White Spruce	19	3	G	G	G	G		Retain
820	*Picea glauca*	White Spruce	32	4.5	G	G	G	G		Retain
821	*Prunus serotina*	Black Cherry	23, 33	4	F	F	F	F	Behind trees 818/819; 23 DBH stem is dead.	Remove
822	*Prunus serotina*	Black Cherry	40	8	P	F	G	P		Retain
823	*Picea glauca*	White Spruce	35	4	G	G	G	G		Retain
824	*Picea glauca*	White Spruce	38	4	G	G	G	G		Retain
825	*Picea glauca*	White Spruce	18	3	G	G	G	G		Retain
826	*Picea glauca*	White Spruce	25	3.5	G	G	G	G		Retain
827	*Picea glauca*	White Spruce	35	4	G	G	G	G		Retain
828	*Prunus serotina*	Black Cherry	25, 23, 28, 31	7	G	F	G	F	1 stem dead.	Retain
829	*Rhamnus*	Buckthorn	(2) 14, (2) 18, 23	7	F	F	G	F		Retain
830	*Picea glauca*	White Spruce	54	5	G	G	G	G	A lot of large clumps of Buckthorn.	Retain
831	*Picea glauca*	White Spruce	18	4	G	G	G	G		Retain
832	*Picea glauca*	White Spruce	35	5	G	G	G	G		Retain
833	*Picea glauca*	White Spruce	28	4	G	G	G	G		Retain
834	*Picea glauca*	White Spruce	38	5	G	G	G	G		Retain
835	*Populus sp.*	Poplar	25	5	G	G	G	G		Retain
836	*Populus sp.*	Poplar	25	5	G	G	G	G		Retain
837	*Populus sp.*	Poplar	25	5	G	G	G	G		Retain
838	*Populus sp.*	Poplar	25	4	G	G	G	G		Retain
839	*Populus sp.*	Poplar	20, 22	5	G	G	G	G		Retain
840	*Ulmus laevis*	White Elm	25	6	G	G	G	G		Retain
841	*Populus sp.*	Poplar	10, 23	5	G	G	G	G		Retain
842	*Populus sp.*	Poplar	29	5	G	G	G	G		Retain
843	*Picea glauca*	White Spruce	39	4	G	G	G	G		Retain
844	*Picea glauca*	White Spruce	39	4	G	G	G	G		Retain
845	*Tilia americana*	Basswood	20, 34, 42, 45, 49	8	P	F	F	P		Retain
846	*Prunus serotina*	Black Cherry	23, 26, 39, 45	8	F	F	F	F		Retain
847	*Fraxinus grandidentata*	Green Ash	10, 21	5	G	G	F	F		Retain
848	Fraxinus grandidentata	Green Ash	13	4	F	P	F	F		Retain
849	*Pinus strobus*	White Pine	37	6	G	G	G	G		Retain
850	*Prunus serotina*	Black Cherry	39, 40, 45		P	F	G	P	40 stem is dead.	Retain
851	*Crataegus*	Hawthorn	12	4	G	G	G	G		Retain
852		N/A	38	N/A	Dead	Dead	Dead	Dead		Remove
853	*Picea glauca*	White Spruce	42	6	G	G	G	G		Remove
854	*Ulmus laevis*	White Elm	16	4.5	G	G	G	G		Remove
855	*Prunus serotina*	Black Cherry	33, 34	6	F	F	F	F		Remove
856	*Pinus strobus*	White Pine	45	5	G	G	G	G		Remove
857	*Acer saccharum*	Sugar Maple	45	6.5	P	P	P	P		Remove
858	*Prunus serotina*	Black Cherry	22	5	G	F	G	F		Remove
859	*Fraxinus grandidentata*	Green Ash	27	3.5	G	F	F	F		Remove
860	*Prunus serotina*	Black Cherry	20, 21, 26	4	P	P	P	P	21 DBH stem is dead.	Remove
861	*Prunus serotina*	Black Cherry	24, 39	5	F	F	F	F		Remove
862	*Pinus strobus*	White Pine	21	3.5	G	G	G	G		Remove
863	*Pinus strobus*	White Pine	25	4	G	G	G	G		Remove
864	*Acer saccharum*	Sugar Maple	45	6	G	G	G	G		Retain
865	*Prunus serotina*	Black Cherry	27	4	F	G	G	F		Remove
866	*Acer saccharum*	Sugar Maple	92	7	G	G	G	G		Retain
867	*Prunus serotina*	Black Cherry	37	5.5	F	F	F	F		Remove
868	*Prunus serotina*	Black Cherry	23, (2) 25, 27		G	F	G	F	23 DBH stem is poor.	Remove
869	*Tilia americana*	Basswood	32, 44	5	G	G	G	G	Dirt piled against stem.	Retain
870	*Prunus serotina*	Black Cherry	23	4	G	F	G	F		Retain
871	*Malus sp.*	Apple sp.	(2) 26	6	G	F	F	F	Dirt piled against stem.	Retain
872	*Prunus serotina*	Black Cherry	18, 22, 25		G	F	G	F		Retain
873	*Crataegus*	Hawthorn	15	3	G	G	G	G		Retain
874	*Prunus serotina*	Black Cherry	17, 28	5	P	F	F	P		Remove
875	*Fraxinus grandidentata*	Green Ash	22	5	P	P	P	P		Remove
876	*Prunus serotina*	Black Cherry	38, 43		G	F	G	F		Remove
877	*Prunus serotina*	Black Cherry	(2) 18, (4)20	5.5	P	P	P	P		Remove
878	*Picea pungens*	Colorado Blue Spruce	14	2	G	G	G	G		Remove
879	*Picea glauca*	White Spruce	14	2	F	F	F	F		Remove
880	*Picea pungens*	Colorado Blue Spruce	28	3.5	G	G	G	G		Remove
881	*Pinus strobus*	White Pine	30	4	G	G	G	G		Remove
882	*Pinus sylvestris*	Scots Pine	25	4	G	G	G	G		Remove
883	*Picea pungens*	Colorado Blue Spruce	25	2.5	G	G	G	G		Remove
884	*Picea pungens*	Colorado Blue Spruce	25	2.5	G	G	G	G		Remove
885	*Picea pungens*	Colorado Blue Spruce	25	2.5	G	G	G	G		Remove
886	*Picea pungens*	Colorado Blue Spruce	25	3	G	G	G	G		Remove
887	*Picea pungens*	Colorado Blue Spruce	25	2.5	G	G	G	G		Remove
888	*Thuja occidentalis*	Eastern White Cedar	2 (21)	2	G	G	G	G		Remove
889	*Thuja occidentalis*	Eastern White Cedar	4 (15), 2 (18)	2	G	G	G	G		Remove
890	*Thuja occidentalis*	Eastern White Cedar	14, 16, (2) 20, 22	2.5	G	G	G	G		Remove
891	*Picea glauca*	White Spruce	(2) 18	3	G	G	G	G		Remove
892	*Picea glauca*	White Spruce	32	3.5	G	G	G	G		Remove
893	*Pinus sylvestris*	Scots Pine	30	4	G	G	G	G		Remove
894	*Pinus sylvestris*	Scots Pine	18	3.5	G	G	G	G		Remove
895	*Acer negundo*	Manitoba Maple	10, 18	4	G	G	G	G		Remove
896	*Acer saccharinum*	Silver Maple	2 (18), 30	6	G	G	G	G		Remove
897	*Picea glauca*	White Spruce	32	2.5	G	G	G	G		Remove
898	*Acer rubrum*	Red Maple	32, 34	7	G	G	G	G		Retain
899	*Picea glauca*	White Spruce	39	3	G	G	G	G		Retain
900	*Thuja occidentalis*	Eastern White Cedar	8, (2) <10, 15	2	G	G	G	G		Remove
901	Acer rubrum	Red Maple	52	6	G	G	G	G		Remove
902	Pinus sylvestris	Scots Pine	25	4	G	G	G	G		Remove
903	*Pinus sylvestris*	Scots Pine	16	3	G	G	G	G		Remove
904	*Pinus sylvestris*	Scots Pine	22	3	G	G	G	G		Remove
905	*Acer platanoides*	Norway Maple	31	4.5	G	G	G	G		Remove
906	*Acer platanoides*	Norway Maple	34	6	G	G	G	G		Retain
907	*Picea glauca*	White Spruce	25	4	G	G	G	G		Remove
908	*Picea glauca*	White Spruce	30	3	G	G	G	G		Remove
909	*Picea glauca*	White Spruce	35	4	G	G	G	G		Remove
910	*Picea glauca*	White Spruce	34	4	G	G	G	G		Remove
911	*Pinus sylvestris*	Scots Pine	15	2	G	F	F	F		Remove
912	*Acer sp.*	Maple sp.	38		Dead	Dead	Dead	Dead		Remove
913	*Picea glauca*	White Spruce	30	3	G	G	G	G		Remove
914	*Pinus sylvestris*	Scots Pine	21	3	G	G	G	G		Remove
915	*Pinus strobus*	White Pine	21	3	G	G	G	G		Remove
916	*Picea glauca*	White Spruce	24	3.5	G	G	G	G		Remove
917	*Picea glauca*	White Spruce	27	4	G	G	G	G		Remove
918	*Thuja occidentalis*	Eastern White Cedar	12	1.5	G	G	G	G		Remove
919	*Acer saccharum*	Sugar Maple	48	5	G	G	G	G		Remove
920	*Fraxinus grandidentata*	Green Ash	14, 15, (2) 18, 19	4	G	P	P	P	Signs of Emerald Ash Borer in trunk.	Remove
921	*Thuja occidentalis*	Eastern White Cedar	10	2	G	G	G	G		Remove
922	*Pinus strobus*	White Pine	21	3	G	G	G	G		Remove
923	Pinus sylvestris	Scots Pine	18	3	F	F	G	F		Remove
924	*Picea glauca*	White Spruce	18	3	G	G	G	G		Remove
925	*Pinus strobus*	White Pine	22	3.5	G	G	G	G		Remove
926	*Picea glauca*	White Spruce	22	3	G	G	G	G		Remove
927	*Thuja occidentalis*	Eastern White Cedar	11	1.5	G	G	G	G		Remove
928	*Malus sp.*	Apple sp.	42	6	F	F	G	F		Remove
929	*Thuja occidentalis*	Eastern White Cedar	16	2	G	G	G	G		Remove
930	*Salix sp.*	Willow sp.	50, 55, 57	6	G	G	G	G		Remove
931	*Salix sp.*	Willow sp.	26, 28	5	G	G	G	G		Remove
932	*Picea glauca*	White Spruce	20	3	G	G	G	G		Remove
933	*Malus sp.*	Apple sp.	35	5	G	F	F	F		Remove
934	*Pinus strobus*	White Pine	18	2	G	G	G	G		Remove
935	*Malus sp.*	Apple sp.	20, 37	6	P	F	G	P		Remove
936	*Thuja occidentalis*	Eastern White Cedar	16	2	G	G	G	G		Retain
937	*Salix sp.*	Willow sp.	56	8	G	F	G	F	Large dead wood in canopy.	Remove
938	*Salix sp.*	Willow sp.	25, 43, 53	10	G	G	G	G		Retain
939	*Picea glauca*	White Spruce	18	3	G	G	G	G		Retain
940	*Picea glauca*	White Spruce	15	2.5	G	G	G	G		Retain
941	*Thuja occidentalis*	Eastern White Cedar	14	2	G	G	G	G		Retain
942	*Pinus sylvestris*	Scots Pine	20	3.5	G	G	G	G		Retain
943	*Picea glauca*	White Spruce	22	3	G	G	G	G		Retain
944	*Salix sp.*	Willow sp.	27	5	F	F	G	F		Retain
945	*Salix sp.*	Willow sp.	34		F	P	P	P	More than 50% live crown.	Retain
946	*Picea glauca*	White Spruce	20	3	G	G	G	G		Retain
947	*Pinus sylvestris*	Scots Pine	20	3.5	G	G	G	G		Retain
948	*Thuja occidentalis*	Eastern White Cedar	16	2.5	G	G	G	G		Retain
949	*Picea glauca*	White Spruce	32	3.5	G	G	G	G		Retain
950	*Picea glauca*	White Spruce	21	3.5	G	G	G	G		Retain
951	*Salix sp.*	Willow sp.	26	4	P	P	P	P	Less than 50% live crown.	Retain
952	*Salix sp.*	Willow sp.	23	3.5	F	P	F	P		Retain
953	*Acer saccharinum*	Silver Maple	23, 58	6	G	G	G	G		Retain
954	*Acer saccharinum*	Silver Maple	40, (2) 45	7	G	G	G	G		Retain
955	*Acer saccharinum*	Silver Maple	26	5	F	F	G	F		Retain
956	*Acer saccharinum*	Silver Maple	(2) 42	6	G	G	G	G		Retain
957	*Acer saccharinum*	Silver Maple	32	6	F	G	G	F		Remove
958	*Acer saccharinum*	Silver Maple	(2) 21	6	G	G	G	G		Remove
959	*Acer saccharinum*	Silver Maple	23	4	P	P	P	P		Remove
960	*Acer saccharinum*	Silver Maple	25	5	F	G	G	F		Remove
961	*Acer saccharinum*	Silver Maple	(2) 28, 30	6	G	G	G	G		Remove
962	*Acer saccharinum*	Silver Maple	10, 20, 42	4	G	G	G	G		Remove
963	*Acer saccharinum*	Silver Maple	43	5	G	G	G	G		Remove
964	*Acer saccharinum*	Silver Maple	55	6	G	G	G	G		Retain
965	*Acer saccharinum*	Silver Maple	37	4.5	F	F	F	F		Retain
966	*Acer saccharinum*	Silver Maple	24	5.5	P	P	P	P	Less than 50% live crown.	Retain
967	*Acer saccharinum*	Silver Maple	38, 45	6	F	G	G	F		Retain
968	*Picea glauca*	White spruce	21	3	G	G	G	G		Remove
969	*Acer saccharinum*	Silver Maple	2(14), 17, 20	4.5	F	F	F	F		Retain
970	*Picea glauca*	White Spruce	50	4	G	G	G	G		Retain
971	*Picea glauca*	White Spruce	44	5	G	G	G	G		Remove
972	*Larix laricina*	Tamarack	43	5	G	G	G	G		Remove
973	*Picea glauca*	White Spruce	45	4.5	G	G	G	G		Retain
974	*Picea glauca*	White Spruce	29	4.5	G	G	G	G		Remove
975	*Thuja occidentalis*	Eastern White Cedar	23	3.5	G	G	G	G		Remove
976	*Thuja occidentalis*	Eastern White Cedar	22	2.5	G	G	G	G		Remove
977	*Picea glauca*	White Spruce	24	4	G	G	G	G		Remove
978	*Picea glauca*	White Spruce	31	4.5	G	G	G	G		Remove
979	*Acer saccharinum*	Silver Maple	35	4	F	G	G	F		Remove
980	*Picea glauca*	White Spruce	30	3	G	G	G	G		Remove
981	*Gleditsia triacanthos*	Honey Locust	(2) 29		P	P	P	P	Less than 50% live crown.	Retain
982	*Acer saccharinum*	Silver Maple	33	6	G	G	G	G	Wound in upper mid stem; possible rot.	Remove
983	*Acer saccharinum*	Silver Maple	22	6	G	G	G	G		Remove
984	*Acer saccharinum*	Silver Maple	18	5	G	G	G	G		Remove
985	*Picea glauca*	White Spruce	21	3.5	G	G	G	G		Remove
986	*Pinus strobus*	White Pine	24	4	G	G	G	G		Remove
987	*Picea glauca*	White Spruce	18	2	G	G	G	G		Remove
988	*Picea glauca*	White Spruce	20	4	G	G	G	G		Remove
989	*Picea glauca*	White Spruce	23	4	G	G	G	G		Remove
990	*Pinus sylvestris*	Scots Pine	20	3.5	G	G	G	G		Remove
991	*Pinus strobus*	White Pine	33	5	G	G	G	G		Remove
992	*Picea glauca*	White Spruce	22	4.5	G	G	G	G	Some trees in central lawn area <10 include: (1) Apple sp., (1) Juniper	Remove
993	*Picea glauca*	White Spruce	30	4.5	G	G	G	G		Remove
994	*Picea glauca*	White Spruce	30	3.5	G	G	G	G		Remove
995	*Picea glauca*	White Spruce	21	3	G	G	G	G		Remove
996	*Picea glauca*	White Spruce	21	3	G	G	G	G		Remove
997		Dead	N/A	N/A	N/A	N/A	N/A	N/A		Remove
998	*Picea glauca*	White Spruce	24	3.5	G	G	G	G		Remove
999	*Pinus strobus*	White Pine	25	3.5	G	G	G	G		Remove
1000	*Pinus strobus*	White Pine	30	4	G	G	G	G		Remove
****										
1101	*Pinus strobus*	White Pine	28	4	G	G	G	G		Remove
1102	*Thuja occidentalis*	Eastern White Cedar	21	2	G	G	G	G		Remove
1103	*Thuja occidentalis*	Eastern White Cedar	20	2.5	G	G	G	G		Remove
1104	*Thuja occidentalis*	Eastern White Cedar	20	2.5	G	G	G	G		Remove
1105	*Thuja occidentalis*	Eastern White Cedar	23	2	G	G	G	G		Remove
1106	*Thuja occidentalis*	Eastern White Cedar	18	2	G	G	G	G		Remove
1107	*Thuja occidentalis*	Eastern White Cedar	16	2	G	G	G	G		Remove
1108	*Thuja occidentalis*	Eastern White Cedar	21	2	G	G	G	G		Remove
1109	*Acer saccharinum*	Silver Maple	14, 28	6	G	G	G	G		Remove
1110	*Thuja occidentalis*	Eastern White Cedar	12	10	G	G	G	G		Remove
1111	*Pinus sylvestris*	Scots Pine	14	2	G	G	G	G		Remove
1112	*Thuja occidentalis*	Eastern White Cedar	(2) <10, 10	2	G	G	G	G		Remove
1113	*Pinus sylvestris*	Scots Pine	22	3	G	G	G	G		Remove
1114	*Pinus sylvestris*	Scots Pine	21	4	G	G	G	G		Remove
1115	*Pinus sylvestris*	Scots Pine	23	4	G	G	G	G		Remove
1116	*Thuja occidentalis*	Eastern White Cedar	12	2	G	G	G	G		Remove
1117	*Picea glauca*	White Spruce	36	3	G	G	G	G		Retain
1118	*Thuja occidentalis*	Scots Pine	46	6	G	G	G	G		Remove
1119	*Picea glauca*	White Spruce	42	4	G	G	G	G		Remove
1120	*Betula papyrifera*	White Birch	29	5	G	G	G	G		Remove
1121	*Picea glauca*	White Spruce	26	3.5	G	G	G	G		Remove
1122	*Larix laricina*	Tamarack	49	5	G	G	G	G		Remove
1123	*Thuja occidentalis*	Eastern White Cedar	20	2	G	G	G	G		Remove
1124	*Picea glauca*	White Spruce	35	4	G	G	G	G		Remove
1125	*Picea glauca*	White Spruce	32	3.5	G	G	G	G		Remove
1126	*Larix laricina*	Tamarack	26	3	G	G	G	G		Retain
1127	*Pinus strobus*	White Pine	25	4	G	G	G	G		Remove
1128	*Thuja occidentalis*	Eastern White Cedar	(3) <10, 10, 14	1.5	G	G	G	G		Retain
1129	*Picea glauca*	White Spruce	21		G	G	G	G		Retain
1130	*Acer saccharinum*	Silver Maple	26, 32	7	G	G	G	G		Retain
1131	*Acer saccharinum*	Silver Maple	30, 32, 45	8	G	G	G	G		Retain
1132	*Larix laricina*	Tamarack	24	3.5	G	G	G	G		Retain
1133	*Picea glauca*	White Spruce	16	2	G	G	G	G		Retain
Start of Hedgerow										
1134	*Prunus serotina*	Black Cherry	30	6	G	P	G	P		Remove
1135	*Prunus serotina*	Black Cherry	26		P	P	P	P	Less than 50% live crown.	Remove
1136	*Picea glauca*	White spruce	31	4	G	G	G	G		Remove
1137	*Malus sp.*	Apple sp.	16, 18	2.5	F	F	G	F		Remove
1138	*Picea glauca*	White spruce	14	2	G	G	G	G	Dead branch hung up in crown.	Remove
1139	*Malus sp.*	Apple sp.	25, 28	5	P	F	F	P		Remove
1140	*Prunus serotina*	Black Cherry	18, 21	4	P	P	P	P		Retain
1141	*Prunus serotina*	Black Cherry	35, 39	6	P	P	P	P	Less than 50% live crown.	Retain
1142	*Crataegus*	Hawthorn	21	4	G	F	F	F		Remove
1143	*Prunus serotina*	Black Cherry	22, 26, 34	3.5	P	P	P	P	Less than 50% live crown.	Remove
1144	*Crataegus*	Hawthorn	23	3.5	G	G	G	G		Remove
1145	*Malus sp.*	Apple sp.	32	5	G	G	G	G		Remove
1146	*Prunus serotina*	Black Cherry	10, 16, 18	4	G	G	G	G	More than 50% live crown.	Retain
1147	*Acer saccharum*	Sugar Maple	35	6	G	G	G	G		Retain
1148	*Prunus serotina*	Black Cherry	21	5	G	G	G	G		Retain
1149	*Malus sp.*	Apple sp.	21, 23	4	F	F	F	F		Retain
1150	*Malus sp.*	Apple sp.	26, (2) 33	7	G	F	G	F		Retain
1151	*Acer saccharum*	Sugar Maple	29	5	G	G	G	G		Retain
1152	*Prunus serotina*	Black Cherry	26	6	G	F	G	F		Retain

TABLE 2. TREE IMPACT TOTALS:

Total Number of Trees Inventoried	268
Total Number Trees to be Retained:	98
Total Number Trees to be Removed:	154

Stantec

300 Hagey Blvd. Suite 100
Waterloo, ON, N2L 0A4
Tel. 519.579.4410
www.stantec.com

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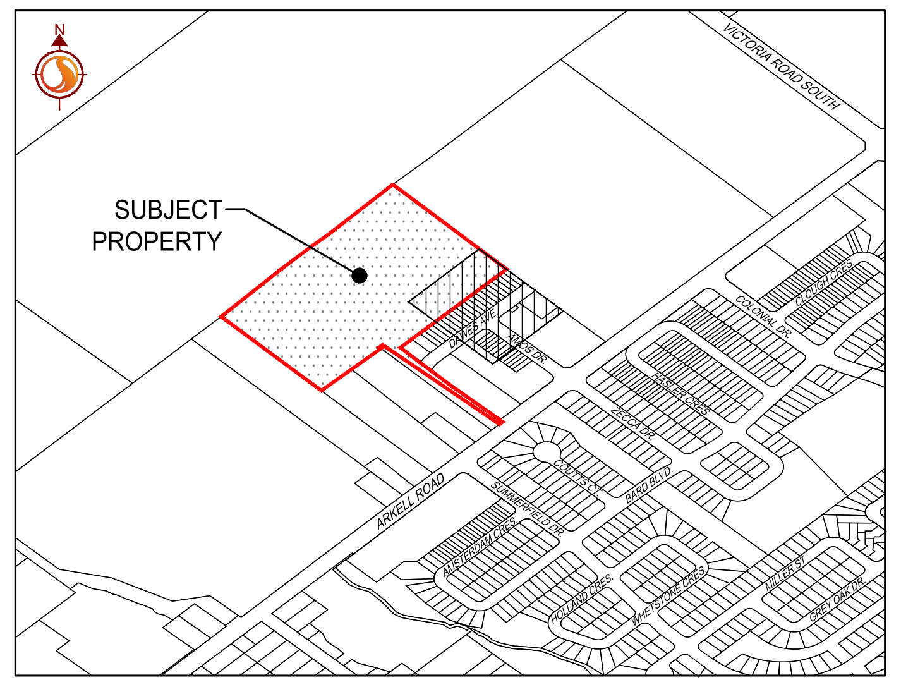
Key Map NTS.



Legend

0. FIRST SUBMISSION	JJ	JK	19.05.30
Revision	By	Appd.	YY.MM.DD

File Name: 161413338_L-TM.dwg	JJ	JK		18.01.30
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

CERTIFIED ARBORIST ISA
JENNIFER KOSKINEN
0N-1234A

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

GUELPH, ON

Title

TREE MANAGEMENT CHARTS

Project No. 161413338

Scale 1:750 0 7.5 22.5 37.5m

Drawing No. L-905

Sheet 6 of 6

Revision 0

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2019/05/30 2:16 PM By: Hulsman, Michael

ORIGINAL SHEET - ARCH D

APPENDIX G
Field Notes

APPENDIX G1

ELC

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE (project no./name): 16141 3338	POLYGON: SWDM4	
	SURVEYOR(S): J. Ball	DATE: Sep 23, 2016	PHOTO No.:
	START: 14:30	END:	ZONE & UTM:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☐ TERRESTRIAL	☐ ORGANIC	☐ LACUSTRINE	☒ NATURAL	☐ PLANKTON	☐ LAKE
☒ WETLAND	☒ MINERAL SOIL	☐ RIVERINE	☐ CULTURAL	☐ SUBMERGED	☐ POND
☐ AQUATIC	☐ PARENT MIN.	☒ BOTTOMLAND		☐ FLOATING-LVD.	☐ RIVER
	☐ ACIDIC BEDRK.	☐ TERRACE		☐ GRAMINOID	☐ STREAM
	☐ BASIC BEDRK.	☐ VALLEY SLOPE		☐ FORB	☐ MARSH
	☐ CARB. BEDRK.	☐ TABLELAND		☐ LICHEN	☒ SWAMP
		☐ ROLL. UPLAND		☐ BRYOPHYTE	☐ FEN
		☐ CLIFF		☒ DECIDUOUS	☐ BOG
		☐ TALUS		☐ CONIFEROUS	☐ BARREN
		☐ CREVICE / CAVE		☐ MIXED	☐ MEADOW
		☐ ALVAR			☐ PRAIRIE
		☐ ROCKLAND			☐ THICKET
		☐ BEACH / BAR			☐ SAVANNAH
		☐ SAND DUNE			☐ WOODLAND
		☐ BLUFF			☐ FOREST
					☐ PLANTATION

SITE	COVER
☐ OPEN WATER	☐ OPEN
☐ SHALLOW WATER	☐ SHRUB
☒ SURFICIAL DEP.	☒ TREED
☐ BEDROCK	

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (>>MUCH GREATER THAN; >GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	4	ACEFREE>POPTREM>BETPAPY=POPBALS
2	SUB-CANOPY	3	3	RHACATH
3	UNDERSTOREY	4	2	RHACATH
4	GRD. LAYER	5	2	RHACATH

HT CODES: 1=>25m 2=10<HT≤25m 3=2<HT≤10m 4=1<HT≤2m 5=0.5<HT≤1m 6=0.2<HT≤0.5m 7=HT<0.2m

CVR CODES: 0=NONE 1=0%<CVR≤10% 2=10<CVR≤25% 3=25<CVR≤60% 4=CVR>60%

STAND COMPOSITION:				BA:
SIZE CLASS ANALYSIS:	A <10	A 10 – 24	O 25 – 50	R >50
STANDING SNAGS:	R <10	R 10 – 24	R 25 – 50	N >50
DEADFALL/LOGS:	A <10	A 10 – 24	R 25 – 50	N >50

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT

COMM. AGE:	PIONEER	YOUNG	✓ MID-AGE	✓ MATURE	OLD GROWTH

SOIL ANALYSIS: mineral

TEXTURE:	DEPTH TO MOTTLES/GLEY	g=	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

COMMUNITY CLASS:		CODE:
COMMUNITY SERIES:		CODE:
ECOSITE: Mineral Decid. Swamp		CODE:
VEGETATION TYPE:		CODE: SWDM4
INCLUSION		CODE:
COMPLEX		CODE:

Notes: (e.g. disturbance, surface water depths, etc.)

- ground disturbed from horses
- dominated by RHACATH

LAYERS: 1=CANOPY>10m 2=SUB-CANOPY 3=UNDERSTOREY 4=GROUND (GRD.) LAYER

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT D=DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COLL.
POPTREM	O				
POPBALS	O				
BETPAPY	O				
ULMAMER			R		
FRAPENN	D			R	
THUOCCI		O			
ACEFREE	A			O	
ABIBALS			R		
FRANIGR		R			
RHACATH		D	D	D	D
CORFORA			R		
VITRIPA				O	
VIBOPUL				R	
PARINSET				O	
CORSERI			R		

SPECIES CODE	LAYER 1	2	3	4	COLL.
GEUALLE				O	
HELERORE				R	
VIOLA sp				R	
Aster sp				R	
DRYCART				R	
Dewberry				R	
moss sp				O	
CARARCT? no beak				R	
CIRCANA				R	
SOLALT				O	
GERROBE				R	
ABRBRYP				R	

Page 1 of 4

Print Name: Janice Ball (Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature: _____ (Field Notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Wildlife Habitat Assessment Form

Project Number: 161413338 Polygon No.: SWDM4

Assessment Type: ☐-Visual; no access/☐-Entire; walk through feature/☒-Partial access *(indicate on map)* – along property line

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (last 24 hrs):
	20	2	100%	light rain	NONE

NOTES & SPECIES OBSERVATIONS (list species and type of observation, indicate on map):

AMCR.
- potential bat maternity roost habitat in silver maples

CA=carcass; DP=distinctive parts; FE=feeding evidence; FY=eggs/nest; HO=house/den; OB=observed; SC=scat; SI=other sign; TK=track; VO=vocalization

Wildlife Habitat Type & Description	Site Assessment	Photo ID	Map ID	UTM Coordinates Zone	Easting	Northing
ALL SITES						
Bat Hibernacula: Caves, abandoned mines, underground foundations, karst features	Size of opening(s) Bedrock Type Depth of feature (if possible)					
Snake Hibernacula: Burrows, rock crevices, fissures that extend below the frost line (i.e. at least 1 m)	Number of access points Size of opening(s) Substrate					
Bank / Cliff Colonial Bird Nesting Habitat: Exposed soil banks, undisturbed, naturally eroding, steep slopes, cliff faces with evidence of nests or burrows	Size of burrow Number of burrows					
Stick Nests: Stick nests found in any forest/ woodland/swamp; includes heron colonies and bald eagle/ osprey/other raptor nests	Tree species Nest size					
WOODLANDS						
Vernal Pools: Permanent or semi-permanent pool or pond. Evidence of holding water in most years through late spring (i.e. late May) or into summer	Number of features Feature size (diameter) Water depth					
Seeps and Springs: Locations where groundwater comes to the surface in forests (see document for indicator species)	Sub/emergent veg present Shrubs/logs at edge present Water permanency					
WETLANDS						
Turtle Wintering Areas: Permanent water bodies, large wetlands, bogs, or fens with soft substrates and deep enough not to freeze solid	Feature size (diameter) Water depth Substrate of water body Water permanency					
Turtle Nesting Habitat: Exposed mineral soil (sand or gravel) areas adjacent (<100 m) to MAM/SA/BOO/ FEO (note if man-made)	Type of substrate Distance to wetland Size of feature					
Terrestrial Crayfish Habitat: Edges of shallow marshes and meadows (no minimum size) with crayfish chimneys	Number of chimneys					

Print Name: Janice Ball (Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature: (Field Notes QA/QC personnel)

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE (project no./name): 16143338		POLYGON: FODM11
	SURVEYOR(S): J. Ball	DATE: Sep 23, 2016	PHOTO No.:
	START:	END:	ZONE & UTM:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☒ TERRESTRIAL	☐ ORGANIC	☐ LACUSTRINE	☐ NATURAL	☐ PLANKTON	☐ LAKE
☐ WETLAND	☒ MINERAL SOIL	☐ RIVERINE	☒ CULTURAL	☐ SUBMERGED	☐ POND
☐ AQUATIC	☐ PARENT MIN.	☐ BOTTOMLAND		☐ FLOATING-LVD.	☐ RIVER
	☐ ACIDIC BEDRK.	☐ TERRACE		☐ GRAMINOID	☐ STREAM
	☐ BASIC BEDRK.	☐ VALLEY SLOPE		☐ FORB	☐ MARSH
	☐ CARB. BEDRK.	☐ TABLELAND		☐ LICHEN	☐ SWAMP
SITE		☒ ROLL. UPLAND		☐ BRYOPHYTE	☐ FEN
☐ OPEN WATER		☐ CLIFF	**COVER**	☒ DECIDUOUS	☐ BOG
☐ SHALLOW WATER		☐ TALUS	☐ OPEN	☐ CONIFEROUS	☐ BARREN
☒ SURFICIAL DEP.		☐ CREVICE / CAVE	☐ SHRUB	☐ MIXED	☐ MEADOW
☐ BEDROCK		☐ ALVAR	☒ TREED		☐ PRAIRIE
		☐ ROCKLAND			☐ THICKET
		☐ BEACH / BAR			☐ SAVANNAH
		☐ SAND DUNE			☐ WOODLAND
		☐ BLUFF			☐ FOREST
					☐ PLANTATION
					☒ Hedgerow

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (>>MUCH GREATER THAN; >GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	3	
2	SUB-CANOPY	3	3	RHACATH
3	UNDERSTOREY	4	3	RHACATH
4	GRD. LAYER	5	2	PARINSE > SOLCANA

HT CODES: 1=>25m 2=10<HT≤25m 3=2<HT≤10m 4=1<HT≤2m 5=0.5<HT≤1m 6=0.2<HT≤0.5m 7=HT<0.2m

CVR CODES: 0=NONE 1=0%<CVR≤10% 2=10<CVR≤25% 3=25<CVR≤60% 4=CVR>60%

STAND COMPOSITION:				BA:
SIZE CLASS ANALYSIS:	A <10	A 10 – 24	A 25 – 50	R >50
STANDING SNAGS:	R <10	R 10 – 24	R 25 – 50	R >50
DEADFALL/LOGS:	A <10	A 10 – 24	R 25 – 50	N >50

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT

COMM. AGE:	PIONEER	✓ YOUNG	✓ MID-AGE	MATURE	OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES/GLEY	g=	G=
MOISTURE:	DEPTH OF ORGANICS:	(cm)	
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:	(cm)	

COMMUNITY CLASSIFICATION:

COMMUNITY CLASS:		CODE:
COMMUNITY SERIES:		CODE:
ECOSITE:		CODE:
VEGETATION TYPE:		CODE:
INCLUSION		CODE:
COMPLEX		CODE:

Notes: (e.g. disturbance, surface water depths, etc.)

hedgerow

LAYERS: 1=CANOPY>10m 2=SUB-CANOPY 3=UNDERSTOREY 4=GROUND (GRD.) LAYER

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT D=DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COLL.	SPECIES CODE	LAYER 1	2	3	4	COLL.
PRUSERO	O	O				ARCMINU				O	
PICABIE	O					SOLCANA				O	
ACEPLAT	O					ACCSIRI				R	
PINSTRO	O					SYMLATE				O	
FRAAMER	O	O	R			SYMNOVA				O	
TILAMER	O					BROINER				O	
RHACATH		D	D								
CORACTE		R									
PARINSE		A	A	A							
VITRIPA		O	A								
RUBSTRI			O								
LONTATA			R								

Page 3 of 4

Quality Control: This form is complete ☐ & legible ☐

Print Name: Janice Ball (Field Notes Author)

Signature: _____ (Field Notes QA/QC personnel)

Stantec Consulting Ltd.
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Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Wildlife Habitat Assessment Form

Project Number: 161413338 Polygon No.: FODM11

Assessment Type: ☐-Visual; no access/☐-Entire; walk through feature/☐-Partial access *(indicate on map)*

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (last 24 hrs):
	20	2	100%	light rain	None

NOTES & SPECIES OBSERVATIONS (list species and type of observation, indicate on map):

CA=carcass; DP=distinctive parts; FE=feeding evidence; FY=eggs/nest; HO=house/den; OB=observed; SC=scat; SI=other sign; TK=track; VO=vocalization

Wildlife Habitat Type & Description	Site Assessment	Photo ID	Map ID	UTM Coordinates Zone	Easting	Northing
ALL SITES						
Bat Hibernacula: Caves, abandoned mines, underground foundations, karst features	Size of opening(s) Bedrock Type Depth of feature (if possible)					
Snake Hibernacula: Burrows, rock crevices, fissures that extend below the frost line (i.e. at least 1 m)	Number of access points Size of opening(s) Substrate					
Bank / Cliff Colonial Bird Nesting Habitat: Exposed soil banks, undisturbed, naturally eroding, steep slopes, cliff faces with evidence of nests or burrows	Size of burrow Number of burrows					
Stick Nests: Stick nests found in any forest/ woodland/swamp; includes heron colonies and bald eagle/ osprey/other raptor nests	Tree species Nest size					
WOODLANDS						
Vernal Pools: Permanent or semi-permanent pool or pond. Evidence of holding water in most years through late spring (i.e. late May) or into summer	Number of features Feature size (diameter) Water depth					
Seeps and Springs: Locations where groundwater comes to the surface in forests (see document for indicator species)	Sub/emergent veg present Shrubs/logs at edge present Water permanency					
WETLANDS						
Turtle Wintering Areas: Permanent water bodies, large wetlands, bogs, or fens with soft substrates and deep enough not to freeze solid	Feature size (diameter) Water depth Substrate of water body Water permanency					
Turtle Nesting Habitat: Exposed mineral soil (sand or gravel) areas adjacent (<100 m) to MAM/SA/BOO/ FEO (note if man-made)	Type of substrate Distance to wetland Size of feature					
Terrestrial Crayfish Habitat: Edges of shallow marshes and meadows (no minimum size) with crayfish chimneys	Number of chimneys					

Print Name: Janice Ball (Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature: (Field Notes QA/QC personnel)

REV: 2014-04-17

W:\active\60960476\graphics\GIS\MXD\60960476_Figure2_0_ELCVegetationCommunities_20100319_CEW.mxd

Legend

- Study Area
- Torrence Creek PSW
- Surveyed Wetland Boundary
- ELC Boundary

ELC Vegetation Communities

Cultural Communities
CUM1-1 Dry-Moist Old Field Cultural Meadow
CUW1-3* Manitoba Maple Cultural Woodland

Swamp Communities
SWT2-13* Poplar Mineral Thicket Swamp

*denotes communities not listed in the southern Ontario ELC manual

ELC/veg/wildlife
Sep 23, 2016
J. Ball
220 Arkell

Notes

1. Coordinate System: UTM NAD 83 - Zone 17 (N).
2. Data Sources: Ontario Ministry of Natural Resources © Queens Printer Ontario, 2009; © Grand River Conservation Authority, 2009.
3. Image Sources: © Google Earth Pro, 2009 (© First Base Solutions, 2009; © TeleAtlas, 2009 - Imagery Date: May 3, 2006).

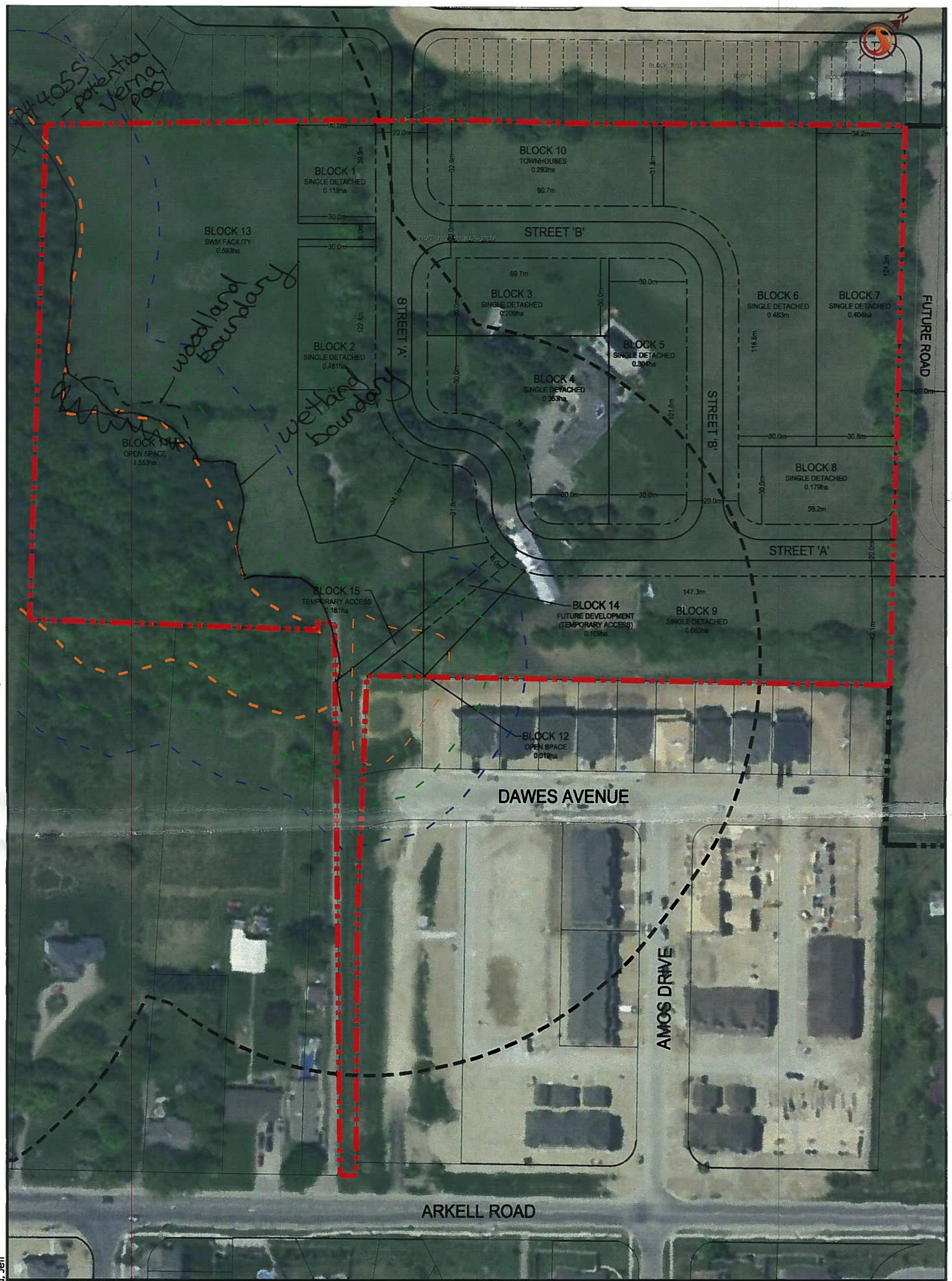
Stantec

March 19, 2010
160960476

Client/Project
VICTORIA WOOD
ARKELL EIS

Figure No.
2

Title
ELC VEGETATION COMMUNITIES AND SIGNIFICANT NATURAL FEATURES



Legend

- PROPERTY BOUNDARY
- REGULATORY LIMIT (GRCA)
- WETLAND BOUNDARY
- 15.0m WETLAND BUFFER
- 30.0m WETLAND BUFFER

Notes

APPROXIMATE PROPERTY AREA - 7.047ha / 17.414ac

BUILDABLE FRONTAGE - 952.3m

CENTRELINE OF ROAD: STREET 'A' - 331.0m
STREET 'B' - 226.6m

* ONCE THE FUTURE ROAD IS BUILT, THE FUTURE DEVELOPMENT BLOCK WITH BECOME A SINGLE RESIDENTIAL LOT.

July, 2016
161413338

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2016/07/06 8:35 AM By: Jaskolka, Jeff

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Tel. 519.579.4410
www.stantec.com

0 15 45 75m
1:1500

- woodland/wetland boundary
- veg/habitat assessment ELC

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD
GUELPH, ON

Figure No.
2

Title
CONCEPTUAL DRAFT PLAN

Spring Botanical - May 9, 2017 - JBall

Summer Botanical - July 10, 2017 J. Ball

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

SITE (project no./name): 16141 3338		POLYGON: SWDM4	
SURVEYOR(S): J. Ball	DATE: Sep 23, 2016		PHOTO No.:
START: 14:30	END:	ZONE & UTM:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☐ TERRESTRIAL	☐ ORGANIC	☐ LACUSTRINE	☒ NATURAL	☐ PLANKTON	☐ LAKE
☒ WETLAND	☒ MINERAL SOIL	☐ RIVERINE	☐ CULTURAL	☐ SUBMERGED	☐ POND
☐ AQUATIC	☐ PARENT MIN.	☒ BOTTOMLAND		☐ FLOATING-LVD.	☐ RIVER
	☐ ACIDIC BEDRK.	☐ TERRACE		☐ GRAMINOID	☐ STREAM
	☐ BASIC BEDRK.	☐ VALLEY SLOPE		☐ FORB	☐ MARSH
	☐ CARB. BEDRK.	☐ TABLELAND		☐ LICHEN	☒ SWAMP
		☐ ROLL. UPLAND		☐ BRYOPHYTE	☐ FEN
		☐ CLIFF		☒ DECIDUOUS	☐ BOG
		☐ TALUS		☐ CONIFEROUS	☐ BARREN
		☐ CREVICE / CAVE		☐ MIXED	☐ MEADOW
		☐ ALVAR			☐ PRAIRIE
		☐ ROCKLAND			☐ THICKET
		☐ BEACH / BAR			☐ SAVANNAH
		☐ SAND DUNE			☐ WOODLAND
		☐ BLUFF			☐ FOREST
					☐ PLANTATION

SITE	COVER
☐ OPEN WATER	☐ OPEN
☐ SHALLOW WATER	☐ SHRUB
☒ SURFICIAL DEP.	☒ TREED
☐ BEDROCK	

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (>>MUCH GREATER THAN; >GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	4	ACEFREE > POPTREM > BETPAPY = POPBALS
2	SUB-CANOPY	3	3	RHACATH
3	UNDERSTOREY	4	2	RHACATH
4	GRD. LAYER	5	2	RHACATH

HT CODES: 1=>25m 2=10<HT≤25m 3=2<HT≤10m 4=1<HT≤2m 5=0.5<HT≤1m 6=0.2<HT≤0.5m 7=HT<0.2m

CVR CODES: 0=NONE 1=0%<CVR≤10% 2=10<CVR≤25% 3=25<CVR≤60% 4=CVR>60%

STAND COMPOSITION: BA:

SIZE CLASS ANALYSIS:	A <10	A 10 – 24	O 25 – 50	R >50
STANDING SNAGS:	R <10	R 10 – 24	R 25 – 50	N >50
DEADFALL/LOGS:	A <10	A 10 – 24	R 25 – 50	N >50

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT

COMM. AGE:	PIONEER	YOUNG	MID-AGE	MATURE	OLD GROWTH
			✓	✓	

SOIL ANALYSIS: mineral

TEXTURE:	DEPTH TO MOTTLES/GLEY	g=	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

COMMUNITY CLASS:		CODE:
COMMUNITY SERIES:		CODE:
ECOSITE: Mineral Decid. Swamp		CODE:
VEGETATION TYPE:		CODE: SWDM4
INCLUSION		CODE:
COMPLEX		CODE:

Notes: (e.g. disturbance, surface water depths, etc.)
- ground disturbed from horses
- dominated by RHACATH

LAYERS: 1=CANOPY>10m 2=SUB-CANOPY 3=UNDERSTOREY 4=GROUND (GRD.) LAYER

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT D=DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COLL.
POPTREM	O				
POPBALS	O				
BETPAPY	O				
ULMAMER			R		
FRAPENN	D			R	
THUOCCI		O			
ACERREE	A			O	
ABIBALS			R		
FRANIGR		R			
B July 10, 2017					
BETPAPY					
RHACATH		D	D	D	D
CORFORA			R		
VITRIPA				O	
VIBOPUL				R	
PARINSE				O	
CORSERI			R		
RIBHUDS			R		
RHAFRAN			O		

SPECIES CODE	LAYER 1	2	3	4	COLL.
GEUALLE				O	
HELFORE				R	
VIOLA sp				R	
Aster sp				R	
DRYCART				R	
Dewberry				R	
moss sp				O	
CARARCT no bat				R	
CIRCANA				R	
SOLALT				O	
GERROBT				R	
AGRGRYP				R	
May 9, 2017					
Trout Lily				R	
GERROBE				R	
ECHLOBT					
URTDIOI					
TAROFFI					
GALPALU				R	
RANACRI					
Carex bebbii/scoparia?					
GLYSTRI					

Page 1 of 4

Print Name: Janice Ball (Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature: _____ (Field Notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Wildlife Habitat Assessment Form

Project Number: 161413338 Polygon No.: SWDM4

Assessment Type: ☐-Visual; no access/☐-Entire; walk through feature/☒-Partial access (indicate on map) – along property line

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (last 24 hrs):
	20	2	100%	Light rain	NONE

NOTES & SPECIES OBSERVATIONS (list species and type of observation, indicate on map):
AMCR, EWEPE, BLJA
– potential bat maternity roost habitat in silver maples

CA=carcass; DP=distinctive parts; FE=feeding evidence; FY=eggs/nest; HO=house/den; OB=observed; SC=scat; SI=other sign; TK=track; VO=vocalization

Wildlife Habitat Type & Description	Site Assessment	Photo ID	Map ID	UTM Coordinates Zone	Easting	Northing
ALL SITES						
Bat Hibernacula: Caves, abandoned mines, underground foundations, karst features	Size of opening(s) Bedrock Type Depth of feature (if possible)					
Snake Hibernacula: Burrows, rock crevices, fissures that extend below the frost line (i.e. at least 1 m)	Number of access points Size of opening(s) Substrate					
Bank / Cliff Colonial Bird Nesting Habitat: Exposed soil banks, undisturbed, naturally eroding, steep slopes, cliff faces with evidence of nests or burrows	Size of burrow Number of burrows					
Stick Nests: Stick nests found in any forest/ woodland/swamp; includes heron colonies and bald eagle/ osprey/other raptor nests	Tree species Nest size					
WOODLANDS						
Vernal Pools: Permanent or semi-permanent pool or pond. Evidence of holding water in most years through late spring (i.e. late May) or into summer	Number of features Feature size (diameter) Water depth		VP1			
Seeps and Springs: Locations where groundwater comes to the surface in forests (see document for indicator species)	Sub/emergent veg present Shrubs/logs at edge present Water permanency		VP2			
WETLANDS						
Turtle Wintering Areas: Permanent water bodies, large wetlands, bogs, or fens with soft substrates and deep enough not to freeze solid	Feature size (diameter) Water depth Substrate of water body Water permanency					
Turtle Nesting Habitat: Exposed mineral soil (sand or gravel) areas adjacent (<100 m) to MAM/SA/BOO/ FEO (note if man-made)	Type of substrate Distance to wetland Size of feature					
Terrestrial Crayfish Habitat: Edges of shallow marshes and meadows (no minimum size) with crayfish chimneys	Number of chimneys					

VP1 – linear vernal pool opens up into a pool ~15x10m ~40cm deep – extensive shallow flooding around pool

VP2 – small vernal pool in NW corner of study area ~4x4m

– no water in either feature by summer

Print Name: Janice Ball (Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature: _____ (Field Notes QA/QC personnel)

Spring Botanical - May 9, 2017, J. Ball Summer Botanical - July 10, 2017 J. Ball

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE (project no./name): 16143338	POLYGON: ~~FOAMTT~~ HR	
	SURVEYOR(S): J. Ball	DATE: Sep 23, 2016	PHOTO No.:
	START:	END:	ZONE & UTM:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☒ TERRESTRIAL	☐ ORGANIC	☐ LACUSTRINE	☐ NATURAL	☐ PLANKTON	☐ LAKE
☐ WETLAND	☒ MINERAL SOIL	☐ RIVERINE	☒ CULTURAL	☐ SUBMERGED	☐ POND
☐ AQUATIC	☐ PARENT MIN.	☐ BOTTOMLAND		☐ FLOATING-LVD.	☐ RIVER
	☐ ACIDIC BEDRK.	☐ TERRACE		☐ GRAMINOID	☐ STREAM
	☐ BASIC BEDRK.	☐ VALLEY SLOPE		☐ FORB	☐ MARSH
	☐ CARB. BEDRK.	☐ TABLELAND		☐ LICHEN	☐ SWAMP
		☒ ROLL. UPLAND		☐ BRYOPHYTE	☐ FEN
		☐ CLIFF		☒ DECIDUOUS	☐ BOG
		☐ TALUS		☐ CONIFEROUS	☐ BARREN
		☐ CREVICE / CAVE		☐ MIXED	☐ MEADOW
		☐ ALVAR			☐ PRAIRIE
		☐ ROCKLAND			☐ THICKET
		☐ BEACH / BAR			☐ SAVANNAH
		☐ SAND DUNE			☐ WOODLAND
		☐ BLUFF			☐ FOREST
					☐ PLANTATION
					☒ Hedgerow

SITE	COVER
☐ OPEN WATER	☐ OPEN
☐ SHALLOW WATER	☐ SHRUB
☒ SURFICIAL DEP.	☒ TREED
☐ BEDROCK	

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (>>MUCH GREATER THAN; >GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	3	
2	SUB-CANOPY	3	3	RHACATH
3	UNDERSTOREY	4	3	RHACATH
4	GRD. LAYER	5	2	PARINSE > SOLCANA

HT CODES: 1=>25m 2=10<HT≤25m 3=2<HT≤10m 4=1<HT≤2m 5=0.5<HT≤1m 6=0.2<HT≤0.5m 7=HT<0.2m

CVR CODES: 0=NONE 1=0%<CVR≤10% 2=10<CVR≤25% 3=25<CVR≤60% 4=CVR>60%

STAND COMPOSITION:				BA:
SIZE CLASS ANALYSIS:	A <10	A 10 – 24	25 – 50	R >50
STANDING SNAGS:	R <10	R 10 – 24	R 25 – 50	R >50
DEADFALL/LOGS:	A <10	A 10 – 24	R 25 – 50	N >50

ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT

COMM. AGE:	PIONEER	✓ YOUNG	✓ MID-AGE	MATURE	OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES/GLEY	g=	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

COMMUNITY CLASS:		CODE:
COMMUNITY SERIES:		CODE:
ECOSITE:		CODE:
VEGETATION TYPE:		CODE:
INCLUSION		CODE:
COMPLEX		CODE:

Notes: (e.g. disturbance, surface water depths, etc.)
- hedgerow

LAYERS: 1=CANOPY>10m 2=SUB-CANOPY 3=UNDERSTOREY 4=GROUND (GRD.) LAYER
ABUNDANCE CODES: N=NONE R=RARE O=OCCASIONAL A=ABUNDANT D=DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COLL.
PRUSERO	O	O			
PICABIE	O				
ACEPLAT	O				
PINSTRO	O				
FRAAMER	R	O	R		
TILAMER	O				
May 9, 2017					
RHACATH		D	D		
CORALTE		R			
PARINSE		A	A	A	
ULTRIPA		O	A		
RUBSTRI			O		
LONTATA			R		
May 9, 2017					
PRUVIRG					
RIBHIRT					
July 10, 2017					
RHUTYPH					
RIBCYNO			R		
VIPOPUL				R	
Privet					

SPECIES CODE	LAYER 1	2	3	4	COLL.
ARCMINU				O	
SOLCANA				O	
ACCSYRI				R	
SYMLATE				O	
SYMNOVA				O	
BROINER				O	
May 9, 2017					
Trout Lily				A	
TAROFFI				O	
~~GEUM SP~~ A-LEEP				A	
VIOLA SP				O	
HYDVIRG				R	
MAISTEL				R	
POTRECT					
CLIVULG					
CIRCANA					
PHAARUN				R	
FRIANNU				R	
DACGLOM				R	
SOLFLEX				R	
THAPUBE				R	
EPIHELL				R	
GERROBE				R	
HYPPERF					
orange hawkweed				R	
ERAVESC					
BROINER				O	
LOTCORN				R	
PLALANC				R	
VICCRAC				R	
CIRVULG				R	
ALLPETI				R	

Page 3 of 4

Print Name: Janice Ball (Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature: _____ (Field Notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Wildlife Habitat Assessment Form

Project Number: 161413338 Polygon No.: FODM11

Assessment Type: ☐-Visual; no access/☐-Entire; walk through feature/☐-Partial access *(indicate on map)*

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (last 24 hrs):
	20	2	100%	Light rain	None

NOTES & SPECIES OBSERVATIONS (list species and type of observation, indicate on map):

CA=carcass; DP=distinctive parts; FE=feeding evidence; FY=eggs/nest; HO=house/den; OB=observed; SC=scat; SI=other sign; TK=track; VO=vocalization

Wildlife Habitat Type & Description	Site Assessment	Photo ID	Map ID	UTM Coordinates Zone	Easting	Northing
ALL SITES						
Bat Hibernacula: Caves, abandoned mines, underground foundations, karst features	Size of opening(s) Bedrock Type Depth of feature (if possible)					
Snake Hibernacula: Burrows, rock crevices, fissures that extend below the frost line (i.e. at least 1 m)	Number of access points Size of opening(s) Substrate					
Bank / Cliff Colonial Bird Nesting Habitat: Exposed soil banks, undisturbed, naturally eroding, steep slopes, cliff faces with evidence of nests or burrows	Size of burrow Number of burrows					
Stick Nests: Stick nests found in any forest/ woodland/swamp; includes heron colonies and bald eagle/ osprey/other raptor nests	Tree species Nest size					
WOODLANDS						
Vernal Pools: Permanent or semi-permanent pool or pond. Evidence of holding water in most years through late spring (i.e. late May) or into summer	Number of features Feature size (diameter) Water depth					
Seeps and Springs: Locations where groundwater comes to the surface in forests (see document for indicator species)	Sub/emergent veg present Shrubs/logs at edge present Water permanency					
WETLANDS						
Turtle Wintering Areas: Permanent water bodies, large wetlands, bogs, or fens with soft substrates and deep enough not to freeze solid	Feature size (diameter) Water depth Substrate of water body Water permanency					
Turtle Nesting Habitat: Exposed mineral soil (sand or gravel) areas adjacent (<100 m) to MAM/SA/BOO/ FEO (note if man-made)	Type of substrate Distance to wetland Size of feature					
Terrestrial Crayfish Habitat: Edges of shallow marshes and meadows (no minimum size) with crayfish chimneys	Number of chimneys					

Print Name: Janice Ball
(Field Notes Author)

Quality Control: This form is complete ☐ & legible ☐

Signature:
(Field Notes QA/QC personnel)

REV: 2014-04-17

Stantec

~~Pasture~~ 220 Arkell July 10, 2017
Summer Botanical J. Ball

Pasture (no horses) - field left to naturalize

SCIPEND
LYCUNIF
LOTCORN - D
~~ERI~~
PRU VULG - A
SCIrpus sp2 (small)
LEUCANVULG - A
PLALANC -
ERIANNU - R
TRIHYBR
POAPRAT
PHLPRAT - A
SCIRPUS sp3
MENCINA
SCIRPUS SP 4
POTBALS - O
CAREX - larg lves - A
TRIPRAT - A
DACGLOM -
RANACRI - R
BROINER - A
Bladder campion

incid cabbage white

Soils

mottles - 25cm
no gley
loam - 0 - 25cm
silty sand - 25 - 45cm

- could not auger past 45cm
- hit sandy soils
moisture regime = 5

17T 565006/
4818983

Designed by: Checked by:

Stantec

220 Arkell
Summer Botanical

July 10, 2017
J. Ball

SWT incl. - no standing water PH4877

Salix - long, tapered lvs, hry underneath, shiny above
- no stipules

RHAFRAN - O
VITRIPA - O
& CORSERI - A
EQUARVE - A
CAREX Spicata? - R
RANACRI - R
LYCAMER
CARINTUR
GALPALU - O
PHAARUN - O
FRAPENN - O - 1 in canopy with no signs of ash borer
POPBALS - R
Joe-pye weed - R
ECHLOBA - R
incid.
WTDE tracks
SOSP

SALERIO - R

SALIX - glaucus underneath

Soils

mottles - 10 cm
gley - 10 cm
soil type - Loam 0-45cm
CL 45-75cm
SCL - 75-95cm
Very moist
water table @ 95cm
augered to water table

17T 565175/4818966

Designed by: Checked by:

W:\active\60960476\graphics\GIS\MXD\60960476_Figure2_0_ELCVegetationCommunities_20100319_CEW.mxd

Legend

- Study Area
- Torrence Creek PSW
- Surveyed Wetland Boundary
- ELC Boundary

ELC Vegetation Communities

Cultural Communities
CUM1-1 Dry-Moist Old Field Cultural Meadow
CUW1-3* Manitoba Maple Cultural Woodland

Swamp Communities
SWT2-13* Poplar Mineral Thicket Swamp

*denotes communities not listed in the southern Ontario ELC manual

ELC/veg/wildlife
Sep 23, 2016
J. Ball
220 Arkell

Notes

1. Coordinate System: UTM NAD 83 - Zone 17 (N).
2. Data Sources: Ontario Ministry of Natural Resources © Queens Printer Ontario, 2009; © Grand River Conservation Authority, 2009.
3. Image Sources: © Google Earth Pro, 2009 (© First Base Solutions, 2009; © TeleAtlas, 2009 - Imagery Date: May 3, 2006).

Stantec

March 19, 2010
160960476

Client/Project
VICTORIA WOOD
ARKELL EIS

Figure No.
2

Title
ELC VEGETATION COMMUNITIES AND SIGNIFICANT NATURAL FEATURES

APPENDIX G2

REPTILES

Stantec

Reptile Survey

Project No: 161413338 Project Name: 220 Arkell

Date: 7 June 2017 Personnel: B. Holden

Weather Conditions: 16-17 (TEMP (°C)) 1-2 (WIND) 10 (CLOUD) / (PPT) / (PPT (last 24-hrs))

Reptile Species Observed

Location			Time		Species	Habitat Description	Other Notes
Zone	Easting	Northing	Start	End			
See map.			/	/	E. Garter snake	Sunning itself on the mowed lawn @ the edge of the hedgerow (see map).	
						— Large (~40cm)	Female?

PAGE 1 OF 1

Print Name & Initial: (field notes author)

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: (field notes QA/QC personnel)

as \\cd1220-f02\work_group\01609\resource\internal info and teams\terrestrial resources\field forms\reptiles\frm_005_reptile-survey_20150326.docx

FORM 005 / REV: 2015-03-26

Stantec

Reptile Survey

Project No: 161413338 Project Name: 220 Arkell

Date: 21 June 2017 Personnel: B. Holden

Weather Conditions: 15-19 (TEMP (°C)) 2 (WIND) 40-70 (CLOUD) / (PPT) Rain (PPT (last 24-hrs))

Reptile Species Observed

Location			Time		Species	Habitat Description	Other Notes
Zone	Easting	Northing	Start	End			
					No snake obs.		
					WT Deer in pasture		

PAGE 1 OF 1

Print Name & Initial: Brandon Holden BH (field notes author)

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: (field notes QA/QC personnel)

Stantec 161413338

Reptile Survey

Project No: 161413338 Project Name: 220 Arkell

Date: 27 July 2017 Personnel: B. Holden

Weather Conditions: TEMP (°C) 22-25 WIND 2 CLOUD 40-70 PPT / PPT (last 24-hrs) Rain

Reptile Species Observed

Location			Time		Species	Habitat Description	Other Notes
Zone	Easting	Northing	Start	End			
			No Snake Species observed				

PAGE 1 OF 1

Print Name & Initial: (field notes author)

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: (field notes QA/QC personnel)

Stantec

Reptile Survey

Project No: 161413338 Project Name: 220 Arkell

Date: Aug 10, 2017 Personnel: Kimberley Zupfer, Jess Sosa Campos

Weather Conditions: 16 (TEMP (°C)) N (WIND) partly cloudy (CLOUD) none (PPT) none (PPT (last 24-hrs))

Reptile Species Observed

Location			Time		Species	Habitat Description	Other Notes
Zone	Easting	Northing	Start	End			
17T	565092	4818932	8:20	8:24	American Toad	woodlot	alive, juvenile (photo)
17T	565115	4819195	8:47	8:49	American Toad	lawn	alive, juvenile (photo)

Photo #1

Photo #2

MAP!

PAGE 1 OF 1

Print Name & Initial: Kimberly Zupfer KZ (field notes author)

Quality Control: This form is complete ☑ & legible ☑

Print Name & Initial: MELISSA STRAUS MAS (field notes QA/QC personnel)

APPENDIX G3

AMPHIBIANS

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Amphibian Call Survey Observation Form

Project Number: 161413338
Project Name: 220 Arkell Rd.
Date: April 25, 2017
Field Personnel: J. Ball, N. Burnett

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	9	2	100%	NONE	RAIN

Record start time at each station

Visit No.:	Start Time:	End Time:
1	20:35	

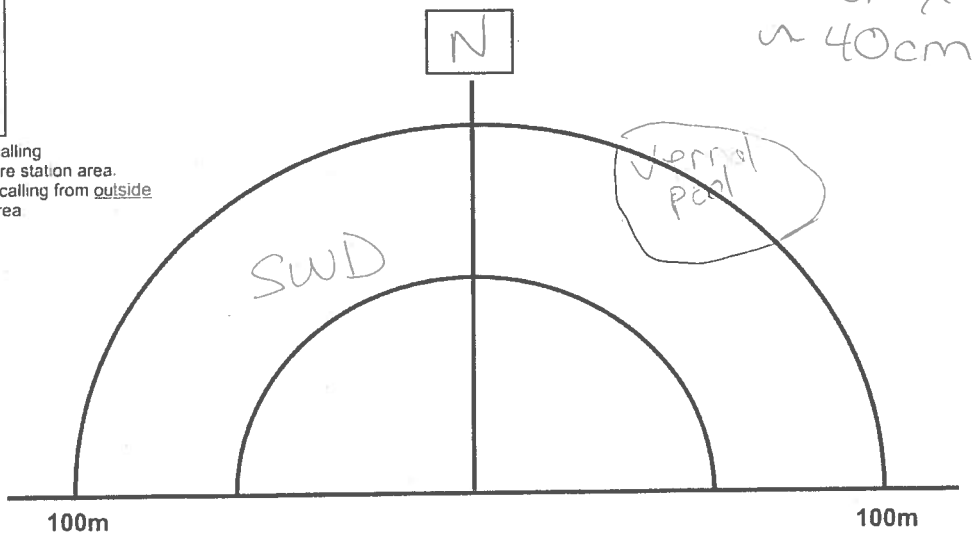
Start Time: 20:35
UTM: 17T 564978/4818990
Habitat: vernal pool
Water Present: YES

~15m x 8m
~40cm deep

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area

Station 1



pasture.

Page 1 of 2

Signature: Laurel Ball
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐
Signature:
(Project Manager)

CONTINUED Site: 220 Arkell Date: Apr 25, 2017 Amphibian Call Survey Observation Form

Start Time: 20:50

17T UTM: 0565149/4818964

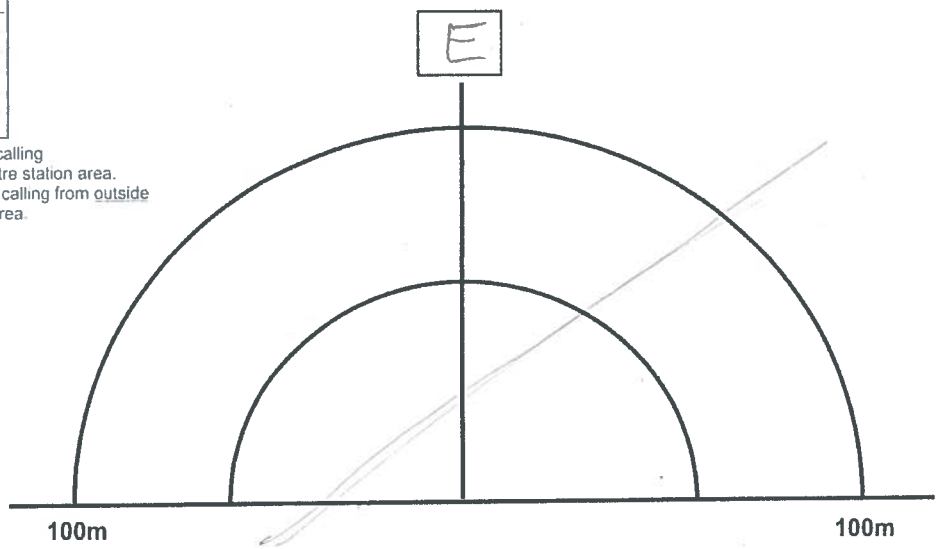
Habitat: SWD

Water Present: unknown

Station 2

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area.



Start Time: 20:54

17T UTM: 565152/4818964

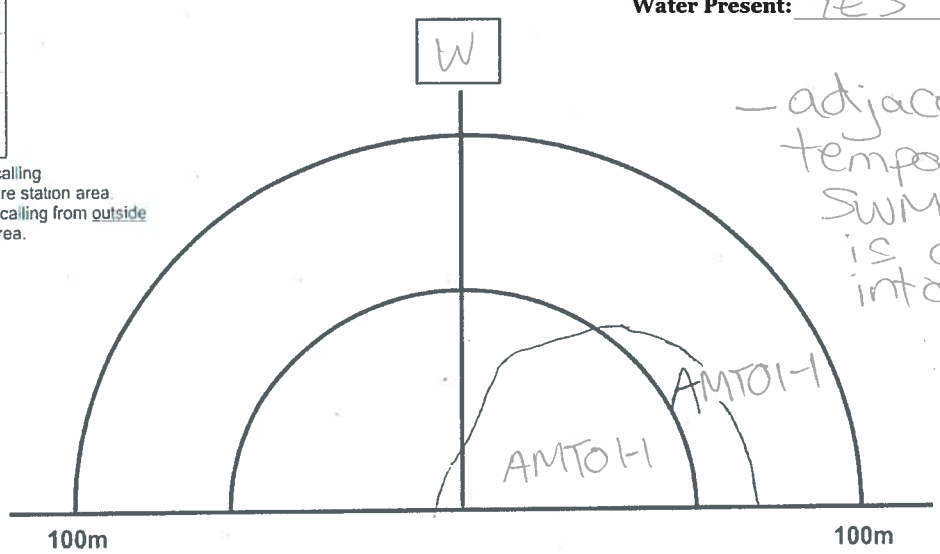
Habitat: SWT-seasonally flooded

Water Present: YES

Station 3

Species	In*	Out**
AMTO	✓	
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area.



– adjacent temporary SWM pond is overflowing into SWT

Signature: Janice Ball (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

FORM 003 / REV. 2014-04-08

Stantec

- Proposed Borehole Location
- Proposed Amphibian Station
- Proposed Corridor Study Location
- Proposed Site Layout
- Major Road
- Minor Road
- Wetland - Evaluated (Provincial)
- E LC Boundary
- Property Boundary

Amphibian Survey April 25, 2017 J. Ball, N. Burnett

0 40 80 metres
1:2,500 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013
3. Orthoimagery © First Base Solutions, 2010

Project Location
Guelph
Ontario

161413338 REVA
Prepared by PRM on 2017-04-05
Technical Review by MS on 2017-04-05

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD
GUELPH, ONTARIO

Figure No.
4

DRAFT

Title
Proposed 2017/2018 Survey Station Locations

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Amphibian Call Survey Observation Form

Project Number: 161413338
Project Name: 220 Arkell
Date: May 25, 2017
Field Personnel: J. Ball, B. Holden

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	11	1	100%	light rain	NONE

Record start time at each station

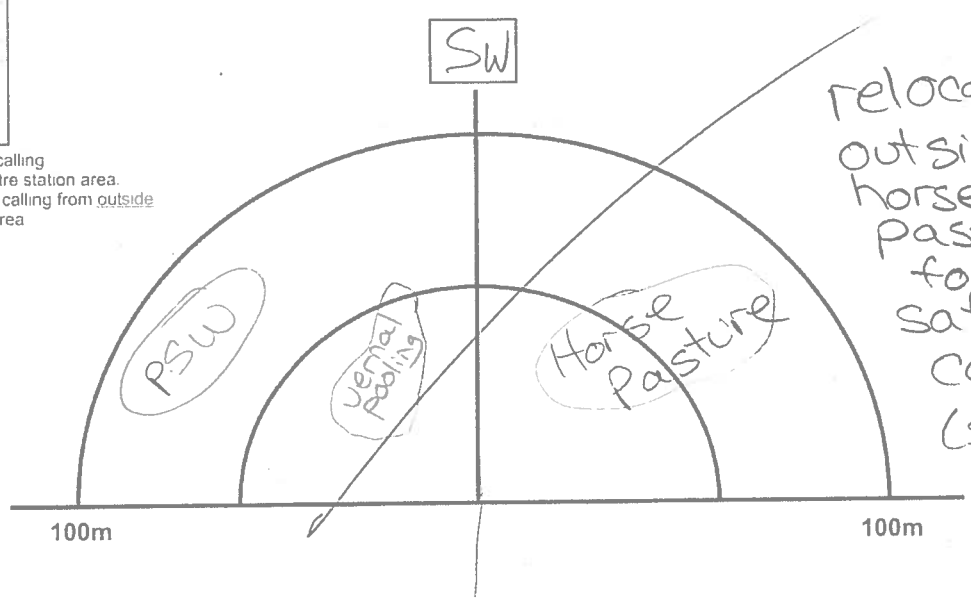
Visit No.:	Start Time:	End Time:
2	21:14	21:27

Start Time: 21:14
UTM: 17T 565061/4818977
Habitat: vernal pooling
Water Present: YES

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area

Station 1



relocated outside of horse pasture for safety concerns (see map)

Page 1 of 2

Signature: Jamie Ball
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐
Signature:
(Project Manager)

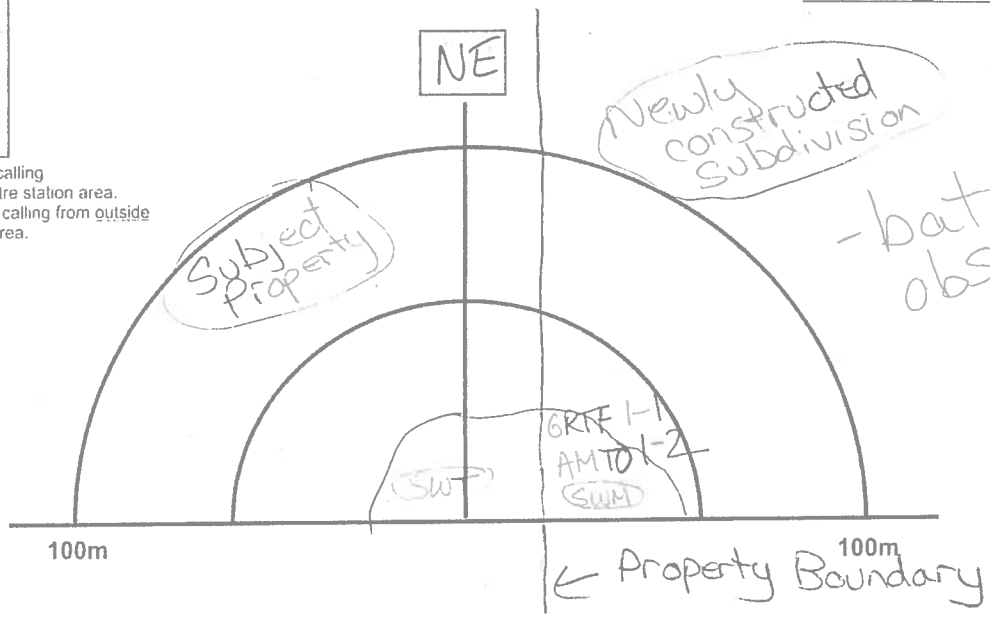
CONTINUED Site: 220 Arkell Date: May 25, 2017 Amphibian Call Survey Observation Form

Station 3

Start Time: 21:21
UTM: 17T 565158/4818960
Habitat: SWM Pond/SWT
Water Present: YES

Species	In*	Out**
AMTO	✓	
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR	✓	
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area.



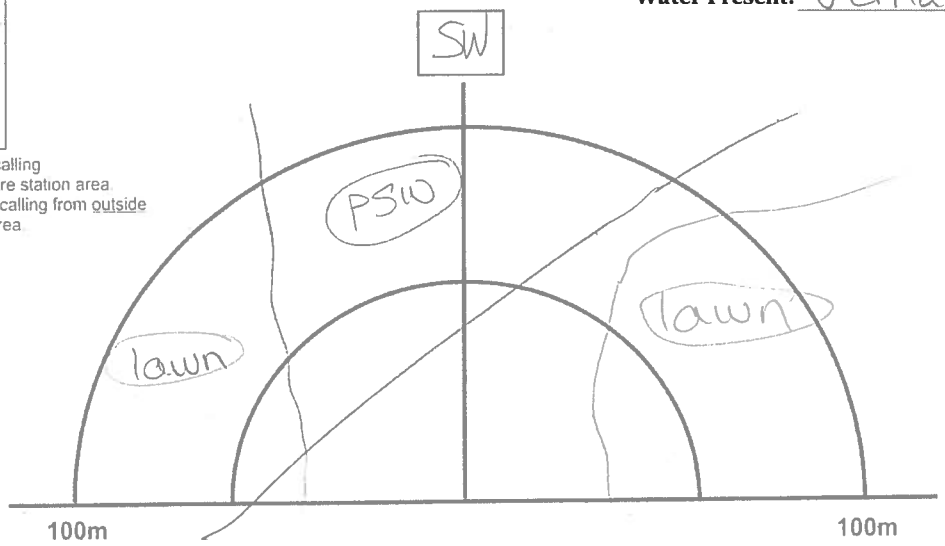
- bat observed

Station 2

Start Time: 21:24
UTM: 17T 565158/4818960
Habitat: PSW (swamp)
Water Present: vernal pooling

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

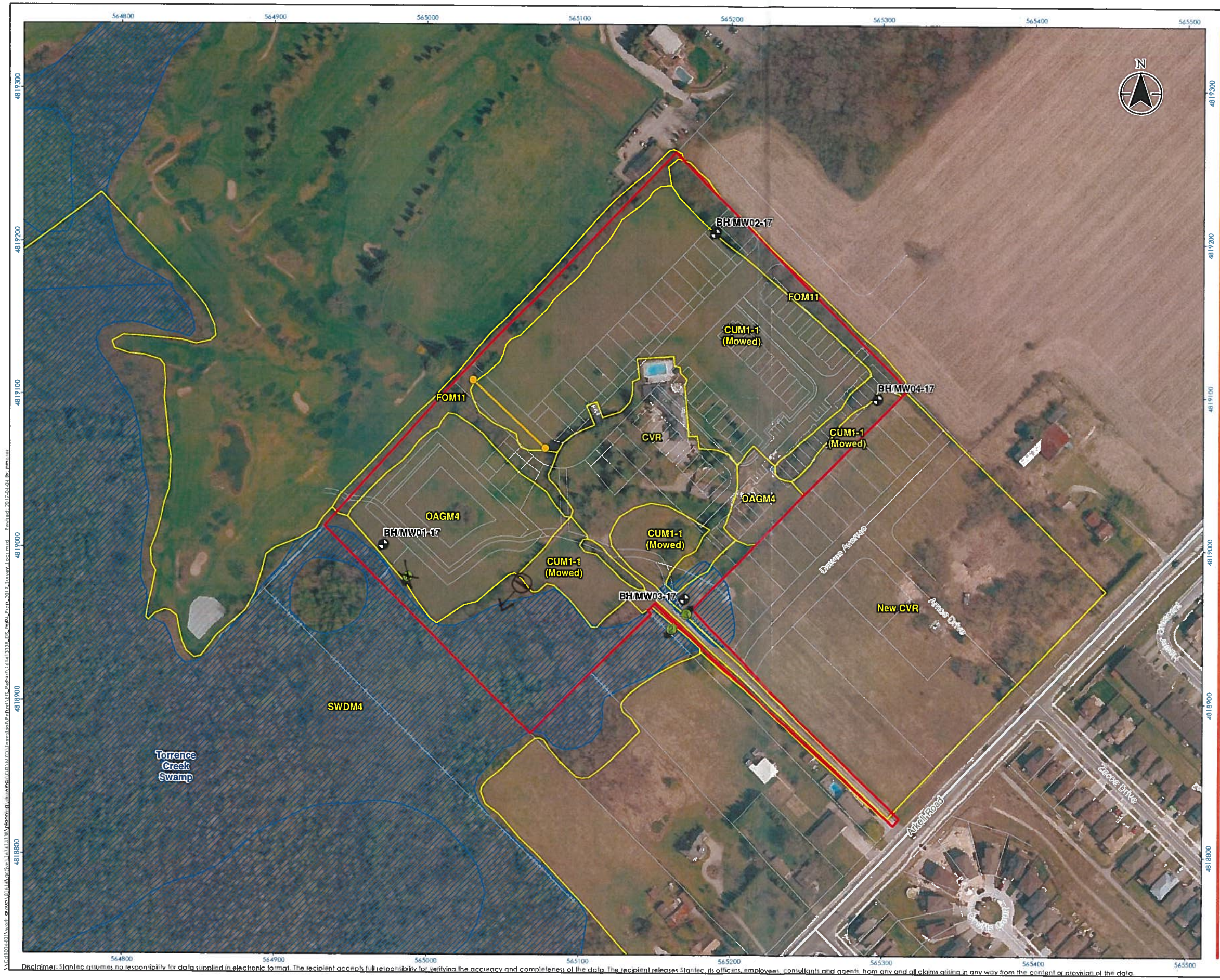
* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area.



Signature: Joyce Ball (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.
Signature: (Project Manager)

FORM 003 / REV. 2014-04-08



Stantec

- Proposed Borehole Location
- Proposed Amphibian Station
- Proposed Corridor Study Location
- Proposed Site Layout
- Major Road
- Minor Road
- Wetland - Evaluated (Provincial)
- E LC Boundary
- Property Boundary

Amphibian Survey

0 40 80 metres
1:2,500 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015
3. Orthoimagery © First Base Solutions, 2010.

Project Location
Guelph,
Ontario

161413338 REVA
Prepared by PRM on 2017-04-04
Technical Review by MS on 2017-04-04

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD
GUELPH, ONTARIO

Figure No.
4

Title
Proposed 2017 Survey Station Locations

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Amphibian Call Survey Observation Form

Project Number: 161413338
Project Name: 220 Arkell
Date: June 21, 2017
Field Personnel: J. Ball, J. Sosa Campos

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	20	1	10%	—	RAIN

Record start time at each station

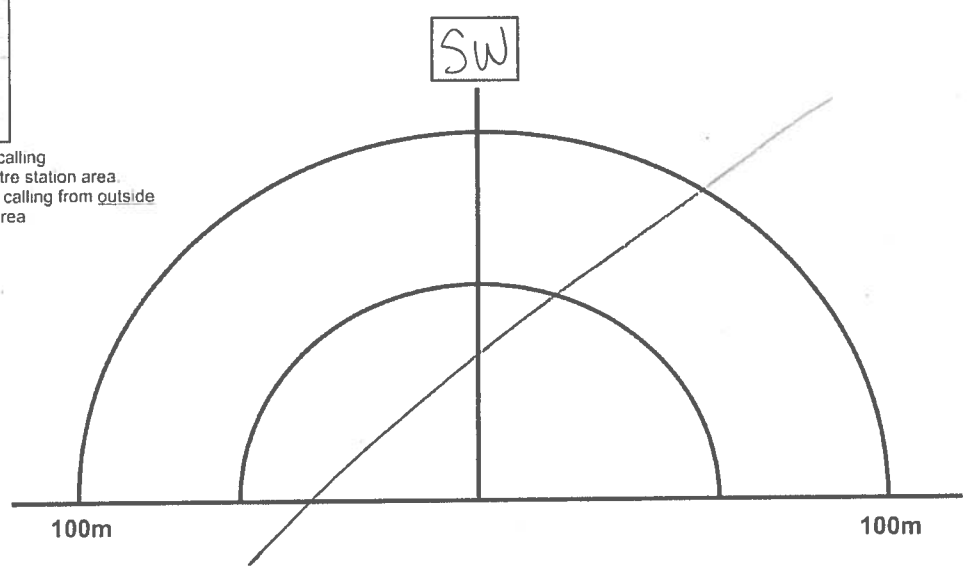
Visit No.:	Start Time:	End Time:
3	9:30pm	9:41pm

Start Time: 9:30pm
UTM: 17T 565063/4818976
Habitat: PSW – vernal pooling
Water Present: unknown

Station 1

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area
** Check if species is calling from outside 100-metre station area



Page 1 of 2

Signature: Jessica Ball (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐

Signature: (Project Manager)

CONTINUED Site: 220 Arkell Date: June 21, 2017

Amphibian Call Survey Observation Form

Station 2

Start Time: 9:35pm

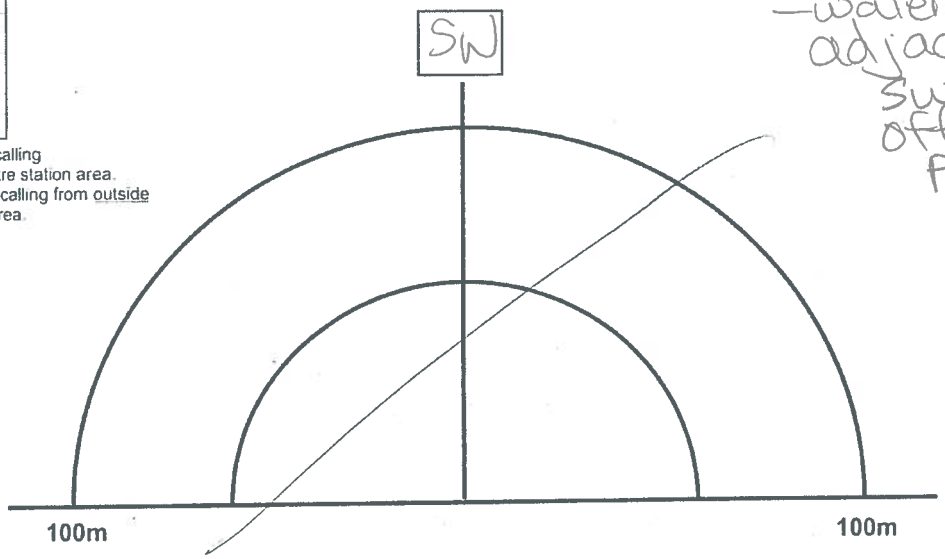
UTM: 17T 565161/4818964

Habitat: SWT

Water Present: no
— water in adjacent SWM Pond off the property

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area.



Station 3

Start Time: 9:38pm

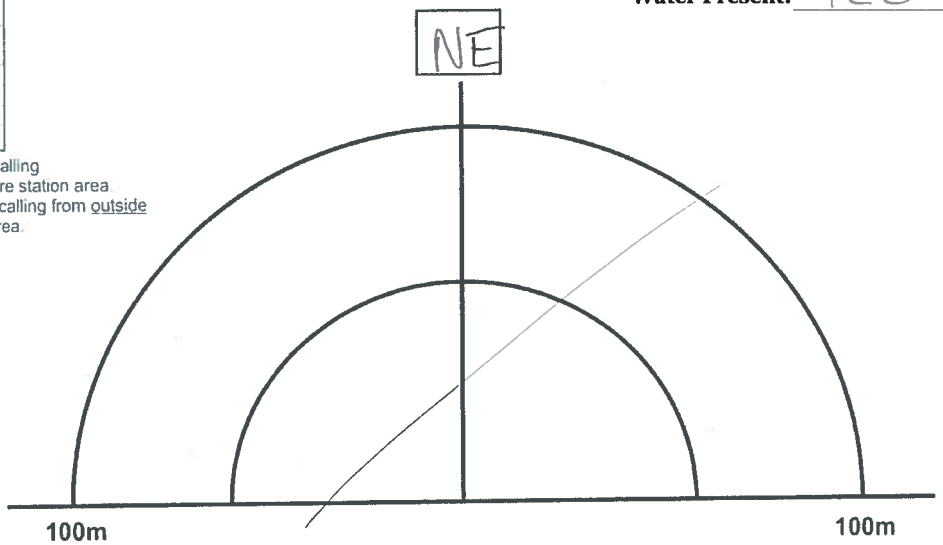
UTM: 17T 565161/4818964

Habitat: SWM pond on adjacent property

Water Present: YES

Species	In*	Out**
AMTO		
BCFR		
BULL		
CHFR		
CGTR		
FOTO		
GRTR		
GRFR		
MIFR		
NLFR		
PIFR		
SPPE		
WOFR		

* Check if species is calling from inside 100-metre station area.
** Check if species is calling from outside 100-metre station area.



Signature: Jarrod Ball (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

FORM 003 / REV. 2014-04-08

APPENDIX G4

PITFALL TRAPS

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Amphibian Corridor Movement Survey Monitoring

Project Number: 161413338 Project Name: 220 Arkell

Date / Time: August 13/17 @ 730-800 Field Personnel: M Strauss

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	13°C	0	0	0	Rain

Site Information
Feature ID:

NB: During set up Aug 12/17 @ 800 PM skunk near trap #2 from roost + walked along edge of hedge row - pasture

1 - @ 730 WTDE observed ~~loaded east~~ stopped to eat on lawn

	Trap Number	Species	Number of Individuals	Notes
727	18	–		
729	17	–		
	16	–		
	15	Shrew	1	see photos
	14	–		
739	13	~~Deer~~ Mouse white footed	1	see photos
	12	–		
	11	–		
	10	–		
	9	–		
	8	–		
	7	–		

Quality Control: This form is complete (✓) & legible (✓).
Signature: M Strauss (Field Personnel) Signature: _____ (Project Manager)

 REV: March 09 Form 009

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Amphibian Corridor Movement Survey Monitoring

Project Number 161413338 Project Name: 220 Arkell Rd.

Date / Time: Aug 13/17 Field Personnel: M Strauss

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	13	0	0	0	Rain.

Site Information
Feature ID:

Trap Number	Species	Number of Individuals	Notes
6		0	
5			
4			
3			
2			
759 1			

Quality Control: This form is complete (__) & legible (__).
Signature: M Strauss (Field Personnel) Signature: _____ (Project Manager)

 REV: March 09 Form 009

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

PITFALL ~~Snake Coverboard~~ Survey Monitoring Form

Project Number: 1614[redacted]138
Project Name: 220 Arkell
Date: Aug 16/17
Field Personnel: MSTRAUS

Weather Conditions:	TEMP (°C)	WIND	CLOUD	PPT	PPT last 24 hrs
	14	0	40	0 - fog/dew	Rain yesterday AM

Start Time: 735
End Time: 815

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

~~Board No.~~ Bucket	Time Checked	Species (if multiple spp. occur under single board, record on multiple lines)	~~Approximate Length (cm)~~ Notes	Photo No.
18	743	—		
17	745	—		
16	747	Mouse	curled up & lethargic not doing well	Phone
15	748	—	released into wooded edge	
14	749	—	↳ ~35cm w tail as long or longer.	
13	750	—		
12	755	—		
11	758	—		
10	800	Green Frog	~35cm	Phone
9	801	—		
8	808	Shrew	dead.	Phone.
7	810	—		
6	811	—		
5	812	—		
4	813	—		
3	814	—		
2	815	—		
1	815	—		

PAGE 1 OF 1

Print Name: MSTRAUS (field notes author)

Quality Control: This form is complete ☐ & legible ☐
Signature: (field notes QA/QC personnel)

project #: 161413338

CONTINUED SITE: 220 Arkell Rd DATE: Aug 22, 2017

Snake Coverboard Survey Monitoring Form

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

Board No.	Time Checked	Species (if multiple spp. occur under single board, record on multiple lines)	Approximate Length (cm)	Photo No.
Horse pasture	8:34 pm	1 Deer seen eating out of horse trough	—	—

PAGE 1 OF 1

Print Name: Jess Sosa Campos (field notes author)

Quality Control: This form is complete ☑ & legible ☑

Signature: Daniel Lisel (field notes: QA/QC personnel)

FORM 009B / REV: 2014-04-10

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Snake Coverboard Survey Monitoring Form

Project Number: 161413838
Date: Aug 23/17

Project Name: 220 Arkell
Field Personnel: MSTRALS

Weather Conditions:	TEMP (°C)	WIND	CLOUD	PPT	PPT last 24 hrs
	12°C	0	0	0	Heavy Rain

Start Time: 640 End Time: 720

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

Board No.	Time Checked	Species (if multiple spp. occur under single board, record on multiple lines)	Approximate Length (cm)	Photo No.
18	642	—		
17	641	—		
16	641	water logged / no animals		
15	640	"		
14	640	—		
13	640	—		
12	700	—		
11	700	—		
10	701	—		
9	701	—		
8	710			
7	710			
6	711			
5	711			
4	712			
3	712			
2	712			
1	713			
		none		
		* NB. checked 1st each section then reset		
		hence clustered times		

Incidentals: Grey Squirrel (Black); CEDW; BLJA; WBNU

PAGE 1 OF 1
Print Name: MSTRALS
(field notes author)

Quality Control: This form is complete ☐ & legible ☐
Signature:
(field notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Amphibian Corridor Movement Survey Monitoring

Project Number 161413338 Project Name: 220 Arkell

Date / Time: Aug 25, 2017 6:30-7:00am Field Personnel: J. Ball

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	7	0	0	NONE	NONE

Site Information
Feature ID: potential wildlife Corridor – no species observed

Trap Number	Species	Number of Individuals	Notes

Quality Control: This form is complete (__) & legible (__).

Signature: Joyce Ball (Field Personnel) Signature: _____ (Project Manager)

Page 1 of 1

REV: March 09 Form 009

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

~~Snake Coverboard~~ Pit Fall Survey Monitoring Form

Project Number: 161413338
Project Name: 220 Arkell Rd.
Date: Aug. 31/17
Field Personnel: Kimberly Zupfer.

Weather Conditions:	TEMP (°C)	WIND	CLOUD	PPT	PPT last 24 hrs
	14	13 km/h N	0	—	—

Start Time: 6:15am
End Time: 7:15am

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

Board No.	Time Checked	Species (if multiple spp. occur under single board, record on multiple lines)	Approximate Length (cm)	Photo No.
13	6:24am	2 juvenille frogs - wood frog		1, 2
14	6:27	1 juvenille toad - american toad.		3
15	6:33	—		
16	6:34	—		
17	6:39	1 juvenille frog - wood frog		4
18	6:40			
11	6:42	—		
12	6:44	—		
9	6:47	—		
10	6:48	—		
8	6:53	—		
7	6:54	~~field mouse~~ Meadow Vole		5, 6,
~~5~~ 6	6:57	2 american toads		7, 8.
~~6~~ 5	6:59	—		
3	~~6~~ 7:00	—		
4	7:01	—		
~~1~~ 2	7:02	strew		9, 10
~~2~~ 1	7:04	strew		11, 12

PAGE 1 OF 1

Print Name: (field notes author)

Quality Control: This form is complete ☐ & legible ☐
Signature: (field notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Snake Coverboard Survey Monitoring Form

Project Number: 160417338
Project Name: 220 Arkell
Date: 1 Sep 2017
Field Personnel: B. Holden

Weather Conditions:	TEMP (°C)	WIND	CLOUD	PPT	PPT last 24 hrs
	7	1-2	10	none	Rain

Start Time: 0630
End Time: 0740

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

Board No.	Time Checked	Species (if multiple spp. occur under single board, record on multiple lines)	Approximate Length (cm)	Photo No.
13	0630	—		
14	0633	—		
15	0637	WOFR	2-3	1,2
16	0640	—		
17	0643	—		
18	0646	—		
11	0653	—		
12	0656	—		
9	0659	—		
10	0701	—		
7	0709	—		
8	0712	—		
5	0715	—		
6	0719	—		
3	0724	—		
4	0727	—		
1	0731	—		
2	0735	—		

Print Name: (field notes author)
Quality Control: This form is complete ☐ & legible ☐
Signature: (field notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

PitFall.

~~Snake Coverboard~~ Survey Monitoring Form

Project Number: 161413338
Project Name: 220 Arkell.
Date: Sept 5/17.
Field Personnel: M STRAUS

Weather Conditions:	TEMP (°C)	WIND	CLOUD	PPT	PPT last 24 hrs
	14°C	0	100%.	Fog (heavy)	T-storms ended @ 9PM.

Start Time: 6:45. End Time: 7:30

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

Board No.	Time Checked	Species (if multiple spp. occur under single board, record on multiple lines)	Approximate Length (cm)	Photo No.
18	6:55	—		
17	6:58	—		
16	7:00	Wood Frog	3 cm	iPhone (x3)
15	7:01	American Toad	7 cm	iPhone (x1).
14	7:03	—		
13	7:05	Wood Frog.	3cm	iPhone (x2)
12	7:06.	—		
11	7:08	Wood Frog		iPhone (x2).
10	7:09	—		
9	7:11	—		
8	7:13	—		
7	7:14	—		
6	7:14	—		
5	7:15	American Toad.	4cm.	iPhone x1
4	7:18	—		
3	7:19	—		
2	7:22	—		
1	7:25	—		

PAGE 1 OF 1

Print Name: M STRAUS (field notes author)

Quality Control: This form is complete ☐ & legible ☐

Signature: (field notes QA/QC personnel)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Pitfall Trap ~~Snake Coverboard~~ Survey Monitoring Form

Project Number: 161413338
Project Name: #220 Arkell
Date: Sept. 8/17
Field Personnel: Kimberly

Weather Conditions:	TEMP (°C)	WIND	CLOUD	PPT	PPT last 24 hrs
	10	7km/h W	90%	<1mm	yes.

Start Time: 6:35
End Time: 7:15

Occurrence Record *(refer to 'Snake Coverboard Survey Set-up Form' for UTM coordinates of placed coverboards)*

Board No.	Time Checked	Species *(if multiple spp. occur under single board, record on multiple lines)*	Approximate Length (cm)	Photo No.
18	6:38	—		
17	6:39	—		
16	6:41	—		
15	6:41	—		
14	6:43	—		
13	6:45	—		
12	6:47	—		
11	6:48	—		
10	6:49	—		
9	6:50	—		
8	6:58	—		
7	6:59	—		
6	7:01	—		
5	7:03	—		
4	7:04	—		
3	7:05	—		
2	7:08	—		
1	7:10	—		

PAGE 1 OF 1

Print Name: [illegible] (field notes author)

Quality Control: This form is complete ☐ & legible ☐
Signature: (field notes QA/QC personnel)

APPENDIX G5

BAT ROOSTS

Stantec

Stantec Consulting Ltd.
70 Southgate Drive, Suite 1, Guelph, ON N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Bat Maternity Roost - Bat Maternity Roost Habitat Assessment Data Form

Project Number: 1614.13338

Project Name: 220 Arkell Rd.

DATE	TIME (start)	TIME (end)	Field Personnel
April 25, 2017	15:30	16:00	J. Ball

Weather Conditions:

FEATURE #	TEMP (°C)	WIND	CLOUD	PPT	PPT (in last 24 hrs)
see notes	12	2	100%	NONE	RAIN

NOTES ABOUT ENTIRE FEATURE

Age/Maturity: mature trees on property (spruce, maple, willow, cedar) (PH 4422)
Black cherry hedgerow (PH 4423) mid-aged

Dominant tree species: mixed hedge row (white pine, black cherry, maple) midaged to mature (PH 4424
Hedgerow thicket w occasional mature cherry (PH 4426) Ash

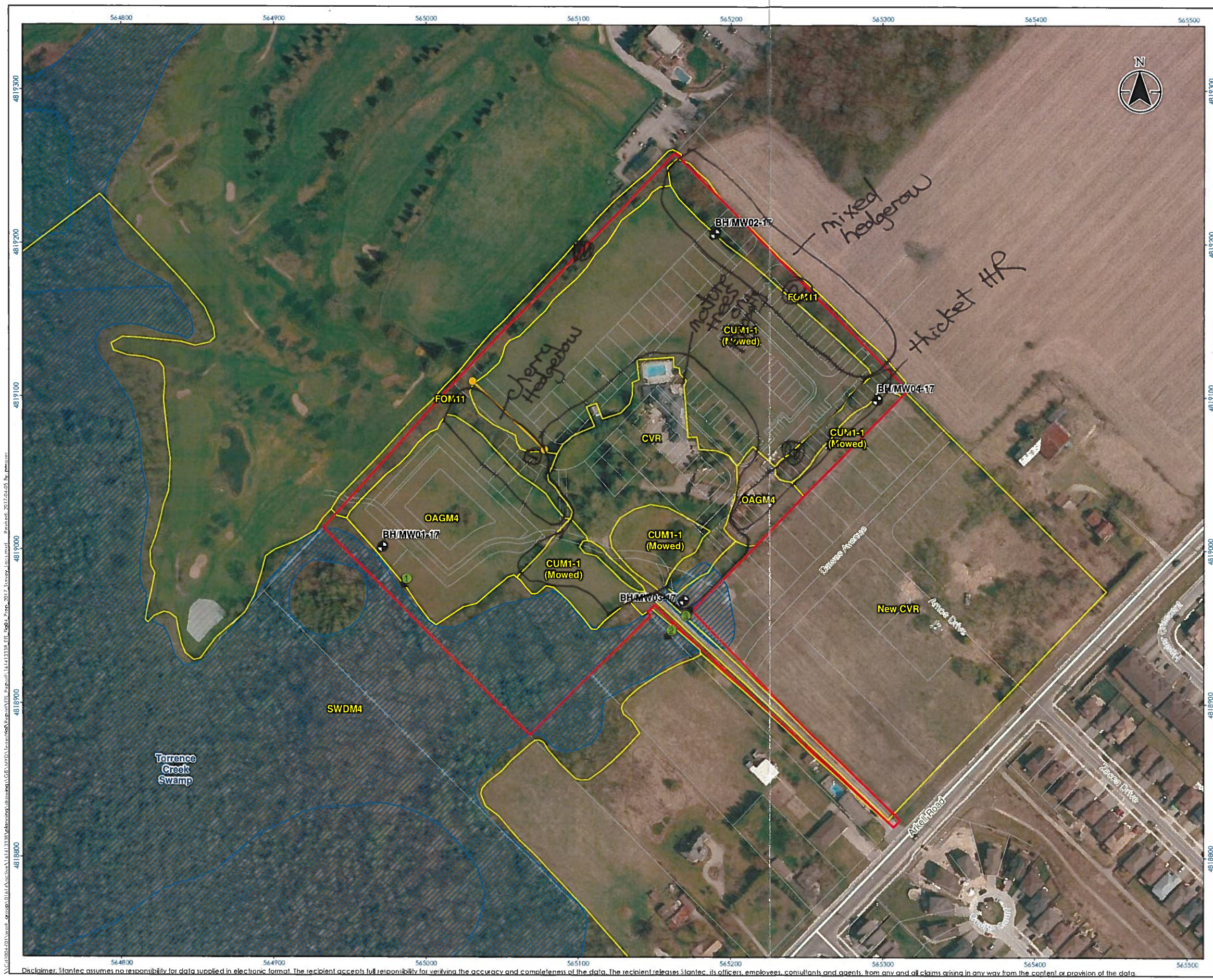
RECORD DETAILS OF ALL SNAG/CAVITY TREES >25 CM DBH BELOW:

Tree No.	Species	Notes	DBH (cm) (>25cm only)	Tree height (m)	Cavity Height (m)	Photo Number(s)	UTM (Zone 17)	One of tallest trees in community	Exhibits cavities /crevices/scars/woodpecker holes	Largest DBH in community	Cavity or crevice is high up in tree (>10 m)	Within highest density or cluster of cavity trees	Large amount of loose, peeling bark	Open canopy	Early stages of decay (class 1-3)
EX	Sugar maple		40	12	9	1, 2	123456 / 1234567	X		X			X		X
1	Black Cherry	3 stems, 1 cavity	37	14	8	4420	565068 / 4819053		X					X	X
2	Sugar maple	- splits at 2 stems ~70	~100	20	12	4425	565244 / 4819171		X	X	X			X	
3	dead white ash	4 stems - 1 cavity	~50	20	14	4427	565245 / 4819068		X		X			X	
							/								

Signature: Janice Ball
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature:
(Project Manager)



Stantec

- Proposed Borehole Location
- Proposed Amphibian Station
- Proposed Corridor Study Location
- Proposed Site Layout
- Major Road
- Minor Road
- Wetland - Evaluated (Provincial)
- ELC Boundary
- Property Boundary

Bat Roost Survey April 25, 2017 J. Ball

- Search Areas

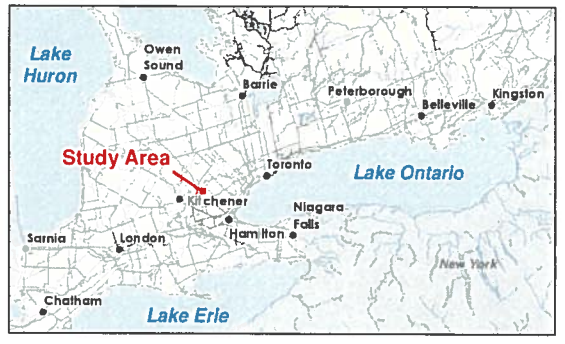
(#) - approx. bat roost location (potential)

0 40 80 metres

1:2,500 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.
3. Orthoimagery © First Base Solutions, 2010.



Project Location
Guelph, Ontario

161413338 REV A
Prepared by PRM on 2017-04-05
Technical Review by MS on 2017-04-05

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD
GUELPH, ONTARIO

Figure No.
4

DRAFT

Title
Proposed 2017/2018 Survey Station Locations

APPENDIX G6

BREEDING BIRDS

Stantec

Breeding Bird Survey Observation Form

Project Number: 161413338 Project Name: 220 Arkell

Date: 7 June 2017 Field Personnel: Brandon Holden

Weather Conditions:	15	1-2	10	/	/
	TEMP (°C)	WIND	CLOUD	PPT (current)	PPT (last 24 hrs)

Habitat No.	ELC Code(s) or Habitat Descriptions	TIME (HH:mm) Start	End
1	FOD1 SWD Feature	0630	0805
2	Hedgerows	0630	0805
3	Pasture.	0630	0805

Breeding Evidence (BE) Codes (Breeding Bird Atlas of Ontario - http://www.birdsontario.org/atlas/codes.jsp?lang=en)

OBSERVED

X Species observed in its breeding season (no breeding evidence)

POSSIBLE

H Species observed in its breeding season in suitable nesting habitat

S Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

PROBABLE

M At least 7 individuals singing or producing other sounds associated with breeding (e.g., calls or drumming), heard during the same visit to a single square and in suitable nesting habitat during the species' breeding season

P Pair observed in suitable nesting habitat in nesting season

T Permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season. Use discretion when using this code

D Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation

V Visiting probable nest site

A Agitated behaviour or anxiety calls of an adult

B Brood Patch on adult female or cloacal protuberance on adult male

N Nest-building or excavation of nest hole, except by a wren or a woodpecker

CONFIRMED

NB Nest-building or excavation of nest hole by a species other than a wren or a woodpecker

DD Distraction display or injury feigning

NU Used nest or egg shells found (occupied or laid during the survey)

FY Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight

AE Adult leaving or entering nest sites in circumstances indicating occupied nest

FS Adult carrying fecal sac

CF Adult carrying food for young

NE Nest containing eggs

NY Nest with young seen or heard

PAGE 1 OF 2 Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: Brandon Holden (field notes author) Print Name & Initial: (field notes QA/QC personnel)

CONTINUED B.Holden SITE: 220 Arkell DATE: 7 June

Breeding Bird Survey Observation Form

Record location of all significant species on site map

Species	Habitats	BE*	Species	Habitats	BE*	Species	Habitats	BE*
Can. Goose			Red-bellied Wo.			**Gold-wing. Wa** † Ω**		
Wood Du. Ω			**Yell-bellied Sap. ‡ Ω**			Nashville Wa.		
Am. Black Duck Ω			Downy Wo.			Yellow Wa.		
Mallard Ω			Hairy Wo.			Chestnut-s. Wa.		
R. N. Pheasant			**No. Flicker †**	1	H	**Magnolia Wa. ‡**		
Ruffed Grouse ‡			**Pileated Wo. ‡ Ω**			**Bl-thr Blue Wa. ‡ Ω**		
W. Turkey			**Ea. Wood-Pewee **†**			**Yel-rumped Wa. ‡**		
Co. Loon ‡ Ω			Alder Fly.			**Bl-thr Gr. Wa. ‡ Ω**		
Pied-b. Grebe Ω			**Willow Fly. † Ω**			**Blackburnian Wa. ‡ Ω**		
D. C. Cormorant ‡			Least Fly.			**Pine Wa. ‡**		
Am. Bittern Ω			Ea. Phoebe			**Cerulean Wa** †‡ Ω**		
Least Bittern ‡**			Gr. Crested Fly.	1	SM	**Bl-and-wh Wa. ‡**		
Gr. B. Heron Ω			**Ea. Kingbird †**	2	H	**Am. Redstart ‡**	1	SM
Gr. Egret Ω			**Yellow-thr. Vireo ‡**			**Ovenbird ‡ Ω**		
Green Heron Ω			**Blue-headed Vireo ‡ Ω**			**No. Waterthrush ‡**		
T. Vulture			Warbling Vireo			**Mourning Wa. ‡**		
Osprey Ω			Red-eyed Vireo	1	SM	Co. Yellowthroat		
N. Harrier †‡ Ω			Blue Jay			**Hooded Wa†‡****		
Sharp-sh. Hawk ‡ Ω			Am. Crow			**Canada Wa. †‡** Ω**		
Coopers Hawk ‡ Ω			Co. Raven			**Scarlet Tanager ‡ Ω**		
Red-shou. Hawk †‡ Ω			Horned Lark			**Eastern Towhee † Ω**		
Red-tailed Hawk			Purple Mart.			Chipping Sp.	2	SM
Am. Kestrel †			Tree Swallow	2 3	H	**Clay-colored Sp. Ω**		
Virginia Rail Ω			**No. R. W. Swal. Ω**			**Field Sp. † Ω**		
Sora Ω			**Bank Swallow †** Ω**			**Vesper Sp. † Ω**		
Killdeer			**Cliff Swallow Ω**			**Savannah Sp. † Ω**		
Spot. Sandpiper			**Barn Swallow****			**Grasshopper Sp. †** Ω**		
Upla. Sandpiper ‡ Ω			Bl-capped Chickadee	1	SM	Song Sp.	1 2	SM
Wilson's Snipe			Tufted Titmouse			Swamp Sp.		
Am. Woodcock			**Red-br. Nuthatch Ω**			**Wh-throated Sp. ‡**		
Ring-b. Gull			Wh-br. Nuthatch			No. Cardinal	1	SM
Herring Gull			**Br. Creeper ‡**			**Rose-br. Grosbeak †**		
Caspian Tern			Carolina Wren.			Indigo Bunt.	1	H
Black Tern ‡ Ω**			House Wren			**Bobolink †****		
Common Tern			**Winter Wren ‡ Ω**			Red-winged Bl.		
Rock Dove			**Sedge Wren Ω**			**Ea. Meadowlark †****		
Mourn. Dove			**Marsh Wren Ω**			Co. Grackle	2	H
Yellow-b Cuckoo			**Golded-cr. Kinglet ‡**			Br-headed Cow.		
Black-b Cuckoo † Ω			**B. G. Gnatcatcher ‡**			Orchard Oriole		
Ea. Screech Owl			Ea. Bluebird			**Baltimore Oriole †**	1	SM
Gr. Horned Owl			**Veery Ω**			Purple Finch	1	SM
Barred Owl ‡ Ω			**Hermit Thrush ‡**			House Finch		
Long-eared Owl			**Wood Thrush †****			Pine Siskin		
No. Saw-whet Owl			Am. Robin	1 2 3	SM	Am. Goldfinch	1 2	H
Co. Nighthawk**			Gray Catbird			House Sparrow		
Whip-poor-will †‡**			No. Mockingbird			Other Species ...		
Chimney Swift †**			**Br. Thrasher † Ω**					
Yellow-b Cuckoo			European Starling					
Black-b Cuckoo † Ω			Cedar Waxwing	1 2	H			
Ea. Screech Owl			**Blue-wing. Wa. †**					

* Record highest Breeding Evidence (BE) observed over all habitat. Use codes as in Breeding Bird Atlas of Ontario (see opposite side of this page).
** Endangered, Threatened or Special Concern
† Partners in Flight
‡ Area Sensitive Species
Ω Significant Wildlife Habitat Indicator

* Least Skipper in pasture.

PAGE 2 OF 2

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: Brandon Holden (field notes author)

Print Name & Initial: _____ (field notes QA/QC personnel)

FORM 031 / REV: 2017-06-02

Stantec

Breeding Bird Survey Observation Form

Project Number: 161413338
Project Name: 220 Arkell
Date: 7 June 2017
Field Personnel: Brandon Holden

Weather Conditions: 15 (TEMP (°C)) | 1-2 (WIND) | 10 (CLOUD) | — (PPT (current)) | — (PPT (last 24 hrs))

Habitat No.	ELC Code(s) or Habitat Descriptions	TIME (HH:mm) Start	TIME (HH:mm) End
4	CVR (not including large mowed lawn)	0630	0805
5	Mowed Lawn Area (large)	0630	0805

Breeding Evidence (BE) Codes (Breeding Bird Atlas of Ontario - http://www.birdsontario.org/atlas/codes.jsp?lang=en)

OBSERVED
- **X** Species observed in its breeding season (no breeding evidence)

POSSIBLE
- **H** Species observed in its breeding season in suitable nesting habitat
- **S** Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

PROBABLE
- **M** At least 7 individuals singing or producing other sounds associated with breeding (e.g., calls or drumming), heard during the same visit to a single square and in suitable nesting habitat during the species' breeding season
- **P** Pair observed in suitable nesting habitat in nesting season
- **T** Permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season. Use discretion when using this code
- **D** Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
- **V** Visiting probable nest site
- **A** Agitated behaviour or anxiety calls of an adult
- **B** Brood Patch on adult female or cloacal protuberance on adult male
- **N** Nest-building or excavation of nest hole, except by a wren or a woodpecker

CONFIRMED
- **NB** Nest-building or excavation of nest hole by a species other than a wren or a woodpecker
- **DD** Distraction display or injury feigning
- **NU** Used nest or egg shells found (occupied or laid during the survey)
- **FY** Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight
- **AE** Adult leaving or entering nest sites in circumstances indicating occupied nest
- **FS** Adult carrying fecal sac
- **CF** Adult carrying food for young
- **NE** Nest containing eggs
- **NY** Nest with young seen or heard

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: Brandon Holden (field notes author)

Print Name & Initial: _____ (field notes QA/QC personnel)

CONTINUED B.Holden SITE: 220 Arkell DATE: 7 June Breeding Bird Survey Observation Form

Record location of all significant species on site map

Species	Habitats	BE*	Species	Habitats	BE*	Species	Habitats	BE*
Can. Goose			Red-bellied Wo.			**Gold-wing. Wa** † Ω**		
Wood Du. Ω			**Yell-bellied Sap. ‡ Ω**			Nashville Wa.		
Am. Black Duck Ω			Downy Wo.	4	H	Yellow Wa.	4	SM
Mallard Ω	4	X	Hairy Wo.			Chestnut-s. Wa.		
R. N. Pheasant			**No. Flicker †**			**Magnolia Wa. ‡**		
Ruffed Grouse ‡			**Pileated Wo. ‡ Ω**			**Bl-thr Blue Wa. ‡ Ω**		
W. Turkey			**Ea. Wood-Pewee **†**			**Yel-rumped Wa. ‡**		
Co. Loon ‡ Ω			Alder Fly.			**Bl-thr Gr. Wa. ‡ Ω**		
Pied-b. Grebe Ω			**Willow Fly. † Ω**			**Blackburnian Wa. ‡ Ω**		
D. C. Cormorant ‡			Least Fly.			**Pine Wa. ‡**		
Am. Bittern Ω			Ea. Phoebe	4	SM	**Cerulean Wa** †‡ Ω**		
Least Bittern ‡**			Gr. Crested Fly.			**Bl-and-wh Wa. ‡**		
Gr. B. Heron Ω			**Ea. Kingbird †**			**Am. Redstart ‡**		
Gr. Egret Ω			**Yellow-thr. Vireo ‡**			**Ovenbird ‡ Ω**		
Green Heron Ω			**Blue-headed Vireo ‡ Ω**			**No. Waterthrush ‡**		
T. Vulture			Warbling Vireo			**Mourning Wa. ‡**		
Osprey Ω			Red-eyed Vireo			Co. Yellowthroat		
N. Harrier †‡ Ω			Blue Jay	4	H	**Hooded Wa†‡****		
Sharp-sh. Hawk ‡ Ω			Am. Crow			**Canada Wa. †‡** Ω**		
Coopers Hawk ‡ Ω			Co. Raven			**Scarlet Tanager ‡ Ω**		
Red-shou. Hawk †‡ Ω			Horned Lark			**Eastern Towhee † Ω**		
Red-tailed Hawk			Purple Mart.			Chipping Sp.		
Am. Kestrel †			Tree Swallow	4	H	**Clay-colored Sp. Ω**		
Virginia Rail Ω			**No. R. W. Swal. Ω**			**Field Sp. † Ω**		
Sora Ω			**Bank Swallow †** Ω**			**Vesper Sp. † Ω**		
Killdeer			**Cliff Swallow Ω**			**Savannah Sp. † Ω**		
Spot. Sandpiper			**Barn Swallow****	4 5	X	**Grasshopper Sp. †** Ω**		
Upla. Sandpiper ‡ Ω			Bl-capped Chickadee			Song Sp.		
Wilson's Snipe			Tufted Titmouse			Swamp Sp.		
Am. Woodcock			**Red-br. Nuthatch Ω**			**Wh-throated Sp. ‡**		
Ring-b. Gull			Wh-br. Nuthatch			No. Cardinal		
Herring Gull			**Br. Creeper ‡**			**Rose-br. Grosbeak †**		
Caspian Tern			Carolina Wren.			Indigo Bunt.		
Black Tern ‡ Ω**			House Wren			**Bobolink †****		
Common Tern			**Winter Wren ‡ Ω**			Red-winged Bl.		
Rock Dove			**Sedge Wren Ω**			**Ea. Meadowlark †****		
Mourn. Dove	4	H	**Marsh Wren Ω**			Co. Grackle		
Yellow-b Cuckoo			**Golded-cr. Kinglet ‡**			Br-headed Cow.	4	H
Black-b Cuckoo † Ω			**B. G. Gnatcatcher ‡**			Orchard Oriole		
Ea. Screech Owl			Ea. Bluebird			**Baltimore Oriole †**		
Gr. Horned Owl			**Veery Ω**			Purple Finch		
Barred Owl ‡ Ω			**Hermit Thrush ‡**			House Finch		
Long-eared Owl			**Wood Thrush †****			Pine Siskin		
No. Saw-whet Owl			Am. Robin	4	CF	Am. Goldfinch	4	H
Co. Nighthawk**			Gray Catbird			House Sparrow		
Whip-poor-will †‡**			No. Mockingbird			Other Species ...		
Chimney Swift †**			**Br. Thrasher † Ω**					
Yellow-b Cuckoo			European Starling	4	H			
Black-b Cuckoo † Ω			Cedar Waxwing					
Ea. Screech Owl			**Blue-wing. Wa. †**					

* Record highest Breeding Evidence (BE) observed over all habitat. Use codes as in Breeding Bird Atlas of Ontario (see opposite side of this page).
** Endangered, Threatened or Special Concern
† Partners in Flight
‡ Area Sensitive Species
Ω Significant Wildlife Habitat Indicator

* Gartersnake @ edge of sun / hedgerow / mowed lawn

* No BARS nests on accessable structures ~Foraging.

PAGE 2 OF 2

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: Brandon Holden (field notes author)

Print Name & Initial: _____ (field notes QA/QC personnel)

FORM 031 / REV: 2017-06-02

Stantec 161413338

Breeding Bird Survey Observation Form

Project Number: 161413338 | Project Name: 220 Arkell

Date: 21 June 2017 | Field Personnel: Brandon Holden

Weather Conditions: 14-18 (TEMP (°C)) | 2 (WIND) | 40-70 (CLOUD) | ✓ (PPT (current)) | Rain (PPT (last 24 hrs))

Habitat No.	ELC Code(s) or Habitat Descriptions	TIME (HH:mm) Start	TIME (HH:mm) End
1	FOD	0700	0845
2	Pasture	↓	↓
3	CVR / Lawn	↓	↓
4	HR	↓	↓

Breeding Evidence (BE) Codes (Breeding Bird Atlas of Ontario - http://www.birdsontario.org/atlas/codes.lsp?lang=en)

OBSERVED
- **X** Species observed in its breeding season (no breeding evidence)

POSSIBLE
- **H** Species observed in its breeding season in suitable nesting habitat
- **S** Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

PROBABLE
- **M** At least 7 individuals singing or producing other sounds associated with breeding (e.g., calls or drumming), heard during the same visit to a single square and in suitable nesting habitat during the species' breeding season
- Pair observed in suitable nesting habitat in nesting season
- Permanent territory presumed through registration of territorial song, or e occurrence of an adult bird, at the same place, in breeding bitat, on at least two days a week or more apart, during its breeding on. Use discretion when using this code
- ship or display, including interaction between a male and a or two males, including courtship feeding or copulation
- **V** Visiting probable nest site
- **A** Agitated behaviour or anxiety calls of an adult
- **B** Brood Patch on adult female or cloacal protuberance on adult male
- **N** Nest-building or excavation of nest hole, except by a wren or a woodpecker

CONFIRMED
- **NB** Nest-building or excavation of nest hole by a species other than a wren or a woodpecker
- **DD** Distraction display or injury feigning
- **NU** Used nest or egg shells found (occupied or laid during the survey)
- **FY** Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight
- **AE** Adult leaving or entering nest sites in circumstances indicating occupied nest
- **FS** Adult carrying fecal sac
- **CF** Adult carrying food for young
- **NE** Nest containing eggs
- **NY** Nest with young seen or heard

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: Brandon Holden (field notes author)

Print Name & Initial: _____ (field notes QA/QC personnel)

CONTINUED B.Holden SITE: 220 Ark Rd 21 DATE: June

Breeding Bird Survey
Observation Form

Record location of all significant species on site map

Species	Habitats	BE*	Species	Habitats	BE*	Species	Habitats	BE*
Can. Goose			Red-bellied Wo.			**Gold-wing. Wa** † Ω**		
Wood Du. Ω			**Yell-bellied Sap. ‡ Ω**			Nashville Wa.		
Am. Black Duck Ω			Downy Wo.			Yellow Wa.		
Mallard Ω			Hairy Wo.			Chestnut-s. Wa.		
R. N. Pheasant			**No. Flicker †**			**Magnolia Wa. ‡**		
Ruffed Grouse ‡			**Pileated Wo. ‡ Ω**			**Bl-thr Blue Wa. ‡ Ω**		
W. Turkey			**Ea. Wood-Pewee **†**	1	SM	**Yel-rumped Wa. ‡**		
Co. Loon ‡ Ω			Alder Fly.			**Bl-thr Gr. Wa. ‡ Ω**		
Pied-b. Grebe Ω			**Willow Fly. † Ω**			**Blackburnian Wa. ‡ Ω**		
D. C. Cormorant ‡			Least Fly.			**Pine Wa. ‡**		
Am. Bittern Ω			Ea. Phoebe			**Cerulean Wa** †‡ Ω**		
Least Bittern ‡**			Gr. Crested Fly.			**Bl-and-wh Wa. ‡**		
Gr. B. Heron Ω			**Ea. Kingbird †**			**Am. Redstart ‡** 4	1	Sm
Gr. Egret Ω			**Yellow-thr. Vireo ‡**			**Ovenbird ‡ Ω**		
Green Heron Ω			**Blue-headed Vireo ‡ Ω**			**No. Waterthrush ‡**		
T. Vulture			Warbling Vireo			**Mourning Wa. ‡**		
Osprey Ω			Red-eyed Vireo	1	SM	Co. Yellowthroat		
N. Harrier †‡ Ω			Blue Jay	1	H	**Hooded Wa†‡****		
Sharp-sh. Hawk ‡ Ω			Am. Crow	3	FY	**Canada Wa. †‡** Ω**		
Coopers Hawk ‡ Ω			Co. Raven			**Scarlet Tanager ‡ Ω**		
Red-shou. Hawk †‡ Ω			Horned Lark			**Eastern Towhee † Ω**		
Red-tailed Hawk			Purple Mart.			Chipping Sp. 4	3	Sm
Am. Kestrel †			Tree Swallow	3	X	**Clay-colored Sp. Ω**		
Virginia Rail Ω			**No. R. W. Swal. Ω**			**Field Sp. † Ω**		
Sora Ω			**Bank Swallow †** Ω**			**Vesper Sp. † Ω**		
Killdeer	3	H	**Cliff Swallow Ω**			**Savannah Sp. † Ω**		
Spot. Sandpiper			**Barn Swallow****	3	X	**Grasshopper Sp. †** Ω**		
Upla. Sandpiper ‡ Ω			Bl-capped Chickadee 4	1 3	FY	Song Sp. 4	1 2 3	A
Wilson's Snipe			Tufted Titmouse			Swamp Sp.		
Am. Woodcock			**Red-br. Nuthatch Ω**			**Wh-throated Sp. ‡**		
Ring-b. Gull			Wh-br. Nuthatch			No. Cardinal	3	Sm
Herring Gull			**Br. Creeper ‡**			**Rose-br. Grosbeak †**		
Caspian Tern			Carolina Wren.			Indigo Bunt.	1	Sm
Black Tern ‡ Ω**			House Wren			**Bobolink †****		
Common Tern			**Winter Wren ‡ Ω**			Red-winged Bl.		
Rock Dove			**Sedge Wren Ω**			**Ea. Meadowlark †****		
Mourn. Dove			**Marsh Wren Ω**			Co. Grackle 4	1	H
Yellow-b Cuckoo			**Golded-cr. Kinglet ‡**			Br-headed Cow. 4		H
Black-b Cuckoo † Ω			**B. G. Gnatcatcher ‡**			Orchard Oriole		
Ea. Screech Owl			Ea. Bluebird			**Baltimore Oriole †**		
Gr. Horned Owl			**Veery Ω**			Purple Finch		
Barred Owl ‡ Ω			**Hermit Thrush ‡**			House Finch		
Long-eared Owl			**Wood Thrush †****			Pine Siskin		
No. Saw-whet Owl			Am. Robin 4	1 3	FY	Am. Goldfinch	1 2	H
Co. Nighthawk**			Gray Catbird			House Sparrow		
Whip-poor-will †‡**			No. Mockingbird			Other Species ...		
Chimney Swift †**			**Br. Thrasher † Ω**					
Yellow-b Cuckoo			European Starling					
Black-b Cuckoo † Ω			Cedar Waxwing	1	H			
Ea. Screech Owl			**Blue-wing. Wa. †**					

* Record highest Breeding Evidence (BE) observed over all habitat. Use codes as in Breeding Bird Atlas of Ontario (see opposite side of this page).
** Endangered, Threatened or Special Concern
† Partners In Flight
‡ Area Sensitive Species
Ω Significant Wildlife Habitat Indicator

PAGE 2 OF 2

Quality Control: This form is complete ☐ & legible ☐

Print Name & Initial: Brandon Holden (field notes author)

Print Name & Initial: _____ (field notes QA/QC personnel)

FORM 031 / REV: 2017-04-08

APPENDIX G7

BARS NEST SEARCH

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Nest Search

Project Number: 161413338

Project Name: 220 Arkell

Date: 21 June 2017

Field Personnel: B. Holden

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs: rain
	14-19	2	40-70	—	

Survey Area: 220 Arkell site

Description of Potential Nesting Structures:

House & outbuildings. - all on site

Structure # (indicate location on map)	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Number of nests present			
			BARS		CLSW	
			Active	Inactive	Active	Inactive

Notes or other nests observed: - No BARS nests on site.

- No other bird nests observed on structures

Photo Numbers:

Quality Control: This form is complete (x__) & legible (_x_).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

REV: June-09 FORM 034

APPENDIX G8

CREPUSCULAR BREEDING BIRD

Stantec

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: 161413338

Project Name: 220 Arkell

Date: June 7, 2017

Field Personnel: J. Ball, N. Burnett

Weather Conditions:

TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
19	0	10%	—	—

~~GPS #: T~~

Station: CON1-1

Feature: pasture

UTM: 17T 0565093/4819015

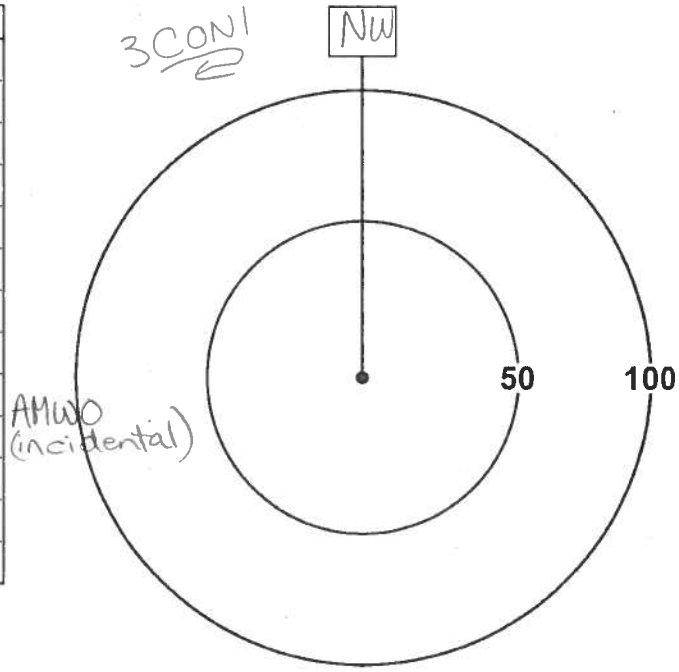
Start Time: 8:55

End Time: 8:58

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
CON1					
AMWO					

** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep; **C**-Above height of blade sweep; **D**-Well above height of blade sweep



Signature: Joyce Ball
(Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

Signature:
(Project Manager)

REV: 2011-05-04 / FORM 020

Station: CON1-2 **Feature:** lawn **UTM:** 17T 565206/4819181

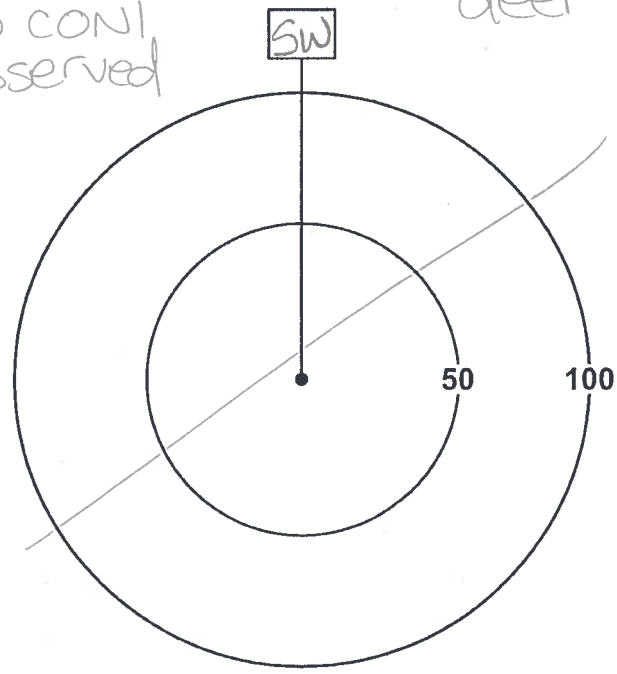
Start Time: 9:08 pm **End Time:** 9:11 pm

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*

No CON1 observed

deer



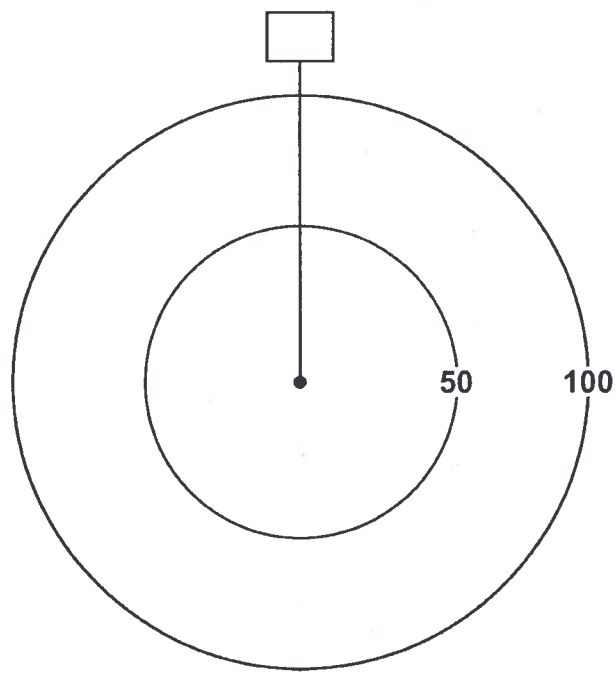
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep; **C**-Above height of blade sweep; **D**-Well above height of blade sweep

Station: **Feature:** **UTM:**

Start Time: **End Time:**

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



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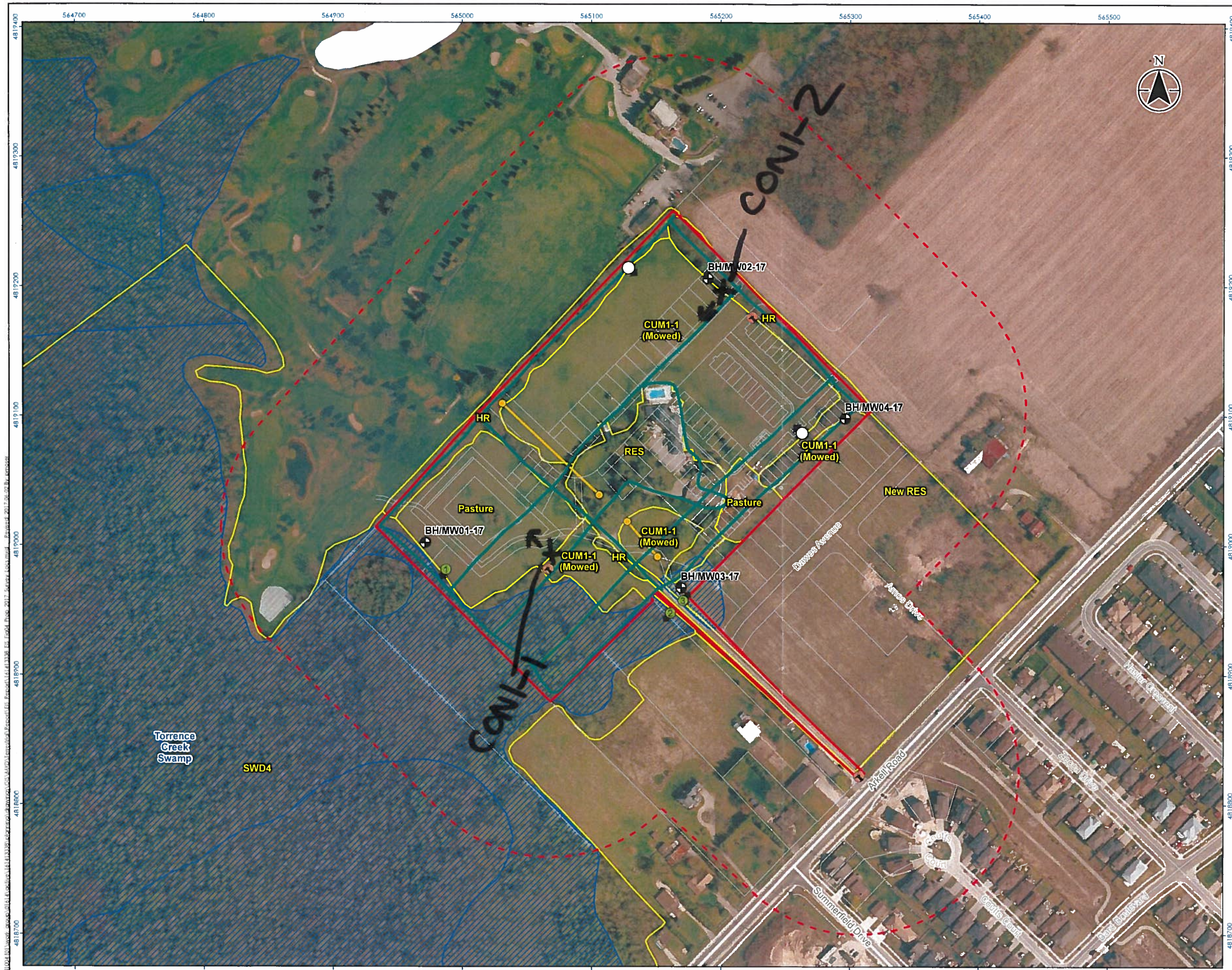
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep; **C**-Above height of blade sweep; **D**-Well above height of blade sweep

Signature: Janice Ball
(Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

Signature:
(Project Manager)

REV: 2011-05-04 / FORM 020



Stantec

- Proposed Borehole Location
- Proposed Amphibian Station
- Crepuscular Survey Location
- Wildlife Camera Location
- Proposed Corridor Study Location
- Snake Area Search Transect
- Proposed Site Layout
- Major Road
- Minor Road
- Waterbody
- Wetland - Evaluated (Provincial)
- Property Boundary
- Study Area (120m Buffer)
- ELC Boundary

CUM1-1: Dry-Moist Old Field Meadow Type
SWD4: Mineral Deciduous Swamp Ecosite
HR: Hedgerow
RES: Residential

CONI Survey
June 7, 2017
J. Ball, N. Burnett

0 50 100 metres
1:3,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.
3. Orthoimagery © First Base Solutions, 2010.

Project Location
Guelph, Ontario

161413338 REVA
Prepared by PRM on 2017-06-02
Technical Review by MS on 2017-06-02

Client/Project
CARSON REID HOMES LTD.
220 ARKELL ROAD
GUELPH, ONTARIO

Figure No.
4

Title
Proposed 2017/2018 Survey Station Locations

Stantec

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: 161413338

Project Name: 220 Arnell Rd.

Date: June 12/17

Field Personnel: N. Burnett, N. Hopysh

Weather Conditions:

TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
31°C	5 km/hr-SW	100	none	none.

GPS #: T - site 1 (near driveway and horse pasture)

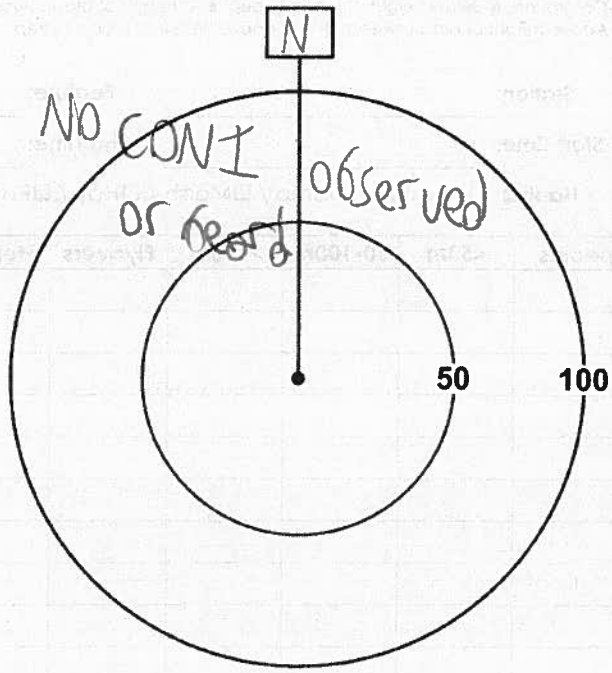
Station: site 1 **Feature:** site 1 **UTM:** 565075, 4818998 17T

Start Time: 21:02 **End Time:** 21:05

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☑Pasture / ☐Crop
- edge of forest and horse pasture

Species	<50m	50-100m	>100m	Flyovers	Height*

** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep; **C**-Above height of blade sweep; **D**-Well above height of blade sweep



Page 1 of 2

Signature: N. Burnett
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature:
(Project Manager)

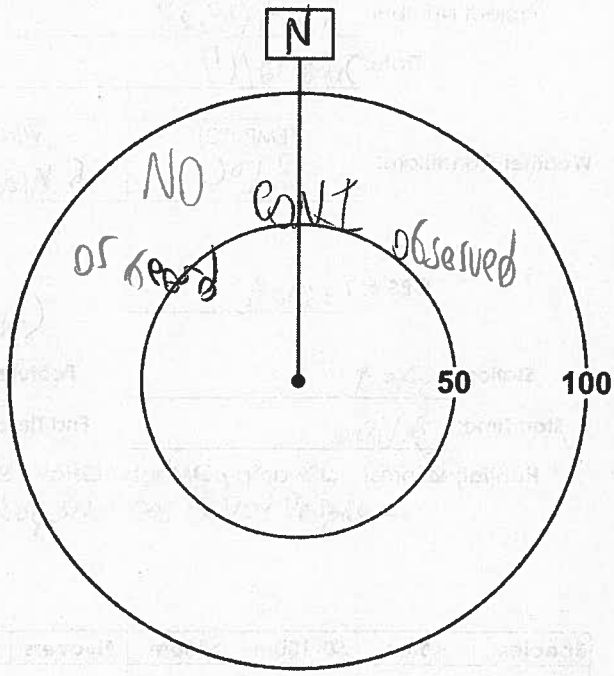
(in backyard - back of yard)

Station: site 2 **Feature:** site 2 **UTM:** 565196, 4819191

Start Time: 21:10 **End Time:** 21:13

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ☑ manicured lawn

Species	<50m	50-100m	>100m	Flyovers	Height*



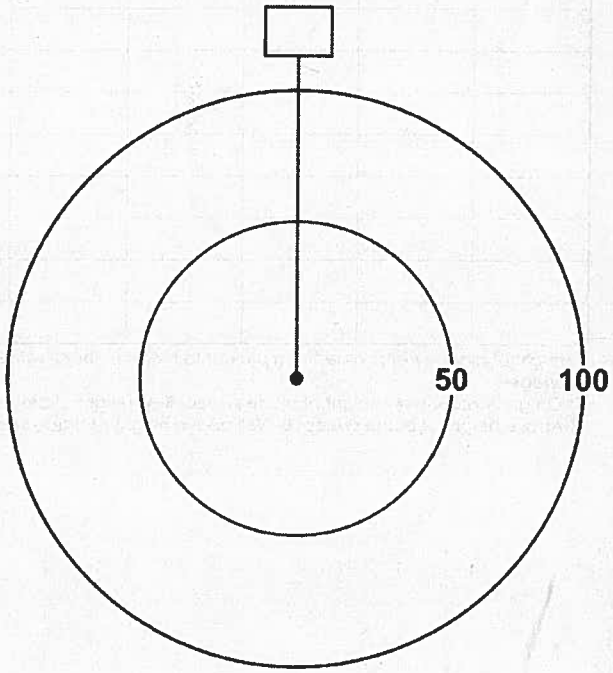
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep; **C**-Above height of blade sweep; **D**-Well above height of blade sweep

Station: **Feature:** **UTM:**

Start Time: **End Time:**

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep; **C**-Above height of blade sweep; **D**-Well above height of blade sweep

Page 2 of 2

Quality Control: This form is complete ❑ & legible ❑.

Signature: N. Burgett (Field Personnel)

Signature: (Project Manager)

REV: 2011-05-04 / FORM 020

APPENDIX G9

BUTTERFLY AND DRAGONFLY

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Wildlife Habitat and Incidental Wildlife Observation Form

Project Number: 21 June 2017
Project Name: 220 Ark
Date / Time: 16/4/3338
Field Personnel: B Holden

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	14-19	2	40-70	—	Rain

Wildlife Habitat

List specific microhabitats present (snags, logs, hibernacula, vernal pools etc.) and what community they were encountered in (use ELC code where applicable).

Potential bumblebee habitat based on historical notes (Yellow-banded is a generalist species in all habitats) but not anticipated to occur in the landscape. Major ON declines

Incidental Species Observations

List species and type of observation:
*(**TK** = track, **SC** = scat, **VO** = vocalization, **OB** = observed, **DP** = distinctive parts, **FE** = feeding evidence, **CA** = carcass, **FY** = eggs, nest, **HO** = house/den, **SI** = other sign)*

Birds	Mammals	Herps	Butterflies / Dragonflies	Other
i.e. AMRO/VO see BOS	WT Deer-OB	See Herp form	Limited Lep. habitat. Most of feature is heavily mowed or grazed.	No high quality odo habitat. No standing water for larval phase.

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Page 1 of 1

REV: May, 07 Form 006

APPENDIX G10

WINTER RAPTORS

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Winter Raptor Observation Form

Project Number: 161413338 Project Name: 220 Arkell

Date / Time: Nov 4, 17 Field Personnel: B Holden

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:	Ave. Snow Depth:
	4	1	60% -90%	—	Snow	3

_____ total **km driven on survey**

Species / Time	# of Individuals	Location	Behaviour
		Habitat type, proximity to features (woodlands, ravines etc.)	*Perched, Hunting, flying, height*
RTHA	1 (1 0)	- Flying over NW corner of property ~100 ft up. - Adult.	

Quality Control: This form is complete (__) & legible (__).

Signature: Brandon Holden (Field Personnel) Signature: _____ (Project Manager)

 REV: May, 07 Form 018

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Winter Raptor Observation Form

Project Number: 161413338 Project Name: 220 Arkell

Date / Time: Dec 22, 2017 Field Personnel: B Holden

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:	Ave. Snow Depth:
	-6°C	3	100	flurries	snow	3-5

_____ total **km driven on survey**

Species / Time	# of Individuals	Location	Behaviour
		Habitat type, proximity to features (woodlands, ravines etc.)	*Perched, Hunting, flying, height*
1314	COHA-1	- Adult male - circling high (100-150m) over site, eventually flew south.	

Quality Control: This form is complete (__) & legible (__)

Signature: Brandon Holden (Field Personnel) Signature: _____ (Project Manager)

 REV: May, 07 Form 018

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Winter Raptor Observation Form

Project Number: 161413338 Project Name: 220 Arkell

Date / Time: Jan 11, 2018 Field Personnel: B Holden

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:	Ave. Snow Depth:
	9	3	100	✓	Rain	10cm

_____ total **km driven on survey**

Species / Time	# of Individuals	Location	Behaviour
		Habitat type, proximity to features (woodlands, ravines etc.)	*Perched, Hunting, flying, height*
	No raptors along route or on site.		

Quality Control: This form is complete (__) & legible (__)

Signature: Brandon Holden (Field Personnel) Signature: _____ (Project Manager)

 REV: May, 07 Form 018

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Winter Raptor Observation Form

Project Number: 160141138 Project Name: 220 Arkell

Date / Time: Jan 24/18 Field Personnel: M Strauss

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:	Ave. Snow Depth:
	-8°C	3	50	0	Snow	<1cm patchy

N/A total km driven on survey onsite

Species / Time	# of Individuals	Location	Behaviour
		Habitat type, proximity to features (woodlands, ravines etc.)	*Perched, Hunting, flying, height*
		no raptors observed	

Quality Control: This form is complete ( ) & legible ( ).

Signature: M Strauss (Field Personnel) Signature: (Project Manager)

 REV: May, 07 Form 018

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Winter Raptor Observation Form

Project Number: 161411138 Project Name: 220 Arkell

Date / Time: Feb 6/2018 Field Personnel: M Strauss

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:	Ave. Snow Depth:
	-6°C	0	35	0	0	11cm

N/A total km driven on survey Onsite 10AM - 1115AM

Snow Feb 4 overnight

Species / Time	# of Individuals	Location	Behaviour
		Habitat type, proximity to features (woodlands, ravines etc.)	*Perched, Hunting, flying, height*
		no raptors	

Quality Control: This form is complete (✓) & legible (✓).

Signature: M Strauss (Field Personnel) Signature: (Project Manager)

 REV: May, 07 Form 018

Stantec Consulting Ltd.
70 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Winter Raptor Observation Form

Project Number: 16143338 Project Name: 220 Arkell

Date / Time: Feb 16, 2018 9:30-11am Field Personnel: J. Ball

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:	Ave. Snow Depth:
	-3	3	100%	None	RAIN	20cm

N/A total km driven on survey No Raptors Observed

Species / Time	# of Individuals	Location	Behaviour
		Habitat type, proximity to features (woodlands, ravines etc.)	*Perched, Hunting, flying, height*

Quality Control: This form is complete (__) & legible (__).

Signature: Joyce Ball (Field Personnel) Signature: _____ (Project Manager)

 REV: May, 07 Form 018

APPENDIX H
Plant and Wildlife Lists

APPENDIX H1

PLANT LIST

Family[1]	Scientific Name[1]	Common Name[1]	Species Code[3,4]	Establishment Means[1]	Coefficient of Conservatism[3]	Wetness Index[3]	Wetland Plant Species[3]	Weediness Index[3]	Provincial Status[2,4]	SARO Status[2]	COSEWIC Status[3]	Global Status[2]	LOCAL STATUS WELL/ DUFF[3]
Dryopteridaceae	*Dryopteris carthusiana*	spinulose wood fern	DRYCART	native	5	-2	T		S5			G5	X
Equisetaceae	*Equisetum arvense*	field horsetail	EQUARVE	native	0	0	T		S5			G5	X
Cupressaceae	*Thuja occidentalis*	eastern white cedar	THUOCCI	native	4	-3	T		S5			G5	X
Pinaceae	*Abies balsamea*	balsam fir	ABIBALS	native	5	-3	T		S5			G5	X
Pinaceae	*Picea abies*	Norway spruce	PICABIE	introduced		5		-1	SE3			G5	
Pinaceae	*Pinus strobus*	eastern white pine	PINSTRO	native	4	3	T		S5			G5	X
Adoxaceae	*Viburnum opulus americanum*	highbush cranberry	VIBOPUL	native		0		-1	-?	-?		-?	X
Adoxaceae	*Viburnum opulus opulus*	cranberry viburnum	VIBOPUL	introduced		0		-1	-?	-?		-?	X
Anacardiaceae	*Rhus typhina*	staghorn sumac	RHUTYPH	native	1	5			S5			G5	X
Apocynaceae	*Asclepias syriaca*	common milkweed	ASCSYRI	native	0	5			S5			G5	X
Asteraceae	*Arctium minus*	common burdock	ARCMINU	introduced		5		-2	SE5			GNR	X
Asteraceae	*Cirsium vulgare*	bull thistle	CIRVULG	introduced		4		-1	SE5			GNR	X
Asteraceae	*Erigeron annuus*	annual fleabane	ERIANNU	native	0	1			S5			G5	
Asteraceae	*Eutrochium maculatum maculatum*	spotted Joe Pye weed	EUTMAMA	native	3	-5	I		-?	-?		-?	X
Asteraceae	*Leucanthemum vulgare*	oxeye daisy	LEUVULG	introduced		5		-1	SE5			GNR	X
Asteraceae	*Pilosella aurantiaca*	orange hawkweed	-?	introduced	-?	-?	-?	-?	SE5		?	GNR	-?
Asteraceae	*Solidago altissima altissima*	tall goldenrod	SOLALTI	native	1	3			-?	-?		-?	R 4
Asteraceae	*Solidago canadensis canadensis*	Canada goldenrod	SOLCANA	native	1	3			-?	-?		-?	X
Asteraceae	*Solidago flexicaulis*	zigzag goldenrod	SOLFLEX	native	6	3			S5			G5	X
Asteraceae	*Symphyotrichum lateriflorum lateriflorum*	calico aster	SYMLATE	native	3	-2	T		S5			G5	X

Family[1]	Scientific Name[1]	Common Name[1]	Species Code[3,4]	Establishment Means[1]	Coefficient of Conservatism[3]	Wetness Index[3]	Wetland Plant Species[3]	Weediness Index[3]	Provincial Status[2,4]	SARO Status[2]	COSEWIC Status[3]	Global Status[2]	LOCAL STATUS WELL/ DUFF[3]
Asteraceae	*Symphyotrichum novae-angliae*	New England aster	SYMNOVA	native	2	-3			S5			G5	X
Asteraceae	*Symphyotrichum sp.*												
Asteraceae	*Taraxacum officinale*	common dandelion	TAROFFI	introduced		3		-2	SE5			G5	X
Betulaceae	*Betula papyrifera*	paper birch	BETPAPY	native		2	T		S5			G5	X
Boraginaceae	*Hydrophyllum virginianum virginianum*	Virginia waterleaf	HYDVIRG	native	6	-2			S5			G5	X
Brassicaceae	*Alliaria petiolata*	garlic mustard	ALLPETI	introduced		0		-3	SE5			GNR	X
Caprifoliaceae	*Lonicera tatarica*	Tartarian honeysuckle	LONTATA	introduced		3		-3	SE5			GNR	X
Caryophyllaceae	*Silene vulgaris*	bladder campion	SILLATI	introduced		-?			SE5			GNR	X
Cornaceae	*Cornus alternifolia*	alternate-leaved dogwood	CORALTE	native	6	5			S5			G5	X
Cornaceae	*Cornus racemosa*	grey dogwood	CORNFOR	native	-?	-?	-?	-?	S5		?	G5?	-?
Cornaceae	*Cornus stolonifera*	red-osier dogwood	CORSERI	native	2	-3	I*		S5			G5	X
Cucurbitaceae	*Echinocystis lobata*	wild cucumber	ECHLOBA	native	3	-2	T		S5			G5	X
Fabaceae	*Lotus corniculatus*	garden bird's-foot trefoil	LOTCORN	introduced		1		-2	SE5			GNR	X
Fabaceae	*Trifolium hybridum*	alsike clover	TRIHYBR	introduced		1		-1	SE5			GNR	X
Fabaceae	*Trifolium pratense*	red clover	TRIPRAT	introduced		2		-2	SE5			GNR	X
Fabaceae	*Vicia cracca*	tufted vetch	VICCRAC	introduced		5		-1	SE5			GNR	X
Geraniaceae	*Geranium robertianum*	herb-Robert	GERROBE	native		5		-2	S5			G5	X
Grossulariaceae	*Ribes cynosbati*	eastern prickly gooseberry	RIBCYNO	native	4	5			S5			G5	X
Grossulariaceae	*Ribes hirtellum*	swamp gooseberry	RIBHIRT	native	6	-3	I		S5			G5	X

Family[1]	Scientific Name[1]	Common Name[1]	Species Code[3,4]	Establishment Means[1]	Coefficient of Conservatism[3]	Wetness Index[3]	Wetland Plant Species[3]	Weediness Index[3]	Provincial Status[2,4]	SARO Status[2]	COSEWIC Status[3]	Global Status[2]	LOCAL STATUS WELL/ DUFF[3]
Grossulariaceae	*Ribes hudsonianum hudsonianum*	northern black currant	RIBHUDS	native	8	-5	I		S5			G5	R 2
Hypericaceae	*Hypericum perforatum perforatum*	common St. John's-wort	HYPPERF	introduced		5		-3	SE5			GNR	X
Lamiaceae	*Clinopodium vulgare*	wild basil	CLIVULG	native	4	5			S5			G5	X
Lamiaceae	*Lycopus americanus*	American water-horehound	LYCAMER	native	4	-5	I		S5			G5	X
Lamiaceae	*Lycopus uniflorus*	northern water-horehound	LYCUNIF	native	5	-5	I		S5			G5	X
Lamiaceae	*Prunella vulgaris lanceolata*	lance-leaved self-heal	PRUVULA	native	5	5	T		-?	-?		-?	
Malvaceae	*Tilia americana*	basswood	TILAMER	native	4	3			S5			G5	X
Oleaceae	*Fraxinus americana*	white ash	FRAAMER	native	4	3			S4			G5	X
Oleaceae	*Fraxinus nigra*	black ash	FRANIGR	native	7	-4	I		S4			G5	X
Oleaceae	*Fraxinus pennsylvanica*	red ash	FRAPENN	native	3	-3	T		S4			G5	X
Oleaceae	*Ligustrum vulgare*	European privet	LIGVULG	introduced		1		-2	SE5			GNR	X
Onagraceae	*Circaea canadensis canadensis*	Canada enchanter's nightshade	CIRCANA	native	3	3			S5			G5T5	X
Plantaginaceae	*Plantago lanceolata*	English plantain	PLALANC	introduced		0		-1	SE5			G5	X
Ranunculaceae	*Ranunculus acris*	common buttercup	RANACRI	introduced		-?	T	-2	SE5			G5	X
Ranunculaceae	*Thalictrum pubescens*	tall meadow-rue	THAPUBE	native	5	-2	T		S5			G5	X
Rhamnaceae	*Frangula alnus*	glossy buckthorn	RHAFRAN	introduced		-1	T	-3	SE5			GNR	X
Rhamnaceae	*Rhamnus cathartica*	European buckthorn	RHACATH	introduced		3	T	-3	SE5			GNR	X
Rosaceae	*Agrimonia gryposepala*	hooked agrimony	AGRGRYP	native	2	2			S5			G5	X
Rosaceae	*Fragaria vesca americana*	American woodland strawberry	FRAVESC	native	4	4			S5			G5	X

Family[1]	Scientific Name[1]	Common Name[1]	Species Code[3,4]	Establishment Means[1]	Coefficient of Conservatism[3]	Wetness Index[3]	Wetland Plant Species[3]	Weediness Index[3]	Provincial Status[2,4]	SARO Status[2]	COSEWIC Status[3]	Global Status[2]	LOCAL STATUS WELL/ DUFF[3]
Rosaceae	*Geum aleppicum*	yellow avens	GEUALEP	native	2	-1	T		S5			G5	X
Rosaceae	*Geum sp.*												
Rosaceae	*Potentilla recta*	sulphur cinquefoil	POTRECT	introduced		5		-2	SE5			GNR	X
Rosaceae	*Prunus serotina serotina*	black cherry	PRUSERO	native	3	3			S5			G5	X
Rosaceae	*Prunus virginiana virginiana*	chokecherry	PRUVIRG	native	2	1			S5			G5	X
Rosaceae	*Rubus ×jacens*	spreading dewberry	-?	native	-?	-?	-?	-?	-?	-?	-?	-?	-?
Rosaceae	*Rubus idaeus strigosus*	American red raspberry	RUBUIDI	native	-?	-?	-?	-?	SNA	-?	-?	-?	-?
Rubiaceae	*Galium palustre*	common marsh bedstraw	GALPALU	native	5	-5	I		S5			G5	X
Salicaceae	*Populus balsamifera*	balsam poplar	POPBALS	native	4	-3	T		S5			G5	X
Salicaceae	*Populus tremuloides*	trembling aspen	POPTREM	native		0	T		S5			G5	X
Sapindaceae	*Acer ×freemanii*	Freeman maple	-?	native	-?	-?	-?	-?	-?	-?	-?	-?	-?
Sapindaceae	*Acer platanoides*	Norway maple	ACEPLAT	introduced		5		-3	SE5			GNR	X
Ulmaceae	*Ulmus americana*	white elm	ULMAMER	native	3	-2	T		S5			G5?	X
Urticaceae	*Urtica dioica dioica*	European stinging nettle	URTDIDI	introduced		-1		-1	-?	-?		-?	
Violaceae	*Viola sp.*												
Vitaceae	*Parthenocissus quinquefolia*	Virginia creeper	PARQUIN	native	6	1			S4?			G5	R 1
Vitaceae	*Vitis riparia*	riverbank grape	VITRIPA	native	0	-2			S5			G5	X
Asparagaceae	*Maianthemum stellatum*	star-flowered false Solomon's seal	MAISTEL	native	6	1			S5			G5	X
Cyperaceae	*Carex arcta*	northern clustered sedge	CARARCT	native		-?	I		S4S 5			G5	R 1

Family[1]	Scientific Name[1]	Common Name[1]	Species Code[3,4]	Establishment Means[1]	Coefficient of Conservatism[3]	Wetness Index[3]	Wetland Plant Species[3]	Weediness Index[3]	Provincial Status[2,4]	SARO Status[2]	COSEWIC Status[3]	Global Status[2]	LOCAL STATUS WELL/ DUFF[3]
Cyperaceae	*Carex bebbii*	Bebb's sedge	CARBEBB	native	3	-5	I		S5			G5	X
Cyperaceae	*Carex intumescens*	bladder sedge	CARINTU	native	6	-4	I		S5			G5	X
Cyperaceae	*Carex spicata*	spiked sedge	CARSPIC	introduced		5		-1	SE5			GNR	X
Cyperaceae	*Scirpus pendulus*	hanging bulrush	SCIPEND	native	3	-5	I		S5			G5	X
Cyperaceae	*Scirpus sp.*												
Liliaceae	*Erythronium americanum americanum*	yellow trout lily	ERYAMER	native	5	5			S5			G5	X
Orchidaceae	*Epipactis helleborine*	broad-leaved helleborine	EPIHELL	introduced		5		-2	SE5			GNR	X
Poaceae	*Bromus inermis*	smooth brome	BROINER	introduced		5		-3	SE5			G5T NR	X
Poaceae	*Dactylis glomerata*	orchard grass	DACGLOM	introduced		3		-1	SE5			GNR	X
Poaceae	*Glyceria striata*	ridged mannagrass	GLYSTRI	native	3	-5	I		S5			G5	X
Poaceae	*Phalaris arundinacea arundinacea*	reed canarygrass	PHAARUN	native	0	-4	T		S5			G5	X
Poaceae	*Phleum pratense pratense*	common timothy	PHLPRAT	introduced		3		-1	SE5			GNR	X
Poaceae	*Poa pratensis pratensis*	Kentucky bluegrass	POAPRPR	introduced	0	1			-?	-?		-?	X

1 Brouillet L, Desmet P, Coursol F, Meades SJ, Favreau M, Anions M, Bélisle P, Gendreau C, Shorthouse D, and contributors (2010+). Database of Vascular Plants of Canada (VASCAN). Online at http://data.canadensys.net/vascan and http://www.gbif.org/dataset/3f8a1297-3259-4700-91fc-acc4170b27ce, released on 2010-12-10. Version [xx]. GBIF key: 3f8a1297-3259-4700-91fc-acc4170b27ce. Data paper ID: doi: http://doi.org/10.3897/phytokeys.25.3100 [accessed on April 18, 2016]

2 Ontario Ministry of Natural Resources and Forestry. 2015. Ontario Vascular Plants. Online at from https://www.ontario.ca/page/get-natural-heritage-information. Accessed on May 3, 2016.

3 Newmaster, S. G., A. Lehela, Peter W. C. Uhlig, Sean McMurray and Michael J. Oldham. 1998. Ontario Plant List. Forest Research Information Paper No. 123, Ontario Forest Research Institute, Ontario Ministry of Natural Resources, Sault Ste. Marie, Ontario

4 Bradley, David J. 2013. Southern Ontario Vascular Plant Ppecies List, 3rd Edition. Ontario Ministry of Natural Resources and Forestry Southern Science & Information Section. Peterborough, Ontario.

Summary

Species Diversity	
Vascular Plants Listed:	**90**
Identified to species or ssp/var	**86**
Identified to Genus (not included in calculations below)	**4**

Provincial Status		**Total Number**	**Percentage**
S1-S3 Species:	*rare in Ontario*	0	0%
S4 Species:	*uncommon in Ontario*	5	6%
S5 Species:	*common in Ontario*	44	51%
Other:		27	31%
Not listed:		0	0%
Not defined ("-?"):		10	12%

Means of Establishment		
Native Species:	57	66%
Introduced Species:	29	34%
Not listed:	0	0%
Not defined ("-?"):	0	0%

Co-efficient of Conservatism (C) and Floristic Quality Index(FQI)			
C 0 to 3	*lowest sensitivity*	24	28%
C 4 to 6	*moderate sensitivity*	23	27%
C 7 to 8	*high sensitivity*	2	2%
C 9 to 10	*highest sensitivity*	0	0%
Not listed:		32	37%
Not defined ("-?"):		5	6%
Average C		***3.5***	
FQI		***45.6***	

Presence of Weedy & Invasive Species			
weediness = 0	*Not invasive*	0	0%
weediness = -1	*low potential invasiveness*	12	14%
weediness = -2	*moderate potential invasiveness*	9	10%
weediness = -3	*high potential invasiveness*	7	8%
Not listed:		53	62%
Not defined ("-?"):		5	6%
Average weediness		***-1.8***	

Wetness Index

upland	*W of 5*	18	21%
facultative upland	*W of 4, 3 or 2*	18	21%
facultative	*W of 1, 0 or -1*	17	20%
facultative wetland	*W of -2, -3 or -4*	17	20%
obligate wetland	*W of -5*	8	9%
Not listed:		0	0%
Not defined ("-?"):		8	9%
Average wetness value		***0.8***	

Presence of Wetland (W) Species

Total Wetland Tolerant (T) Plant Species as identified in OWES Manual	19	22%
Total Wetland Indicator (I) Plant Species as identified in OWES Manual	13	15%
Not listed:	49	57%
Not defined ("-?"):	5	6%

APPENDIX H2

WILDLIFE LIST

COMMON NAME	SCIENTIFIC NAME	ONTARIO STATUS	GLOBAL STATUS
BUTTERFLIES			
Least Skipper	*Ancyloxypha numitor*	S5	G5
Cabbage White	*Pieris rapae*	SNA	G5
AMPHIBIANS			
American Toad	*Anaxyrus americanus*	S5	G5
Northern Green Frog	*Lithobates clamitans*	S5	G5
Wood Frog	*Lithobates sylvatica*	S5	G5
REPTILES			
Eastern Gartersnake	*Thamnophis sirtalis*	S5	G5
BIRDS			
Mallard	*Anas platyrhynchos*	S5	G5
Mourning Dove	*Zenaida macroura*	S5	G5
Common Nighthawk	*Chordeiles minor*	S4B	G5
Killdeer	*Charadrius vociferus*	S5B, S5N	G5
American Woodcock	*Scolopax minor*	S4B	G5
Cooper's Hawk	*Accipiter cooperii*	S4	G5
Red-tailed Hawk	*Buteo jamaicensis*	S5	G5
Downy Woodpecker	*Dryobates pubescens*	S5	G5
Northern Flicker	*Colaptes auratus*	S4B	G5
Eastern Wood-Pewee	*Contopus virens*	S4B	G5
Eastern Phoebe	*Sayornis phoebe*	S5B	G5
Great Crested Flycatcher	*Myiarchus crinitus*	S4B	G5
Eastern Kingbird	*Tyrannus tyrannus*	S4B	G5
Red-eyed Vireo	*Vireo olivaceus*	S5B	G5
Blue Jay	*Cyanocitta cristata*	S5	G5
American Crow	*Corvus brachyrhynchos*	S5B	G5
Common Raven	*Corvus corax*	S5	G5
Tree Swallow	*Tachycineta bicolor*	S4B	G5
Barn Swallow	*Hirundo rustica*	S4B	G5
Black-capped Chickadee	*Poecile atricapillus*	S5	G5
European Starling	*Sturnus vulgaris*	SNA	G5
Cedar Waxwing	*Bombycilla cedrorum*	S5B	G5
Purple Finch	*Haemorhous purpureus*	S4B	G5
American Goldfinch	*Spinus tristis*	S5B	G5
Chipping Sparrow	*Spizella passerina*	S5B	G5
Song Sparrow	*Melospiza melodia*	S5B	G5
Baltimore Oriole	*Icterus galbula*	S4B	G5
Brown-headed Cowbird	*Molothrus ater*	S4B	G5
Common Grackle	*Quiscalus quiscula*	S5B	G5
American Redstart	*Setophaga ruticilla*	S5B	G5
Yellow Warbler	*Setophaga petechia*	S5B	G5
Northern Cardinal	*Cardinalis cardinalis*	S5	G5
Indigo Bunting	*Passerina cyanea*	S4B	G5
MAMMALS			

Virginia Opossum	*Didelphis virginiana*	S4	G5
Northern Short-tailed Shrew	*Blarina brevicauda*	S5	G5
Eastern Cottontail	*Sylvilagus floridanus*	S5	G5
Grey Squirrel	*Sciurus carolinensis*	S5	G5
Red Squirrel	*Tamiasciurus hudsonicus*	S5	G5
Mouse sp.	*Peromyscus sp.*	S5	G5
Meadow Vole	*Microtus pennsylvanicus*	S5	G5
Meadow Jumping Mouse	*Zapus hudsonicus*	S5	G5
Coyote	*Canis latrans*	S5	G5
Red Fox	*Vulpes vulpes*	S5	G5
Raccoon	*Procyon lotor*	S5	G5
Striped Skunk	*Mephitis mephitis*	S5	G5
White-tailed Deer	*Odocoileus virginianus*	S5	G5
SUMMARY			
Total Butterflies:	2		
Total Amphibians:	3		
Total Reptiles:	1		
Total Birds:	33		
Total Breeding Birds:	30		
Total Mammals:	13		
SIGNIFICANT SPECIES			
Global:	0		
National:	3		
Provincial:	3		
Regional:	-		
Local:	9		
Explanation of Status and Acronymns			
COSSARO: Committee on the Status of Species at Risk in Ontario			
COSEWIC: Committee on the Status of Endangered Wildlife in Canada			
REGION: Rare in a Site Region			
S1: Critically Imperiled—Critically imperiled in the province (often 5 or fewer occurrences)			
S2: Imperiled—Imperiled in the province, very few populations (often 20 or fewer),			
S3: Vulnerable—Vulnerable in the province, relatively few populations (often 80 or fewer)			
S4: Apparently Secure—Uncommon but not rare			
S5: Secure—Common, widespread, and abundant in the province			
SX: Presumed extirpated			
SH: Possibly Extirpated (Historical)			
SNR: Unranked			
SU: Unrankable—Currently unrankable due to lack of information			
SNA: Not applicable—A conservation status rank is not applicable because the species is not a suitable target for con			
S#S#: Range Rank—A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about t			
S#B- Breeding status rank			
S#N- Non Breeding status rank			
?: Indicates uncertainty in the assigned rank			
G1: Extremely rare globally; usually fewer than 5 occurrences in the overall range			

G1G2: Extremely rare to very rare globally			
G2: Very rare globally; usually between 5-10 occurrences in the overall range			
G2G3: Very rare to uncommon globally			
G3: Rare to uncommon globally; usually between 20-100 occurrences			
G3G4: Rare to common globally			
G4: Common globally; usually more than 100 occurrences in the overall range			
G4G5: Common to very common globally			
G5: Very common globally; demonstrably secure			
GU: Status uncertain, often because of low search effort or cryptic nature of the species; more data needed			
GNR: Unranked—Global rank not yet assessed.			
END: Endangered			
THR: Threatened			
SC: Special Concern			
2, 3 or NS after a COSEWIC ranking indicates the species is either on Schedule 2, Schedule 3 or No Schec			
NAR: Not At Risk			
Area: Minimum patch size for area-sensitive species (ha)			
LATEST STATUS UPDATE			
Butterflies: Jan 2018			
Amphibans: Jan 2018			
Reptiles: Jan 2018			
Birds: August 2018			
Mammals: May 2018			
S and G ranks and explanations: December 2011			
NOTE			
All rankings for birds refer to breeding birds unless the ranking is followed by N			
REFERENCES			
COSSARO Status			
Endangered Species Act, 2007 (Bill 184). Species at Risk in Ontario List.			
COSEWIC Status			
COSEWIC. 2007. Canadian Species at Risk. Committee on the Status of Endangered Wildlife in Canada.			
Local Status			
Locally Significant Species List - City of Guelph (2012)			

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BUTTERFLIES						
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Wood Frog	*Lithobates sylvatica*	S5	G5			
REPTILES						
Eastern Gartersnake	*Thamnophis sirtalis*	S5	G5			
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Mallard	*Anas platyrhynchos*	S5	G5			
Mourning Dove	*Zenaida macroura*	S5	G5			
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Killdeer	*Charadrius vociferus*	S5B, S5N	G5			
American Woodcock	*Scolopax minor*	S4B	G5			
Cooper's Hawk	*Accipiter cooperii*	S4	G5	NAR	NAR	X
Red-tailed Hawk	*Buteo jamaicensis*	S5	G5	NAR	NAR	
Downy Woodpecker	*Dryobates pubescens*	S5	G5			
Northern Flicker	*Colaptes auratus*	S4B	G5			X
Eastern Wood-Pewee	*Contopus virens*	S4B	G5	SC	SC	X
Eastern Phoebe	*Sayornis phoebe*	S5B	G5			
Great Crested Flycatcher	*Myiarchus crinitus*	S4B	G5			
Eastern Kingbird	*Tyrannus tyrannus*	S4B	G5			X
Red-eyed Vireo	*Vireo olivaceus*	S5B	G5			
Blue Jay	*Cyanocitta cristata*	S5	G5			
American Crow	*Corvus brachyrhynchos*	S5B	G5			
Common Raven	*Corvus corax*	S5	G5			X
Tree Swallow	*Tachycineta bicolor*	S4B	G5			
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American Redstart	*Setophaga ruticilla*	S5B	G5			X
Yellow Warbler	*Setophaga petechia*	S5B	G5			
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Local Status						
Locally Significant Species List - City of Guelph (2012)						

APPENDIX I
Preliminary Servicing, Grading and Stormwater Management Report

220 Arkell Road, Guelph
Preliminary Servicing, Grading and Stormwater Management Report

May 28, 2019

Prepared for:

Rockpoint Properties Inc.
195 Hanlon Creek Blvd.
Unit 100
Guelph ON N1C 0A1

Prepared by:

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100-300 Hagey Boulevard
Waterloo ON N2L 0A4

Project Number: 161423338

Revision	Description	Author		Quality Check		Independent Review	

220 ARKELL ROAD, GUELPH
PRELIMINARY SERVICING, GRADING AND STORMWATER MANAGEMENT REPORT

This document entitled 220 Arkell Road, Guelph – Preliminary Servicing, Grading and Stormwater Management Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Rockpoint Properties Inc. (the "Client") to support the permitting process for Client's application for a Draft Plan of Subdivision (the "Application") for 220 Arkell Road (the "Project"). In connection thereto, this document may be reviewed and used by the provincial and municipal government agencies participating in the permitting process in the normal course of their duties. Except as set forth in the previous sentence, any reliance on this document by any third party for any other purpose is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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Kevin Brousseau, C.E.T., Discipline Leader

Prepared by _____
(signature)
Bryan Weersink, P. Eng., Water Resources Engineer

Approved by _____
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Trevor Fraser, P.Eng., Water Resources Engineer

Peer Reviewed by _____
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Chris Hendriksen, P.Eng.

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LIST OF APPENDICES

1.0 INTRODUCTION

1.1 SITE LOCATION

The 220 Arkell Road site is located along the southeast limit of the City of Guelph, approximately 0.6 km west of the Arkell Road and Victoria Road South intersection as illustrated in Figure 1.0. The subject property is comprised of approximately 7.16 ha and is bounded by Victoria Park Village (VPV) Subdivision to the north, existing agricultural lands to the east, existing Arkell Meadows Subdivision to the South and Torrance Creek Swamp (Provincially Significant Wetlands [PSW]) to the west. The Proposed Draft Plan consists of 31 single-family lots on a single road and a 1.73 ha multiple-family residential block. The described are illustrated on Figure 1.0 – Site Location Plan and the Proposed Draft Plan included in Appendix A.

1.2 PURPOSE OF THIS REPORT

The purpose of this Preliminary Servicing, Grading and Stormwater Management (SWM) Report is to outline how the proposed 220 Arkell Road lands can be supplied with adequate services, including sanitary, domestic water, storm drainage, SWM, and utilities. This report is prepared in support of the Draft Plan Application. Please refer to the Proposed Draft Plan illustrated on Figure 2.0.

Supplementary reports that should be read in conjunction with this report include:

- Tree Preservation Plan, prepared by Stantec Consulting Ltd., May 2019
- Hydrological Assessment, prepared by Stantec Consulting Ltd., May 2019
- Environmental Impact Study (EIS), prepared by Stantec Consulting Ltd., May 2019
- Geotechnical Investigation, prepared by Stantec Consulting Ltd., May 2019
- Phase 1 Environmental Site Assessment, prepared by Stantec Consulting Ltd., May 2019

This Report demonstrates that the 220 Arkell Road lands can be developed with full municipal servicing, SWM, and utilities to the requirements of the various approval agencies.

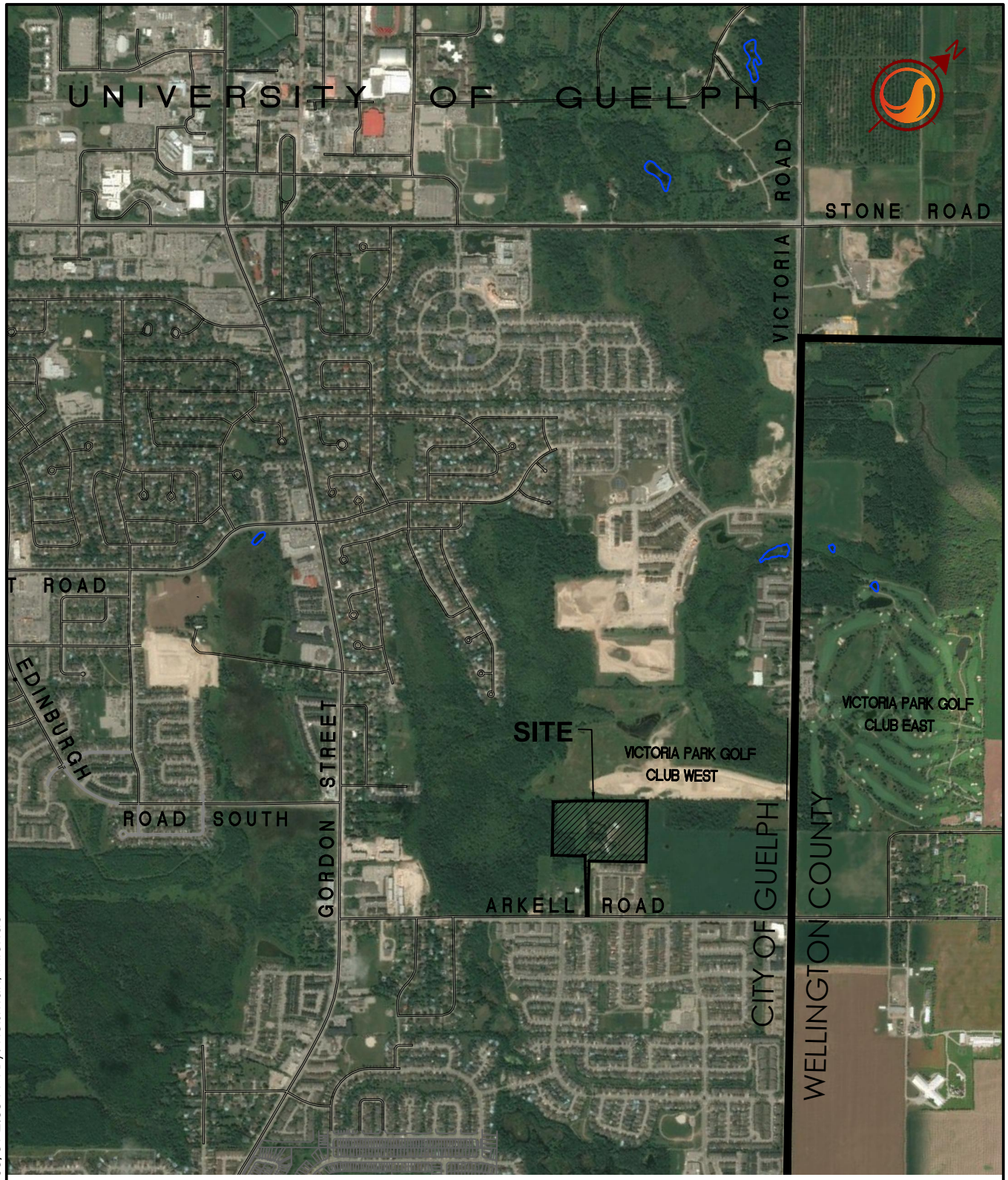
The servicing strategies presented in this Report are conceptual. Detailed engineering drawings (for construction) and a Final SWM Report will be submitted as part of the final engineering design process once the proposed Subdivision has received Draft Plan Approval.

1.3 ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Under the procedures set out in the Municipal Class Environmental Assessment Act (Class EA), projects completed by the Private Sector through a Planning Act Process are considered as having fulfilled the Class EA requirements, except for some specific Schedule 'C' projects that are outlined in the Act.

All of the works required for the 220 Arkell Road lands are described in the subsequent sections of this Report. The plans, included in this Report, show the location of the proposed sanitary and storm sewers, proposed watermains, as well as grading and utilities. The intent of this Report and the supplementary Reports is to ensure that the commenting agencies and the Public are made aware of the servicing strategies for the proposed Development.

As above, all of the other works, and in particular all of the works required for the 220 Arkell Road lands will be completed by the Developer (i.e., by the Private Sector), are clearly described/shown in this Report in support of the Draft Plan and, therefore is exempt from the Class EA.



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2019/05/31 2:35 PM By: Huisman, Michael

ORIGINAL SHEET - ANSI A

March, 2019
161413338

Stantec

300 Hagey Blvd. Suite 100
Waterloo, ON, N2L 0A4
Tel. 519.579.4410
www.stantec.com

Client/Project
ROCKPOINT PROPERTIES INC.
220 ARKELL ROAD, GUELPH

Figure No.
1.0

Title
SITE LOCATION PLAN

2.0 OVERALL GRADING AND DRAINAGE

2.1 EXISTING LAND USE AND SITE TOPOGRAPHY

The existing site conditions for the subject site are illustrated on Drawing No. C-050 included in Appendix A.

The subject lands are presently used as a single-family home and former horse pasture. Existing vegetation surrounds the north, east and west property lines.

The topography of the site is generally rolling with elevations ranging from approximately 340.0 m at the center and southeast corner of the site falling northeast to approximately 337.0 m or falling southwest towards the Torrance Creek Swamp at approximately 333.50 m. The site slopes ranging from 0.5% to 15% with the high point situated in the centre of the property. There are two major existing drainage patterns; the first and largest drains approximately 4.70 ha to Torrance Creek Swamp along the southwest property line; and the second drains approximately a 2.47 ha area via sheet flow uncontrolled offsite to the northeast corner. This area then flows via sheet flow to an existing woodlot approximate 70.0 m east of the property line. This is illustrated on the Existing Conditions Plan, Drawing No. C-050, included in Appendix A.

2.2 EXISTING LAND USE AND SITE TOPOGRAPHY

Constraints in designing the road profiles and lot grading are as follows:

- Match existing grades, where possible, to minimize grading and cut/fill quantities and minimize changes to the surface hydrology and hydrogeology of the area
- Maintain grades along the north limits of the property as it is identified to be protected with a 50.0 m wide ecological linkage for wildlife preservation
- Account for future urbanization of adjacent lands
- Match Hutchison Road elevations proposed for Victoria Park Village
- Satisfy the City of Guelph requirements for minimum and maximum road grades
- Provide a major overland flow route for flows in excess of the storm sewer capacity
- Maintain adequate cover over storm, sanitary sewers and watermain
- Match existing grades along the entire perimeter of the site
- Provide sufficient Parkland Area and ensure 80% of park area is suitable table land (i.e., 2 to 3% slope)

2.3 PROPOSED ROAD PROFILES AND OVERALL SITE GRADING

Preliminary road profile within the subject site was established based on the proposed street pattern to satisfy the constraints outlined in the previous Section 2.2. The road profile has been designed with grades ranging from 0.5% to 2.00% in order to match perimeter grades as well as meet criteria and optimized grading for the proposed servicing solution.

The proposed centerline road elevations are illustrated on the Servicing Concept Plan, Drawing No. C-100, and the Road Profile Concept Drawing No C-200, all included in Appendix A.

The subject lands have a narrow frontage onto the north side of Arkell Road. This narrow frontage facilitates an existing driveway access, constrained by the property boundary which tapers from 6.0 m wide at the Arkell Road Right-of-Way to 14.0 m wide at the end of the access approximately 190.0 m north of Arkell Road. Due to this restriction, the Draft Plan supports one road access through the VPV Subdivision which provides connection to Victoria Road. In the interim, a 10.0 m wide Emergency Access will be provided from the proposed internal road, through the Park Block connecting to the existing road, Dawes Avenue located in the Arkell Meadows Subdivision. The proposed Emergency Access Profile identifying the access grades and slopes is shown on Figure 2.0. This interim emergency access strategy has been reviewed with the City prior to proceeding with the Reports and Plans to support the Draft Plan Subdivision. Additional coordination with the Consultant for the adjacent Developer for 190-216 Arkell Road has occurred to coordinate the future profile of Dawes Avenue and impacts to the Emergency Access connection as shown on Figure 3.0.

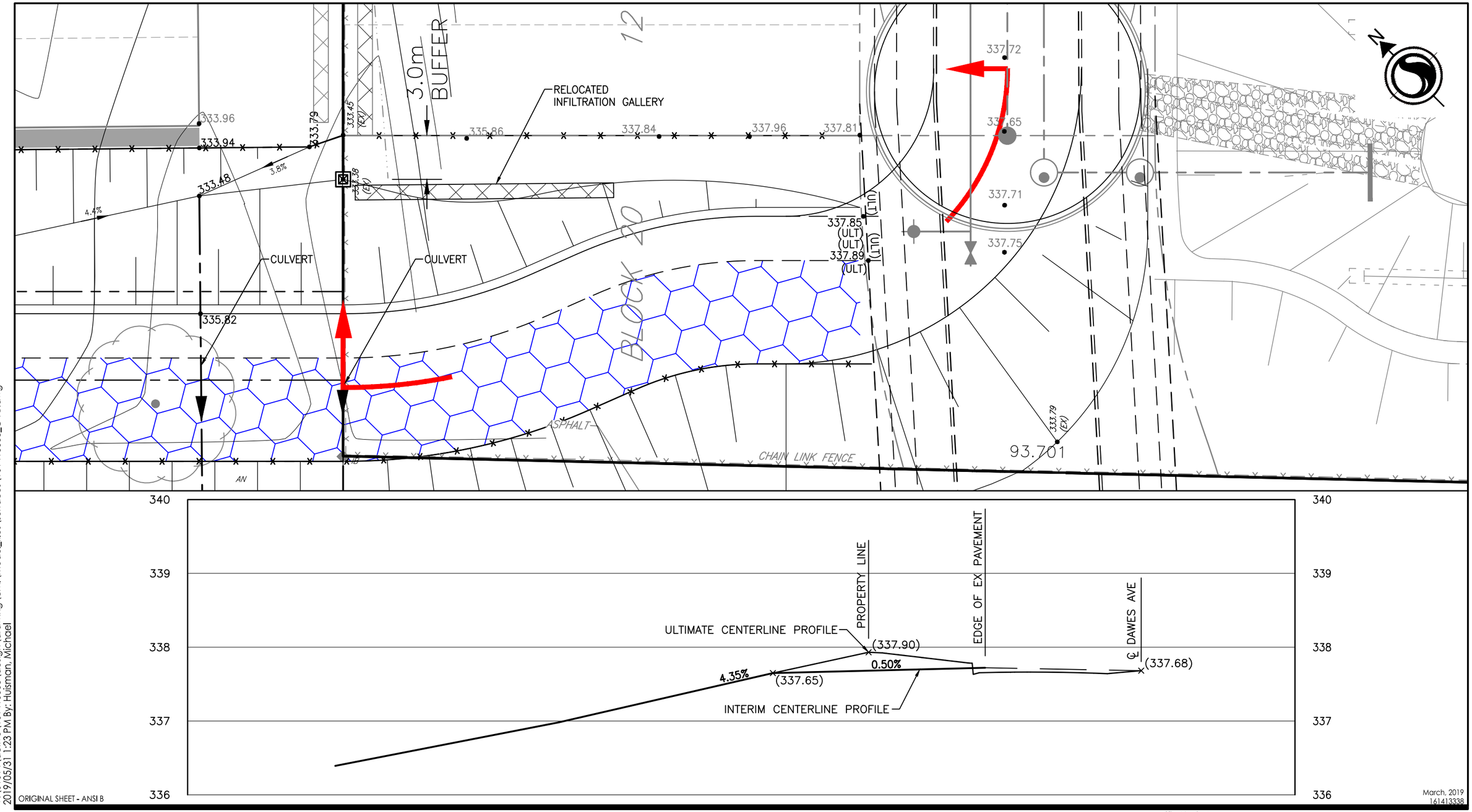
A 17.0 m Right-of-Way cross-section in accordance with City Standards is proposed as it is a continuation of the existing road cross section for the Development lands to the north for the single-family road, shown on Figure 4.0 – 17 m Right-of Way.

A typical road cross-section, similar to the other multiple residential Developments constructed in the City, has been prepared for the multiple-residential block, during the preliminary review of the Development. The 6.1 m wide road cross-section is shown on Figure 5.0 and will be further reviewed during the Site Plan process.

The proposed lot grading within the site ranges from 2.0% to a maximum of 5.0%, with 3:1 transition slopes or retaining walls utilized to accommodate the various grade changes within the proposed subdivision and at various perimeter locations. A combination of Type ‘A’ (back to front drainage), and Type ‘D’ (split drainage) or Type ‘B’ (walkout) are used in the proposed design. No Type ‘C’ (front walk-ins) lots are anticipated. The proposed lot grading is illustrated on the Conceptual Grading Plan, Erosion & Sediment Control Plan, Drawing No. C-400 included in Appendix A.

Preliminary earthwork calculations have been performed for the subject property which indicates that there is complete earth cut/-fill balance with surplus topsoil used as fill in park areas. A Preliminary Cut-Fill Plan, Drawing No. C-900 demonstrates the extents of earth cut/fill and is included in Appendix A.

At detailed design, profiles and grading will be refined to minimize the required earth cut/fill volumes.



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ORIGINAL SHEET - ANSI B

March, 2019
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Legend

Scale

1:250H 0 2.5 7.5 12.5m
1:50V 0 0.5 1.5 2.5m

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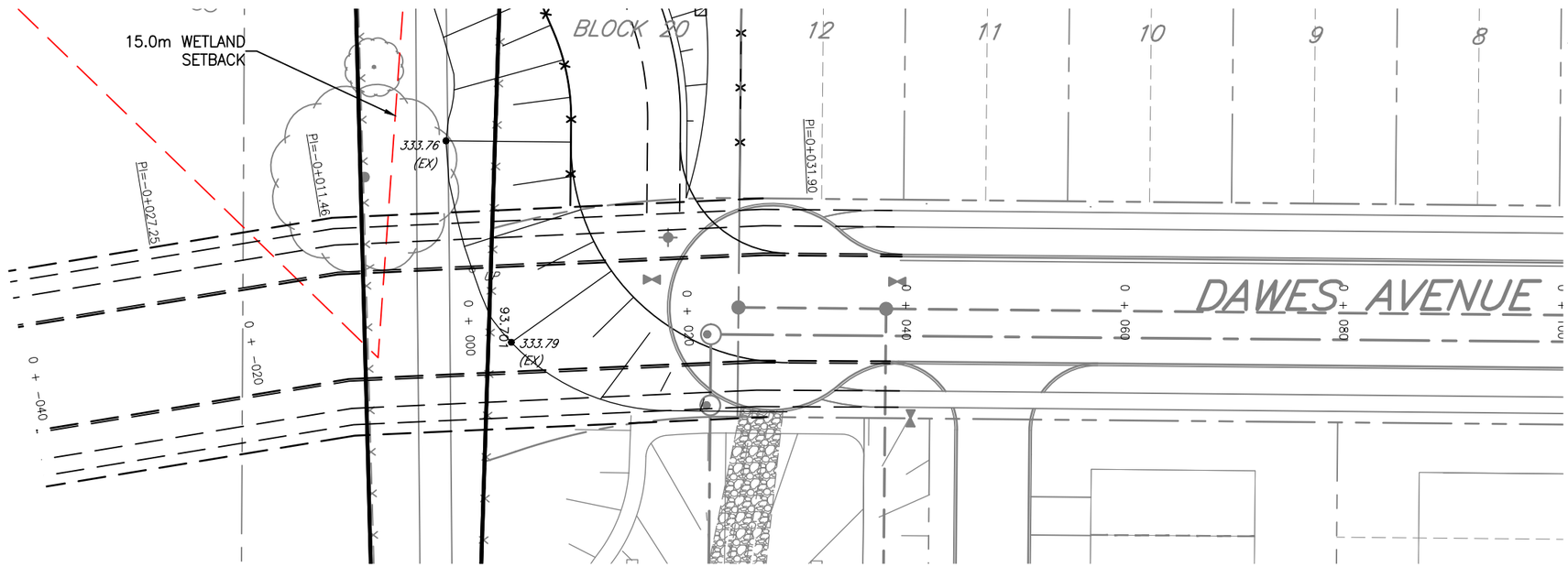
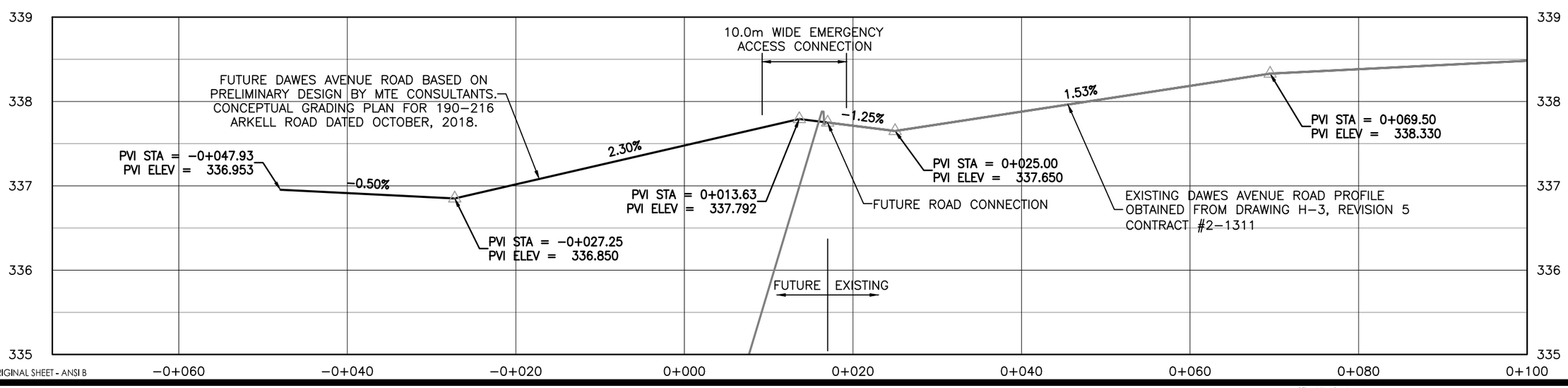
Figure No.
2.0

Title
EMERGENCY ACCESS PROFILE
INTERIM & ULTIMATE





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1:500H 0 5 15 25m
1:50V 0 0.5 1.5 2.5m

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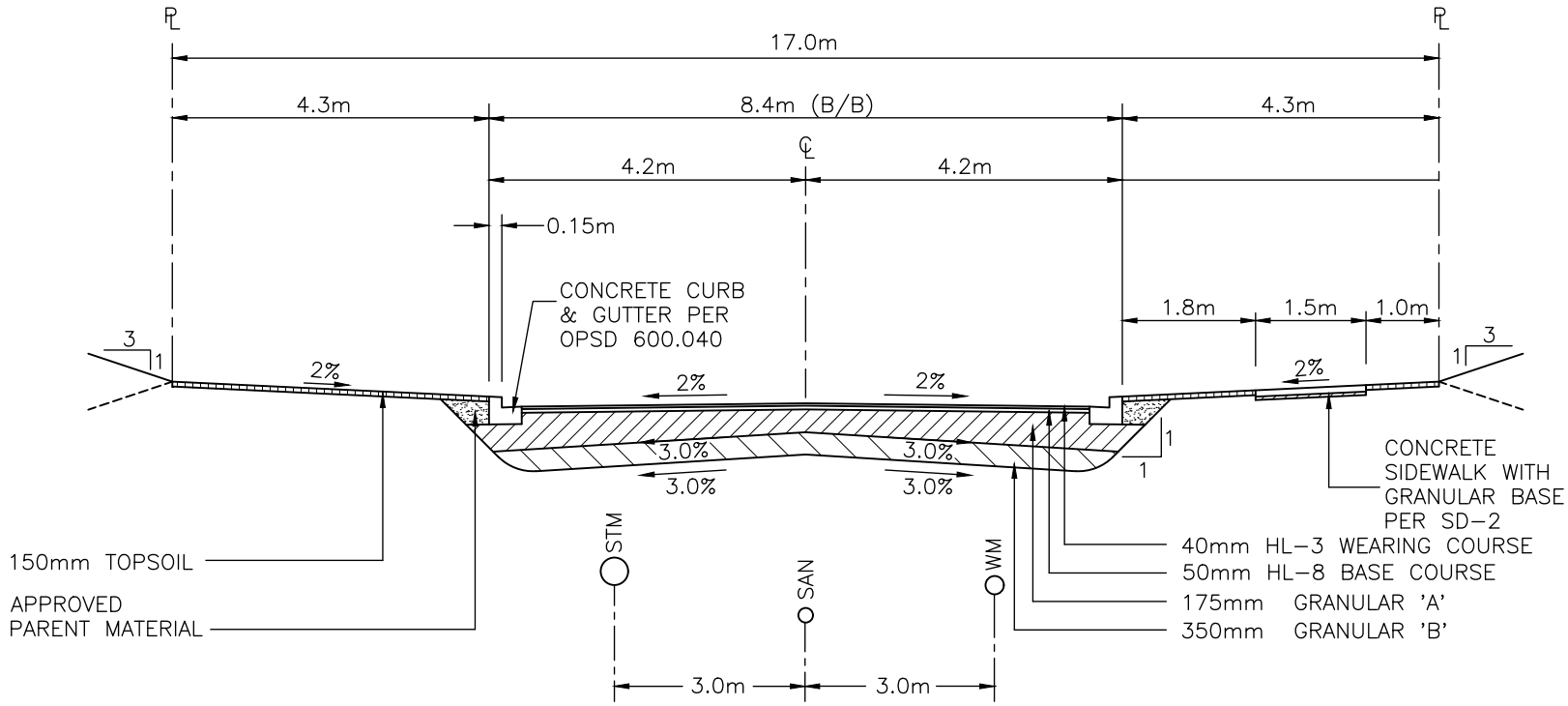
Figure No.
3.0

Title
DAWES AVENUE
CROSS-SECTION & PROFILE



CROSS SECTIONAL POINTS		
DESCRIPTION	VERTICAL OFFSET FR. C/L	HORIZONTAL OFFSET FR. C/L
EDGE / PAVEMENT	-0.074	3.70
GUTTER LINE	-0.099	4.00
TOP / CURB	+0.051	4.20
FRONT / WALK	+0.087	6.00
BACK / WALK	+0.117	7.50
PROPERTY LINE	+0.137	8.50

TYPICAL ROAD CROSS-SECTION
17.0m R.O.W. (8.4m ROAD)
STREET 'A'
STA. 0+000 TO END

NTS

ORIGINAL SHEET - ANSI A

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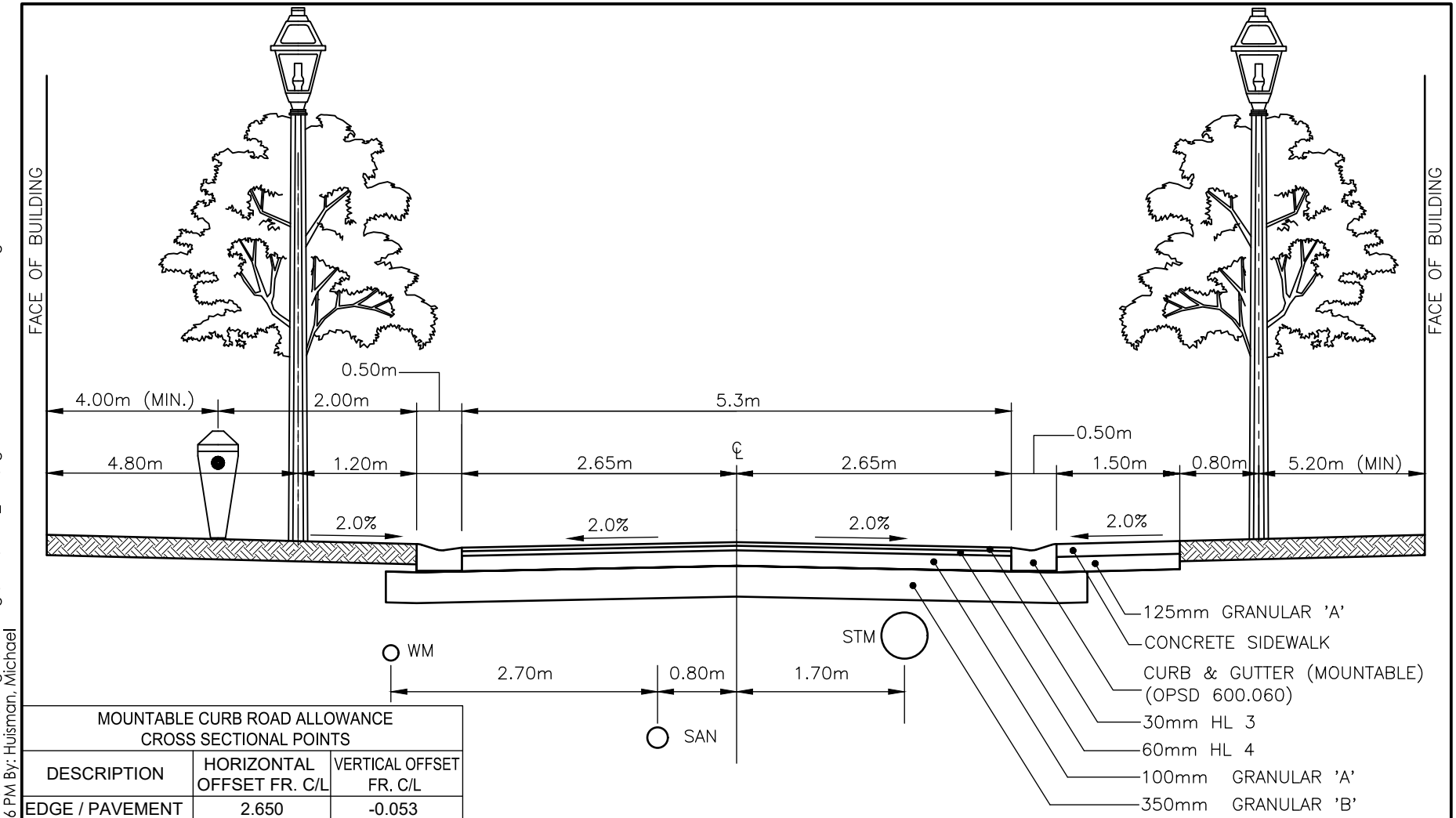
Figure No.
4.0

Title
17.0m RIGHT OF WAY
TYPICAL ROAD CROSS-SECTION



MOUNTABLE CURB ROAD ALLOWANCE CROSS SECTIONAL POINTS		
DESCRIPTION	HORIZONTAL OFFSET FR. C/L	VERTICAL OFFSET FR. C/L
EDGE / PAVEMENT	2.650	-0.053
GUTTER LINE	2.925	-0.078
TOP / CURB	3.150	-0.003
FRONT / WALK	3.150	-0.003
BACK / WALK	4.650	0.027

ORIGINAL SHEET - ANSI A

FUTURE MULTI–FAMILY BLOCK TYPICAL ROAD CROSS–SECTION

March, 2019
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Figure No.
5.0

Title
MULTI-FAMILY BLOCK
TYPICAL ROAD CROSS-SECTION

3.0 SANITARY SERVICING

3.1 ULTIMATE SERVICING

As part of the VPV Subdivision, a 300 mm dia. sanitary sewer was extended from the trunk line on Victoria Road into the aforementioned Development. This sanitary sewer provides an outlet for the VPV Subdivision as well as makes provision to service the upstream lands south of the VPV Development as shown in the approved Sanitary Drainage Area Plans included in Appendix C.

The VPV sanitary servicing strategy accounted for one 200 mm dia. outlet located on Poole Street to accommodate 7.0 ha of external lands. This outlet is located east of the subject property and access to this outlet is not available.

For this Report, we are demonstrating the ability to accommodate flow from the subject Development by making a connection at the intersection of Hutchison Road and Jell Street intersection within the VPV Subdivision and providing a sewer connection south to the north limits of subject Development.

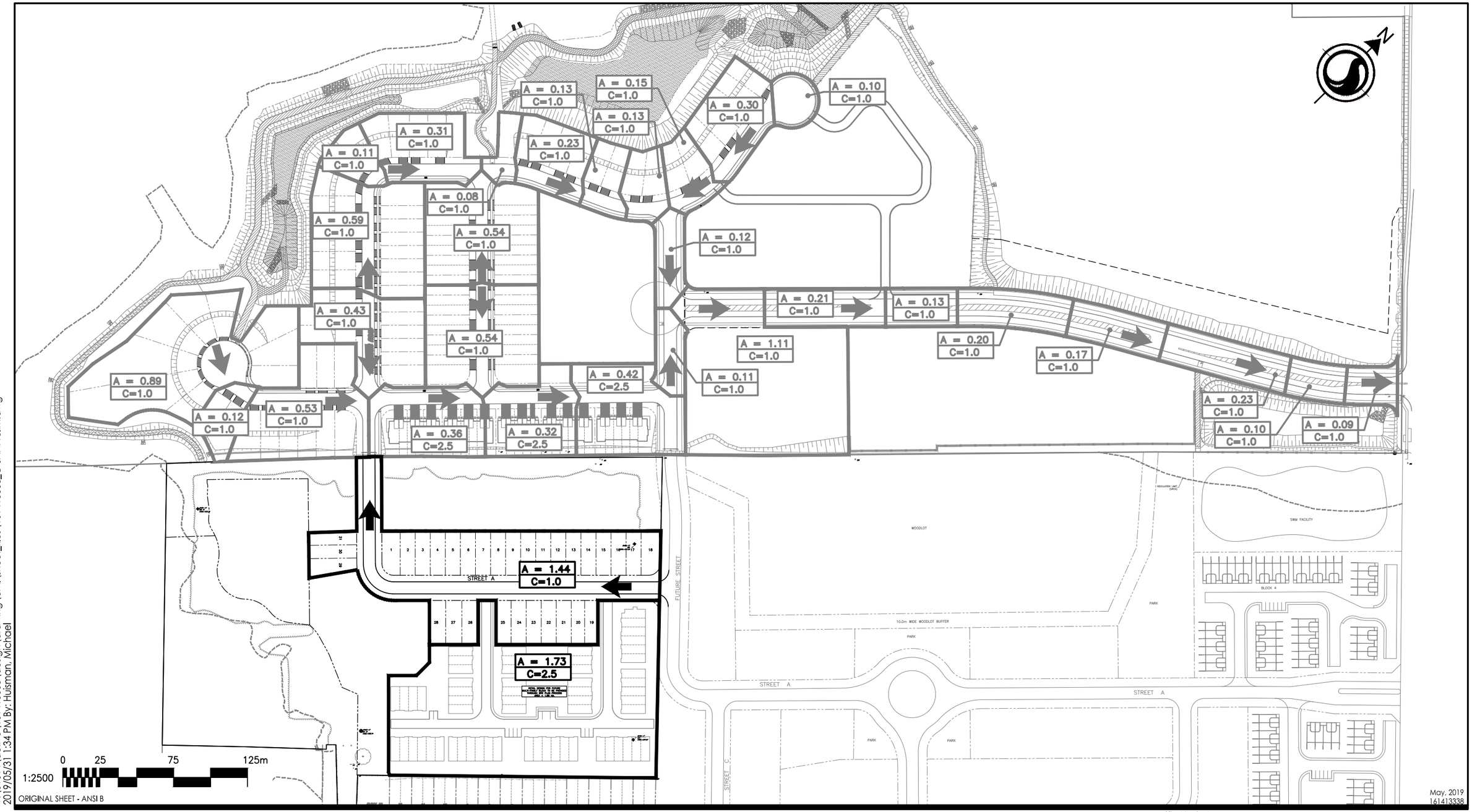
Local sanitary sewers of 200 mm dia. will be constructed throughout the proposed subject lands and within the proposed roadway for Street A and a service stub will be provided for the future Multi-family Block.

Based on the City of Guelph Design Manual, when calculating the sanitary flow, the proposed or future zoning/density for the Development is to be utilized. Single-family homes are designed based on a factor of 1.0 L/s/ha and Multi-family Block based on 2.52 L/s/ha equating to a total flow of 5.64 L/s/ha from the subject Development. Please refer to our Sanitary Drainage Area Plan, Figure 6.0.

With our proposed sanitary servicing strategy of making a connection at the Hutchison Road and Jell Street intersection, by inserting this flow we confirm there is sufficient capacity in the downstream sewers within the VPV Subdivision to accommodate the subject lands. Please refer to our (post-development) Sanitary Design Sheet in Appendix C.

In conclusion, routing the flow from the Development up to the Hutchison Road intersection does not adversely affect the sanitary sewers downstream.

Onsite sewers will have adequate capacity and will be installed at sufficient depths to enable servicing the subject lands by gravity. Please refer to the Conceptual Servicing Plan Drawing No. C-100 (Appendix A) for an illustration of the sanitary servicing strategy.



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May, 2019
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A = 1.68 / C=2.5	PROPOSED DRAINAGE AREA (HECTARES) SANITARY CO–EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	PROPOSED FLOW DIRECTION
	PROPOSED DRAINAGE BOUNDARY
A = 1.68 / C=2.5	EXISTING DRAINAGE AREA (HECTARES) SANITARY CO–EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	EXISTING FLOW DIRECTION
	EXISTING DRAINAGE BOUNDARY

Notes

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Figure No.
6.0

Title
SANITARY DRAINAGE AREA PLAN

4.0 WATER DISTRIBUTION SYSTEM ANALYSIS

The proposed water servicing layout is show on the Conceptual Servicing Plan, Drawing No. C-100 (Appendix A).

Water supply for domestic water service use and fire protection to the proposed Development will be provided by a single connection in the interim to the existing 150 mm diameter watermain stub on Hutchison Road.

The Internal watermains will be terminated at the east limits of Street A with the intention of 'looping' the watermain back to the adjacent Development to the east providing the ultimate connection back to existing Poole Street to the north.

The proposed residential units will be provided with 25 mm dia. water service connections from the 150 mm dia. watermain and a 150 mm dia. water stub will be provided at the property limits of the Multi-family Block.

Watermain flow and pressure analysis to confirm appropriate supply and capacity for the subject Development will be completed by the City of Guelph at a later time

5.0 STORMWATER MANAGEMENT

5.1 OVERVIEW

This section has been completed in support of the proposed development located at 220 Arkell Road within the Torrance Creek watershed in the City of Guelph. As mentioned in previous sections of this Report, the subject property is approximately 7.2 ha in size and is generally bounded by Victoria Park Village Subdivision to the North, existing woodlot and greenfield property to the East, developed and established Arkell Meadows Subdivision to the South and a large wetland and woodland to the West. The Proposed Draft Plan consists of 31 single-family lots on a single road, a multiple-family residential block, a SWM block, a wildlife corridor, and a wetland setback. The total developable area is 4.4 ha. The described areas are illustrated on Figure 1.0 – Site Location Plan and the Proposed Draft Plan included in Appendix A.

This section outlines the analysis undertaken to assess the existing hydrology for the site and design a SWM system to meet the City of Guelph criteria using traditional SWM and Low Impact Development (LID) features to achieve the water quantity and water quality targets.

5.2 BACKGROUND

A following sources have been referenced during the preparation of this Report in addition to the documents referenced in Chapter 1.0, Section 1.2 and should be read in conjunction with this Report:

- *Letter Re: 220 Arkell Road – Response to Stormwater Management City Comments Dated July 19, 2018,* Stantec Consulting Ltd., November 5, 2018
- *City of Guelph Development Engineering Manual*, City of Guelph, November 2018
- *Low Impact Development Stormwater Management Planning and Design Guide*, Credit Valley Conservation Authority and Toronto and Region Conservation Authority, 2010
- *Stormwater Management Planning and Design Manual (SWMPD Manual),* Ontario Ministry of the Environment, March 2003
- *Torrance Creek Subwatershed Study (TCSS), Management Strategy Addendum*, Totten Sims Hubucki et al, January 1999
- *Eramosa River Watershed Hydrology Study*, H.O. Schroeter and D.K. Boyd, 1998

5.3 DESIGN CRITERIA

SWM criteria were established based on the *Torrance Creek Subwatershed Study* (TCSS) and the characteristics of the receiving systems. The SWM criteria applied to the site are as follows:

- Water Quality – Provide quality control to meet MECP Enhanced (Level 1) criteria as identified in Table 3.2 of the SWMPD Manual
- Water Quantity – Control post-development peak flows to Torrance Creek, to target flow rates from the TCSS. Target peak flow rates have been pro-rated to the developed area
- Extended Detention – Provide at least 24 hours of extended detention of the 25 mm event
- Infiltration – Evaluate the infiltration potential on site as it relates to the existing water budget and maintain existing infiltration rates on the site where possible
- Temperature – The thermal impacts of stormwater discharge to Torrance Creek be assessed and appropriate mitigation practices implemented
- Erosion and Sediment Control – Provide appropriate erosion and sediment control during construction to protect neighbouring properties and downstream receivers from potential siltation

5.4 EXISTING CONDITIONS

5.4.1 Geotechnical Information

As identified in the Geotechnical Investigation, the soils for the site are comprised of sand or fill overlaying glacial till, which was generally comprised of silty sand and gravel till.

Groundwater was measured in four (4) onsite boreholes with measurements during spring conditions in April 2017 ranging from 333.19 mASL in the north-west corner of the site to 337.10 mASL in the south-east corner of the site. Groundwater levels were also monitored from April 2017 to May 2018 as part of the *Hydrogeological Assessment* (Stantec, 2019) with the above reported levels representing the seasonally high levels for the site. Groundwater generally flows from east to west towards the Torrance Creek Swamp PSW.

Estimates for infiltration rates were calculated based on percolation times determined in the *Geotechnical Investigation* (Stantec, 2019) which were based on soils from borehole logs. Percolation times were estimated for Glacial Till and Sand onsite and ranged from 8 min/cm to 50 min/cm. Using the approach outlined in the *LID SWM Planning and Design Manual* (CVC/TRCA, 2010), the factored infiltration rates were determined to range from 4.8 mm/hr to 30 mm/hr based on the above percolation times. These factored infiltration rates use the required safety factor of 2.5 for areas where the soil horizon is found to be continuous within 1.5 m below the proposed bottom elevation of the infiltration trench. It is recommended that in-situ infiltration tests be performed at detailed design at the locations and depths of any proposed infiltration measures to confirm that the soils are sufficiently permeable.

5.5 STORWMATER MANAGEMENT DESIGN

5.5.1 Hydrologic Modeling

Per City of Guelph requirements, a hydrologic model was prepared using the software program MIDUSS to simulate drainage conditions for the subject development under proposed development conditions. The model was employed to predict flows and design a SWM system to ensure the design criteria are achieved. An existing conditions model was not prepared since all flow targets for the site are based on unit requirements from the TCSS.

Precipitation events were taken from the TCSS and are based on a regional analysis due to a lack of long-term streamflow information for Torrance Creek. A large known rainfall pattern (Hurricane Hazel) was selected and its volume and intensity adjusted to known return-period streamflows in Torrance Creek, similar to the Eramosa River Watershed Hydrology Study (Schroeter and Body, 1998). Table 1 presents the rainfall adjustment factors taken from Table 4.6.3 of the TCSS.

Table 1: Rainfall Factors Applied to the Regional Storm Pattern to Match Frequency Flows in the Eramosa River Watershed

Return Period	Adjustment Factor (Table 4.6.3 in TCSS)	Last 24-hour Volume (mm)
2-year	0.345	81.8
5-year	0.425	100.7
10-year	0.495	117.3
25-year	0.525	124.4
100-year	0.627	148.6

The 25 mm rainfall event was used in the design of infiltration and erosion control measures for the site and not considered from a peak flow or quantity control perspective as a target rate for the 25 mm event is not included in the TCSS.

5.5.1.1 Existing Conditions

The existing drainage conditions for the site were originally delineated in the TCSS and have been updated based on revised topographic information of the site. The original subcatchments are illustrated on Figure 4.6.1 from the TCSS (provided in Appendix D). The site covers three (3) of the TCSS subcatchments. A detailed topographic survey of the site was completed to improve the accuracy of the existing drainage patterns. The hydrologic model only includes the portion of the site that is proposed for development.

The existing conditions catchment delineation is based on the original delineation shown on Figure 4.6.1 of the TCSS. The revisions are shown on Figure 7.0 and are summarized as follows:

- Catchment 105: 0.85 ha of wooded/wetland area at the west end of the site draining to Torrance Creek
- Catchment 106: 3.85 ha of agricultural land, some forested and lawn coverage, and a residential property including a driveway and several buildings draining from west to Torrance Creek
- Catchment 110: 2.47 ha of mostly agricultural and lawn area with a portion of the residential building draining northeast, eventually to Torrance Creek

Additionally, the Arkell Meadows Subdivision is located immediately south of the proposed site.

No existing conditions hydrologic model was created for this site as the target flow rates are based on pro-rated targets from the GAWSER hydrologic model created for the TCSS. Details for specific subcatchments were taken directly from the output of the GAWSER model and are included in Appendix D. A summary of the peak flow rates for each of the TCSS catchments relevant to the subject site is presented in Table 2. Calculations are provided in Appendix D.

Table 2: Existing Conditions Unit Flow Rates from TCSS

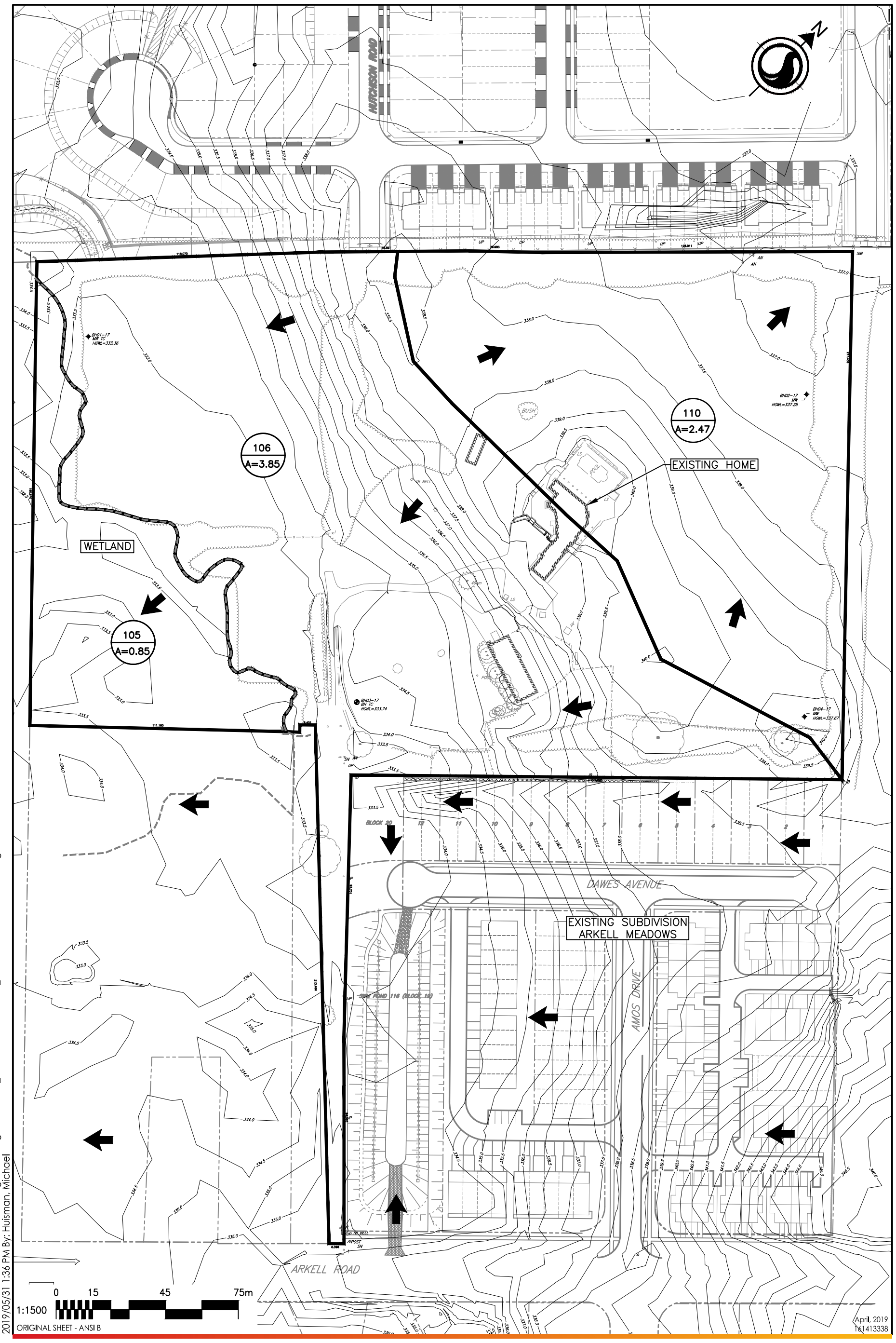
TCSS Catchment within Subject Lands ID	TCSS Point of Interest ID (from Table 6.2.2 in TCSS)	Unit Flow Rates ($m^3/s/ha$)			
		2-year event	5-year event	20-year event	100-year event
105	505	0.0002	0.0003	0.0003	0.0003
106	505	0.004	0.006	0.010	0.013
110	510	0.004	0.006	0.009	0.012

5.5.1.2 Proposed Conditions

The proposed development incorporates primarily Presidential land use with an onsite Stormwater Management Facility (SWMF) located adjacent to the Torrance Creek Swamp PSW. As per City of Guelph Standards, preliminary estimates for Horton infiltration parameters were used for each catchment based on land use and soil type and are provided in Appendix D.

MIDUSS modelling files are provided in Appendix D. The delineation of the proposed drainage catchments is provided on Figure 8.0 and is summarized as follows:

- Catchment 200: 2.73 ha of internal drainage from single family homes, multi-family block, and roadway draining to the onsite SWMF
- Catchment 201: 1.06 ha of naturalized area (ecological linkage) draining uncontrolled, offsite to the neighbouring site
- Catchment 202: 0.36 ha of park area draining uncontrolled to Torrance Creek



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100 / A=1.57 — CATCHMENT ID (FROM TCSS FIG 4.6.1) / CONTRIBUTING AREA (ha)

MAJOR OVERLAND FLOOD ROUTE

DRAINAGE BOUNDARY

REGULATION LIMIT

Client/Project

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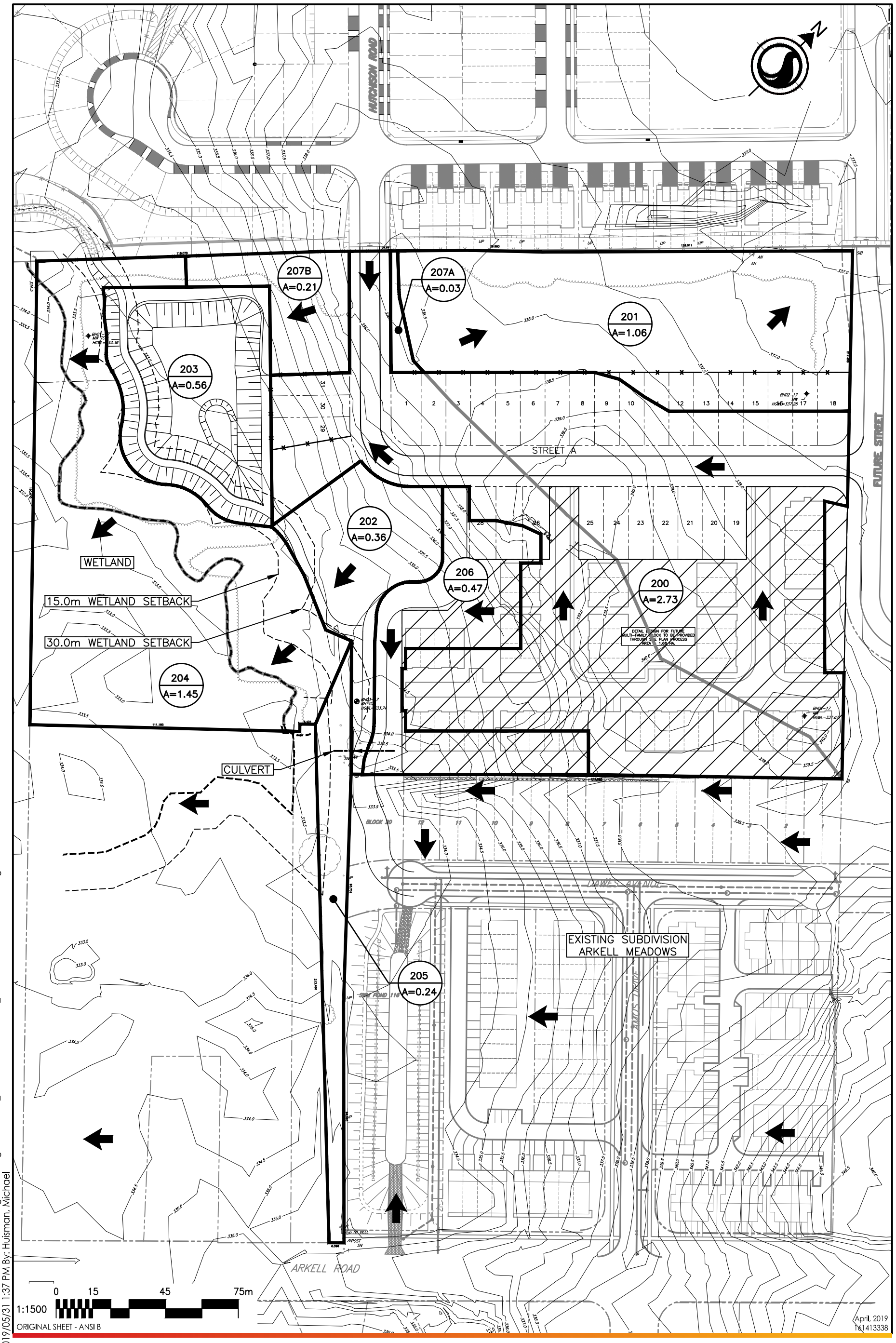
Figure No.

7.0

Title

EXISTING CATCHMENTS



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100 / A=1.57 — CATCHMENT ID / CONTRIBUTING AREA (ha)

MAJOR OVERLAND FLOOD ROUTE

PROPOSED DRAINAGE BOUNDARY

EXISTING DRAINAGE BOUNDARY FROM TCSS

REGULATION LIMIT

MULTI BLOCK

Client/Project

ROCKPOINT PROPERTIES INC.
220 ARKELL ROAD, GUELPH

Figure No.

8.0

Title

PROPOSED CATCHMENTS

- Catchment 203: 0.56 ha representing the onsite SWMF Block
- Catchment 204: 1.45 ha forested/wetland coverage including the required buffer distance remaining undeveloped and draining to Torrance Creek
- Catchment 205: 0.24 ha of existing driveway draining uncontrolled to Torrance Creek
- Catchment 206: 0.47 ha of asphalt pathway and rear yards draining to a low-lying area before spilling to Torrance Creek via a proposed culvert. Ponding occurs in the low-lying area, similar to existing conditions, promoting infiltration and delaying flows to the wetland to mimic the current flow regime. This area accounts for the 10 m wide access to the site from Dawes Avenue, which will eventually be reduced to just a 3 m wide pathway
- Catchment 207A: 0.03 ha of naturalized area (ecological linkage) draining uncontrolled, west through the proposed wildlife crossing culvert and subsequently to Torrance Creek (around proposed SWMF)
- Catchment 207B: 0.21 ha of naturalized area (ecological linkage) draining uncontrolled, west to Torrance Creek (around proposed SWMF)

5.6 STORMWATER MANAGEMENT STRATEGY

The proposed stormwater management strategy adheres to the Guidelines as presented in the *SWMPD Manual* (2003) and *City of Guelph Development Engineering Manual* (November 2018).

The strategy incorporates a combination of lot level and centralized infiltration trenches to promote groundwater recharge of rooftop runoff and an end of pipe dry SWMF promoting infiltration and quantity control. A treatment train approach using an Oil/Grit Separator (OGS) unit in series with a forebay in the dry SWMF has been designed to achieve the required quality control target. The preliminary calculations and design of the SWM components are described in the following sections. All design calculations are provided in Appendix D.

The target rates for the proposed SWMF are pro-rated and are based on the contributing areas from each TCSS catchment. They are presented in Table 3. Proposed Catchments 201, 204, and 207 have not been included in the calculations or modelling as they will remain undeveloped from existing to proposed conditions and will therefore not change hydrologically. See Appendix D for calculations.

Table 3: Pro-rated Target Rates for SWMF from TCSS Existing Conditions

	Rainfall Events			
	2-year	**5-year**	**25-year**	**100-year**
Pro-rated Target Peak Flow Rates (m^3/s)	0.02	0.03	0.04	0.05

5.6.1 Water Quality Control

The water quality requirement for the site is to achieve the long-term removal of 80% TSS (Level 1) from developed areas. This will be achieved using a treatment train approach per City of Guelph criteria. To treat runoff from the developed portion of the site, the grading and servicing have been designed to convey 'clean' runoff (i.e., rooftop areas) to infiltration facilities where a groundwater separation of 1 m (minimum) is achieved. 'Clean' runoff does not require additional treatment to remove TSS prior to entering the subsurface infiltration facilities and is therefore directly connected via dedicated roof leaders to the infiltration facilities. The remaining impervious portions of the site consisting of parking, roadways, and drive isles require treatment prior to infiltration.

Runoff from all roads, driveways and other impervious surfaces enters the onsite storm sewer system which connects to an OGS unit prior to discharging to the end of pipe facility. The OGS unit provides initial removal of TSS and oil from the runoff while a combination of a forebay and the end of pipe dry SWMF provides additional sediment removal. The forebay has been sized to provide 'Enhanced' sediment removal in the SWMF as well as provide an isolated location of sediment deposition to facilitate the cleanout and maintenance of the SWMF. The remaining areas flowing uncontrolled from the site are pervious or undeveloped and do not require water quality treatment.

The proposed OGS unit (EF10 or approved equivalent – must meet the Canadian Environmental Technology Verification Program per City of Guelph requirements) has been sized to provide 60% TSS removal for the contributing area (refer to OGS Sizing Calculations in Appendix D); however, it is understood that the City of Guelph recognizes OGS units only provide up to a long term TSS removal of 50% due to long-term maintenance concerns. Therefore, following treatment by the OGS, runoff flows to a forebay at the inlet of the end of pipe 'dry' SWMF to provide further treatment as well as to isolate sediment to facilitate future cleanouts. Per Table 3.2 in the *Stormwater Management Planning and Design Manual* (MOE, 2003), the dry SWMF can provide up to 60% TSS removal. In addition, the dry SWMF is intended to promote end-of-pipe infiltration due to its raised outlet configuration. As such, minimal runoff is anticipated during smaller, more frequent rainfall events thereby reducing sediment loading to the downstream receiver.

Overall, with the OGS achieving a 50% TSS removal efficiency and the dry SWMF achieving another 60% TSS removal minimum (without accounting for the end-of-pipe infiltration), the combined TSS removal rate between these two systems conservatively achieves the required 80% TSS removal efficiency.

Sizing of the OGS is provided in Appendix E. SWMF design characteristics are summarized in Table 4, with detailed design calculations provided in Appendix D.

5.6.2 Water Quantity Control

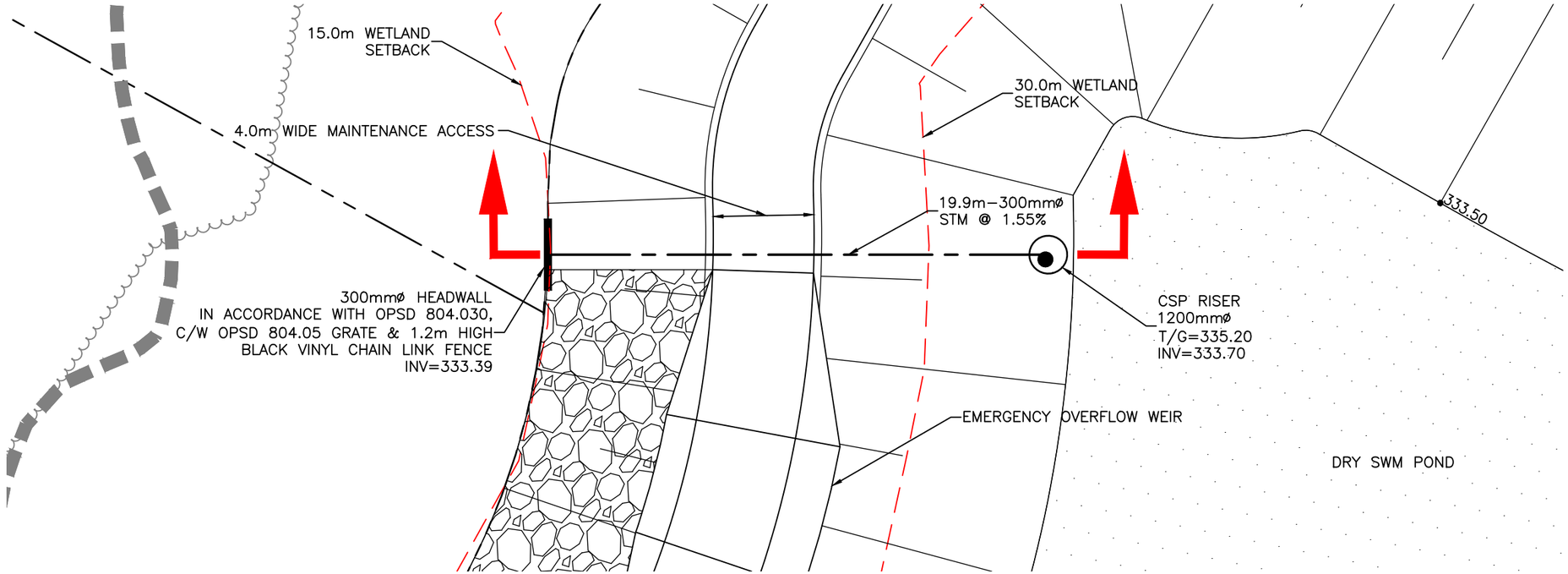
To meet the target peak flow rates as outlined by the TCSS, control for the site will be provided through a combination of lot level and end-of-pipe controls. Lot level and centralized infiltration trenches provide retention for all storms up to and including the 4-hour, 25 mm rainfall event while an end of pipe dry SWMF provides detention prior to discharging to the adjacent wetland. Additionally, the end of pipe dry SWMF has been designed with a raised outlet to promote infiltration in the bottom 0.2 m of the pond. Modelling for quantity control events only accounted for active storage above the 0.2 m of infiltration in order to provide a conservative estimate of volumes and flow rates in the event that the infiltration portion of the pond is saturated prior to a rainfall event. Further discussion on the infiltration measures is described in Section 5.7. The proposed end-of-pipe SWMF is located at the northwest corner of the site, adjacent to the Torrance Creek Swamp PSW and provides attenuation for runoff from the majority of the site including roadways, driveways, rooftops and landscaped coverage. The design uses a dry SWMF configuration with an upstream OGS unit to provide an enhanced level of water quality control (as discussed above) with a maximum ponding elevation of approximately 335.06 m during the 100-year return-period rainfall event.

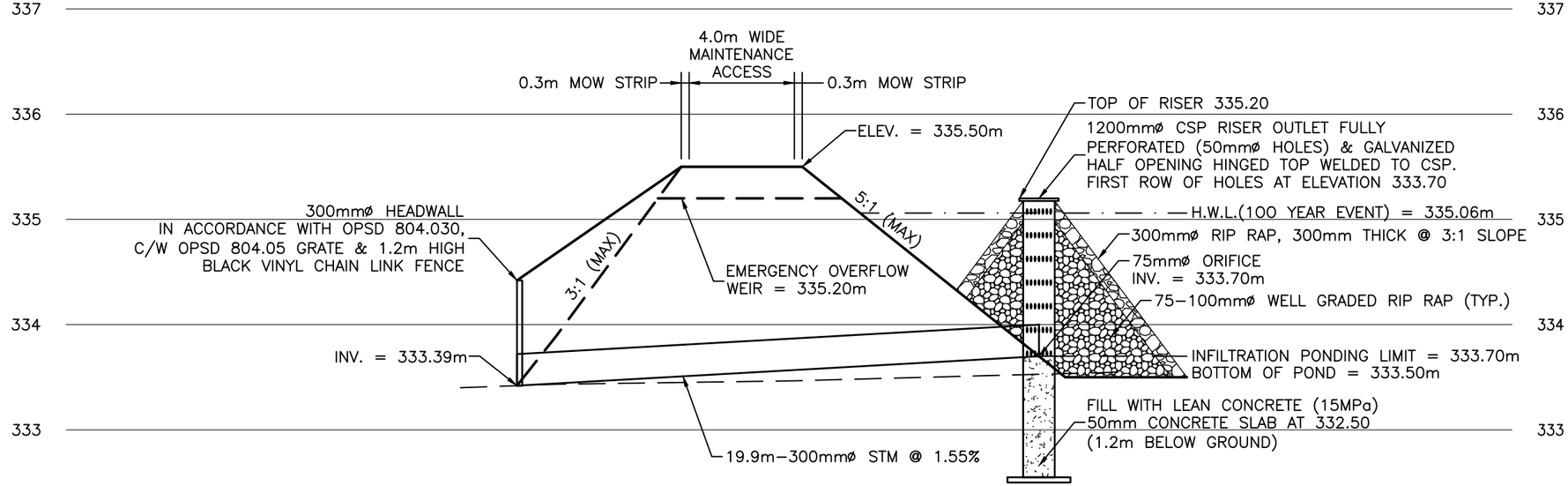
The preliminary outlet structure for the dry SWMF consists of a low flow orifice to meet the peak flow targets outlined by the TCSS and an overflow emergency weir in the event the orifice gets clogged or for rainfall events larger than the 100-year event. Details of the outlet structure are provided in Table 4 and shown on Figure 9.0 with further details and calculations provided in Appendix D.

Table 4: SWMF Design Characteristics

Parameter	Basin Characteristics
Total Contributing Area (Including Major Flow Drainage)	3.5 ha
Total Contributing Area req. Quality Control	2.8 ha
Total Percent Impervious	65%
Bottom Elevation of forebay	333.00 m
Bottom Elevation Dry Facility	333.50 m
Facility Top Elevation	335.50 m
High Water Level (100-Year Storm Event)	335.06 m
Freeboard Provided Above High Water Level	0.44 m
Orifice Control Outlet	
Orifice 1 Diameter	75 mm
Orifice 1 Invert Elevation	333.70 m
Emergency Weir	
Spillway Width (m)	5 m
Spillway Invert (m)	335.20 m
Side slopes	10:1

Peak flow rates from the proposed SWMF and overall developed site area are summarized in Table 5 with detailed modeling files included in Appendix C. The volumes and depths reported in the table below do not include the bottom 0.2 m of the SWMF that is proposed for infiltration. The facility is proposed to discharge to the adjacent Torrance Creek Swamp PSW. It is recommended at detailed design to explore





ORIGINAL SHEET - ANSI B

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Legend

Scale

1:200H 0 2 6 10m
1:50V 0 0.5 1.5 2.5m

Client/Project
ROCKPOINT PROPERTIES INC.
220 ARKELL ROAD, GUELPH

Figure No.
9.0

Title
SWM POND OUTLET

different methods of dispersing flow to reduce potential erosion effects from discharge to the wetland. The outlet design is illustrated on Figure 9.0.

Table 5: SWMF Operating Characteristics

	Rainfall Event		
	2-year	**5-year**	**100-year**
Pro-Rated Target Rate from TCSS (m^3/s)[1]	0.02	0.03	0.05
Proposed Peak Flow from Facility (m^3/s)	0.01	0.01	0.01
Proposed Peak Flow Site (m^3/s)	0.02	0.03	0.05
Maximum Active Storage Volume (m^3)	1,355	1,795	2,930
Maximum Active Ponding Depth (m)	0.73	0.93	1.36
Maximum Active Ponding Elevation (m)	334.43	334.63	335.06
Drawdown Time (hours)	80	92	118

As shown in Table 5, the peak flow rates from the proposed SWMF and overall site are equal to or less than existing conditions for all storm events and therefore meet the water quantity requirements for Torrance Creek.

Due to the very low release rate targets established for the site based on TCSS requirements, the drawdown times for the proposed SWMF are longer than typically desired; however, reducing the drawdown times would require an increase in peak flow rates which would no longer meet the design targets. The proposed lot level and centralized infiltration measures upstream as well as the infiltration proposed in the SWMF have not been considered in the MIDUSS modelling to provide a conservative estimate of facility volumes; however, realistically these measures will reduce the volume of runoff to the facility and increase the rate at which water draws down. As such, drawdown times are anticipated to be less than those reported in Table 5.

5.6.3 Surface Water to the PSW

The existing Arkell Meadows Subdivision calculated a 41% increase in runoff to the adjacent PSW from pre-development to the current condition (17 mm/year to 24 mm/year). With the proposed access road from the site running through Block 20 to Dawes Avenue, there was an overall post-development increase in the Arkell Meadows site runoff from 24 mm/year to 25 mm/year, or 4%, bringing the overall percentage increase from pre-development to post-development conditions to 47% as identified in City comments in response to *Re: 220 Arkell Road – Response to Stormwater Management City comments dated July 19, 2018* (Stantec, 2018) which is presented in Appendix D . As a result of this concern and as mentioned previously, Stantec proposes a slight change to the access road culvert configuration to mimic the current hydrologic regime and maintain surface flow to the wetland.

Under current conditions along the existing driveway, there is a low-lying area east of the existing driveway at the location of the proposed culvert under the access road/trail where surface water ponds, allowing for infiltration and evaporation prior to spilling west to the wetland (contour 333.5 m. Given the location of the proposed access road and ultimate trail alignment illustrated on Figure 10.0, surface water runoff from Catchment 206 flows west through a culvert and under the road/trail to the PSW. As outlined in *Re: 220 Arkell Road – Response to Stormwater Management City comments dated July 19, 2018* (Stantec, 2018), a culvert is proposed to convey surface flows under the access road/trail to maintain this flow west under proposed conditions; however, to attenuate surface flows to address City of Guelph concerns (i.e., reduce surface flow to the wetland and increase evapotranspiration and infiltration), the proposed culvert is reverse sloped to encourage ponding and infiltration, similar to the existing hydrologic regime, and to match existing grades on the site (natural depression within the site). The specific details of this ponding area will be finalized at detailed design.

5.7 INFILTRATION ASSESSMENT & WATER BALANCE

5.7.1 Water Balance Analysis

Water balance calculations were completed as part of the *Hydrogeological Assessment* (Stantec 2019) for pre-development and post-development conditions to quantity infiltration volumes at the Site and confirm the recharge function.

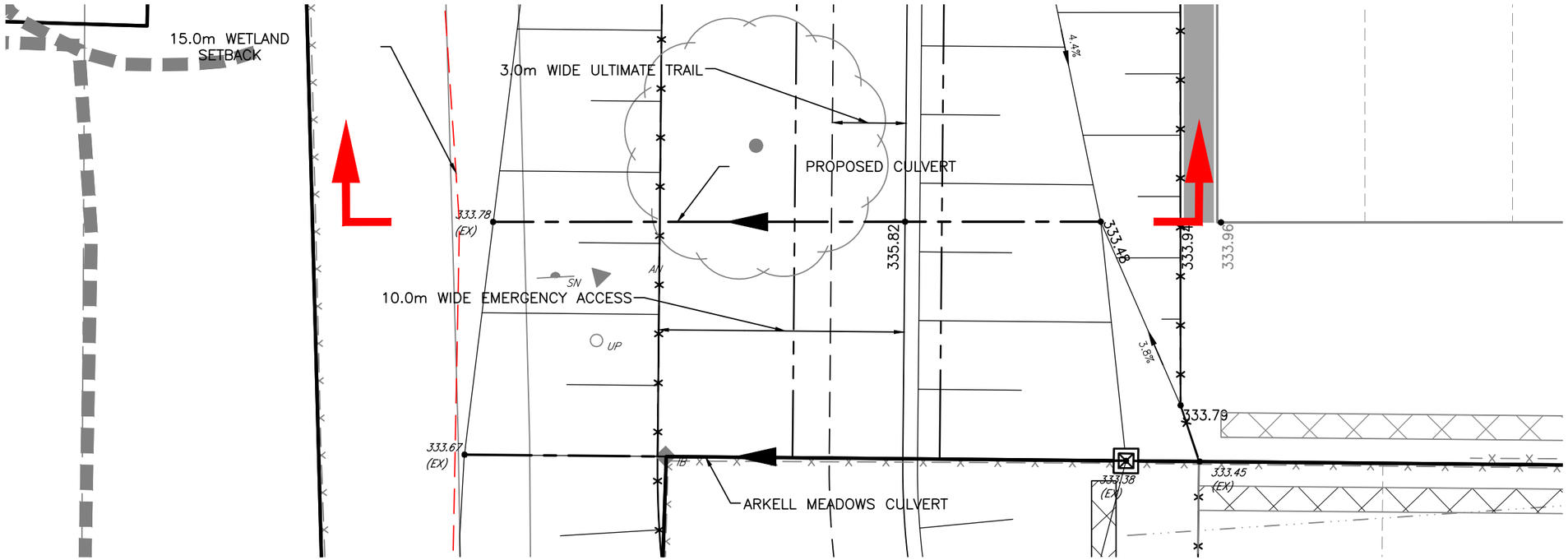
Under pre-development conditions, the average annual volume of infiltration is estimated at 15,950 m^3/year for a rate of 223 mm/year and the average annual volume of runoff is estimated at 10,030 m^3/year for a rate of 140 mm/year. Under post-development conditions, impervious surfaces are expected to cover 39% of the Site (2.8 ha of 7.2 ha), resulting in a projected infiltration volume deficit of 4,910 m^3/year. Details of the calculations and results can be found in the *Hydrogeological Assessment, 220 Arkell Road, City of Guelph, Ontario* (Stantec, 2019).

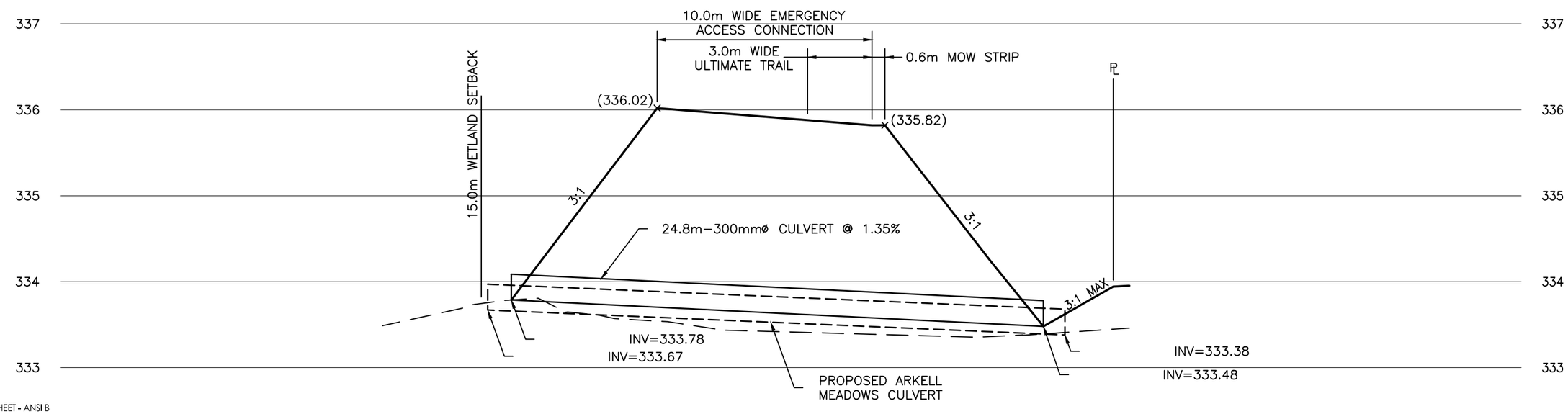
To reduce the infiltration deficit and establish a recharge balance, rear yard soakaway pits and centralized infiltration trenches are recommended to be implemented throughout the site.

Based on the results of the *Geotechnical Investigation* (Stantec 2019), site soils generally consist of a mix of glacial till to sand which are both generally conducive to infiltration practices. As discussed in previous sections, the estimated percolation rates for these soils correspond to factored infiltration rates of 5 – 30 mm/hour; however, per City of Guelph guidelines, it is recommended that in-situ infiltration tests, such as the double-ring infiltrometer or the Guelph permeameter tests, be performed at the detailed design stage at the locations and depths of the proposed infiltration trenches to confirm the underlying soil infiltration rates.

5.7.2 Lot Level and Centralized Infiltration

Rear yard soakaway pits infiltrating roof water are proposed for all single-family homes within the subdivision, provided the separation from the high groundwater table is achieved. Similarly, centralized infiltration trenches are proposed for the multi-family block to direct shared roof areas to recharge locations. Rooftop runoff is considered ‘clean’ and does not require water quality treatment prior to





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1:200H 0 2 6 10m
1:50V 0 0.5 1.5 2.5m

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ROCKPOINT PROPERTIES INC.
220 ARKELL ROAD, GUELPH

Figure No.
10.0

Title
TEMPORARY ACCESS CULVERT CROSS SECTION

infiltrating. As such, roof leaders from all homes are to be directly connected to the soakaway pits or centralized trenches with an overflow provided at grade for single family lots or an overflow connection to the storm sewer for the centralized trenches.

Both soakaway pits and centralized trenches have been sized assuming 40% of the lot is building coverage. This value was taken from *Section 5 – Residential Zones* of the City of Guelph Zoning Bylaw. There will be a mix of different residential units within the subdivision; however, this provides an accurate preliminary estimate on recharge volumes from the development. The average rooftop area has therefore been conservatively estimated as 120 m^2.

5.7.3 End-of-Pipe Infiltration

End-of-pipe infiltration in the dry SWMF is proposed by using a raised catchbasin grate for the SWMF's outlet to encourage ponding and infiltration through the bottom of the facility and to delay the peak flow to the receiving PSW; however, due to the facility's proximity to the PSW, the high groundwater table is close to surface, particularly during spring months, so infiltration is anticipated to occur during the summer and fall months only from June to November when groundwater levels are typically lower (as shown in the appended calculations). Despite this high groundwater condition, it is recommended to incorporate end-of-pipe infiltration to promote recharge to the adjacent PSW for as much of the year as possible. In addition to the groundwater recharge benefits, the ponded water will help to promote evapotranspiration and maintain the natural hydrologic regime of the site.

The infiltration component of the SWMF provides sufficient retention volume to contain the runoff resulting from all rainfall events up to and including the 10 mm rainfall event. This event has been assumed to represent 50% of the average annual rainfall volume.

A key constraint to the proposed infiltration measures on-site is the high groundwater table. Based on the proposed grades and the seasonally high groundwater results from the *Hydrogeological Assessment* (Stantec 2019), the proposed lot level infiltration trenches can maintain at least 1 m of separation from the bottom of the systems to the seasonally high groundwater level for the majority of the site. Trenches are not proposed in areas where this separation is not achieved. This requires the centralized trench locations (particularly in the multi-block) to be located in specific areas to avoid the measured high groundwater table. Monitoring of the high groundwater table is ongoing and design assumptions will be revised, if required, at detailed design.

Details of the proposed rooftop infiltration trenches as well as potential implementation of alternative LID and/or Green Infrastructure (GI) or infiltration measures shall be explored at the detailed design stage of the project.

The post-development water balance values following implementation of the proposed retention practices are presented in Table 6.

Table 6 - Results of Site Water Balance

Site Condition	Site Area (ha)	Annual Volumes (m^3/yr.)			
		Rainfall	ET	Runoff	Infiltration
Pre-Development	7.2	65,580	39,610	10,030	15,950
Post-Development			28,220	26,330	11,040
Post-Development with Infiltration			28,220	17,480	19,880

By implementing the recharge augmentation practices, there is a recharge surplus of 3,930 m^3/year, a runoff surplus of 7,450 m^3/year, and an ET deficit of 11,390 m^3/year.

5.7.4 Consideration of Multi-Block

At this stage in the design, the site plan for the multi-family block is unknown. It is assumed that all rooftop areas within the block can and will be directed to centralized infiltration trenches to achieve the intended recharge target. At a minimum, the multi-family block must infiltrate all rainfall events up to and including the 25 mm storm from all rooftops (assumed rooftop coverage is 6,000 m^2 or approximately 30% of the block) for a total average annual rooftop infiltration volume of 3,500 m^3/year. This is the target annual recharge volume for the multi-block and should be met at the Site Plan Approval stage.

5.7.5 Interim Access Road

In addition to the water balance and infiltration assessment conducted within the site boundaries, an assessment was conducted for the addition of a 10 m wide maintenance access path connecting to Dawes Avenue to the south of the site. Details of this assessment are documented within a letter from Stantec to the City of Guelph, sent on November 5, 2018 *Re: 220 Arkell Road – Response to Stormwater Management City comments dated July 19, 2018*, which has also been included in Appendix D for reference. The maintenance access increases the impervious area slightly within the site to the south but was shown to not result in a significant change in the overall water balance or affect the function of the rear-yard infiltration trench.

6.0 STORM SERVICING

Storm drainage for the proposed Development will discharge at a single outlet. The storm sewer system will convey run-off and lot level flows from the single-family units and Multi-family Block and drain via servicing easement between the Park Block and single-family lotting discharging to a dry pond SWMF along the west limits of the subject Development. The major overland flow for the route follows generally the same path with the route following the servicing easement west into the main cell of the dry pond SWMF.

The proposed storm sewer system will be designed to convey all minor storm events or those less than 5-year return-period, as per the City of Guelph Standards. The conveyance system for major flow events or those greater than a 5-year return-period frequency will be confined to the road Right-of-Ways and generally mimics the direction of the minor system.

7.0 EROSION AND SEDIMENT CONTROL PLAN

An Erosion and Sediment Control Strategy will be completed during the final design and implemented during the construction process in order to minimize the potential for offsite discharge of sediment and the resultant negative environmental impacts. This Plan will focus on the protection of downstream watercourses and lands.

7.1 EROSION POTENTIAL

The *Greater Golden Horseshoe Area Conservation Authorities' Erosion and Sediment Control Guideline for Urban Construction* (2006) was used to determine the erosion potential of the site. The erosion potential is based on slope gradient, slope length and soil texture and is then used to determine the appropriate erosion control methods, as follows:

- Site Slopes: Moderate (2-10%) – average slope is approximately 3.0%
- Slope Lengths: Long (generally greater than 30 m)
- Erodibility Factor: For Silty Sand, K = high

Therefore, based on this classification, the site has a high erosion potential.

7.2 PRELIMINARY EROSION AND SEDIMENTATION CONTROL PLAN

The following approach to erosion and sediment control onsite has been prepared to minimize the potential impacts associated with onsite erosion and/or offsite transport of sediment.

Prior to any grading or servicing works commencing onsite, erosion and sedimentation control measures shall be implemented as detailed on the Pre-grading, Erosion and Sedimentation Control Plans (prepared during detail design). The erosion and sedimentation controls will include the following items:

- Steep slopes (>3:1) shall have erosion blankets
- Light and/or heavy-duty silt fencing will be erected on all site boundaries where there is potential for runoff to be discharged offsite, to protect adjacent downstream lands from migration of sediment in overland flow. The location of this fencing will be adjacent to the limit of grading. Silt fence attached to paige wire fencing will be installed periodically throughout the site adjacent to sensitive areas. Silt fencing should be erected before grading begins to protect adjacent and downstream areas from migration of sediment in overland flow
- Storm service outlets will be installed during servicing and roadworks construction to provide lot level dead and live storage

- Erosion control berms/swales will be located in appropriate (critical) areas to divert flows to temporary sediment basins

- A construction entrance feature ("mud-mat") will be provided at all site entrances to minimize the offsite transport of sediment via construction vehicles

- Swales constructed onsite will have temporary rock check dams to help attenuate flows and encourage deposition of suspended sediment where appropriate

- All disturbed areas where construction is not expected for 30 days shall be re-vegetated with 50 mm of topsoil and hydro-seeding according to OPSS 572

- During construction, all catchbasins are to be sealed until roads are paved to prevent sediment deposition in the catchbasin's sumps and conveyance of silt to the SWMF

- An Erosion Control Implementation Schedule has been included with the Detailed Erosion and Sedimentation Control Plan, prepared in conjunction with the pregrading application and/or final engineering design

- Following completion of construction, defined as 90% house construction, and site stabilization, all erosion and sediment control measures and accumulated sediment are to be removed

The erosion control measures shall be maintained in good repair during the entire construction period and shall only be removed as contributing drainage areas are restored and stabilized. In addition, the condition of erosion control works, their overall performance, and any repairs, replacement or modifications to the installed items shall be noted in Monitoring Reports submitted to the Grand River Conservation Authority (GRCA) and the City of Guelph. Monitoring Reports should be submitted bi-monthly (quarterly during periods of inactivity or house construction) and should be based on inspection completed bi-weekly or after any significant rainfall events (>13 mm), whichever is more frequent.

7.3 MONITORING, MAINTENANCE AND MITIGATION

Monitoring and maintenance activities are an important part of a SWM Strategy to ensure the designed features continue to operate as intended. As such, it is recommended that regularly scheduled inspections take place to observe any evidence of sediment deposition or malfunctioning of the proposed infiltration trenches or SWM facility. Given the proximity of the site to the Torrance Creek swamp PSW, the details and frequency of these inspections should be discussed with the City and the GRCA with details provided at the detailed design stage. Similarly, upon receipt of an Environmental Compliance Approval (ECA) from the MECP, the maintenance and monitoring schedule outlined in the ECA should be incorporated into the site development. The inspections should occur following significant rainfall events (where possible) and will also include inspection of the conditions of any temporary SWM controls (such as temporary sedimentation basins and sediment traps).

8.0 UTILITIES

8.1 HYDRO

Hydro is currently supplying the property via an overhead system located on the south side of Arkell Road, adjacent the 220 Arkell property. Guelph Hydro Electric Systems Inc. has indicated that an electrical distribution system will be supplied from the Victoria Park Village Subdivision located northwest of the property. There will be no constraints with providing hydro service to the proposed Development.

8.2 BELL CANADA

Bell has indicated that they would supply the proposed Development with a joint trench from Guelph Hydro Electric Systems Inc. They do not foresee any issues servicing the proposed Development.

8.3 ROGERS CABLE

Rogers Cable Systems will follow the services of Bell Canada. It was indicated by Rogers Cable that services will be supplied from the Victoria Park Village Subdivision and do not anticipate any restraints with servicing the proposed Development.

8.4 GAS

Gas service to the 220 Arkell Development would be provided from the Victoria Park Village Subdivision. Union Gas has expressed that they see no constraints with an extension of distribution.

Hydro, Bell, Cable and Gas lines would be buried within the boulevards per the City of Guelph typical road cross-section.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the finding of this report, it is concluded that:

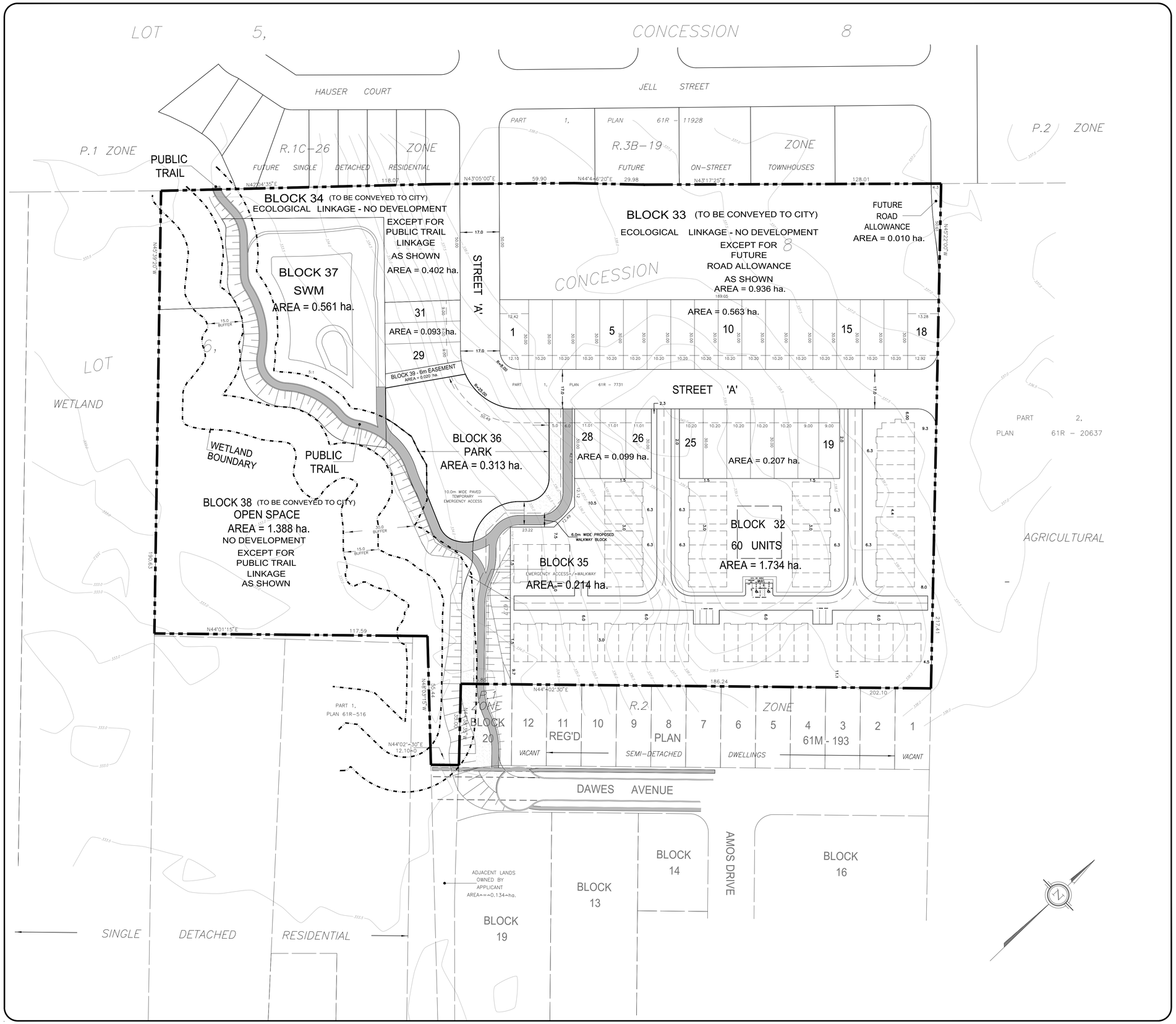
- The proposed 220 Arkell Road Subdivision can be adequately serviced through the connection to the existing sanitary, watermain, and utilities available on Hutchison Road to the north
- Stormwater management for the subject Development can be accommodated by the facility proposed onsite

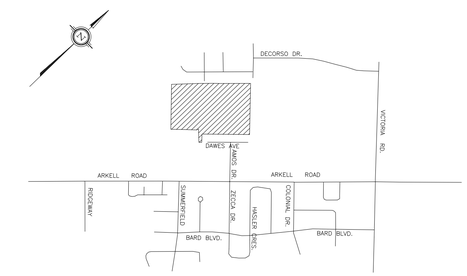
It is further recommended that:

- This report be circulated to the Municipality and various approval agencies in support of Draft Plan of Subdivision Approval for the 220 Arkell Road lands
- Detailed grading and servicing design drawings be prepared, a Final Stormwater Management Report and Erosion Settlement Control Plan be completed once the Draft Plan of Subdivision for 220 Arkell Road lands has been approved

APPENDIX A

Proposed Draft Plan
Existing Conditions Plan (Drawing No. C-050)
Conceptual Servicing Plan (Drawing No. C-100)
Conceptual Plan and Profiles (Drawing No. C-200)
Conceptual Grading Plan (Drawing No. C-400)
Preliminary Cut/Fill Plan (Drawing No. C-900)





KEY PLAN N.T.S. SUBJECT LANDS

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 (17) OF THE PLANNING ACT

51 (17) (a) – (c) AS SHOWN
(d) SEE SCHEDULE
(e) – (g) AS SHOWN
(h) MUNICIPAL WATER SUPPLY
(i) GUELPH LOAM
(j) AS SHOWN
(k) MUNICIPAL STORM AND SANITARY SEWERS
(l) NONE KNOWN

OWNERS CERTIFICATE

WE HEREBY AUTHORIZE BLACK, SHOEMAKER, ROBINSON, AND DONALDSON LIMITED, ONTARIO LAND SURVEYORS, URBAN AND RURAL PLANNERS TO SUBMIT THIS DRAFT PLAN OF SUBDIVISION.

DATE — ROCKPOINT PROPERTIES INC.

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE — IAN D. ROBINSON, ONTARIO LAND SURVEYOR

METRIC

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

RELEVANT INFORMATION

LOTS/BLOCKS	LAND USE	UNITS	AREAS (ha)
LOTS 1 TO 31	SINGLE-DETACHED RESIDENTIAL	31	0.962
BLOCK 32	CLUSTER TOWNHOUSES	60	1.734
BLOCKS 33~&~34	ECOLOGICAL LINKAGE		1.338
BLOCK 35	EMERGENCY ACCESS~/~WALKWAY		0.214
BLOCK 36	PARK SITE		0.313
BLOCK 37	STORM WATER MANAGEMENT		0.561
BLOCK 38	OPEN SPACE		1.388
BLOCK 39	6.0m WIDE EASEMENT		0.020
STREETS	ROADS		0.485
TOTAL		91	7.015 ha.

NOTES:
CONTOURS & ELEVATIONS AND RELEVANT INFORMATION FROM

DRAFT PLAN OF SUBDIVISION

OF PART OF
LOT 6, CONCESSION 8
(GEOGRAPHIC TOWNSHIP OF PUSLINCH)
CITY OF GUELPH
COUNTY OF WELLINGTON

SCALE 1~:~750 (0 10 20 30 40 50 METRES)

BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED
BSR&D Ontario Land Surveyors, Urban and Rural Planners
A wholly owned subsidiary of J.D.Barnes Ltd.
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FAX: (519) 822-1220
WWW.BSRD.COM

DATE: APRIL 3, 2019
DRAWN BY: KS
PROJECT 16-14-118-00-B

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Notes

1. BENCHMARK:
   ND-27 RWW374.3
   GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD. ELEVATION: 336.245m
2. TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED JULY 2017.
3. LEGAL PLAN PROVIDED BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED. DATED MARCH 2019.
4. DRAFT PLAN BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED MARCH, 2019.

Legend

- PROPERTY BOUNDARY
- 549.00 ORIGINAL GROUND CONTOUR
- EXISTING VEGETATION
- DRIPLINE
- MW GWL MONITORING WELL GROUND WATER LEVEL
- BH BOREHOLE
- HYD HYDRANT
- V&B VALVE & BOX
- VC VALVE CHANBER
- MH STORM MANHOLE
- SANITARY MANHOLE
- CB CATCHBASIN
- FENCE
- HP HYDRO POLE

Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	MHH	KRB	19.05.30

File Name: 161413338_C-DP-Concept.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
				19.05.10

Permit-Seal

CERTIFIED ENGINEERING TECHNOLOGIST OACETT ONTARIO KEVIN BROUSSEAU No. 804296

LICENSED PROFESSIONAL ENGINEER K.M. FERGIN PROVINCE OF ONTARIO

Client/Project

ROCKPOINT PROPERTIES LTD.

220 ARKELL ROAD

Guelph, ON

Title

EXISTING CONDITIONS PLAN

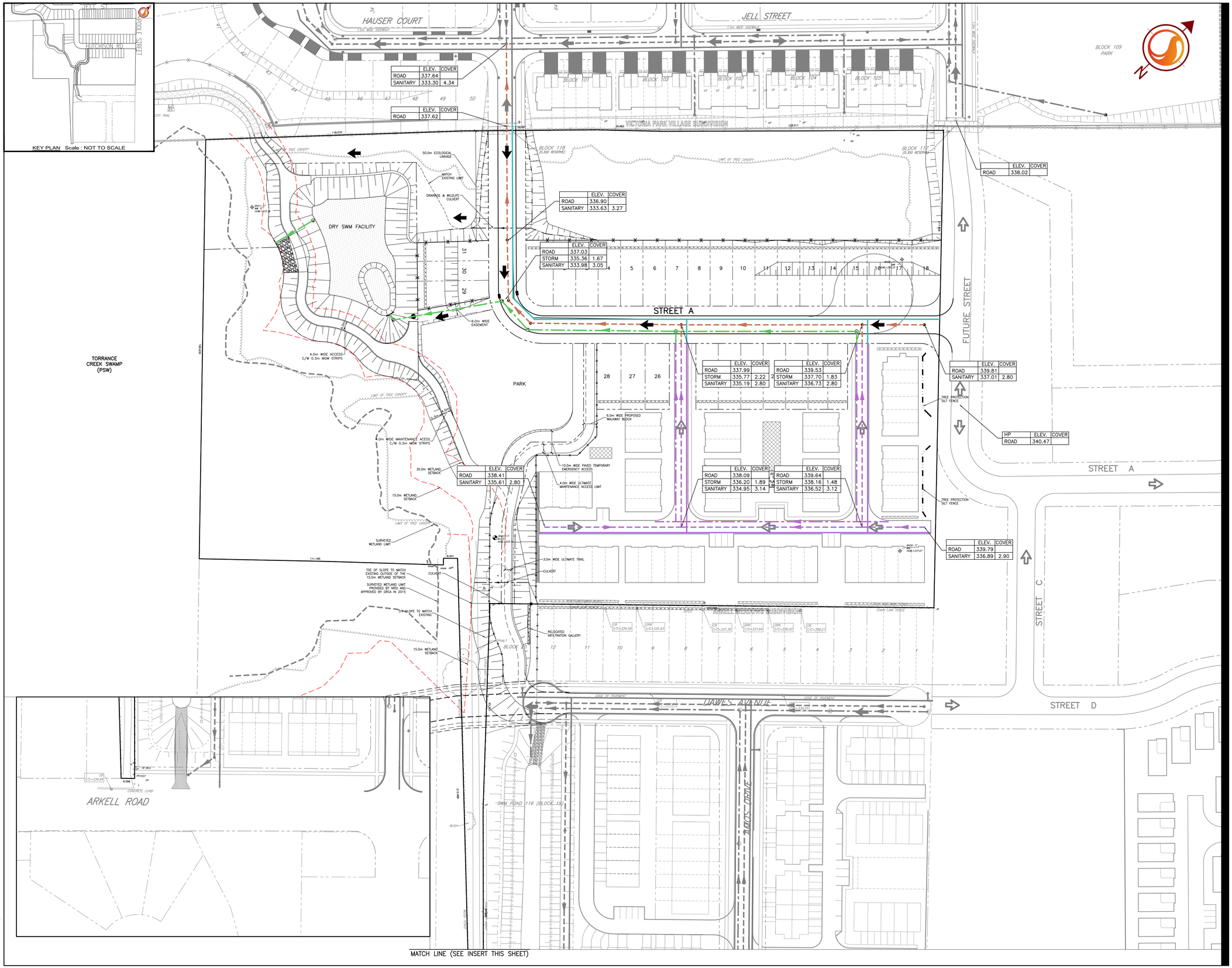
Project No. 161413338

Scale 1:750 (0 7.5 22.5 37.5m)

Drawing No. C-050

Sheet

Revision 0



	ELEV.	COVER
ROAD	337.64	
SANITARY	333.30	4.34

	ELEV.	COVER
ROAD	337.62	

	ELEV.	COVER
ROAD	336.90	
SANITARY	333.63	3.27

	ELEV.	COVER
ROAD	337.03	
STORM	335.36	1.67
SANITARY	333.98	3.05

	ELEV.	COVER
ROAD	338.02	

	ELEV.	COVER
ROAD	337.99	
STORM	335.77	2.22
SANITARY	335.19	2.80

	ELEV.	COVER
ROAD	339.53	
STORM	337.70	1.83
SANITARY	336.73	2.80

	ELEV.	COVER
ROAD	339.81	
SANITARY	337.01	2.80

HP	ELEV.	COVER
ROAD	340.47	

	ELEV.	COVER
ROAD	338.41	
SANITARY	335.61	2.80

	ELEV.	COVER
ROAD	338.09	
STORM	336.20	1.89
SANITARY	334.95	3.14

	ELEV.	COVER
ROAD	339.64	
STORM	338.16	1.48
SANITARY	336.52	3.12

	ELEV.	COVER
ROAD	339.79	
SANITARY	336.89	2.90

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Notes

1. BENCHMARK:
   ND-27 RMWY376.3
   GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD. ELEVATION: 336.245m
2. TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED JULY 2017.
3. LEGAL PLAN PROVIDED BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED. DATED MARCH 2019.
4. DRAFT PLAN BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED MARCH, 2019.

Legend

- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- PROPOSED SANITARY SEWER
- EXISTING SANITARY SEWER
- FUTURE SANITARY FORCEMAIN
- PROPOSED STORM SEWER
- EXISTING STORM SEWER
- EXISTING OVERLAND FLOW DIRECTION
- OVERLAND FLOW DIRECTION
- FUTURE OVERLAND FLOW DIRECTION

ROAD STATUS (LP = LOW POINT, HP = HIGH POINT)

LP	ELEV.	COVER
ROAD	300.82	
STORM	297.88	2.8
SANITARY	297.11	3.4

ROAD ELEVATION
COVER OVER SEWER
SEWER OBVERT ELEVATION

BH / HGWL — BORE HOLE, GROUND WATER LEVEL

INFILTRATION GALLERY

0. FIRST SUBMISSION	MHH	KRB	19.05.30
Revision	By	Appd.	YY.MM.DD
File Name: 161413338_C-UC-Concept.dwg	Dwn.	Chkd.	19.05.31 YY.MM.DD

Permit-Seal

CERTIFIED ENGINEERING TECHNOLOGIST — OACETT — ONTARIO — KEVIN BROUSSEAU — Nº 804296

LICENSED PROFESSIONAL ENGINEER — K.M. FERGIN — PROVINCE OF ONTARIO

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

Guelph, ON

Title

CONCEPTUAL SERVICING PLAN

Project No. 161413338

Scale 1:750 — 0 7.5 22.5 37.5m

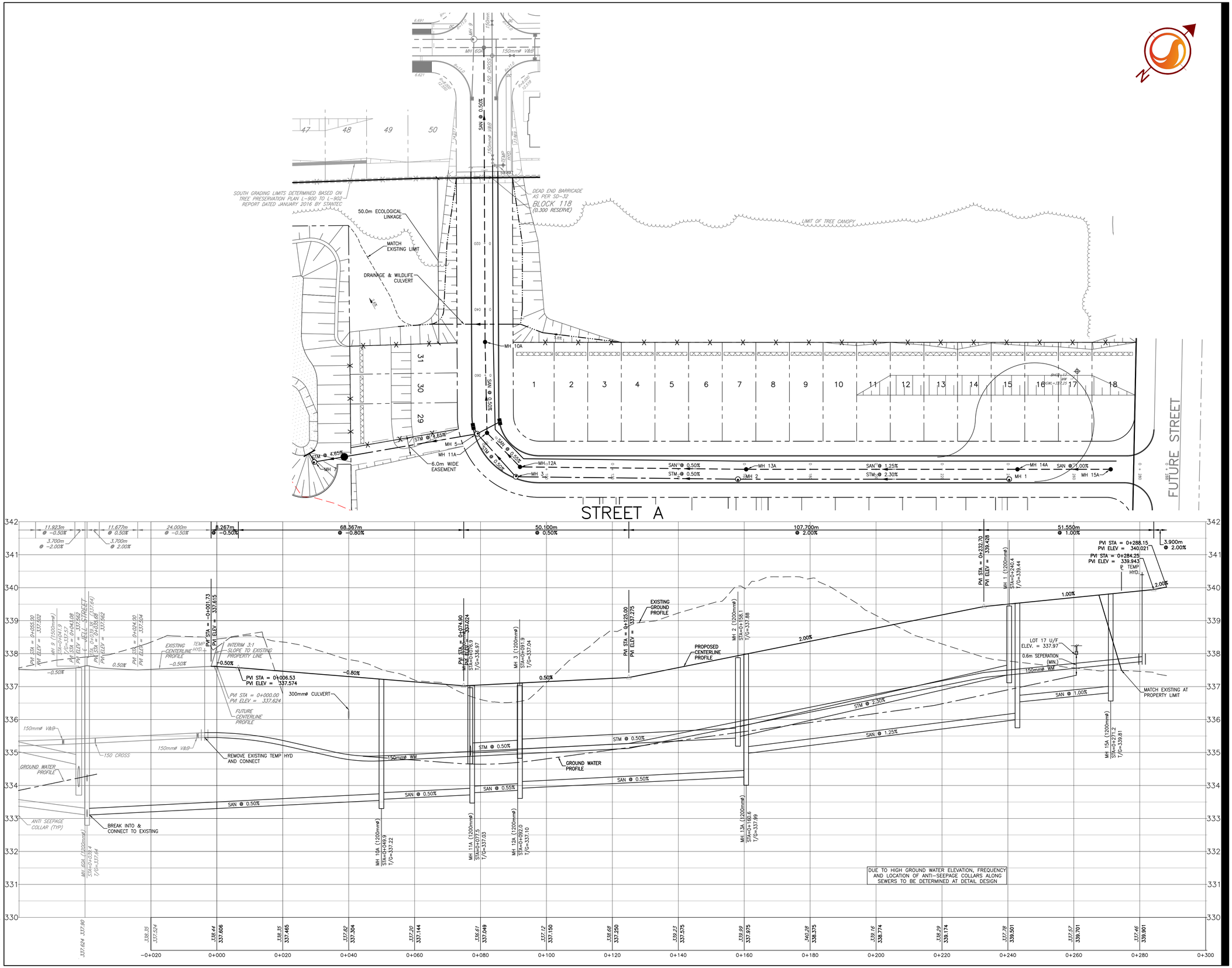
Drawing No. C-100

Sheet

Revision 0

V:\01614\active\161413338\design\drawing\civil\sheet_files\161413338_C-UC-Concept.dwg
2019/05/03 2:39 PM By: Hashem, Michael

ORIGINAL SHEET - ARCH D



Stantec

300 Hagey Blvd. Suite 100
Waterloo, ON, N2L 0A4
Tel. 519.579.4410
www.stantec.com

Notes

1. BENCHMARK:
   ND-27 RMW376.3
   GUELPH BENCHMARK #392, BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD. ELEVATION: 336.245m
2. TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED JULY 2017.
3. LEGAL PLAN PROVIDED BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED. DATED MARCH 2019.
4. DRAFT PLAN BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED MARCH, 2019.

Legend

0.	FIRST SUBMISSION	MHH	KRB	19.05.30
Revision		By	Appd.	YY.MM.DD

File Name: 161413338_C-200-Concept.dwg

Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

CERTIFIED ENGINEERING TECHNOLOGIST — OACETT — ONTARIO — KEVIN BROUSSEAU — Nº 804296

LICENSED PROFESSIONAL ENGINEER — K.M. FERGIN — PROVINCE OF ONTARIO

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

Guelph, ON

Title

CONCEPTUAL PLAN AND PROFILES

Project No. 161413338

Scale 1:500H 1:50V

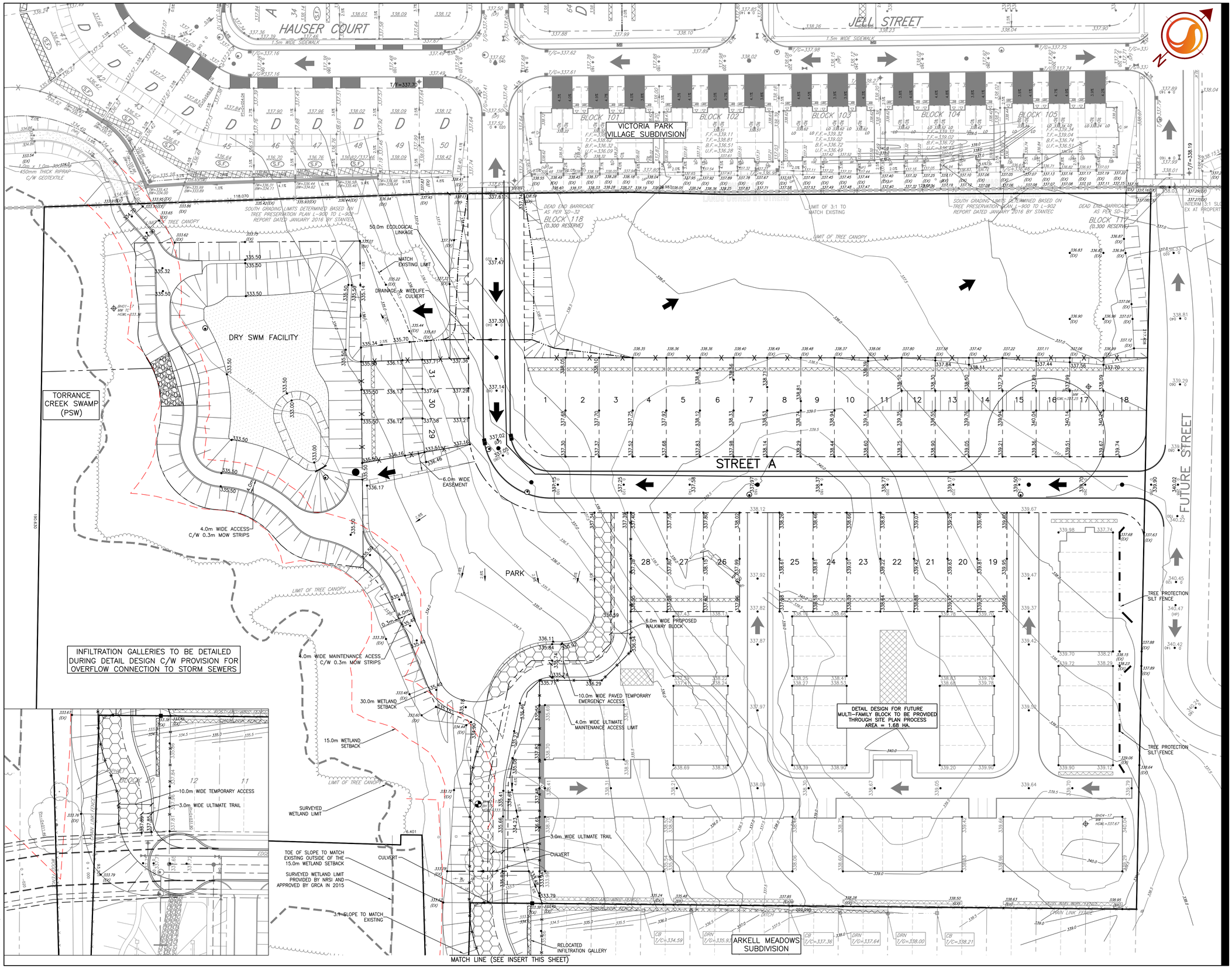
Drawing No. C-200

Sheet

Revision 0

V:\01614\active\161413338\design\drawing\civil\sheet_files\161413338_C-200-Concept.dwg
2019/06/03 3:31 PM By: Hastman, Michael

ORIGINAL SHEET - ARCH D



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2019/06/03 3:32 PM By: Hasnain, Michael

ORIGINAL SHEET - ARCH D

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Notes

1. BENCHMARK:
   ND-27 RMW376.3
   GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD. ELEVATION: 336.245m
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4. DRAFT PLAN BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED MARCH, 2019.

Legend

- PHASE LIMIT
- 352.52 ORIGINAL GROUND ELEVATION
- 352.92 PROPOSED ELEVATION
- 351.91 EXISTING ELEVATIONS
- 352.92 FUTURE PROPOSED ELEVATION
- 2.0% 2.0% FLOW DIRECTION
- 349.00 ORIGINAL GROUND CONTOUR
- PROPOSED STORM MANHOLE
- PROPOSED STORM CATCHBASIN MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED DOUBLE CATCHBASIN
- PROPOSED SANITARY MANHOLE
- PROPOSED VALVE & BOX
- PROPOSED HYDRANT
- EXISTING INTERIM SLOPE (3:1 UNLESS NOTED OTHERWISE)
- PROPOSED SLOPE (3:1 UNLESS NOTED OTHERWISE)
- OVERLAND FLOW DIRECTION
- FUTURE OVERLAND FLOW DIRECTION
- BH OWL BORE HOLE GROUND WATER LEVEL
- FUTURE RESTORATION
- INFILTRATION GALLERY

Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	MHH	KRB	19.05.30

File Name: 161413338_C-GP.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
				19.05.31

Permit-Seal

CERTIFIED ENGINEERING TECHNOLOGIST — OACETT ONTARIO — KEVIN BROUSSEAU — № 804296

LICENSED PROFESSIONAL ENGINEER — K.M. FERGIN — PROVINCE OF ONTARIO

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

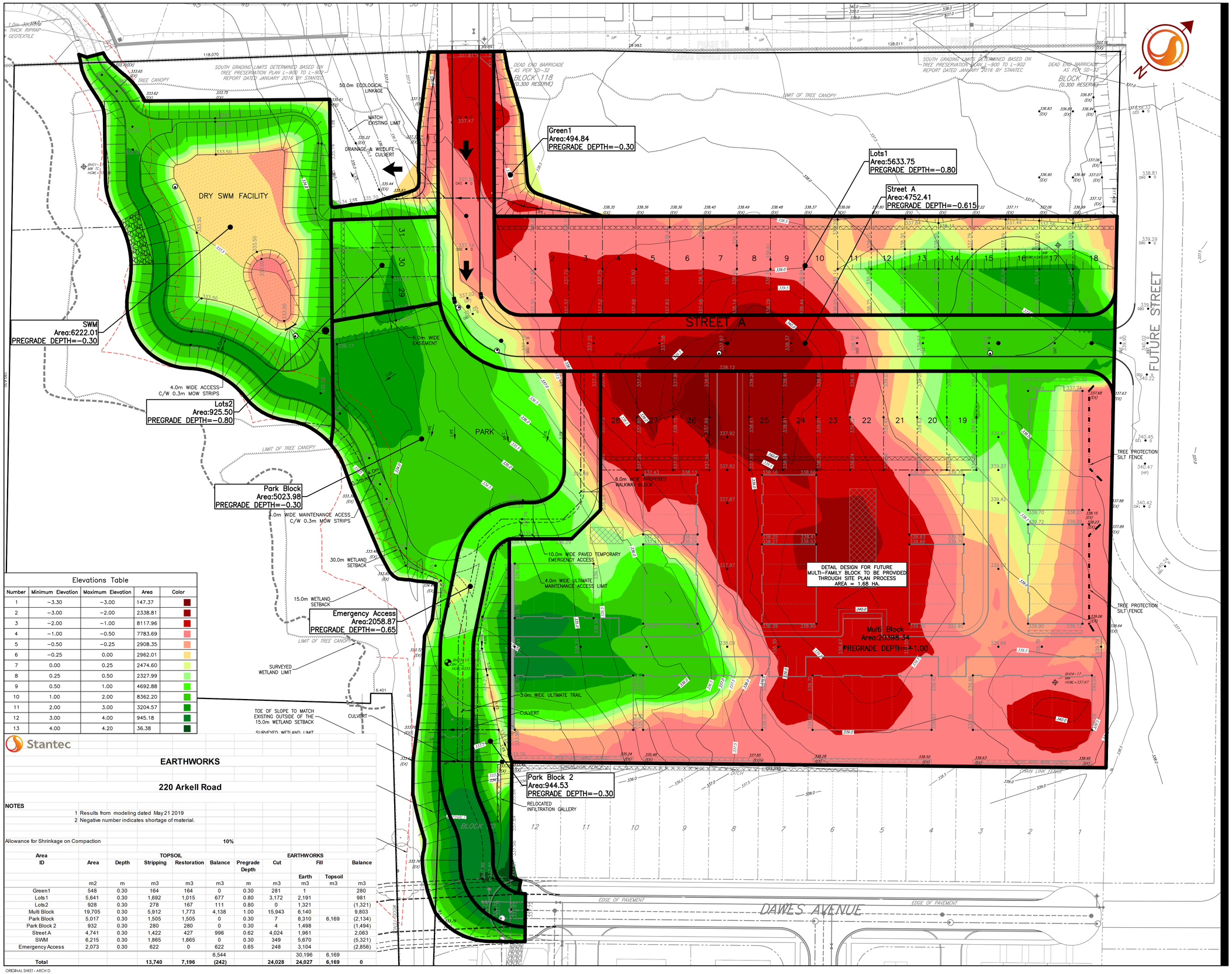
Guelph, ON

Title

CONCEPTUAL GRADING PLAN

Project No.	Scale
161413338	1:500 (0 5 15 25m)

Drawing No.	Sheet	Revision
C-400		0



Elevations Table				
Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-3.30	-3.00	147.37	
2	-3.00	-2.00	2338.81	
3	-2.00	-1.00	8117.96	
4	-1.00	-0.50	7783.69	
5	-0.50	-0.25	2908.35	
6	-0.25	0.00	2962.01	
7	0.00	0.25	2474.60	
8	0.25	0.50	2327.99	
9	0.50	1.00	4692.88	
10	1.00	2.00	8362.20	
11	2.00	3.00	3204.57	
12	3.00	4.00	945.18	
13	4.00	4.20	36.38	

Stantec

EARTHWORKS

220 Arkell Road

NOTES

1 Results from modeling dated May 21 2019
2 Negative number indicates shortage of material.

Allowance for Shrinkage on Compaction **10%**

Area ID	Area	TOPSOIL Depth	TOPSOIL Stripping	TOPSOIL Restoration	TOPSOIL Balance	EARTHWORKS Pregrade Depth	EARTHWORKS Cut	EARTHWORKS Fill Earth	EARTHWORKS Fill Topsoil	EARTHWORKS Balance
	m2	m	m3	m3	m3	m	m3	m3	m3	m3
Green1	548	0.30	164	164	0	0.30	281	1		280
Lots1	5,641	0.30	1,692	1,015	677	0.80	3,172	2,191		981
Lots2	928	0.30	278	167	111	0.80	0	1,321		(1,321)
Multi Block	19,705	0.30	5,912	1,773	4,138	1.00	15,943	6,140		9,803
Park Block	5,017	0.30	1,505	1,505	0	0.30	7	8,310	6,169	(2,134)
Park Block 2	932	0.30	280	280	0	0.30	4	1,498		(1,494)
Street A	4,741	0.30	1,422	427	996	0.62	4,024	1,961		2,063
SWM	6,215	0.30	1,865	1,865	0	0.30	349	5,670		(5,321)
Emergency Access	2,073	0.30	622	0	622	0.65	248	3,104		(2,856)
					6,544			30,196	6,169	
Total			**13,740**	**7,196**	**(242)**		**24,028**	**24,027**	**6,169**	**0**

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2019/06/04 11:58 AM By: Huenhan, Michael

ORIGINAL SHEET - ARCH D

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300 Hagey Blvd. Suite 100
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Tel. 519.579.4410
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Notes

1. BENCHMARK:
   ND-27 RMW376.3
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4. DRAFT PLAN BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED MARCH, 2019.

Legend

Revision	By	Appd.	YY.MM.DD
0. FIRST SUBMISSION	MHH	KRB	19.05.30

File Name: 161413338_C-CF.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
				19.05.21

Permit-Seal

CERTIFIED ENGINEERING TECHNOLOGIST OACETT ONTARIO KEVIN BROUSSEAU Nº 804296

LICENSED PROFESSIONAL ENGINEER K.M. FERGIN PROVINCE OF ONTARIO

Client/Project
ROCKPOINT PROPERTIES LTD.

220 ARKELL ROAD

Guelph, ON

Title
CONCEPTUAL CUT/FILL PLAN

Project No. 161413338

Scale 1:500 (0 5 15 25m)

Drawing No. C-900

Sheet

Revision 0

APPENDIX B

City and Utility Correspondence

Huisman, Michael

From: Ian Bolton <ibolton@guelphhydro.com>
Sent: Tuesday, March 20, 2018 3:31 PM
To: Huisman, Michael
Subject: RE: 220 Arkell Road, City of Guelph
Attachments: 220 Arkell Rd_Existing.pdf

Michael,
The new development would be supplied from an electrical distribution system that connects to the Victoria Village subdivision to the north. We do not anticipate any supply constraints. The site is presently supplied from an overhead connection on Arkell Rd, along the driveway and then goes underground to supply a pad mount transformer.
Please see attached.
Thanks

Ian

Ian Bolton, C.E.T.
Distribution Design Supervisor
Guelph Hydro Electric Systems Inc.
E: ibolton@guelphhydro.com
P: 519 837-4717 | Cell: 519 241-1447

Guelph Hydro
Electric Systems Inc.
395 Southgate Drive, Guelph, Ontario N1G 4Y1
www.guelphhydro.com | @GuelphHydro

Guelph Hydro is a scent-free environment. If you will be visiting our offices, please do not wear or use scented products (perfume, cologne, after shave, lotions, shampoo, conditioner, hair spray, fabric softener, dryer sheets and scented laundry detergent).
The use of laser pointers is also not permitted.

From: Huisman, Michael [mailto:Michael.Huisman@stantec.com]
Sent: March-19-18 12:41 PM
To: SArtt@uniongas.com; Brian A Murray (BrianA.Murray@rci.rogers.com) <BrianA.Murray@rci.rogers.com>; Owen, Crystal (crystal.owen@bell.ca) <crystal.owen@bell.ca>; Ian Bolton <ibolton@guelphhydro.com>
Cc: Brousseau, Kevin <kevin.brousseau@stantec.com>; Vleeming, John <John.Vleeming@stantec.com>
Subject: 220 Arkell Road, City of Guelph

Good afternoon everyone,

We are currently working towards completing the preliminary engineering for the above noted site in support of Draft Plan approval which will follow with detail design.

Please refer to the attached proposed Draft Plan and Site Location plan for your reference.

At this time we understand that a potential/viable proposed utility connection would be subject to the construction of proposed Victoria Park Village Subdivision located at the North West property line. We wish to confirm that your utility has no constraints with providing service to the proposed development and request that you provide any additional available information which shows existing and proposed utilities within the area of the proposed development.

In the case that your organization does not have existing or proposed services within the area please provide a brief description as to how this site will be serviced.

Should you have any questions, please call or email to discuss.

Thank you,

Michael Huisman
C. Tech.
Engineering Technologist, Community Development

Direct: 519-585-7299
Mobile: 905-929-7056
Fax: 519-579-6733

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4 CA

http://www.stantec.com/" style='position:absolute;margin-left:0;margin-top:0;width:75pt;height:20.25pt;z-index:251659264;visibility:visible;mso-wrap-style:square;mso-width-percent:0;mso-height-percent:0;mso-wrap-distance-left:0;mso-wrap-distance-top:0;mso-wrap-distance-right:0;mso-wrap-distance-bottom:0;mso-position-horizontal:left;mso-position-horizontal-relative:text;mso-position-vertical:absolute;mso-position-vertical-relative:line;mso-width-percent:0;mso-height-percent:0;mso-width-relative:page;mso-height-relative:page' o:allowoverlap="f" o:button="t"> http://www.stantec.com/content/dam/stantec/images/esignature/stantec.png" />

Huisman, Michael

From: Ackerman, R. Neil <neil.ackerman1@bell.ca>
Sent: Monday, March 19, 2018 4:34 PM
To: Huisman, Michael
Subject: RE: 220 Arkell Road, City of Guelph

Perfect that is what I thought. My arrow was just the direction from which my fiber feed would come from.

We would be joint use trench with Guelph Hydro.

Bell

Neil Ackerman
Guelph,Acton,Breslau & Rockwood
Specialist - Network Provisioning

F1-575 Riverbend Drive
Kitchener, Ontario
N2K 3S3
P 519.568.5797
C 226.750.5389
neil.ackerman1@bell.ca

From: Huisman, Michael [mailto:Michael.Huisman@stantec.com]
Sent: Monday, March 19, 2018 4:10 PM
To: Ackerman, R. Neil <neil.ackerman1@bell.ca>
Subject: RE: 220 Arkell Road, City of Guelph

Hey Neil,

Sorry if my email wasn't clear. The area is correct but the road connection from Victoria Park Village would be from future Hutchison Road. I've attached a PDF of the road connection, in red, from Victoria Park Village Subdivision to 220 Arkell. If you need any further clarification please let me know.

Regards,

Michael Huisman
C. Tech.
Engineering Technologist, Community Development

Direct: 519-585-7299
Mobile: 905-929-7056
Fax: 519-579-6733

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4 CA

Stantec

From: Ackerman, R. Neil [mailto:neil.ackerman1@bell.ca]
Sent: Monday, March 19, 2018 3:55 PM
To: Huisman, Michael <Michael.Huisman@stantec.com>
Subject: FW: 220 Arkell Road, City of Guelph

Hello Michael

Please can you confirm your site is related to the new development with entrance off Victoria Rd S. See the red box below, this is where I perceive you to be.

From: Huisman, Michael [mailto:Michael.Huisman@stantec.com]
Sent: March-19-18 12:41 PM
To: SArtt@uniongas.com; Brian A Murray (BrianA.Murray@rci.rogers.com) <BrianA.Murray@rci.rogers.com>; Owen,

Crystal <crystal.owen@bell.ca>; ibolton@guelphhydro.com
Cc: Brousseau, Kevin <kevin.brousseau@stantec.com>; Vleeming, John <John.Vleeming@stantec.com>
Subject: 220 Arkell Road, City of Guelph

Good afternoon everyone,

We are currently working towards completing the preliminary engineering for the above noted site in support of Draft Plan approval which will follow with detail design.

Please refer to the attached proposed Draft Plan and Site Location plan for your reference.

At this time we understand that a potential/viable proposed utility connection would be subject to the construction of proposed Victoria Park Village Subdivision located at the North West property line. We wish to confirm that your utility has no constraints with providing service to the proposed development and request that you provide any additional available information which shows existing and proposed utilities within the area of the proposed development.

In the case that your organization does not have existing or proposed services within the area please provide a brief description as to how this site will be serviced.

Should you have any questions, please call or email to discuss.

Thank you,

Michael Huisman
C. Tech.
Engineering Technologist, Community Development

Direct: 519-585-7299
Mobile: 905-929-7056
Fax: 519-579-6733

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100-300 Hagey Boulevard
Waterloo ON N2L 0A4 CA

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Huisman, Michael

From: Gwen Keep <GKeep@uniongas.com>
Sent: Tuesday, March 20, 2018 9:25 AM
To: Huisman, Michael
Subject: RE: [External] 220 Arkell Road, City of Guelph
Attachments: Victoria Park Page1.pdf

Good Morning Michael,
I am attaching the Union Gas proposal for servicing of the Victoria Park Village subdivision to the north of this proposed development.
There are no constraints with supplying this proposed development with an extension of distribution main from the Victoria Park Village development.

Trusting this is the information required at this time.

Regards,

Gwen Keep
New Business Project Coordinator
Waterloo/Guelph
Union Gas Limited | An Enbridge Company
603 Kumpf Drive P.O. Box 340 | Waterloo, ON N2J 4A4
Tel: 519-885-7400 ext 5067488
gkeep@uniongas.com

Visit www.uniongas.com/GetConnected to electronically submit service requests

---

From: Shawn Artt
Sent: March 19, 2018 12:57 PM
To: Kevin Schimus; Gwen Keep
Subject: Fwd: [External] 220 Arkell Road, City of Guelph

Think this would be something for one of you two to look into!?

Thanks

Shawn

Sent from my iPhone

Begin forwarded message:

> **From:** "Huisman, Michael" <Michael.Huisman@stantec.com>
> **To:** "Shawn Artt" <SArtt@uniongas.com>, "Brian A Murray (BrianA.Murray@rci.rogers.com)" <BrianA.Murray@rci.rogers.com>, "Owen, Crystal (crystal.owen@bell.ca)" <crystal.owen@bell.ca>,

"ibolton@guelphhydro.com" <ibolton@guelphhydro.com>
Cc: "Brousseau, Kevin" <kevin.brousseau@stantec.com>, "Vleeming, John" <John.Vleeming@stantec.com>
Subject: [External] 220 Arkell Road, City of Guelph

Good afternoon everyone,

We are currently working towards completing the preliminary engineering for the above noted site in support of Draft Plan approval which will follow with detail design.

Please refer to the attached proposed Draft Plan and Site Location plan for your reference.

At this time we understand that a potential/viable proposed utility connection would be subject to the construction of proposed Victoria Park Village Subdivision located at the North West property line. We wish to confirm that your utility has no constraints with providing service to the proposed development and request that you provide any additional available information which shows existing and proposed utilities within the area of the proposed development.

In the case that your organization does not have existing or proposed services within the area please provide a brief description as to how this site will be serviced.

Should you have any questions, please call or email to discuss.

Thank you,

Michael Huisman
C. Tech.
Engineering Technologist, Community Development

Direct: 519-585-7299
Mobile: 905-929-7056
Fax: 519-579-6733

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4 CA

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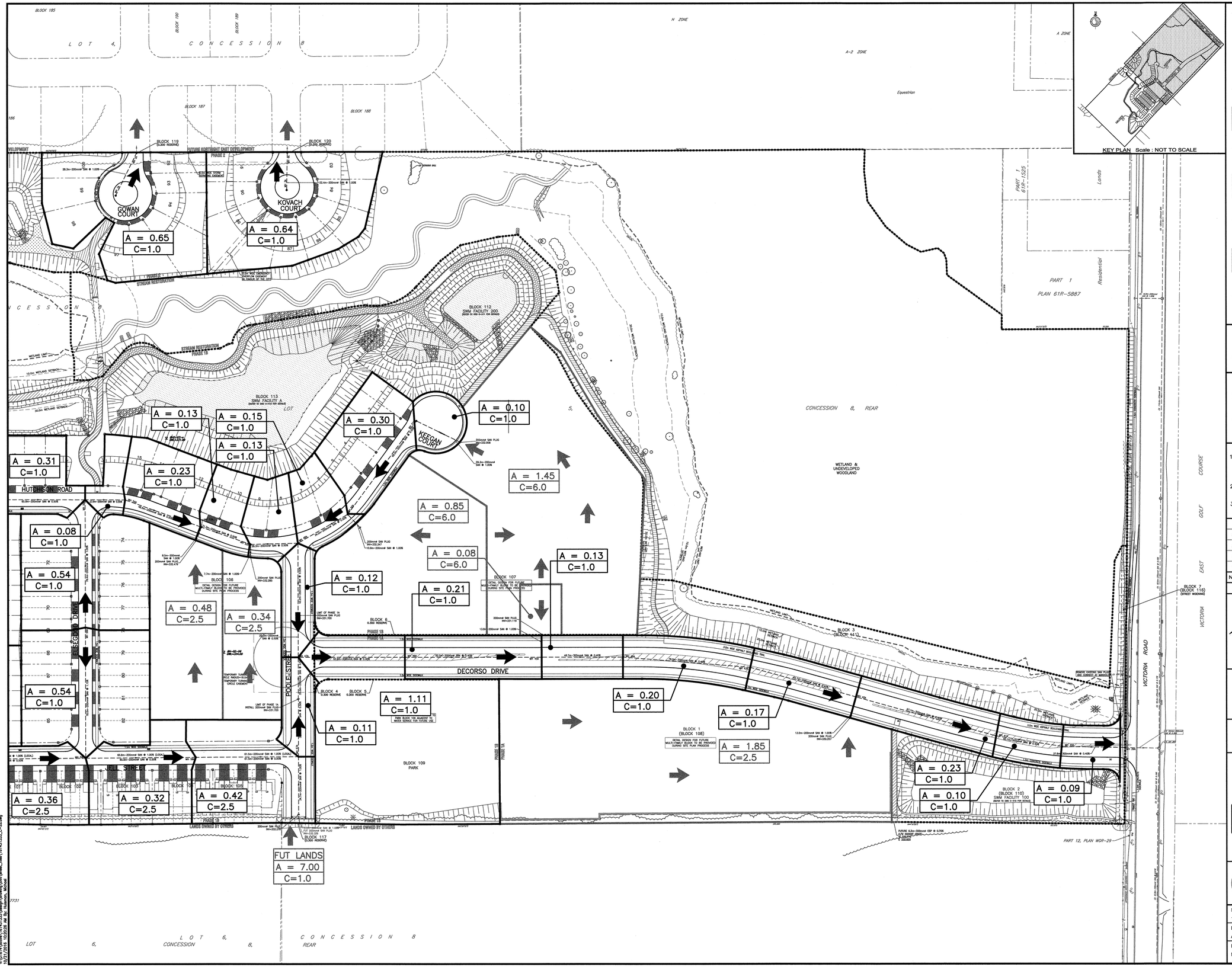
APPENDIX C

VPV Sanitary Drainage Area Plans (Drawing No. C-110 and C-111)
(Post Development) Sanitary Design Sheets)



North:

LEGEND:

A = 0.50 / C=1.0	DRAINAGE AREA (HECTARES) / SANITARY CO-EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	AREA BOUNDARY
	FLOW DIRECTION
A = 0.50 / C=1.0	DRAINAGE AREA (HECTARES) / EXISTING SANITARY CO-EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	EXISTING AREA BOUNDARY
	EXISTING FLOW DIRECTION
A = 0.50 / C=1.0	DRAINAGE AREA (HECTARES) / FUTURE SANITARY CO-EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	FUTURE AREA BOUNDARY
	FUTURE FLOW DIRECTION

ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
PIPE SIZES ARE IN MILLIMETRES.
NOTE: LOCATIONS OF UTILITY STRUCTURES ARE APPROX.
BELL PEDESTAL / CABLE PEDESTAL / TRANSFORMER
HYDRO LIGHT STANDARD
COMMUNITY MAIL BOX

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them. Drawings shall not be used for construction unless sealed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

GENERAL NOTES:

1. BENCHMARK: GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD. ELEVATION=336.245m
2. LEGAL INFORMATION TAKEN FROM J.D. BARNES LTD. REFERENCE #11-30-246-00 DATED JANUARY 6, 2015.
3. TOPOGRAPHICAL SURVEY DONE BY OTHERS. ADDITIONAL TOPO DONE BY STANTEC DATED FEBRUARY, 2015.

No.	DATE	DESCRIPTION	BY:	CH'KD.
3	16.10.19	FOURTH/MOE SUBMISSION	MHH	KRB
2	16.06.24	THIRD SUBMISSION	MHH	KRB
1	15.12.23	SECOND SUBMISSION	MHH	KRB
0	15.04.24	FIRST SUBMISSION	MHH	KRB

SCHEDULE OF REVISIONS

CITY OF Guelph — Making a Difference

ENGINEERING SERVICES

SANITARY DRAINAGE AREA PLAN

VICTORIA PARK VILLAGE

DESIGNED BY: CERTIFIED ENGINEERING TECHNOLOGIST, OACETT, ONTARIO, KEVIN BROUSSEAU, Nº 804296, Oct 21/16

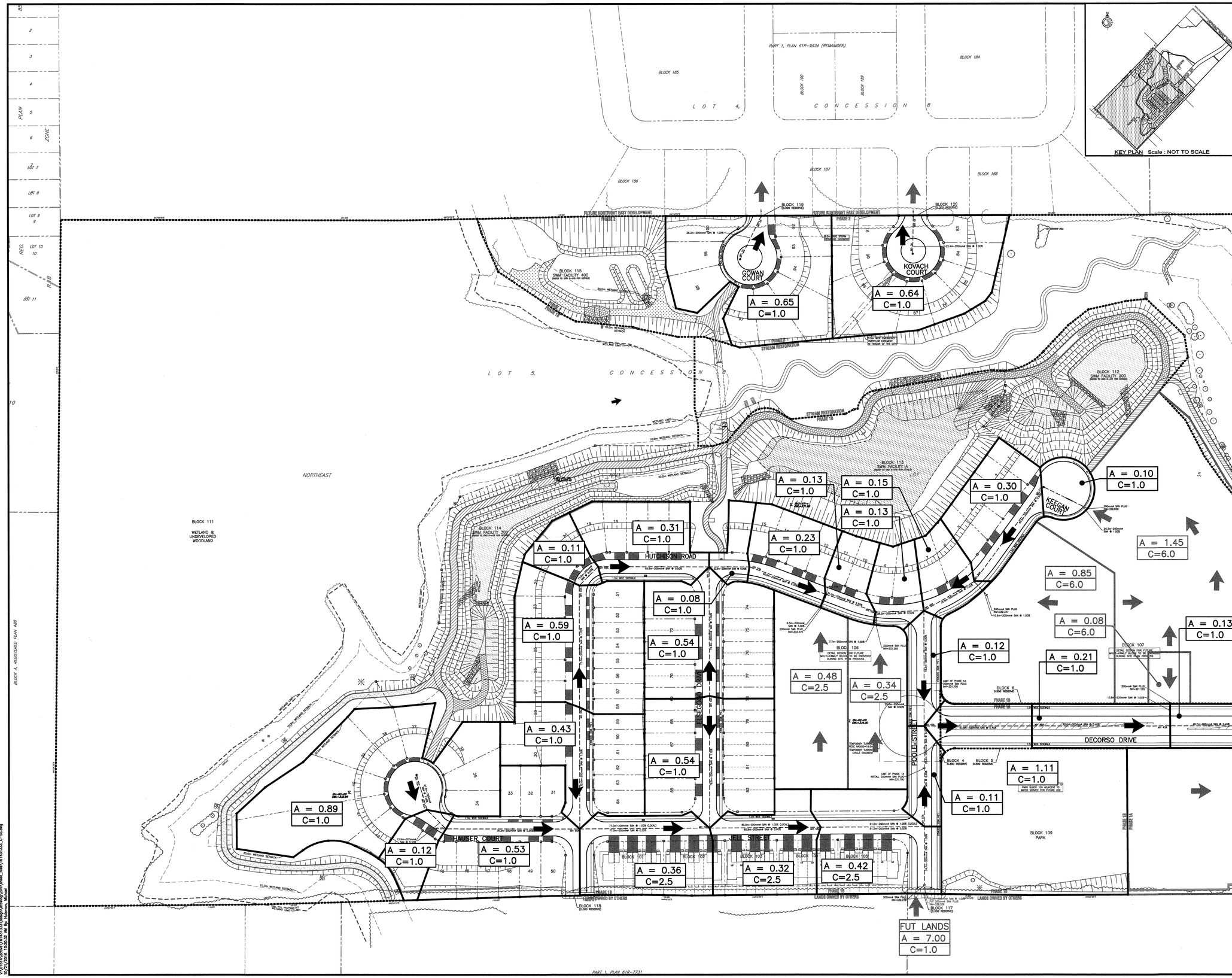
APPROVED BY: LICENSED PROFESSIONAL ENGINEER, K.M. FERGIN, OCT 21/16, PROVINCE OF ONTARIO

Stantec
100-300 Hagey Boulevard, Waterloo, ON, N2L 0A4
Tel. 519.579.4410 www.stantec.com

SCALES: 1:1000	CHECKED BY: KRB
DATE DRAWN: APRIL 24/15	CONTRACT No. X-XXXX
DRAWN BY: MHH	DRAWING No. C-110

- 000

V:\01614\active\161433337\design\drawing\civil\sheet_files\161433333_C-SS.dwg
10/21/2016 10:50:26 AM By: Robinson, Michael



North:

LEGEND:

A = 0.50 / C=1.0	DRAINAGE AREA (HECTARES) / SANITARY CO-EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	AREA BOUNDARY
	FLOW DIRECTION
A = 0.50 / C=1.0	DRAINAGE AREA (HECTARES) / EXISTING SANITARY CO-EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	EXISTING AREA BOUNDARY
	EXISTING FLOW DIRECTION
A = 0.50 / C=1.0	DRAINAGE AREA (HECTARES) / FUTURE SANITARY CO-EFFICIENT (CUBIC METRES PER SECOND PER HECTARE)
	FUTURE AREA BOUNDARY
	FUTURE FLOW DIRECTION

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NOTE: LOCATIONS OF UTILITY STRUCTURES ARE APPROX.
BELL PEDESTAL / CABLE PEDESTAL / TRANSFORMER
HYDRO LIGHT STANDARD
COMMUNITY MAIL BOX

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them. Drawings shall not be used for construction unless sealed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

GENERAL NOTES:

1. BENCHMARK: GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD. ELEVATION=336.245m
2. LEGAL INFORMATION TAKEN FROM J.D. BARNES LTD. REFERENCE #11-30-246-00 DATED JANUARY 6, 2015.
3. TOPOGRAPHICAL SURVEY DONE BY OTHERS. ADDITIONAL TOPO DONE BY STANTEC DATED FEBRUARY, 2015.

No.	DATE	DESCRIPTION	BY:	CHKD.
3	16.10.19	FOURTH/MOE SUBMISSION	MHH	KRB
2	16.06.24	THIRD SUBMISSION	MHH	KRB
1	15.12.23	SECOND SUBMISSION	MHH	KRB
0	15.04.24	FIRST SUBMISSION	MHH	KRB

SCHEDULE OF REVISIONS

CITY OF Guelph
Making a Difference

ENGINEERING SERVICES

SANITARY DRAINAGE AREA PLAN

VICTORIA PARK VILLAGE

DESIGNED BY:

CERTIFIED ENGINEERING TECHNOLOGIST — OACETT — ONTARIO — KEVIN BROUSSEAU — Nº 804296

APPROVED BY:

LICENSED PROFESSIONAL ENGINEER — K.M. FERGIN — OCT 21/16 — PROVINCE OF ONTARIO

Stantec
100-300 Hagey Boulevard, Waterloo, ON. N2L 0A4
Tel. 519.579.4410 www.stantec.com

SCALES: 1:1000	CHECKED BY: KRB
DATE DRAWN: APRIL 24/15	CONTRACT No. X-XXXX
DRAWN BY: MHH	DRAWING No. C-111

- 000

- 000

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10/21/2016 10:55:32 AM By: Robinson, Michael

Stantec

SUBDIVISION

VICTORIA PARK VILLAGE
1159 VICTORIA ROAD SOUTH

SANITARY SEWER DESIGN SHEET

DATE: May 27, 2019
DESIGNED BY: KDB
CHECKED BY: KRB

FILE NUMBERS: 23T07506
THIRD SUBMISSION

DESIGN PARAMETERS: City of Guelph — 4.000

AVERAGE DAILY FLOW PER PERSON = 275 l/p/day
MINIMUM VELOCITY = 0.600 m/s
n = 0.013
MAX PEAK FAC.= 4.500
MIN PEAK FAC.= 1.500

RESIDENTIAL: 1.0000 L/s/ha
COMMERCIAL/INDUST: 1.7000 L/s/Ha
SCHOOL/MULTI FAMILY: 2.5000 L/s/Ha
APARTMENT 150U/HA 6.0000 L/s/Ha
APARTMENT 295U/Ha 7.0000 L/s/Ha
RESIDENTIAL HARMON PEAKING FACTOR

LOCATION			RESIDENTIAL AREA				COMM/INDUST				SCHOOL/MULTI-FAMILY				APT				C+I+I	TOTAL	PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	FLOW (L/s)	FLOW (L/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (L/s)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)	% Capacity
PHASE 1																										
HAUSER COURT																										
	70	62	0.89	1.000	0.890	0.890		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	0.890	21.60	200	1.0	31.9	1.03	0.41	2.8%
	62	61	0.12	1.000	0.120	1.010		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	1.010	15.90	200	0.5	22.6	0.73	0.34	4.5%
	61	60	0.53	1.000	0.530	1.540		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	1.540	79.30	200	0.5	22.6	0.73	0.38	6.8%
HUTCHISON RD																										
	64	60	0.43	1.000	0.430	0.430		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	0.430	72.00	200	1.3	36.3	1.17	0.00	1.2%
220 Arkel																										
	PLUG	60	1.44	1.000	1.440	1.440		1.70	0.00	0.00	1.68	2.50	4.20	4.20		6.00	0.00	0.00	4.200	5.64	39.70	200	1.0	31.9	1.03	0.74	17.7%
JELL STREET																										
	60	59	0.00	1.000	0.000	1.97		1.70	0.00	0.00	0.36	2.50	0.90	5.10		6.00	0.00	0.00	5.100	7.07	77.00	200	0.5	22.6	0.73	0.64	31.3%
ELSEGOOD DR																										
	56	59	0.54	1.000	0.540	0.540		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	0.540	78.00	200	1.15	34.1	1.10	0.00	1.6%
JELL STREET																										
	59	58	0.00	1.000	0.000	2.51		1.70	0.00	0.00	0.32	2.50	0.80	5.90		6.00	0.00	0.00	5.900	8.41	65.90	200	0.5	22.6	0.73	0.66	37.2%
	58	57	0.00	1.000	0.000	2.51		1.70	0.00	0.00	0.42	2.50	1.05	6.95		6.00	0.00	0.00	6.950	9.46	61.50	200	0.5	22.6	0.73	0.69	41.9%
POOLE STREET											(Area reduced from 7.0ha)															
	PLUG	57	0.00	1.000	0.000	0.000		1.70	0.00	0.00	5.00	2.50	12.50	12.50		6.00	0.00	0.00	12.500	12.500	39.70	200	1.0	31.9	1.03	0.95	39.2%
POOLE STREET	57	47	0.11	1.000	0.110	2.62		1.70	0.00	0.00		2.50	0.00	19.45		6.00	0.00	0.00	19.450	22.07	59.40	250	0.5	41.6	0.85	0.86	53.1%
HUTCHISON RD																										
	64	65	0.59	1.000	0.590	0.590		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	0.590	72.00	200	1.0	31.9	1.03	0.00	1.8%
	65	66	0.11	1.000	0.110	0.700		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	0.700	15.80	200	0.5	22.6	0.73	0.29	3.1%
	66	55	0.31	1.000	0.310	1.010		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	1.010	65.80	200	0.5	22.6	0.73	0.34	4.5%
ELSEGOOD DR																										
	56	55	0.54	1.000	0.540	0.540		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	0.540	76.30	200	1.0	31.9	1.03	0.00	1.7%
HUTCHISON RD																										
	55	54	0.08	1.000	0.080	1.630		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	1.630	23.90	200	0.5	22.6	0.73	0.38	7.2%
	54	53	0.23	1.000	0.230	1.860		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	0.00	0.000	1.860	48.50	200	0.5	22.6	0.73	0.42	8.2%
BLOCK 106 WEST																										
	PLUG	53	0.00	1.000	0.000	0.000		1.70	0.00	0.00	0.48	2.50	1.20	1.20		6.00	0.00	0.00	1.200	1.200	8.50	200	1.0	31.9	1.03	0.41	3.8%
HUTCHISON RD																										
	53	52	0.13	1.000	0.130	1.990		1.70	0.00	0.00		2.50	0.00	1.20		6.00	0.00	0.00	1.200	3.190	31.30	200	0.5	22.6	0.73	0.50	14.1%
BLOCK 106 EAST																										
	PLUG	52	0.00	1.000	0.000	0.000		1.70	0.00	0.00	0.34	2.50	0.85	0.85		6.00	0.00	0.00	0.850	0.850	7.60	200	1.0	31.9	1.03	0.41	2.7%
HUTCHISON RD																										
	52	48	0.13	1.000	0.130	2.120		1.70	0.00	0.00		2.50	0.00	2.05		6.00	0.00	0.00	2.050	4.170	28.30	200	0.5	22.6	0.73	0.54	18.5%
BLOCK 107 EAST																										
	PLUG	51	0.10	1.000	0.100	0.100		1.70	0.00	0.00		2.50	0.00	0.00	1.45	6.00	8.70	8.70	8.700	8.800	29.30	200	1.0	31.9	1.03	0.84	27.6%
	51	50	0.30	1.000	0.300	0.400		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	8.70	8.700	9.100	69.50	200	0.5	22.6	0.73	0.69	40.3%

Stantec

SUBDIVISION

VICTORIA PARK VILLAGE
1159 VICTORIA ROAD SOUTH

SANITARY SEWER

DESIGN SHEET

DATE: May 27, 2019
DESIGNED BY: KDB
CHECKED BY: KRB

FILE NUMBERS: 23T07506
THIRD SUBMISSION

DESIGN PARAMETERS City of Guelph 4.000

AVERAGE DAILY FLOW PER PERSON = 275 l/p/day
MINIMUM VELOCITY = 0.600 m/s
n = 0.013
MAX PEAK FAC.= 4.500
MIN PEAK FAC.= 1.500

RESIDENTIAL: 1.0000 L/s/ha
COMMERCIAL/INDUST: 1.7000 L/s/Ha
SCHOOL/MULTI FAMILY: 2.5000 L/s/Ha
APARTMENT 150U/HA 6.0000 L/s/Ha
APARTMENT 295U/Ha 7.0000 L/s/Ha
RESIDENTIAL HARMON PEAKING FACTOR

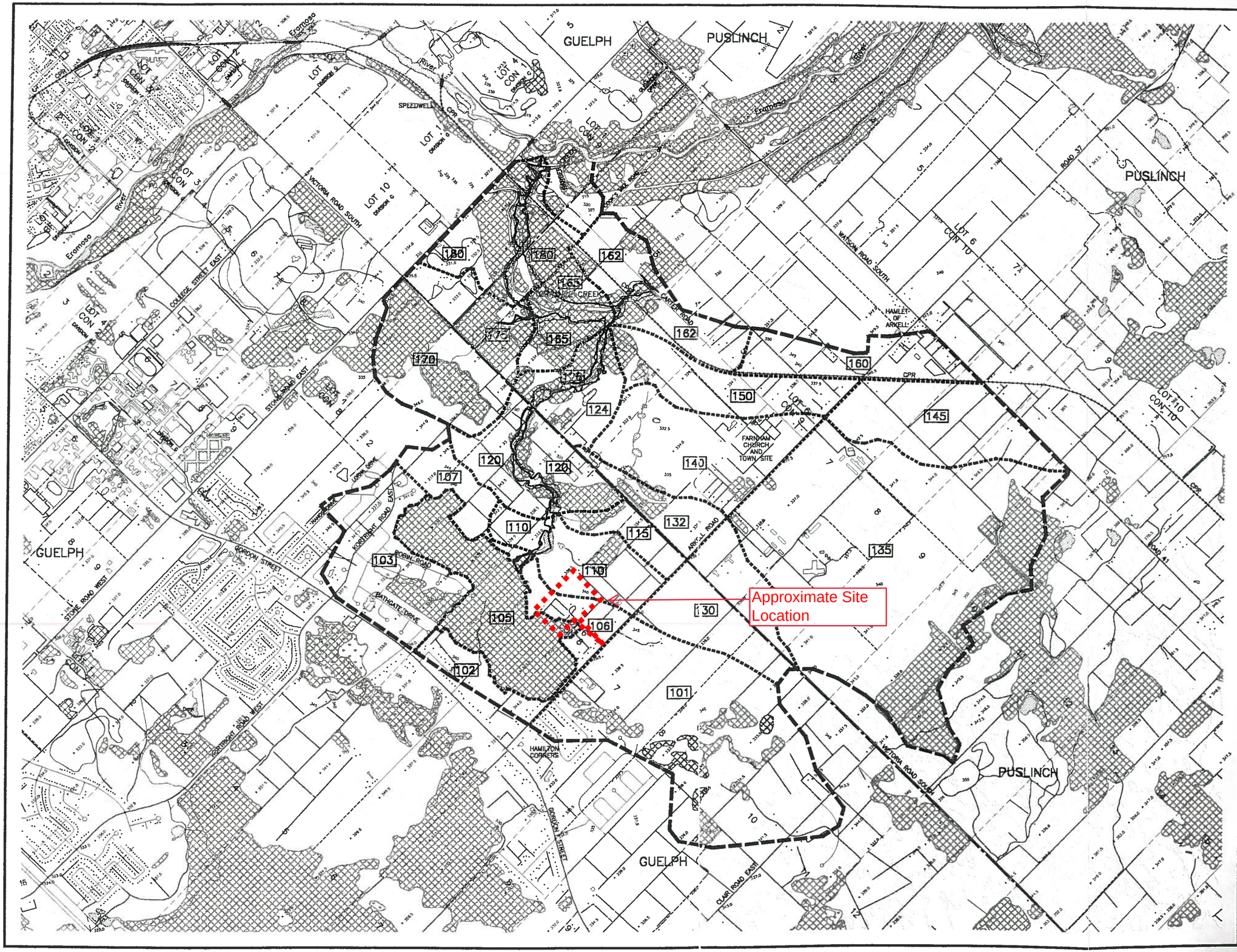
LOCATION			RESIDENTIAL AREA				COMM/INDUST				SCHOOL/MULTI-FAMILY				APT				C+I+I	TOTAL	PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	AREA (ha)	FLOW RATE (L/s/Ha)	FLOW (L/s)	CUMML. FLOW (L/s)	FLOW (L/s)	FLOW (L/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (L/s)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)	% Capacity
BLOCK 107 WEST																										
	PLUG	50	0.00	1.000	0.000	0.000		1.70	0.00	0.00		2.50	0.00	0.00	0.85	6.00	5.10	5.10	5.100	5.100	10.90	200	1.0	31.9	1.03	0.71	16.0%
HUTCHISON RD																										
	50	48	0.15	1.000	0.150	0.550		1.70	0.00	0.00		2.50	0.00	0.00		6.00	0.00	13.80	13.800	14.350	34.50	200	0.5	22.6	0.73	0.77	63.5%
POOLE STREET																										
	48	47	0.12	1.000	0.120	2.79		1.70	0.00	0.00		2.50	0.00	2.05		6.00	0.00	13.80	15.850	18.640	68.20	250	0.5	41.6	0.85	0.82	44.8%
DECORSO DR																										
	47	46	1.11	1.000	1.110	6.52		1.70	0.00	0.00		2.50	0.00	21.50		6.00	0.00	13.80	35.300	41.820	63.90	300	0.4	61.8	0.87	0.94	67.7%
	46	45	0.21	1.000	0.210	6.730		1.70	0.00	0.00		2.50	0.00	21.50		6.00	0.00	13.80	35.300	42.030	82.00	300	0.4	61.8	0.87	0.94	68.0%
BLOCK 107 SOUTH																										
	PLUG	45	0.00	1.000	0.000	0.000		1.70	0.00	0.00		2.50	0.00	0.00	0.08	6.00	0.48	0.48	0.480	0.480	13.80	200	1.0	31.9	1.03	0.00	1.5%
DECORSO DR																										
	45	44	0.13	1.000	0.130	6.860		1.70	0.00	0.00		2.50	0.00	21.50		6.00	0.00	14.28	35.780	42.640	48.70	300	0.4	61.8	0.87	0.94	69.0%
	44	43	0.20	1.000	0.200	7.060		1.70	0.00	0.00		2.50	0.00	21.50		6.00	0.00	14.28	35.780	42.840	76.50	300	0.4	61.8	0.87	0.94	69.3%
	43	42	0.17	1.000	0.170	7.230		1.70	0.00	0.00		2.50	0.00	21.50		6.00	0.00	14.28	35.780	43.010	65.70	300	0.4	61.8	0.87	0.94	69.6%
BLOCK 1																										
	PLUG	42	0.00	1.000	0.000	0.000		1.70	0.00	0.00	1.85	2.50	4.63	4.63		6.00	0.00	0.00	4.630	4.630	13.00	200	1.0	31.9	1.03	0.71	14.5%
DECORSO DR																										
	42	41	0.23	1.000	0.230	7.460		1.70	0.00	0.00		2.50	0.00	26.13		6.00	0.00	14.28	40.410	47.870	87.10	300	0.4	61.8	0.87	0.97	77.5%
	41	40	0.10	1.000	0.100	7.560		1.70	0.00	0.00		2.50	0.00	26.13		6.00	0.00	14.28	40.410	47.970	40.10	300	0.4	61.8	0.87	0.97	77.6%
	40	39	0.09	1.000	0.090	7.650		1.70	0.00	0.00		2.50	0.00	26.13		6.00	0.00	14.28	40.410	48.060	37.80	300	0.4	61.8	0.87	0.97	77.8%
	39	*Ex 38*	*0.00*	*1.000*	*0.000*	*7.650*		*1.70*	*0.00*	*0.00*		*2.50*	*0.00*	*26.13*		*6.00*	*0.00*	*14.28*	*40.410*	*48.060*	*19.60*	*300*	*0.4*	*61.8*	*0.87*	*0.97*	*77.8%*

APPENDIX D

Stormwater Management

Stormwater Management Hydrologic Model

Design Calculations



NORTH

LEGEND:

- WOODED AREA
- MARSH
- WATERSHED BOUNDARY
- SUBWATERSHED DRAINAGE BOUNDARY
- 145 SUBWATERSHED DRAINAGE NUMBER
- 330 CONTOUR (5m INTERVAL)
- CITY OF GUELPH – TOWNSHIP OF PUSLINCH BOUNDARY
- SPOT ELEVATION

ALL DIMENSIONS AND INFORMATION SHALL BE CHECKED AND VERIFIED ON THE JOB AND ANY DISCREPANCIES MUST BE REPORTED TO THE CONSULTANT BEFORE COMMENCING THE WORK.

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO INFORM HIMSELF OF THE EXACT LOCATION OF, AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES, SERVICES AND STRUCTURES WHETHER ABOVE GROUND OR BELOW GRADE BEFORE COMMENCING THE WORK. SUCH INFORMATION IS NOT NECESSARILY SHOWN ON THE DRAWINGS, AND WHERE SHOWN, THE ACCURACY CANNOT BE GUARANTEED.

ALL DRAWINGS REMAIN THE PROPERTY OF THE CONSULTANT AND MAY NOT BE REPRODUCED OR REVISED WITHOUT THE CONSULTANT'S WRITTEN PERMISSION.

WITH THE SOLE EXCEPTION OF THE BENCHMARKS SPECIFICALLY DESCRIBED FOR THIS PROJECT, NO ELEVATION INDICATED OR ASSUMED HEREON IS TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

Study Team:

Totten Sims Hubicki Associates
Ecological Services Group
Mark L. Dorfman, Planner Inc.
Stanley Consulting
Donald G. Weatherbe Associates
Schroeter & Associates

THE CITY OF **Guelph**

TORRANCE CREEK SUBWATERSHED
GUELPH ONTARIO

Grand River Conservation Authority

SUBWATERSHED DRAINAGE BOUNDARIES

DRAWN BY	DESIGNED BY –	DATE SEPT. 1998
CHECKED BY	APPROVED BY –	PROJECT No.
SCALE Horiz. N.T.S. Vert. –	DRAWING No. FIGURE 4.6.1	

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* Torrance Creek   Watershed Model
* ==========================================================================
* File created by Dr. H.O. Schroeter, P.Eng., April 17, 1998
* Revised: May 18, 1998; September 17, 1998
* ==========================================================================
* Soil Drainage parameters
* ========================
* Note: Here, soil zones defined by infiltrability and cover type.
* Zone Descriptions:
*   1=Impervious
*   2=wetlands
*   3=Low vegetative cover, lacustrine, kame outwash sand, like muck
*   4=Low vegetative cover, Wentworth Till (sandy till)
*   5=Low vegetative cover, Kame, eskers, sand and gravel
*   6=Low vegetative cover, Outwash gravel
*   7=Forest Cover, bedrock
*   8=Forest Cover, Like RU 4 and 5 but lumped together
*   9=Forest Cover, Outwash gravel
*
READ SOIL PARAMETERS  NZONE=9
                            Wet    Low Vegetative Cover      Forest Cover
                       IMP Lands Muck STill S & G Gravel BedR  Sand Gravel
                  DS=    2   200     5   5.0   5.0   6.0  10.0  15.0  15.0
                  KEFF=  0   0.5   2.0   8.0  16.0  20.0   4.0  40.0  60.0
                  CS=    0   0.5   1.5   6.0  12.0  15.0   3.0  30.0  45.0
                  D=     0   0.5   0.1   0.4   1.6   2.0   0.4   4.0   6.0
                  SAV=   0   200   200   200   200   200   200   200   200
                  HI=    0  0.01   100   100   100   150   200   200   200
                  SMCI=  0  0.56  0.56  0.46  0.46  0.40  0.40  0.46  0.40
                  FCAPI= 0  0.46  0.46  0.23  0.23  0.10  0.10  0.23  0.10
                  IMCI=  0  0.46  0.46  0.23  0.23  0.10  0.10  0.23  0.10
                  WILTI= 0  0.27  0.27  0.07  0.07  0.04  0.04  0.07  0.04
                  HII=   0  0.01   400   800   800  1000   800  1000  1000
                  SMCII= 0  0.56  0.56  0.46  0.46  0.40  0.40  0.46  0.40
                  FCAPII=0  0.46  0.46  0.23  0.23  0.10  0.10  0.23  0.10
                  IMCII= 0  0.46  0.46  0.23  0.23  0.10  0.10  0.23  0.10
                  WILTII=0  0.27  0.27  0.07  0.07  0.04  0.04  0.07  0.04
                  X=     0    1     1     1     0     0     1     0     0
                  FATR=  1    1     1     1     1     1     1     1     1
                  INCS=  0   2.0   0.5   0.5   1.0   1.0   2.5   2.5   2.5
*
* Go to event file
*
CHANGE INPUT FILE
*
* Typical off-channel (Flat areas)                                        6
*
COMPUTE RATING CURVE ID=1  VS=     1.000   NSEGS=3
                      MIN EL= 100.00    MAX EL= 100.60
                      CHNSLP= 0.0050    FLNSLP= 0.0050
                      N= 0.350  DIST=   39.15
                      N=-0.150  DIST=   40.85
                      N= 0.350  DIST=   80.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  100.60    39.15  100.20    39.75  100.00
                       40.25  100.00    40.85  100.20    80.00  100.60
                     RFN=0.0000 PCODE=1
*
* Typical off-channel (Steep areas)                                       6
*
COMPUTE RATING CURVE ID=5  VS=     2.000   NSEGS=3
                      MIN EL= 100.00    MAX EL= 100.80
                      CHNSLP= 0.0100    FLNSLP= 0.0100
```



```
                      N= 0.350  DIST=   24.45
                      N=-0.150  DIST=   25.55
                      N= 0.350  DIST=   50.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  100.80    24.45  100.30    24.75  100.00
                       25.50  100.00    25.55  100.30    50.00  100.80
                     RFN=0.0000 PCODE=1
*
* Part of SW quadrant of Arkell & Victoria Rd Intersect.
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=1 NHD= 130 AREA=   0.5030 Sq km  L=  1230 m  W=   410 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                       2.0   0.0  0.0   5.0  0.6  92.4  0.0   0.0  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Divert flow from 130 into ground and hold
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=5 HYD=3130 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.4600 CMS  IDFLAG=2 IDSTOR=0
*
* SECTION G-G                                                            16
*
COMPUTE RATING CURVE ID=2  VS= 20062.900   NSEGS=3
                      MIN EL= 322.96    MAX EL= 324.00
                      CHNSLP= 0.0190    FLNSLP= 0.0190
                      N= 0.120  DIST=   18.72
                      N=-0.070  DIST=   30.22
                      N= 0.120  DIST=   70.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  323.12     6.89  323.02     7.57  323.05
                       14.21  323.03    18.41  323.17    18.72  323.17
                       22.17  323.15    24.17  322.96    25.00  322.98
                       30.22  323.11    30.85  323.08    31.38  323.05
                       39.24  323.05    39.88  323.05    50.00  323.14
                       70.00  324.00
                     RFN=0.0000 PCODE=1
*
* Route 3130 through reach   30
* Using Valley Section  20062.900 As channel Rating Curve
*
ROUTE CHANNEL       ID=2 HYD NO=  30 INFLOW=5 LENGTH=   800 m  SLOPE=0.0062
                    RCID=2 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Compute runoff hydrograph from area  132
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=3 NHD= 132 AREA=   0.1730 Sq km  L=   450 m  W=   250 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                       2.0   0.0  0.0   0.0  0.0  81.3  0.0   5.2 11.5
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Sum hydr.  132 &   30 call result  232
*
ADD HYD             ID=4 HYD NO= 232 IDA=3 IDB=2 ICODE=0                AREA=
```

```
0.173
*
* Area draining U of G Poultry Farm
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 135 AREA=   2.2800 Sq km  L=  1900 m  W=   650 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.0   0.0  0.0   8.3  8.8  66.7  0.0  12.9  1.2
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=2 RBPCODE=0 FACTOR= 0.347
                     ILEVEL= 250.000      HDIFF=    8.0 QO=   0.0000
                     ZG= 250.000 CG=   0.000 EG=   1.000 Gate
                     ZS= 256.000 CS= 100.000 ES=   1.500 Spillway
                     ZO= 250.000  K=  22.000 DZ=     4.0 Recharge
                     AS=  80.000 AN=   0.000  N=   0.000 Storage
                     FSS=0.000 FGW=0.000 GLEVEL=  0.000 QGWI=  0.0000
                     IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0 GWFACT=0.00 GWON=0
*
* Divert flow from 135 into ground and hold
*
DIVERT FLOWS        INFLO/THRU=2 DIVERT ID=5 HYD=3135 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.9000 CMS  IDFLAG=2 IDSTOR=0
*
* Add GW components from 130 and 135 together
*
ADD HYD             ID=3 HYD NO=4135 IDA=1 IDB=2 ICODE=0                  AREA=
0.000
*
* Route flows through Channel 35
* Using Valley Section  20062.900 As channel Rating Curve
*
ROUTE CHANNEL       ID=1 HYD NO=  35 INFLOW=5 LENGTH=   800 m  SLOPE=0.0062
                    RCID=2 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Part of Southern Tributary thru Golf Course
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 140 AREA=   0.5890 Sq km  L=   970 m  W=   365 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     7.3   0.0  0.0   0.0  0.0  89.3  0.0   0.0  3.3
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                     GWFACT=0.00 GWON=0
*
* Sum hydr.  140 &   35 call result  235
*
ADD HYD             ID=5 HYD NO= 235 IDA=2 IDB=1 ICODE=0                  AREA=
0.589
*
* Southern Tributary through Golf Course
*
ADD HYD             ID=1 HYD NO= 240 IDA=5 IDB=4 ICODE=0                  AREA=
0.762
*
* Route  240 through reach   40
* Using Valley Section  20062.900 As channel Rating Curve
*
ROUTE CHANNEL       ID=2 HYD NO=  40 INFLOW=1 LENGTH=   900 m  SLOPE=0.0062
                    RCID=2 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
```



```
*
* Compute runoff hydrograph from area  145
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=1 NHD= 145 AREA=   0.5540 Sq km  L=  1680 m  W=   315 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.0   0.0  0.0  12.9  0.0  85.1  0.0   0.0  0.0
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                     GWFACT=0.00 GWON=0
*
* Divert flow from 145 into ground
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=5 HYD=3145 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.4200 CMS  IDFLAG=2 IDSTOR=0
*
* Add GW components from 145 to running total
*
ADD HYD             ID=4 HYD NO=4145 IDA=3 IDB=1 ICODE=0                  AREA=
0.000
*
* Valley Section for Channel 35                                           5
*
COMPUTE RATING CURVE ID=3  VS=    35.000   NSEGS=3
                      MIN EL= 335.00    MAX EL= 337.50
                      CHNSLP= 0.0010    FLNSLP= 0.0010
                      N= 0.120  DIST=   20.00
                      N=-0.080  DIST=   40.00
                      N= 0.120  DIST=   60.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  337.50    20.00  335.20    30.00  335.00
                       40.00  335.20    60.00  337.50
                     RFN=0.0000 PCODE=1
*
* Eastern Side of Arkell U of G Farm
* Using Valley Section     35.000 As channel Rating Curve
*
ROUTE CHANNEL       ID=1 HYD NO=  50 INFLOW=5 LENGTH=  1240 m  SLOPE=0.0010
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Compute runoff hydrograph from area  150
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=3 NHD= 150 AREA=   0.3990 Sq km  L=   500 m  W=   207 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     6.6   0.0  0.0   0.0  0.0  87.3  0.0   0.0  6.1
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                     GWFACT=0.00 GWON=0
*
* Sum hydr.  150 &   50 call result  245
*
ADD HYD             ID=5 HYD NO= 245 IDA=3 IDB=1 ICODE=0                  AREA=
0.399
*
* Outflow from Southern Tributary =================
*
ADD HYD             ID=1 HYD NO= 250 IDA=2 IDB=5 ICODE=0                  AREA=
1.161
```

```
*
PRINT HYD           ID=1 PCODE=1
*
* Divert flow from 250 into ground
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=5 HYD=3250 PCODE=1 OPTION=5
                    PERCENT INFLOW= 90.00 IDFLAG=2 IDSTOR=0
*
* Add GW from 250 to running total
*
ADD HYD             ID=2 HYD NO=4250 IDA=4 IDB=1 ICODE=0                  AREA=
0.000
*
* Area u/s Arkell Road, inc Hamilton Corners
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=1 NHD= 101 AREA=   1.4200 Sq km  L=  2290 m  W=   625 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                      3.1   0.0  0.0   7.2 33.2  43.8  0.0   4.5  8.2
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=2 RBPCODE=0 FACTOR= 0.386
                    ILEVEL= 250.000      HDIFF=    8.0 QO=   0.0000
                    ZG= 250.000 CG=   0.000 EG=   1.000 Gate
                    ZS= 256.000 CS= 100.000 ES=   1.500 Spillway
                    ZO= 250.000  K=  20.000 DZ=     4.0 Recharge
                    AS=  55.230 AN=   0.000  N=   0.000 Storage
                    FSS=0.000 FGW=0.000 GLEVEL=  0.000 QGWI=  0.0000
                    IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0 GWFACT=0.00 GWON=0
*
* Divert flow from 101 into ground
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=6 HYD=3101 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.4800 CMS  IDFLAG=2 IDSTOR=0
*
* Add GW from 101 to running total
*
ADD HYD             ID=3 HYD NO=4101 IDA=2 IDB=1 ICODE=0                  AREA=
0.000
*
* Typical Urban Cross-section                                            6
*
COMPUTE RATING CURVE ID=4  VS=     3.000   NSEGS=3
                     MIN EL= 120.00    MAX EL= 125.00
                     CHNSLP= 0.0050    FLNSLP= 0.0050
                     N= 0.015  DIST=   33.30
                     N=-0.015  DIST=   66.67
                     N= 0.015  DIST=  100.00
                       DIST    ELEV     DIST    ELEV     DIST    ELEV
                       0.00  125.00     0.01  120.00    33.33  120.00
                      66.67  120.00    99.99  120.00   100.00  125.00
                    RFN=0.0000 PCODE=1
*
* Typical Urban Cross-section                                            6
*
COMPUTE RATING CURVE ID=6  VS=     3.000   NSEGS=3
                     MIN EL= 120.00    MAX EL= 125.00
                     CHNSLP= 0.0050    FLNSLP= 0.0050
                     N= 0.015  DIST=   33.30
                     N=-0.015  DIST=   66.67
                     N= 0.015  DIST=  100.00
                       DIST    ELEV     DIST    ELEV     DIST    ELEV
```



```
                       0.00  125.00     0.01  120.00    33.33  120.00
                      66.67  120.00    99.99  120.00   100.00  125.00
                    RFN=0.0000 PCODE=1
*
* Southwestern urban area
* VS=   3.000 is main channel & VS=   3.000 is off-channel
*
COMPUTE FLOWRATE    ID=1 NHD= 102 AREA=   0.1400 Sq km  L=   450 m  W=    50 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                      25.0   0.0 17.0  58.0  0.0   0.0  0.0   0.0  0.0
                    RATING CURVES: IDMC=4 IDOC=6 QRMC= 0.25 QROC= 0.15
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 1.2 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Part 1 of Inflow to big swamp
*
ADD HYD             ID=2 HYD NO= 202 IDA=6 IDB=1 ICODE=0                  AREA=
0.140
*
* Compute runoff hydrograph from area  103
* VS=   3.000 is main channel & VS=   3.000 is off-channel
*
COMPUTE FLOWRATE    ID=1 NHD= 103 AREA=   0.4620 Sq km  L=   450 m  W=    50 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                      35.0   0.0  4.8   4.7 48.1   0.0  0.0   7.4  0.0
                    RATING CURVES: IDMC=4 IDOC=4 QRMC= 0.25 QROC= 0.15
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 1.2 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Part 2 inflow to big swamp
*
ADD HYD             ID=4 HYD NO= 203 IDA=1 IDB=2 ICODE=0                  AREA=
0.602
*
* Divert flow from 203 into ground
*
DIVERT FLOWS        INFLO/THRU=4 DIVERT ID=6 HYD=3203 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.0008 CMS  IDFLAG=2 IDSTOR=0
*
* Add GW from 250 to running total
*
ADD HYD             ID=1 HYD NO=4203 IDA=3 IDB=4 ICODE=0                  AREA=
0.000
*
* Catchment area directly to swamp
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 105 AREA=   0.6830 Sq km  L=   826 m  W=   826 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                       2.0  98.0  0.0   0.0  0.0   0.0  0.0   0.0  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 3.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Part 3 inflow to big swamp
*
ADD HYD             ID=3 HYD NO= 205 IDA=2 IDB=6 ICODE=0                  AREA=
```

```
0.683
*
* Compute runoff hydrograph from area  106
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 106 AREA=   0.1870 Sq km  L=  1000 m  W=   350 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.8   0.0  8.0  24.8  0.0  64.4  0.0   0.0  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Part 4 inflow to big swamp
*
ADD HYD             ID=4 HYD NO= 206 IDA=2 IDB=3 ICODE=0                  AREA=
0.870
*
* Compute runoff hydrograph from area  107
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 107 AREA=   0.1880 Sq km  L=  1000 m  W=   200 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.0   0.0  9.0  31.9 51.8   5.3  0.0   0.0  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Part 5 inflow to big swamp
*
ADD HYD             ID=3 HYD NO= 207 IDA=2 IDB=4 ICODE=0                  AREA=
1.058
*
PRINT HYD           ID=3 PCODE=1
*
* Route flows through Big Swamp
*
ROUTE RESERVOIR     ID=2 HYD NO= 505 INFLOW=3 PCODE=0 OPTION=1
                    ILEVEL=  -1.000  HDIFF=    6.0
                    CONSTANT OUTFLOW  QO=   0.0000
                    ZG= 331.100 CG=   0.900 EG=   0.500 Gate
                    ZS= 333.000 CS=   6.000 ES=   1.500 Spillway
                    ZO= 331.000 AS=  30.000 AN=  55.280 N= 2.000
*
* Go to event file: Route flows through Big Swamp
*
CHANGE INPUT FILE
*
* Area contributing to Headwater Pond (No. 8)
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=3 NHD= 110 AREA=   0.3330 Sq km  L=  1030 m  W=   260 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.6   0.0  7.7  13.7  8.3  60.7  0.0   0.4  6.6
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
```



```
* Inflow to Pond 8
*
ADD HYD             ID=4 HYD NO= 210 IDA=3 IDB=2 ICODE=0                  AREA=
1.391
*
* Route flows through Pond 8
*
ROUTE RESERVOIR     ID=2 HYD NO= 510 INFLOW=4 PCODE=0 OPTION=1
                    ILEVEL=  -1.000  HDIFF=    6.0
                    CONSTANT OUTFLOW  QO=   0.0000
                    ZG= 330.670 CG=   0.500 EG=   0.500 Gate
                    ZS= 331.400 CS=   4.000 ES=   1.500 Spillway
                    ZO= 330.670 AS=   0.000 AN=   0.150 N= 2.100
*
* SECTION U-U                                                          17
*
COMPUTE RATING CURVE ID=3  VS=  3577.700   NSEGS=3
                      MIN EL= 329.90    MAX EL= 331.26
                      CHNSLP= 0.0062    FLNSLP= 0.0062
                      N= 0.120  DIST=   20.62
                      N=-0.070  DIST=   31.58
                      N= 0.120  DIST=   60.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  330.81    20.62  330.63    28.86  330.38
                       28.92  330.36    29.59  329.90    29.60  329.91
                       30.00  329.91    30.20  329.94    30.27  329.97
                       31.58  330.54    31.74  330.54    38.81  331.26
                       39.13  331.25    39.71  331.26    40.92  331.23
                       54.92  330.94    60.00  330.59
                     RFN=0.0000 PCODE=1
*
* Route  510 through reach   10
* Using Valley Section   3577.700 As channel Rating Curve
*
ROUTE CHANNEL       ID=3 HYD NO=  10 INFLOW=2 LENGTH=  1030 m  SLOPE=0.0062
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* South Central Area (includes Victoria Road)
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 115 AREA=   0.1250 Sq km  L=   430 m  W=   290 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.7   0.0 40.9   0.0  0.0  39.9  0.0  16.5  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Sum hydr.  115 &   10 call result  215
*
ADD HYD             ID=4 HYD NO= 215 IDA=2 IDB=3 ICODE=0                  AREA=
1.516
*
* Remove some flow from groundwater
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=6 HYD= 415 PCODE=1 OPTION=5
                    PERCENT INFLOW= 50.00 IDFLAG=2 IDSTOR=0
*
* Sum hydr.  415 &  215 call result 1215
*
ADD HYD             ID=2 HYD NO=1215 IDA=6 IDB=4 ICODE=0                  AREA=
1.516
```

```
*
* SECTION S-S                                                                  16
*
COMPUTE RATING CURVE ID=3  VS=  3101.800   NSEGS=3
                      MIN EL= 328.22    MAX EL= 329.25
                      CHNSLP= 0.0021    FLNSLP= 0.0021
                      N= 0.120  DIST=   10.85
                      N=-0.070  DIST=   11.26
                      N= 0.120  DIST=   50.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  328.60     0.62  328.61     1.16  328.62
                        6.20  328.69    10.85  328.47    10.94  328.22
                       11.26  328.44    12.47  328.66    12.52  328.70
                       15.00  328.70    17.49  328.71    20.94  328.72
                       21.20  328.71    23.23  328.72    30.00  328.72
                       50.00  329.25
                     RFN=0.0000 PCODE=1
*
* Route 1215 through reach   20
* Using Valley Section   3101.800 As channel Rating Curve
*
ROUTE CHANNEL       ID=3 HYD NO=  20 INFLOW=2 LENGTH=  1230 m  SLOPE=0.0062
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Compute runoff hydrograph from area  120
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 120 AREA=   0.4210 Sq km  L=   560 m  W=   383 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                       2.0  15.0  2.7  14.9  5.3  47.2  0.0  13.0  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 4.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Inflow to Victoria Pond (Number 5)
*
ADD HYD             ID=4 HYD NO= 220 IDA=2 IDB=3 ICODE=0                  AREA=
1.937
*
* Remove some flow from groundwater
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=6 HYD= 420 PCODE=1 OPTION=5
                    PERCENT INFLOW=100.00 IDFLAG=2 IDSTOR=0
*
* Sum hydr.  420 &  220 call result 1220
*
ADD HYD             ID=2 HYD NO=1220 IDA=6 IDB=4 ICODE=0                  AREA=
1.937
*
* Route flows through Victoria Pond
*
ROUTE RESERVOIR     ID=3 HYD NO= 520 INFLOW=2 PCODE=0 OPTION=1
                    ILEVEL=  -1.000  HDIFF=    6.0
                    CONSTANT OUTFLOW  QO=   0.0000
                    ZG= 327.160 CG=   0.000 EG=   0.500 Gate
                    ZS= 327.160 CS=   2.550 ES=   1.500 Spillway
                    ZO= 327.160 AS=   0.000 AN=   0.230 N= 3.000
*
* Go to event file: Route flows through Victoria Pond
*
CHANGE INPUT FILE
```



```
*
* SECTION R-R                                                                  24
*
COMPUTE RATING CURVE ID=3  VS=  2556.800   NSEGS=3
                      MIN EL= 326.89    MAX EL= 333.02
                      CHNSLP= 0.0024    FLNSLP= 0.0024
                      N= 0.120  DIST=   44.82
                      N=-0.070  DIST=   49.37
                      N= 0.120  DIST=  100.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  333.02     1.19  332.93     8.62  331.41
                       21.46  328.70    24.91  328.60    26.90  328.58
                       42.17  327.63    44.82  327.37    45.02  327.29
                       45.85  326.95    46.42  326.94    48.18  326.89
                       48.82  327.22    48.99  327.31    49.37  327.52
                       50.00  327.52    51.82  327.53    74.47  328.59
                       75.54  328.64    85.80  329.99    89.19  330.44
                       90.09  330.64    99.31  332.78   100.00  332.84
                     RFN=0.0000 PCODE=1
*
* Route  520 through reach   24
* Using Valley Section   2556.800 As channel Rating Curve
*
ROUTE CHANNEL       ID=2 HYD NO=  24 INFLOW=3 LENGTH=   450 m  SLOPE=0.0021
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Route flows through Pond 4
*
ROUTE RESERVOIR     ID=3 HYD NO= 524 INFLOW=2 PCODE=0 OPTION=1
                    ILEVEL=  -1.000  HDIFF=    6.0
                    CONSTANT OUTFLOW  QO=   0.0000
                    ZG= 327.160 CG=   0.000 EG=   0.500 Gate
                    ZS= 327.160 CS=   3.000 ES=   1.500 Spillway
                    ZO= 327.160 AS=   0.030 AN=   0.000 N= 2.000
*
* Compute runoff hydrograph from area  124
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 124 AREA=   0.1820 Sq km  L=   450 m  W=   251 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                       2.0   0.0  0.0  38.1  0.0  35.6  0.0   3.6 20.7
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Sum hydr.  524 &  124 call result  224
*
ADD HYD             ID=4 HYD NO= 224 IDA=3 IDB=2 ICODE=0                   AREA=
2.119
*
* Compute runoff hydrograph from area  126
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 126 AREA=   0.0990 Sq km  L=   200 m  W=   133 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                       2.0   0.0  0.0   0.0  1.8  29.2  0.0   7.1 59.6
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
```

```
*
* Sum hydr.  224 &  126 call result  226
*
ADD HYD             ID=3 HYD NO= 226 IDA=4 IDB=2 ICODE=0                  AREA=
2.218
*
* SECTION M-M                                                            30
*
COMPUTE RATING CURVE ID=3  VS=  2071.500   NSEGS=3
                      MIN EL= 324.84    MAX EL= 326.79
                      CHNSLP= 0.0003    FLNSLP= 0.0003
                      N= 0.250  DIST=   80.14
                      N=-0.150  DIST=   84.87
                      N= 0.250  DIST=  100.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  326.25    18.67  325.99    19.01  325.98
                       37.50  325.77    38.28  325.76    50.00  325.63
                       56.61  325.56    57.15  325.56    64.38  325.59
                       64.76  325.58    69.10  325.44    69.65  325.45
                       75.10  325.52    75.60  325.47    80.14  325.09
                       80.91  324.84    83.89  324.87    83.97  324.84
                       84.26  324.85    84.82  325.15    84.87  325.17
                       88.17  325.50    88.39  325.52    93.17  325.83
                       93.42  325.84    96.49  326.12    96.59  326.13
                       99.90  326.77    99.93  326.78   100.00  326.79
                     RFN=0.0000 PCODE=1
*
* Main Stem flows u/s confluence with south branch
* Using Valley Section   2071.500 As channel Rating Curve
*
ROUTE CHANNEL       ID=2 HYD NO=  26 INFLOW=3 LENGTH=   450 m  SLOPE=0.0006
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Main Stem Flows d/s of South Tributary ========
*
ADD HYD             ID=3 HYD NO= 251 IDA=2 IDB=5 ICODE=0                  AREA=
2.218
*
* Arkell Tributary, headwaters
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 160 AREA=   0.3150 Sq km  L=  1500 m  W=   417 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     7.0   0.0  0.0  51.6 12.8  28.6  0.0   0.0  0.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Divert flow from 160 into ground
*
DIVERT FLOWS        INFLO/THRU=2 DIVERT ID=5 HYD=3160 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.3300 CMS  IDFLAG=2 IDSTOR=0
*
* Add GW from 160 to running total
*
ADD HYD             ID=4 HYD NO=4160 IDA=1 IDB=2 ICODE=0                  AREA=
0.000
*
* Valley Section for Channel 35                                           5
*
COMPUTE RATING CURVE ID=3  VS=    35.000   NSEGS=3
```



```
                      MIN EL= 335.00    MAX EL= 337.50
                      CHNSLP= 0.0010    FLNSLP= 0.0010
                      N= 0.120  DIST=   20.00
                      N=-0.080  DIST=   40.00
                      N= 0.120  DIST=   60.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  337.50    20.00  335.20    30.00  335.00
                       40.00  335.20    60.00  337.50
                     RFN=0.0000 PCODE=1
*
* Route flows alongside CPR Tracks
* Using Valley Section     35.000 As channel Rating Curve
*
ROUTE CHANNEL       ID=1 HYD NO=  60 INFLOW=5 LENGTH=   780 m  SLOPE=0.0010
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Compute runoff hydrograph from area  162
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 162 AREA=   0.3930 Sq km  L=   350 m  W=   233 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.0   0.0  0.0  17.9  0.0  52.8  0.0   0.0 27.3
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                    GWFACT=0.00 GWON=0
*
* Outflow from Arkell Tributary
*
ADD HYD             ID=5 HYD NO= 260 IDA=1 IDB=2 ICODE=0                  AREA=
0.393
*
* Main Stem Flows d/s Arkell Tributary
*
ADD HYD             ID=1 HYD NO= 262 IDA=3 IDB=5 ICODE=0                  AREA=
2.611
*
* SECTION F-F                                                            13
*
COMPUTE RATING CURVE ID=3  VS=   995.900   NSEGS=3
                      MIN EL= 322.09    MAX EL= 323.25
                      CHNSLP= 0.0011    FLNSLP= 0.0011
                      N= 0.250  DIST=   38.70
                      N=-0.120  DIST=   63.96
                      N= 0.250  DIST=  100.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  322.45    30.98  322.29    35.89  322.31
                       38.70  322.30    45.52  322.09    45.94  322.09
                       48.21  322.10    63.96  322.20    76.96  322.47
                       77.06  322.47    91.89  322.55    95.46  322.97
                      100.00  323.25
                     RFN=0.0000 PCODE=1
*
* Route  262 through reach   65
* Using Valley Section    995.900 As channel Rating Curve
*
ROUTE CHANNEL       ID=2 HYD NO=  65 INFLOW=1 LENGTH=   535 m  SLOPE=0.0021
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Compute runoff hydrograph from area  165
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
```

```
COMPUTE FLOWRATE    ID=1 NHD= 165 AREA=   0.2390 Sq km  L=   550 m  W=   367 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.0   0.0  0.0   0.0  2.7  24.5  0.0   2.4 68.4
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                     GWFACT=0.00 GWON=0
*
* Sum hydr.  165 &   65 call result  265
*
ADD HYD             ID=3 HYD NO= 265 IDA=1 IDB=2 ICODE=0                  AREA=
2.850
*
* Divert flow from 265 into ground
*
DIVERT FLOWS        INFLO/THRU=3 DIVERT ID=5 HYD=3265 PCODE=1 OPTION=5
                    PERCENT INFLOW= 75.00 IDFLAG=2 IDSTOR=0
*
* Add GW from 265 to running total
*
ADD HYD             ID=1 HYD NO=4265 IDA=4 IDB=3 ICODE=0                  AREA=
0.000
*
* Compute runoff hydrograph from area  170
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 170 AREA=   0.4530 Sq km  L=   507 m  W=   338 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     2.0  18.4  5.3   7.0 17.3  14.6  0.0  21.8 13.6
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 4.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                     GWFACT=0.00 GWON=0
*
* Northern Tributary Swamp
*
ROUTE RESERVOIR     ID=3 HYD NO= 570 INFLOW=2 PCODE=0 OPTION=1
                    ILEVEL=  -1.000  HDIFF=    6.0
                    CONSTANT OUTFLOW  QO=   0.0000
                    ZG= 332.000 CG=   1.000 EG=   0.500 Gate
                    ZS= 333.000 CS=  10.000 ES=   1.000 Spillway
                    ZO= 332.000 AS=   8.290 AN=   0.000 N= 2.000
*
* SECTION H-H                                                           10
*
COMPUTE RATING CURVE ID=3  VS= 20346.900   NSEGS=3
                      MIN EL= 328.32    MAX EL= 329.66
                      CHNSLP= 0.0026    FLNSLP= 0.0026
                      N= 0.120  DIST=   17.87
                      N=-0.070  DIST=   28.69
                      N= 0.120  DIST=   36.31
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  329.66     0.53  329.63     5.12  328.72
                       10.17  328.60    17.86  328.40    20.65  328.32
                       21.16  328.32    28.34  328.44    28.69  328.45
                       36.31  328.75
                     RFN=0.0000 PCODE=1
*
* Route  570 through reach   75
* Using Valley Section  20346.900 As channel Rating Curve
*
```



```
ROUTE CHANNEL       ID=2 HYD NO=  75 INFLOW=3 LENGTH=   607 m  SLOPE=0.0062
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Compute runoff hydrograph from area  175
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=3 NHD= 175 AREA=   0.2570 Sq km  L=   340 m  W=   250 m
               SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     9.0   0.0  0.0   0.0 43.1   3.3  0.0  38.6  5.9
                     RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                     ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                     SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                     RBASIN=0 IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0
                     GWFACT=0.00 GWON=0
*
* Sum hydr.   75 &  175 call result  275
*
ADD HYD             ID=4 HYD NO= 275 IDA=2 IDB=3 ICODE=0                  AREA=
0.710
*
* Main Stem Flows d/s of Northern Tributary
*
ADD HYD             ID=2 HYD NO= 277 IDA=5 IDB=4 ICODE=0                  AREA=
0.710
*
* Remove some flow from groundwater
*
DIVERT FLOWS        INFLO/THRU=1 DIVERT ID=5 HYD= 477 PCODE=1 OPTION=5
                    PERCENT INFLOW=100.00 IDFLAG=2 IDSTOR=0
*
* Sum hydr.  477 &  277 call result 1277
*
ADD HYD             ID=3 HYD NO=1277 IDA=5 IDB=2 ICODE=0                  AREA=
0.710
*
* Divert flow into low flow channel (79)
*
DIVERT FLOWS        INFLO/THRU=3 DIVERT ID=5 HYD=3277 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.3000 CMS  IDFLAG=2 IDSTOR=0
*
* SECTION D-D                                                           19
*
COMPUTE RATING CURVE ID=3  VS=   328.300   NSEGS=3
                      MIN EL= 318.22    MAX EL= 321.02
                      CHNSLP= 0.0061    FLNSLP= 0.0061
                      N= 0.250  DIST=   23.45
                      N=-0.120  DIST=   28.26
                      N= 0.250  DIST=   40.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  319.31     4.29  318.27     4.35  318.26
                        4.49  318.26    15.16  318.46    17.72  318.46
                       20.00  318.46    23.45  318.47    23.65  318.38
                       24.04  318.22    25.00  318.22    25.33  318.22
                       28.26  319.17    28.87  319.37    30.65  320.37
                       30.98  320.55    38.17  320.54    38.25  320.54
                       40.00  321.02
                     RFN=0.0000 PCODE=1
*
* High flow channel
*
ROUTE CHANNEL       ID=2 HYD NO=  78 INFLOW=3 K= -37.000 TL= 0.000
                     X= 0.400 NS=1 PCODE=1 IDX=1 PIPE=0 CANOPY=  0.0%
*
```

```
* SECTION D-D                                                          19
*
COMPUTE RATING CURVE ID=3  VS= 30328.301   NSEGS=3
                      MIN EL= 318.22    MAX EL= 321.02
                      CHNSLP= 0.0121    FLNSLP= 0.0121
                      N= 0.250  DIST=   23.45
                      N=-0.070  DIST=   28.26
                      N= 0.250  DIST=   40.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  319.31     4.29  318.27     4.35  318.26
                        4.49  318.26    15.16  318.46    17.72  318.46
                       20.00  318.46    23.45  318.47    23.65  318.38
                       24.04  318.22    25.00  318.22    25.33  318.22
                       28.26  319.17    28.87  319.37    30.65  320.37
                       30.98  320.55    38.17  320.54    38.25  320.54
                       40.00  321.02
                     RFN=0.0000 PCODE=1
*
* Low flow channel
* Using Valley Section  30328.301 As channel Rating Curve
*
ROUTE CHANNEL       ID=3 HYD NO=  79 INFLOW=5 LENGTH=  1200 m  SLOPE=0.0120
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Sum flows for channel 78*
*
ADD HYD             ID=4 HYD NO= 279 IDA=3 IDB=2 ICODE=0                  AREA=
0.000
*
* Compute runoff hydrograph from area  180
* VS=   1.000 is main channel & VS=   2.000 is off-channel
*
COMPUTE FLOWRATE    ID=2 NHD= 180 AREA=   0.4700 Sq km  L=   800 m  W=   300 m
              SOIL ZONE I    II  III    IV    V    VI  VII  VIII   IX
                     14.0   3.8  0.0   3.3 18.6   8.2 18.4  12.6 21.0
                    RATING CURVES: IDMC=1 IDOC=5 QRMC= 0.50 QROC= 0.05
                    ROUTING MODEL=2 CONSTANTS: OVERLAND FTB= 2.0 TLO= 0.0
                    SUBSURFACE: KSS= 5.0 KGW= 384 h PCODE=1 WQPCODE=1
                    RBASIN=2 RBPCODE=0 FACTOR= 0.400
                    ILEVEL= 250.000      HDIFF=    8.0 QO=   0.0000
                    ZG= 250.000 CG=   0.000 EG=   1.000 Gate
                    ZS= 256.000 CS= 100.000 ES=   1.500 Spillway
                    ZO= 250.000  K=  22.000 DZ=     4.0 Recharge
                    AS=  22.300 AN=   0.000  N=   0.000 Storage
                    FSS=0.000 FGW=0.000 GLEVEL=  0.000 QGWI=  0.0000
                    IDA=0 IDB=0 IDC=0 IDD=0 RBDUMP=0 GWFACT=0.00 GWON=0
*
* Inflow to Mill Pond (Number 1)
*
ADD HYD             ID=3 HYD NO= 278 IDA=4 IDB=2 ICODE=0                  AREA=
0.470
*
* Torrance Creek flows out of Mill Pond
*
ROUTE RESERVOIR     ID=2 HYD NO= 580 INFLOW=3 PCODE=0 OPTION=1
                    ILEVEL=  -1.000  HDIFF=    8.0
                    CONSTANT OUTFLOW  QO=   0.0000
                    ZG= 320.220 CG=   0.000 EG=   0.500 Gate
                    ZS= 320.220 CS=   1.360 ES=   1.500 Spillway
                    ZO= 319.220 AS=   0.000 AN=   0.078 N= 2.100
*
* Go to event file: Torrance Creek flows out of Mill Pond
*
```



```
CHANGE INPUT FILE
*
* Divert flow from 580 into ground
*
DIVERT FLOWS        INFLO/THRU=2 DIVERT ID=5 HYD=3580 PCODE=1 OPTION=1
                    INLET CAPACITY=   0.0250 CMS  IDFLAG=2 IDSTOR=0
*
* SECTION D-D                                                          19
*
COMPUTE RATING CURVE ID=3  VS=   328.300   NSEGS=3
                      MIN EL= 318.22    MAX EL= 321.02
                      CHNSLP= 0.0061    FLNSLP= 0.0061
                      N= 0.250  DIST=   23.45
                      N=-0.120  DIST=   28.26
                      N= 0.250  DIST=   40.00
                        DIST    ELEV     DIST    ELEV     DIST    ELEV
                        0.00  319.31     4.29  318.27     4.35  318.26
                        4.49  318.26    15.16  318.46    17.72  318.46
                       20.00  318.46    23.45  318.47    23.65  318.38
                       24.04  318.22    25.00  318.22    25.33  318.22
                       28.26  319.17    28.87  319.37    30.65  320.37
                       30.98  320.55    38.17  320.54    38.25  320.54
                       40.00  321.02
                     RFN=0.0000 PCODE=1
*
* Torrance Creek Flows at Eramosa River (outlet)
* Using Valley Section    328.300 As channel Rating Curve
*
ROUTE CHANNEL       ID=2 HYD NO=  80 INFLOW=5 LENGTH=   578 m  SLOPE=0.0120
                    RCID=3 NS=1 PCODE=1 INDEX=1 PIPE=0 CANOPY=  0.0%
*
* Go to event file: Torrance Creek Flows at Eramosa River (outlet)
*
CHANGE INPUT FILE
*
FINISH
```

```
1  130    0.5030     12.54    0.1066          0. RCFLAGS    0    0 return1.dat
                      scene1.wat
1 3130    0.5030      0.00    0.0000          0. RCFLAGS    0    0
1   30    0.5030      0.00    0.0000          0. RCFLAGS    0    0
1  132    0.1730     12.01    0.0656          0. RCFLAGS    0    0
1  232    0.6760      3.07    0.0656          0. RCFLAGS    0    0
1  135    2.2800      7.10    0.2192         15. RCFLAGS    0   10
1 3135    2.2800      0.00    0.0000          0. RCFLAGS    0    0
1 4135    2.7830      8.08    0.3216          0. RCFLAGS    0    0
1   35    2.2800      0.00    0.0000          0. RCFLAGS    0    0
1  140    0.5890     15.10    0.1630          0. RCFLAGS    0    0
1  235    2.8690      3.10    0.1630          0. RCFLAGS    0    0
1  240    3.5450      3.10    0.2235          0. RCFLAGS    0    0
1   40    3.5450      3.06    0.2172          0. RCFLAGS    0    0
1  145    0.5540     12.60    0.1042          0. RCFLAGS    0    0
1 3145    0.5540      0.00    0.0000          0. RCFLAGS    0    0
1 4145    3.3370      8.83    0.4253          0. RCFLAGS    0    0
1   50    0.5540      0.00    0.0000          0. RCFLAGS    0    0
1  150    0.3990     16.51    0.1859          0. RCFLAGS    0    0
1  245    0.9530      6.91    0.1859          0. RCFLAGS    0    0
1  250    4.4980      3.88    0.3764          0. RCFLAGS    0    0
1 3250    4.4980      3.49    0.3388          0. RCFLAGS    0    0
1 4250    7.8350      3.98    0.4615          0. RCFLAGS    0    0
1  101    1.4200      7.56    0.1387         12. RCFLAGS    0    0
1 3101    1.4200      0.00    0.0000          0. RCFLAGS    0    0
1 4101    9.2550      4.53    0.5936          0. RCFLAGS    0    0
1  102    0.1400     65.45    0.7214          0. RCFLAGS    0    0
1  202    1.5600      5.87    0.7214          0. RCFLAGS    0    0
1  103    0.4620     56.41    2.1189          0. RCFLAGS    0    0
1  203    2.0220     17.42    2.8403          0. RCFLAGS    0    0
1 3203    2.0220     17.31    2.8395          0. RCFLAGS    0    0
1 4203   11.2770      3.74    0.5944          0. RCFLAGS    0    0
1  105    0.6830      3.06    0.0153          0. RCFLAGS    0    0
1  205    2.7050     13.71    2.8501          0. RCFLAGS    0    0
1  106    0.1870     23.43    0.0779          0. RCFLAGS    0    0
1  206    2.8920     14.34    2.8737          0. RCFLAGS    0    0
1  107    0.1880     33.20    0.1138          0. RCFLAGS    0    0
1  207    3.0800     15.49    2.9073          0. RCFLAGS    0    0
1  505    3.0800      5.94    0.1564      70000. RCFLAGS    0    0
1  110    0.3330     20.87    0.1231          0. RCFLAGS    0    0
1  210    3.4130      7.40    0.2771          0. RCFLAGS    0    0
1  510    3.4130      7.37    0.2766        165. RCFLAGS    0    0
1   10    3.4130      7.22    0.2746          0. RCFLAGS    0    0
1  115    0.1250     37.54    0.1167          0. RCFLAGS    0    0
1  215    3.5380      8.30    0.3710          0. RCFLAGS    0    0
1  415   11.2770      1.87    0.2972          0. RCFLAGS    0    0
1 1215    3.5380     14.26    0.6652          0. RCFLAGS    0    0
1   20    3.5380     13.69    0.6434          0. RCFLAGS    0    0 return1.dat
                      scene1.wat
1  120    0.4210     14.51    0.0970          0. RCFLAGS    0    0
1  220    3.9590     13.78    0.7262          0. RCFLAGS    0    0
1  420   11.2770      1.87    0.2972          0. RCFLAGS    0    0
1 1220    3.9590     19.10    1.0108          0. RCFLAGS    0    0
1  520    3.9590     19.08    1.0097        378. RCFLAGS    0    0
1   24    3.9590     18.95    1.0086          0. RCFLAGS    0    0
1  524    3.9590     18.93    1.0086        145. RCFLAGS    0    0
1  124    0.1820     23.36    0.1208          0. RCFLAGS    0    0
1  224    4.1410     19.12    1.0819          0. RCFLAGS    0    0
1  126    0.0990      6.15    0.0321          0. RCFLAGS    0    0
1  226    4.2400     18.82    1.0911          0. RCFLAGS    0    0
1   26    4.2400     17.82    0.9756          0. RCFLAGS    0    0
1  251    8.7380     10.44    1.1815          0. RCFLAGS    0    0
1  160    0.3150     26.08    0.1229          0. RCFLAGS    0    0
```



```
1 3160    0.3150      0.00    0.0000          0. RCFLAGS    0    0
1 4160   11.5920      0.71    0.1229          0. RCFLAGS    0    0
1   60    0.3150      0.00    0.0000          0. RCFLAGS    0    0
1  162    0.3930     16.90    0.2278          0. RCFLAGS    0    0
1  260    0.7080      9.38    0.2278          0. RCFLAGS    0    0
1  262    9.4460     10.36    1.2655          0. RCFLAGS    0    0
1   65    9.4460     10.06    1.2592          0. RCFLAGS    0    0
1  165    0.2390      5.54    0.0320          0. RCFLAGS    0    0
1  265    9.6850      9.95    1.2747          0. RCFLAGS    0    0
1 3265    9.6850      7.46    0.9560          0. RCFLAGS    0    0
1 4265   21.2770      1.52    0.4181          0. RCFLAGS    0    0
1  170    0.4530     13.52    0.0986          0. RCFLAGS    0    0
1  570    0.4530     12.02    0.0565       1440. RCFLAGS    0    0
1   75    0.4530     11.61    0.0565          0. RCFLAGS    0    0
1  175    0.2570     20.64    0.1725          0. RCFLAGS    0    0
1  275    0.7100     14.88    0.1972          0. RCFLAGS    0    0
1  277   10.3950      7.97    1.0631          0. RCFLAGS    0    0
1  477   21.2770      1.52    0.4181          0. RCFLAGS    0    0
1 1277   10.3950     11.08    1.4811          0. RCFLAGS    0    0
1 3277   10.3950      7.52    1.1811          0. RCFLAGS    0    0
1   78   10.3950      1.50    0.2174          0. RCFLAGS    0    0
1   79   10.3950      7.40    1.1801          0. RCFLAGS    0    0
1  279   10.3950      8.90    1.2847          0. RCFLAGS    0    0
1  180    0.4700     17.90    0.1398         12. RCFLAGS    0    0
1  278   10.8650      9.29    1.3668          0. RCFLAGS    0    0
1  580   10.8650      9.17    1.3634       3350. RCFLAGS    0    0
1 3580   10.8650      8.63    1.3384          0. RCFLAGS    0    0
1   80   10.8650      8.51    1.3380          0. RCFLAGS    0    0
2  130    0.5030     23.12    0.1944          0. RCFLAGS    0    0 return1.dat
                      scene1.wat
2 3130    0.5030      0.00    0.0000          0. RCFLAGS    0    0
2   30    0.5030      0.00    0.0000          0. RCFLAGS    0    0
2  132    0.1730     23.13    0.1214          0. RCFLAGS    0    0
2  232    0.6760      5.92    0.1214          0. RCFLAGS    0    0
2  135    2.2800     12.20    0.3793         27. RCFLAGS    0   10
2 3135    2.2800      0.00    0.0000          0. RCFLAGS    0    0
2 4135    2.7830     14.17    0.5696          0. RCFLAGS    0    0
2   35    2.2800      0.00    0.0000          0. RCFLAGS    0    0
2  140    0.5890     26.31    0.2834          0. RCFLAGS    0    0
2  235    2.8690      5.40    0.2834          0. RCFLAGS    0    0
2  240    3.5450      5.50    0.4003          0. RCFLAGS    0    0
2   40    3.5450      5.44    0.3927          0. RCFLAGS    0    0
2  145    0.5540     22.15    0.1825          0. RCFLAGS    0    0
2 3145    0.5540      0.00    0.0000          0. RCFLAGS    0    0
2 4145    3.3370     15.50    0.7520          0. RCFLAGS    0    0
2   50    0.5540      0.00    0.0000          0. RCFLAGS    0    0
2  150    0.3990     30.97    0.3234          0. RCFLAGS    0    0
2  245    0.9530     12.97    0.3234          0. RCFLAGS    0    0
2  250    4.4980      7.04    0.6775          0. RCFLAGS    0    0
2 3250    4.4980      6.33    0.6097          0. RCFLAGS    0    0
2 4250    7.8350      7.00    0.8179          0. RCFLAGS    0    0
2  101    1.4200     12.19    0.2241         20. RCFLAGS    0    0
2 3101    1.4200      0.00    0.0000          0. RCFLAGS    0    0
2 4101    9.2550      7.80    1.0342          0. RCFLAGS    0    0
2  102    0.1400     86.01    0.8904          0. RCFLAGS    0    0
2  202    1.5600      7.72    0.8904          0. RCFLAGS    0    0
2  103    0.4620     74.82    2.6353          0. RCFLAGS    0    0
2  203    2.0220     23.05    3.5257          0. RCFLAGS    0    0
2 3203    2.0220     22.94    3.5249          0. RCFLAGS    0    0
2 4203   11.2770      6.42    1.0350          0. RCFLAGS    0    0
2  105    0.6830      3.30    0.0176          0. RCFLAGS    0    0
2  205    2.7050     17.98    3.5369          0. RCFLAGS    0    0
2  106    0.1870     36.50    0.1200          0. RCFLAGS    0    0
```

```
2  206    2.8920     19.18    3.5730          0. RCFLAGS    0    0
2  107    0.1880     48.44    0.1627          0. RCFLAGS    0    0
2  207    3.0800     20.97    3.6356          0. RCFLAGS    0    0
2  505    3.0800      7.94    0.2102      81800. RCFLAGS    0    0
2  110    0.3330     32.61    0.1915          0. RCFLAGS    0    0
2  210    3.4130     10.35    0.3972          0. RCFLAGS    0    0
2  510    3.4130     10.31    0.3814        557. RCFLAGS    0    0
2   10    3.4130     10.13    0.3811          0. RCFLAGS    0    0
2  115    0.1250     53.25    0.1607          0. RCFLAGS    0    0
2  215    3.5380     11.66    0.4955          0. RCFLAGS    0    0
2  415   11.2770      3.21    0.5175          0. RCFLAGS    0    0
2 1215    3.5380     21.89    1.0130          0. RCFLAGS    0    0
2   20    3.5380     21.14    0.9962          0. RCFLAGS    0    0 return1.dat
                    scene1.wat
2  120    0.4210     23.12    0.1554          0. RCFLAGS    0    0
2  220    3.9590     21.35    1.1289          0. RCFLAGS    0    0
2  420   11.2770      3.21    0.5175          0. RCFLAGS    0    0
2 1220    3.9590     30.49    1.6251          0. RCFLAGS    0    0
2  520    3.9590     30.45    1.6216        950. RCFLAGS    0    0
2   24    3.9590     30.23    1.6200          0. RCFLAGS    0    0
2  524    3.9590     30.20    1.6200        199. RCFLAGS    0    0
2  124    0.1820     35.46    0.1782          0. RCFLAGS    0    0
2  224    4.1410     30.43    1.7275          0. RCFLAGS    0    0
2  126    0.0990     10.94    0.0562          0. RCFLAGS    0    0
2  226    4.2400     29.97    1.7442          0. RCFLAGS    0    0
2   26    4.2400     28.56    1.5939          0. RCFLAGS    0    0
2  251    8.7380     17.12    1.9813          0. RCFLAGS    0    0
2  160    0.3150     38.16    0.1779          0. RCFLAGS    0    0
2 3160    0.3150      0.00    0.0000          0. RCFLAGS    0    0
2 4160   11.5920      1.04    0.1779          0. RCFLAGS    0    0
2   60    0.3150      0.00    0.0000          0. RCFLAGS    0    0
2  162    0.3930     27.61    0.3619          0. RCFLAGS    0    0
2  260    0.7080     15.32    0.3619          0. RCFLAGS    0    0
2  262    9.4460     16.98    2.1267          0. RCFLAGS    0    0
2   65    9.4460     16.55    2.1163          0. RCFLAGS    0    0
2  165    0.2390      9.54    0.0550          0. RCFLAGS    0    0
2  265    9.6850     16.38    2.1451          0. RCFLAGS    0    0
2 3265    9.6850     12.28    1.6088          0. RCFLAGS    0    0
2 4265   21.2770      2.43    0.6828          0. RCFLAGS    0    0
2  170    0.4530     20.02    0.1471          0. RCFLAGS    0    0
2  570    0.4530     16.77    0.0808       2490. RCFLAGS    0    0
2   75    0.4530     16.17    0.0808          0. RCFLAGS    0    0
2  175    0.2570     33.31    0.2530          0. RCFLAGS    0    0
2  275    0.7100     22.37    0.2812          0. RCFLAGS    0    0
2  277   10.3950     12.97    1.7662          0. RCFLAGS    0    0
2  477   21.2770      2.43    0.6828          0. RCFLAGS    0    0
2 1277   10.3950     17.94    2.4489          0. RCFLAGS    0    0
2 3277   10.3950     14.09    2.1489          0. RCFLAGS    0    0
2   78   10.3950      1.62    0.2228          0. RCFLAGS    0    0
2   79   10.3950     13.90    2.1481          0. RCFLAGS    0    0
2  279   10.3950     15.52    2.2595          0. RCFLAGS    0    0
2  180    0.4700     24.57    0.1932         17. RCFLAGS    0    0
2  278   10.8650     15.91    2.3798          0. RCFLAGS    0    0
2  580   10.8650     15.73    2.3732       5120. RCFLAGS    0    0
2 3580   10.8650     15.18    2.3482          0. RCFLAGS    0    0
2   80   10.8650     15.01    2.3478          0. RCFLAGS    0    0
3  130    0.5030     33.79    0.2832          0. RCFLAGS    0    0 return1.dat
                    scene1.wat
3 3130    0.5030      0.00    0.0000          0. RCFLAGS    0    0
3   30    0.5030      0.00    0.0000          0. RCFLAGS    0    0
3  132    0.1730     34.74    0.1806          0. RCFLAGS    0    0
3  232    0.6760      8.89    0.1806          0. RCFLAGS    0    0
3  135    2.2800     17.46    0.5439         37. RCFLAGS    0    0
```



```
3 3135    2.2800      0.00    0.0000          0. RCFLAGS    0    0
3 4135    2.7830     20.41    0.8214          0. RCFLAGS    0    0
3   35    2.2800      0.00    0.0000          0. RCFLAGS    0    0
3  140    0.5890     39.95    0.4104          0. RCFLAGS    0    0
3  235    2.8690      8.20    0.4104          0. RCFLAGS    0    0
3  240    3.5450      8.33    0.5841          0. RCFLAGS    0    0
3   40    3.5450      8.25    0.5742          0. RCFLAGS    0    0
3  145    0.5540     31.58    0.2596          0. RCFLAGS    0    0
3 3145    0.5540      0.00    0.0000          0. RCFLAGS    0    0
3 4145    3.3370     22.26    1.0809          0. RCFLAGS    0    0
3   50    0.5540      0.00    0.0000          0. RCFLAGS    0    0
3  150    0.3990     43.88    0.4634          0. RCFLAGS    0    0
3  245    0.9530     18.37    0.4634          0. RCFLAGS    0    0
3  250    4.4980     10.40    0.9856          0. RCFLAGS    0    0
3 3250    4.4980      9.36    0.8871          0. RCFLAGS    0    0
3 4250    7.8350     10.08    1.1767          0. RCFLAGS    0    0
3  101    1.4200     16.58    0.3044         27. RCFLAGS    0    0
3 3101    1.4200      0.00    0.0000          0. RCFLAGS    0    0
3 4101    9.2550     11.08    1.4699          0. RCFLAGS    0    0
3  102    0.1400    103.05    1.0298          0. RCFLAGS    0    0
3  202    1.5600      9.25    1.0298          0. RCFLAGS    0    0
3  103    0.4620     90.65    3.0796          0. RCFLAGS    0    0
3  203    2.0220     27.85    4.1094          0. RCFLAGS    0    0
3 3203    2.0220     27.74    4.1086          0. RCFLAGS    0    0
3 4203   11.2770      9.11    1.4707          0. RCFLAGS    0    0
3  105    0.6830      3.51    0.0196          0. RCFLAGS    0    0
3  205    2.7050     21.62    4.1217          0. RCFLAGS    0    0
3  106    0.1870     48.56    0.1595          0. RCFLAGS    0    0
3  206    2.8920     23.36    4.1716          0. RCFLAGS    0    0
3  107    0.1880     61.20    0.2031          0. RCFLAGS    0    0
3  207    3.0800     25.67    4.2582          0. RCFLAGS    0    0
3  505    3.0800      9.66    0.2564      92000. RCFLAGS    0    0
3  110    0.3330     43.75    0.2568          0. RCFLAGS    0    0
3  210    3.4130     12.99    0.5063          0. RCFLAGS    0    0
3  510    3.4130     12.94    0.4989        873. RCFLAGS    0    0
3   10    3.4130     12.72    0.4961          0. RCFLAGS    0    0
3  115    0.1250     67.95    0.2043          0. RCFLAGS    0    0
3  215    3.5380     14.67    0.6502          0. RCFLAGS    0    0
3  415   11.2770      4.55    0.7354          0. RCFLAGS    0    0
3 1215    3.5380     29.19    1.3855          0. RCFLAGS    0    0
3   20    3.5380     28.30    1.3613          0. RCFLAGS    0    0 return1.dat
                    scene1.wat
3  120    0.4210     32.02    0.2151          0. RCFLAGS    0    0
3  220    3.9590     28.69    1.5475          0. RCFLAGS    0    0
3  420   11.2770      4.55    0.7354          0. RCFLAGS    0    0
3 1220    3.9590     41.67    2.2576          0. RCFLAGS    0    0
3  520    3.9590     41.58    2.2458        1800. RCFLAGS    0    0
3   24    3.9590     41.28    2.2428          0. RCFLAGS    0    0
3  524    3.9590     41.24    2.2421         261. RCFLAGS    0   10
3  124    0.1820     46.63    0.2317          0. RCFLAGS    0    0
3  224    4.1410     41.48    2.3827          0. RCFLAGS    0    0
3  126    0.0990     16.02    0.0819          0. RCFLAGS    0    0
3  226    4.2400     40.89    2.4066          0. RCFLAGS    0    0
3   26    4.2400     39.23    2.2292          0. RCFLAGS    0    0
3  251    8.7380     23.85    2.8152          0. RCFLAGS    0    0
3  160    0.3150     48.79    0.2259          0. RCFLAGS    0    0
3 3160    0.3150      0.00    0.0000          0. RCFLAGS    0    0
3 4160   11.5920      1.33    0.2259          0. RCFLAGS    0    0
3   60    0.3150      0.00    0.0000          0. RCFLAGS    0    0
3  162    0.3930     37.85    0.4916          0. RCFLAGS    0    0
3  260    0.7080     21.01    0.4916          0. RCFLAGS    0    0
3  262    9.4460     23.64    3.0248          0. RCFLAGS    0    0
3   65    9.4460     23.18    3.0134          0. RCFLAGS    0    0
```

```
3  165    0.2390     13.56    0.0786          0. RCFLAGS    0    0
3  265    9.6850     22.94    3.0572          0. RCFLAGS    0    0
3 3265    9.6850     17.21    2.2929          0. RCFLAGS    0    0
3 4265   21.2770      3.33    0.9550          0. RCFLAGS    0    0
3  170    0.4530     26.72    0.1974          0. RCFLAGS    0    0
3  570    0.4530     21.67    0.1063       3600. RCFLAGS    0    0
3   75    0.4530     20.87    0.1063          0. RCFLAGS    0    0
3  175    0.2570     44.36    0.3406          0. RCFLAGS    0    0
3  275    0.7100     29.38    0.3720          0. RCFLAGS    0    0
3  277   10.3950     18.04    2.5094          0. RCFLAGS    0    0
3  477   21.2770      3.33    0.9550          0. RCFLAGS    0    0
3 1277   10.3950     24.86    3.4641          0. RCFLAGS    0    0
3 3277   10.3950     20.76    3.1641          0. RCFLAGS    0    0
3   78   10.3950      1.72    0.2270          0. RCFLAGS    0    0
3   79   10.3950     20.49    3.1629          0. RCFLAGS    0    0
3  279   10.3950     22.20    3.2798          0. RCFLAGS    0    0
3  180    0.4700     30.69    0.2425         21. RCFLAGS    0    0
3  278   10.8650     22.57    3.4379          0. RCFLAGS    0    0
3  580   10.8650     22.33    3.4263       7040. RCFLAGS    0    0
3 3580   10.8650     21.78    3.4013          0. RCFLAGS    0    0
3   80   10.8650     21.59    3.4006          0. RCFLAGS    0    0
4  130    0.5030     40.13    0.3345          0. RCFLAGS    0    0 return1.dat
                     scene1.wat
4 3130    0.5030      0.00    0.0000          0. RCFLAGS    0    0
4   30    0.5030      0.00    0.0000          0. RCFLAGS    0    0
4  132    0.1730     41.57    0.2136          0. RCFLAGS    0    0
4  232    0.6760     10.64    0.2136          0. RCFLAGS    0    0
4  135    2.2800     20.55    0.6390         44. RCFLAGS    0    0
4 3135    2.2800      0.00    0.0000          0. RCFLAGS    0    0
4 4135    2.7830     24.09    0.9667          0. RCFLAGS    0    0
4   35    2.2800      0.00    0.0000          0. RCFLAGS    0    0
4  140    0.5890     46.83    0.4810          0. RCFLAGS    0    0
4  235    2.8690      9.61    0.4810          0. RCFLAGS    0    0
4  240    3.5450      9.81    0.6863          0. RCFLAGS    0    0
4   40    3.5450      9.74    0.6806          0. RCFLAGS    0    0
4  145    0.5540     37.17    0.3042          0. RCFLAGS    0    0
4 3145    0.5540      0.00    0.0000          0. RCFLAGS    0    0
4 4145    3.3370     26.26    1.2708          0. RCFLAGS    0    0
4   50    0.5540      0.00    0.0000          0. RCFLAGS    0    0
4  150    0.3990     51.50    0.5418          0. RCFLAGS    0    0
4  245    0.9530     21.56    0.5418          0. RCFLAGS    0    0
4  250    4.4980     12.25    1.1829          0. RCFLAGS    0    0
4 3250    4.4980     11.02    1.0646          0. RCFLAGS    0    0
4 4250    7.8350     11.89    1.3829          0. RCFLAGS    0    0
4  101    1.4200     19.14    0.3505         31. RCFLAGS    0    0
4 3101    1.4200      0.00    0.0000          0. RCFLAGS    0    0
4 4101    9.2550     13.00    1.7198          0. RCFLAGS    0    0
4  102    0.1400    112.75    1.1085          0. RCFLAGS    0    0
4  202    1.5600     10.12    1.1085          0. RCFLAGS    0    0
4  103    0.4620     99.62    3.3790          0. RCFLAGS    0    0
4  203    2.0220     30.57    4.4875          0. RCFLAGS    0    0
4 3203    2.0220     30.46    4.4867          0. RCFLAGS    0    0
4 4203   11.2770     10.69    1.7206          0. RCFLAGS    0    0
4  105    0.6830      3.62    0.0206          0. RCFLAGS    0    0
4  205    2.7050     23.68    4.5004          0. RCFLAGS    0    0
4  106    0.1870     55.60    0.1820          0. RCFLAGS    0    0
4  206    2.8920     25.75    4.5616          0. RCFLAGS    0    0
4  107    0.1880     68.49    0.2259          0. RCFLAGS    0    0
4  207    3.0800     28.36    4.6621          0. RCFLAGS    0    0
4  505    3.0800     10.65    0.2828      97800. RCFLAGS    0    0
4  110    0.3330     50.26    0.2940          0. RCFLAGS    0    0
4  210    3.4130     14.51    0.5685          0. RCFLAGS    0    0
4  510    3.4130     14.44    0.5636        961. RCFLAGS    0    0
```



```
4   10    3.4130     14.21    0.5613          0. RCFLAGS    0    0
4  115    0.1250     76.41    0.2287          0. RCFLAGS    0    0
4  215    3.5380     16.41    0.7415          0. RCFLAGS    0    0
4  415   11.2770      5.34    0.8603          0. RCFLAGS    0    0
4 1215    3.5380     33.45    1.6011          0. RCFLAGS    0    0
4   20    3.5380     32.42    1.5706          0. RCFLAGS    0    0 return1.dat
                     scene1.wat
4  120    0.4210     37.11    0.2487          0. RCFLAGS    0    0
4  220    3.9590     32.92    1.7875          0. RCFLAGS    0    0
4  420   11.2770      5.34    0.8603          0. RCFLAGS    0    0
4 1220    3.9590     48.14    2.6220          0. RCFLAGS    0    0
4  520    3.9590     48.03    2.5996       2420. RCFLAGS    0    0
4   24    3.9590     47.68    2.5964          0. RCFLAGS    0    0
4  524    3.9590     47.64    2.5956        289. RCFLAGS    0   10
4  124    0.1820     53.07    0.2615          0. RCFLAGS    0    0
4  224    4.1410     47.88    2.7542          0. RCFLAGS    0    0
4  126    0.0990     18.98    0.0956          0. RCFLAGS    0    0
4  226    4.2400     47.21    2.7821          0. RCFLAGS    0    0
4   26    4.2400     45.39    2.5940          0. RCFLAGS    0    0
4  251    8.7380     27.70    3.2767          0. RCFLAGS    0    0
4  160    0.3150     55.16    0.2540          0. RCFLAGS    0    0
4 3160    0.3150      0.00    0.0000          0. RCFLAGS    0    0
4 4160   11.5920      1.50    0.2540          0. RCFLAGS    0    0
4   60    0.3150      0.00    0.0000          0. RCFLAGS    0    0
4  162    0.3930     43.85    0.5637          0. RCFLAGS    0    0
4  260    0.7080     24.34    0.5637          0. RCFLAGS    0    0
4  262    9.4460     27.45    3.5199          0. RCFLAGS    0    0
4   65    9.4460     26.93    3.5066          0. RCFLAGS    0    0
4  165    0.2390     15.93    0.0919          0. RCFLAGS    0    0
4  265    9.6850     26.66    3.5583          0. RCFLAGS    0    0
4 3265    9.6850     19.99    2.6688          0. RCFLAGS    0    0
4 4265   21.2770      3.85    1.1049          0. RCFLAGS    0    0
4  170    0.4530     30.56    0.2258          0. RCFLAGS    0    0
4  570    0.4530     24.50    0.1209       4240. RCFLAGS    0    0
4   75    0.4530     23.91    0.1209          0. RCFLAGS    0    0
4  175    0.2570     50.62    0.3886          0. RCFLAGS    0    0
4  275    0.7100     33.57    0.4266          0. RCFLAGS    0    0
4  277   10.3950     20.92    2.9196          0. RCFLAGS    0    0
4  477   21.2770      3.85    1.1049          0. RCFLAGS    0    0
4 1277   10.3950     28.80    4.0243          0. RCFLAGS    0    0
4 3277   10.3950     24.63    3.7243          0. RCFLAGS    0    0
4   78   10.3950      1.74    0.2282          0. RCFLAGS    0    0
4   79   10.3950     24.36    3.7235          0. RCFLAGS    0    0
4  279   10.3950     26.11    3.8414          0. RCFLAGS    0    0
4  180    0.4700     34.15    0.2702         23. RCFLAGS    0    0
4  278   10.8650     26.46    4.0209          0. RCFLAGS    0    0
4  580   10.8650     26.18    4.0069       8140. RCFLAGS    0    0
4 3580   10.8650     25.64    3.9819          0. RCFLAGS    0    0
4   80   10.8650     25.42    3.9810          0. RCFLAGS    0    0
5  130    0.5030     51.02    0.4192          0. RCFLAGS    0    0 return1.dat
                     scene1.wat
5 3130    0.5030      0.00    0.0000          0. RCFLAGS    0    0
5   30    0.5030      0.00    0.0000          0. RCFLAGS    0    0
5  132    0.1730     54.04    0.2707          0. RCFLAGS    0    0
5  232    0.6760     13.83    0.2707          0. RCFLAGS    0    0
5  135    2.2800     26.04    0.8038         55. RCFLAGS    0    0
5 3135    2.2800      0.00    0.0000          0. RCFLAGS    0    0
5 4135    2.7830     30.56    1.2145          0. RCFLAGS    0    0
5   35    2.2800      0.00    0.0000          0. RCFLAGS    0    0
5  140    0.5890     58.74    0.5987          0. RCFLAGS    0    0
5  235    2.8690     12.06    0.5987          0. RCFLAGS    0    0
5  240    3.5450     12.40    0.8587          0. RCFLAGS    0    0
5   40    3.5450     12.31    0.8524          0. RCFLAGS    0    0
```

5	145	0.5540	46.76	0.3785	0.	RCFLAGS	0	0	
5	3145	0.5540	0.00	0.0000	0.	RCFLAGS	0	0	
5	4145	3.3370	33.25	1.5930	0.	RCFLAGS	0	0	
5	50	0.5540	0.00	0.0000	0.	RCFLAGS	0	0	
5	150	0.3990	64.83	0.6712	0.	RCFLAGS	0	0	
5	245	0.9530	27.14	0.6712	0.	RCFLAGS	0	0	
5	250	4.4980	15.46	1.4760	0.	RCFLAGS	0	0	
5	3250	4.4980	13.91	1.3284	0.	RCFLAGS	0	0	
5	4250	7.8350	15.05	1.7325	0.	RCFLAGS	0	0	
5	101	1.4200	23.72	0.4320	38.	RCFLAGS	0	0	
5	3101	1.4200	0.00	0.0000	0.	RCFLAGS	0	0	
5	4101	9.2550	16.38	2.1480	0.	RCFLAGS	0	0	
5	102	0.1400	129.02	1.2400	0.	RCFLAGS	0	0	
5	202	1.5600	11.58	1.2400	0.	RCFLAGS	0	0	
5	103	0.4620	114.87	3.8659	0.	RCFLAGS	0	0	
5	203	2.0220	35.18	5.1059	0.	RCFLAGS	0	0	
5	3203	2.0220	35.07	5.1051	0.	RCFLAGS	0	0	
5	4203	11.2770	13.46	2.1488	0.	RCFLAGS	0	0	
5	105	0.6830	3.82	0.0225	0.	RCFLAGS	0	0	
5	205	2.7050	27.18	5.1199	0.	RCFLAGS	0	0	
5	106	0.1870	67.63	0.2192	0.	RCFLAGS	0	0	
5	206	2.8920	29.80	5.2037	0.	RCFLAGS	0	0	
5	107	0.1880	80.75	0.2639	0.	RCFLAGS	0	0	
5	207	3.0800	32.91	5.3274	0.	RCFLAGS	0	0	
5	505	3.0800	12.32	0.3278	108000.	RCFLAGS	0	0	
5	110	0.3330	61.72	0.3578	0.	RCFLAGS	0	0	
5	210	3.4130	17.14	0.6750	0.	RCFLAGS	0	0	
5	510	3.4130	16.99	0.6708	1110.	RCFLAGS	0	0	
5	10	3.4130	16.74	0.6689	0.	RCFLAGS	0	0	
5	115	0.1250	91.15	0.2702	0.	RCFLAGS	0	0	
5	215	3.5380	19.37	0.8877	0.	RCFLAGS	0	0	
5	415	11.2770	6.73	1.0744	0.	RCFLAGS	0	0	
5	1215	3.5380	40.82	1.9586	0.	RCFLAGS	0	0	
5	20	3.5380	39.69	1.9288	0.	RCFLAGS	0	0	return1.dat

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5	120	0.4210	46.07	0.3067	0.	RCFLAGS	0	0	
5	220	3.9590	40.36	2.1995	0.	RCFLAGS	0	0	
5	420	11.2770	6.73	1.0744	0.	RCFLAGS	0	0	
5	1220	3.9590	59.54	3.2496	0.	RCFLAGS	0	0	
5	520	3.9590	59.36	3.2074	3670.	RCFLAGS	0	0	
5	24	3.9590	58.96	3.2040	0.	RCFLAGS	0	0	
5	524	3.9590	58.92	3.2039	313.	RCFLAGS	0	0	
5	124	0.1820	65.37	0.3186	0.	RCFLAGS	0	0	
5	224	4.1410	59.20	3.3982	0.	RCFLAGS	0	0	
5	126	0.0990	27.98	0.1428	0.	RCFLAGS	0	0	
5	226	4.2400	58.47	3.4401	0.	RCFLAGS	0	0	
5	26	4.2400	56.67	3.2708	0.	RCFLAGS	0	0	
5	251	8.7380	34.66	4.1628	0.	RCFLAGS	0	0	
5	160	0.3150	65.64	0.2999	0.	RCFLAGS	0	0	
5	3160	0.3150	0.00	0.0000	0.	RCFLAGS	0	0	
5	4160	11.5920	1.78	0.2999	0.	RCFLAGS	0	0	
5	60	0.3150	0.00	0.0000	0.	RCFLAGS	0	0	
5	162	0.3930	55.73	0.7054	0.	RCFLAGS	0	0	
5	260	0.7080	30.94	0.7054	0.	RCFLAGS	0	0	
5	262	9.4460	34.38	4.4906	0.	RCFLAGS	0	0	
5	65	9.4460	33.81	4.4736	0.	RCFLAGS	0	0	
5	165	0.2390	24.08	0.1419	0.	RCFLAGS	0	0	
5	265	9.6850	33.57	4.5569	0.	RCFLAGS	0	0	
5	3265	9.6850	25.18	3.4177	0.	RCFLAGS	0	0	
5	4265	21.2770	4.79	1.3994	0.	RCFLAGS	0	0	
5	170	0.4530	38.29	0.2833	0.	RCFLAGS	0	0	
5	570	0.4530	30.16	0.1503	5520.	RCFLAGS	0	0	
5	75	0.4530	29.42	0.1503	0.	RCFLAGS	0	0	

5	175	0.2570	62.64	0.4825	0.	RCFLAGS	0	0	
5	275	0.7100	41.45	0.5268	0.	RCFLAGS	0	0	
5	277	10.3950	26.29	3.7418	0.	RCFLAGS	0	0	
5	477	21.2770	4.79	1.3994	0.	RCFLAGS	0	0	
5	1277	10.3950	36.10	5.1412	0.	RCFLAGS	0	0	
5	3277	10.3950	31.80	4.8412	0.	RCFLAGS	0	0	
5	78	10.3950	1.79	0.2302	0.	RCFLAGS	0	0	
5	79	10.3950	31.46	4.8399	0.	RCFLAGS	0	0	
5	279	10.3950	33.26	4.9581	0.	RCFLAGS	0	0	
5	180	0.4700	40.90	0.3258	28.	RCFLAGS	0	0	
5	278	10.8650	33.59	5.1836	0.	RCFLAGS	0	0	
5	580	10.8650	33.26	5.1626	10400.	RCFLAGS	0	0	
5	3580	10.8650	32.71	5.1376	0.	RCFLAGS	0	0	
5	80	10.8650	32.48	5.1367	0.	RCFLAGS	0	0	
6	130	0.5030	56.06	0.4579	0.	RCFLAGS	0	0	return1.dat

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6	3130	0.5030	0.00	0.0000	0.	RCFLAGS	0	0	
6	30	0.5030	0.00	0.0000	0.	RCFLAGS	0	0	
6	132	0.1730	59.85	0.2966	0.	RCFLAGS	0	0	
6	232	0.6760	15.32	0.2966	0.	RCFLAGS	0	0	
6	135	2.2800	28.60	0.8800	60.	RCFLAGS	0	0	
6	3135	2.2800	0.00	0.0000	0.	RCFLAGS	0	0	
6	4135	2.7830	33.56	1.3285	0.	RCFLAGS	0	0	
6	35	2.2800	0.00	0.0000	0.	RCFLAGS	0	0	
6	140	0.5890	64.26	0.6524	0.	RCFLAGS	0	0	
6	235	2.8690	13.19	0.6524	0.	RCFLAGS	0	0	
6	240	3.5450	13.60	0.9374	0.	RCFLAGS	0	0	
6	40	3.5450	13.51	0.9307	0.	RCFLAGS	0	0	
6	145	0.5540	51.22	0.4126	0.	RCFLAGS	0	0	
6	3145	0.5540	0.00	0.0000	0.	RCFLAGS	0	0	
6	4145	3.3370	36.49	1.7411	0.	RCFLAGS	0	0	
6	50	0.5540	0.00	0.0000	0.	RCFLAGS	0	0	
6	150	0.3990	71.00	0.7296	0.	RCFLAGS	0	0	
6	245	0.9530	29.73	0.7296	0.	RCFLAGS	0	0	
6	250	4.4980	16.94	1.6092	0.	RCFLAGS	0	0	
6	3250	4.4980	15.25	1.4483	0.	RCFLAGS	0	0	
6	4250	7.8350	16.52	1.8931	0.	RCFLAGS	0	0	
6	101	1.4200	25.84	0.4694	44.	RCFLAGS	0	10	
6	3101	1.4200	0.00	0.0000	0.	RCFLAGS	0	0	
6	4101	9.2550	17.95	2.3448	0.	RCFLAGS	0	0	
6	102	0.1400	136.49	1.2999	0.	RCFLAGS	0	0	
6	202	1.5600	12.25	1.2999	0.	RCFLAGS	0	0	
6	103	0.4620	121.84	4.0972	0.	RCFLAGS	0	0	
6	203	2.0220	37.29	5.3971	0.	RCFLAGS	0	0	
6	3203	2.0220	37.18	5.3963	0.	RCFLAGS	0	0	
6	4203	11.2770	14.75	2.3456	0.	RCFLAGS	0	0	
6	105	0.6830	3.91	0.0233	0.	RCFLAGS	0	0	
6	205	2.7050	28.78	5.4115	0.	RCFLAGS	0	0	
6	106	0.1870	73.16	0.2362	0.	RCFLAGS	0	0	
6	206	2.8920	31.65	5.5059	0.	RCFLAGS	0	0	
6	107	0.1880	86.37	0.2812	0.	RCFLAGS	0	0	
6	207	3.0800	34.99	5.6402	0.	RCFLAGS	0	0	
6	505	3.0800	13.09	0.3483	112000.	RCFLAGS	0	0	
6	110	0.3330	67.02	0.3870	0.	RCFLAGS	0	0	
6	210	3.4130	18.35	0.7237	0.	RCFLAGS	0	0	
6	510	3.4130	18.17	0.7212	1170.	RCFLAGS	0	0	
6	10	3.4130	17.89	0.7188	0.	RCFLAGS	0	0	
6	115	0.1250	97.96	0.2891	0.	RCFLAGS	0	0	
6	215	3.5380	20.72	0.9562	0.	RCFLAGS	0	0	
6	415	11.2770	7.37	1.1728	0.	RCFLAGS	0	0	
6	1215	3.5380	44.23	2.1238	0.	RCFLAGS	0	0	
6	20	3.5380	43.01	2.0905	0.	RCFLAGS	0	0	return1.dat

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6	120	0.4210	50.24	0.3334	0.	RCFLAGS	0	0	
6	220	3.9590	43.77	2.3857	0.	RCFLAGS	0	0	
6	420	11.2770	7.37	1.1728	0.	RCFLAGS	0	0	
6	1220	3.9590	64.78	3.5333	0.	RCFLAGS	0	0	
6	520	3.9590	64.58	3.4837	4320.	RCFLAGS	0	0	
6	24	3.9590	64.14	3.4796	0.	RCFLAGS	0	0	
6	524	3.9590	64.10	3.4796	331.	RCFLAGS	0	0	
6	124	0.1820	71.09	0.3446	0.	RCFLAGS	0	0	
6	224	4.1410	64.40	3.6896	0.	RCFLAGS	0	0	
6	126	0.0990	32.26	0.1641	0.	RCFLAGS	0	0	
6	226	4.2400	63.65	3.7376	0.	RCFLAGS	0	0	
6	26	4.2400	61.70	3.5531	0.	RCFLAGS	0	0	
6	251	8.7380	37.79	4.5262	0.	RCFLAGS	0	0	
6	160	0.3150	70.47	0.3209	0.	RCFLAGS	0	0	
6	3160	0.3150	0.00	0.0000	0.	RCFLAGS	0	0	
6	4160	11.5920	1.91	0.3209	0.	RCFLAGS	0	0	
6	60	0.3150	0.00	0.0000	0.	RCFLAGS	0	0	
6	162	0.3930	61.27	0.7697	0.	RCFLAGS	0	0	
6	260	0.7080	34.01	0.7697	0.	RCFLAGS	0	0	
6	262	9.4460	37.51	4.8845	0.	RCFLAGS	0	0	
6	65	9.4460	36.94	4.8688	0.	RCFLAGS	0	0	
6	165	0.2390	27.97	0.1651	0.	RCFLAGS	0	0	
6	265	9.6850	36.72	4.9663	0.	RCFLAGS	0	0	
6	3265	9.6850	27.54	3.7248	0.	RCFLAGS	0	0	
6	4265	21.2770	5.22	1.5211	0.	RCFLAGS	0	0	
6	170	0.4530	41.92	0.3101	0.	RCFLAGS	0	0	
6	570	0.4530	32.83	0.1642	6120.	RCFLAGS	0	0	
6	75	0.4530	32.02	0.1642	0.	RCFLAGS	0	0	
6	175	0.2570	68.27	0.5259	0.	RCFLAGS	0	0	
6	275	0.7100	45.14	0.5732	0.	RCFLAGS	0	0	
6	277	10.3950	28.74	4.0808	0.	RCFLAGS	0	0	
6	477	21.2770	5.22	1.5211	0.	RCFLAGS	0	0	
6	1277	10.3950	39.43	5.6017	0.	RCFLAGS	0	0	
6	3277	10.3950	35.07	5.3017	0.	RCFLAGS	0	0	
6	78	10.3950	1.81	0.2310	0.	RCFLAGS	0	0	
6	79	10.3950	34.71	5.3004	0.	RCFLAGS	0	0	
6	279	10.3950	36.52	5.4200	0.	RCFLAGS	0	0	
6	180	0.4700	44.04	0.3515	30.	RCFLAGS	0	0	
6	278	10.8650	36.85	5.6651	0.	RCFLAGS	0	0	
6	580	10.8650	36.49	5.6415	11400.	RCFLAGS	0	0	
6	3580	10.8650	35.95	5.6165	0.	RCFLAGS	0	0	
6	80	10.8650	35.70	5.6155	0.	RCFLAGS	0	0	
7	130	0.5030	116.18	0.9108	0.	RCFLAGS	0	0	return1.dat

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7	3130	0.5030	25.31	0.4508	0.	RCFLAGS	0	0	
7	30	0.5030	25.50	0.4473	0.	RCFLAGS	0	0	
7	132	0.1730	130.27	0.6018	0.	RCFLAGS	0	0	
7	232	0.6760	52.31	0.9451	0.	RCFLAGS	0	0	
7	135	2.2800	60.61	1.8019	123.	RCFLAGS	0	0	
7	3135	2.2800	17.01	0.9019	0.	RCFLAGS	0	0	
7	4135	2.7830	52.14	1.3600	0.	RCFLAGS	0	0	
7	35	2.2800	17.04	0.8997	0.	RCFLAGS	0	0	
7	140	0.5890	129.97	1.2812	0.	RCFLAGS	0	0	
7	235	2.8690	40.22	2.0728	0.	RCFLAGS	0	0	
7	240	3.5450	42.53	2.9916	0.	RCFLAGS	0	0	
7	40	3.5450	42.41	2.9877	0.	RCFLAGS	0	0	
7	145	0.5540	104.47	0.8126	0.	RCFLAGS	0	0	
7	3145	0.5540	24.28	0.3926	0.	RCFLAGS	0	0	
7	4145	3.3370	56.80	1.7800	0.	RCFLAGS	0	0	
7	50	0.5540	24.74	0.3733	0.	RCFLAGS	0	0	
7	150	0.3990	144.64	1.4098	0.	RCFLAGS	0	0	
7	245	0.9530	74.94	1.4519	0.	RCFLAGS	0	0	
7	250	4.4980	49.30	4.4138	0.	RCFLAGS	0	0	

7	3250	4.4980	44.37	3.9724	0.	RCFLAGS	0	0	
7	4250	7.8350	27.02	2.2214	0.	RCFLAGS	0	0	
7	101	1.4200	51.79	0.9215	82.	RCFLAGS	0	0	
7	3101	1.4200	15.02	0.4415	0.	RCFLAGS	0	0	
7	4101	9.2550	28.52	2.7014	0.	RCFLAGS	0	0	
7	102	0.1400	226.57	2.0055	0.	RCFLAGS	0	0	
7	202	1.5600	34.01	2.0055	0.	RCFLAGS	0	0	
7	103	0.4620	205.52	6.4698	0.	RCFLAGS	0	0	
7	203	2.0220	73.20	8.4753	0.	RCFLAGS	0	0	
7	3203	2.0220	73.09	8.4745	0.	RCFLAGS	0	0	
7	4203	11.2770	23.42	2.7022	0.	RCFLAGS	0	0	
7	105	0.6830	57.59	0.6046	0.	RCFLAGS	0	0	
7	205	2.7050	69.18	8.5085	0.	RCFLAGS	0	0	
7	106	0.1870	140.30	0.4361	0.	RCFLAGS	0	0	
7	206	2.8920	73.78	8.7278	0.	RCFLAGS	0	0	
7	107	0.1880	154.74	0.4868	0.	RCFLAGS	0	0	
7	207	3.0800	78.72	8.9894	0.	RCFLAGS	0	0	
7	505	3.0800	19.25	0.5048	220000.	RCFLAGS	0	0	
7	110	0.3330	135.18	0.7376	0.	RCFLAGS	0	0	
7	210	3.4130	30.56	1.1678	0.	RCFLAGS	0	0	
7	510	3.4130	30.25	1.1657	1600.	RCFLAGS	0	0	
7	10	3.4130	29.85	1.1643	0.	RCFLAGS	0	0	
7	115	0.1250	180.44	0.5133	0.	RCFLAGS	0	0	
7	215	3.5380	35.17	1.6062	0.	RCFLAGS	0	0	
7	415	11.2770	11.71	1.3511	0.	RCFLAGS	0	0	
7	1215	3.5380	72.50	2.9429	0.	RCFLAGS	0	0	
7	20	3.5380	70.49	2.9267	0.	RCFLAGS	0	0	return1.dat

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7	120	0.4210	110.46	0.7182	0.	RCFLAGS	0	0	
7	220	3.9590	74.74	3.5881	0.	RCFLAGS	0	0	
7	420	11.2770	11.71	1.3511	0.	RCFLAGS	0	0	
7	1220	3.9590	108.10	4.9392	0.	RCFLAGS	0	0	
7	520	3.9590	107.38	4.8625	8400.	RCFLAGS	0	0	
7	24	3.9590	106.56	4.8589	0.	RCFLAGS	0	0	
7	524	3.9590	106.49	4.8582	454.	RCFLAGS	0	10	
7	124	0.1820	142.92	0.6597	0.	RCFLAGS	0	0	
7	224	4.1410	108.09	5.2831	0.	RCFLAGS	0	0	
7	126	0.0990	90.01	0.4373	0.	RCFLAGS	0	0	
7	226	4.2400	107.67	5.4374	0.	RCFLAGS	0	0	
7	26	4.2400	104.63	5.3049	0.	RCFLAGS	0	0	
7	251	8.7380	73.61	9.0289	0.	RCFLAGS	0	0	
7	160	0.3150	129.58	0.5717	0.	RCFLAGS	0	0	
7	3160	0.3150	21.67	0.2417	0.	RCFLAGS	0	0	
7	4160	11.5920	2.93	0.3300	0.	RCFLAGS	0	0	
7	60	0.3150	22.07	0.2281	0.	RCFLAGS	0	0	
7	162	0.3930	130.24	1.5455	0.	RCFLAGS	0	0	
7	260	0.7080	82.11	1.5455	0.	RCFLAGS	0	0	
7	262	9.4460	74.25	10.2229	0.	RCFLAGS	0	0	
7	65	9.4460	73.41	10.1683	0.	RCFLAGS	0	0	
7	165	0.2390	81.11	0.4745	0.	RCFLAGS	0	0	
7	265	9.6850	73.60	10.5094	0.	RCFLAGS	0	0	
7	3265	9.6850	55.20	7.8821	0.	RCFLAGS	0	0	
7	4265	21.2770	9.97	2.9574	0.	RCFLAGS	0	0	
7	170	0.4530	102.65	0.7436	0.	RCFLAGS	0	0	
7	570	0.4530	77.89	0.3884	15900.	RCFLAGS	0	0	
7	75	0.4530	76.27	0.3884	0.	RCFLAGS	0	0	
7	175	0.2570	140.00	1.0564	0.	RCFLAGS	0	0	
7	275	0.7100	99.34	1.1576	0.	RCFLAGS	0	0	
7	277	10.3950	58.22	8.7581	0.	RCFLAGS	0	0	
7	477	21.2770	9.97	2.9574	0.	RCFLAGS	0	0	
7	1277	10.3950	78.63	11.7134	0.	RCFLAGS	0	0	
7	3277	10.3950	73.45	11.4134	0.	RCFLAGS	0	0	
7	78	10.3950	2.04	0.2395	0.	RCFLAGS	0	0	

7	79	10.3950	72.99	11.4100	0.	RCFLAGS	0	0
7	279	10.3950	75.03	11.5367	0.	RCFLAGS	0	0
7	180	0.4700	85.32	0.6873	59.	RCFLAGS	0	0
7	278	10.8650	75.48	12.0968	0.	RCFLAGS	0	0
7	580	10.8650	74.80	11.9749	25500.	RCFLAGS	0	0
7	3580	10.8650	74.26	11.9499	0.	RCFLAGS	0	0
7	80	10.8650	73.93	11.9473	0.	RCFLAGS	0	0

1614-13338 220 Arkell Road
Torrance Creek Subwatershed Study Management Strategy (Revised November 1998)
Target Unit Flow Rates

TOTAL FROM SITE

			Flow Rate from TCSS GAWSER Model (cms)				
TCSS Subcatchments		Area from TCSS (ha)	2-year	5-year	10-year	25-year	100-year
	105	68.3	0.015	0.018	0.020	0.021	0.023
	106	18.7	0.078	0.120	0.160	0.182	0.236
	110	33.3	0.123	0.192	0.257	0.294	0.387

TCSS Subcatchments		Unit Flow Rate ($m^3/s/ha$)			
		2-year	5-year	25-year	100-year
	105	0.0002	0.0003	0.0003	0.0003
	106	0.0042	0.0064	0.0097	0.0126
	110	0.0037	0.0058	0.0088	0.0116

Catchment ID		**Proposed drainage from TCSS catchments to proposed SWMF (ha)**			**Total (ha)**
		105	106	110	
	200		1.36	1.37	2.73
	202		0.36		0.36
	203		0.56		0.56
	206		0.5		0.5
Total (ha)		0	2.78	1.37	
				Total	4.15

Targets per catchment		Weighted Target Rates (m^3/s)			
		2-year	5-year	25-year	100-year
	200	0.011	0.017	0.025	0.033
	202	0.001	0.002	0.004	0.005
	203	0.002	0.004	0.005	0.007
	206	0.002	0.003	0.005	0.006
Total from site		**0.02**	**0.03**	**0.04**	**0.05**

1614-13338 220 Arkell Road
Proposed MIDUSS Parameters

Proposed Conditions

Area Description	Catchment Number	Area	Pervious Length	Gradient	% Impervious	Impervious Length	Overland Manning's 'n'	Max Infiltration (1)	Min Infiltration (2)	Lag Constant (3)	Depression Storage (4)
		(ha)	(m)	(%)		(m)		(mm/hr)	(mm/hr)	(hrs)	(mm)
Residential area consisting of approximately half single family and half townhomes	200	2.73	20	2	65	46	0.25	75	13	0.5	5.1
Ecological Linkage draining east	201	1.04	150	2	0	10	0.25	75	13	0.5	5.1
Park	202	0.36	50	3	10	4	0.25	75	13	0.5	5.1
SWM Block	203	0.56	50	1	15	10	0.25	75	13	0.5	5.1
Wetland	204	1.49	50	1	0	10	0.25	75	13	0.5	5.1
Former Driveway to site/landscaped area	205	0.24	10	1	0	10	0.25	75	13	0.5	5.1
Rear lots and portion or rooftops from townhome units	206	0.47	90	2	40	40	0.25	75	13	0.5	5.1
Ecological Linkage draining west (around SWM)	207A + 207B	0.24	70	3	0	10	0.25	75	13	0.5	5.1

Total	**7.1**
Developed	**4.1**

Notes:

1. Maximum infiltration rate based on neighbouring Victoria Park Village as well as Geotechnical Investigation for 220 Arkell Road (Stantec, 2018)
2. Minimum infiltration rate based on neighbouring Victoria Park Village as well as Geotechnical Investigation for 220 Arkell Road (Stantec, 2018)
3. Typical value for lag constant from MTO Design Chart 1.13 from the MTO Drainage Management Manual (1997)
4. Depression storage based on typical values for a pasture from *Water Resources Engineering (Chin, 2000)*

1614-13338 220 Arkell Road
SWM Facility: Stage-Storage-Discharge Calculations

SSD used in MIDUSS modelling

Rating Curve for MIDUSS

	Elevation (m)	Infiltration (m³/s)	Discharge to PSW (m³/s)	Total Outflow (m³/s)	Active Storage (m³)	Storage without Infiltration Portion (m³)	Drawdown (hrs) - including infiltration: Increment	Drawdown (hrs) - including infiltration: Total
Bottom of Forebay	333.00							
	333.10							
	333.20							
	333.30							
	333.40							
Top of forebay / Bottom of 'dry' cell	333.50							
	333.60	0.003		0.003	139		23.1	23.1
Outflow starts	333.70	0.003		0.003	286		12.2	35.4
	333.80	0.003	0.003	0.006	441	156	9.0	44.4
	333.90	0.003	0.005	0.008	605	320	6.4	50.7
	334.00	0.003	0.006	0.009	779	493	5.5	56.2
	334.10	0.003	0.007	0.010	961	676	5.1	61.4
	334.20	0.003	0.008	0.011	1,153	867	4.9	66.3
	334.30	0.003	0.009	0.012	1,355	1,069	4.8	71.1
	334.40	0.003	0.010	0.013	1,566	1,280	4.7	75.8
	334.50	0.003	0.010	0.014	1,787	1,502	4.6	80.4
	334.60	0.003	0.011	0.014	2,019	1,733	4.6	85.0
	334.70	0.003	0.012	0.015	2,261	1,976	4.6	89.7
	334.80	0.003	0.012	0.015	2,515	2,229	4.6	94.3
	334.90	0.003	0.013	0.016	2,779	2,493	4.7	99.0
	335.00	0.003	0.013	0.017	3,055	2,769	4.7	103.7
	335.10	0.003	0.014	0.017	3,343	3,057	4.8	108.5
	335.20	0.003	0.094	0.097	3,643	3,358	1.5	109.9
	335.30	0.003	0.486	0.490	3,957	3,671	0.3	110.2
	335.40	0.003	0.993	0.996	4,285	3,999	0.1	110.3
Top of Pond	335.50	0.003	1.650	1.654	4,630	4,344	0.1	110.4

Volume Estimation

Elevation (m)	Forebay Area (m²)	Forebay Perm Vol (m³)	Main Cell Area (m²)	Main Cell Perm Vol (m³)	Total Act Vol (m³)
333.000					
333.100		14			
333.200		31			
333.300		50			
333.400		73			
333.50		98			
333.60				139	139
333.70				286	286
333.80				441	441
333.90				605	605
334.00				779	779
334.10				961	961
334.20				1,153	1,153
334.30				1,355	1,355
334.40				1,566	1,566
334.50				1,787	1,787
334.60				2,019	2,019
334.70				2,261	2,261
334.80				2,515	2,515
334.90				2,779	2,779
335.00				3,055	3,055
335.10				3,343	3,343
335.20				3,643	3,643
335.30				3,957	3,957
335.40				4,285	4,285
335.50				4,630	4,630

Outlet Controls

Elevation (m)	Orifice 1 (m³/s)	Orifice 2 (m³/s)	DICB Flow (m³/s)	Control (m³/s)	Overflow Weir (m³/s)	Total Flow (m³/s)	Infiltration (m³/s)
333.00							
333.10							
333.20							
333.30							
333.40							
333.50							
333.60							0.003
333.70							0.003
333.80	0.003					0.003	0.003
333.90	0.005					0.005	0.003
334.00	0.006					0.006	0.003
334.10	0.007					0.007	0.003
334.20	0.008					0.008	0.003
334.30	0.009					0.009	0.003
334.40	0.010					0.010	0.003
334.50	0.010					0.010	0.003
334.60	0.011					0.011	0.003
334.70	0.012					0.012	0.003
334.80	0.012					0.012	0.003
334.90	0.013					0.013	0.003
335.00	0.013					0.013	0.003
335.10	0.014					0.014	0.003
335.20	0.014	0.192	0.080	0.080		0.094	0.003
335.30	0.015	0.201	0.234	0.201	0.270	0.486	0.003
335.40	0.015	0.210	0.491	0.210	0.767	0.993	0.003
335.50	0.016	0.218	0.855	0.218	1.416	1.650	0.003

Parameters

Orifice 1	
Orifice Invert Elev. (m)	Orifice Coeff.
333.70	0.60
Orifice Mid-point Elev. (m)	Perimeter (m)
333.74	0.24
Orifice Diam.(mm)	Area (m²)
75	0.004
Weir Coeff. (semi-circular)	Orientation
1.62	Vertical
Orifice 2 + DICB	
DICB Elev. (low side):	DICB width (m)
335.10	0.60
Orifice Invert Elev. (m)	Orifice Coeff.
334.00	0.60
Orifice Mid-point Elev. (m)	Perimeter (m)
334.15	0.94
Orifice Diam.(mm)	Area (m²)
300	0.071
Weir Coeff. (semi-circular)	Orientation
1.62	Vertical
Infiltration out of bottom	
Infiltration Area (m2)	Infiltration invert (m)
1000	333.50
Infiltration Rate (mm/hr)	Safety Factor
30	2.50
Factored Infiltration Rate (mm/hr)	Infiltration Rate (m3/s)
12	0.003
Overflow Spillway	
Spillway Invert (m)	Top of Berm (m)
335.20	335.50
Spillway Length @ Invert (m)	Max. Flow Depth (m)
5	0.30
Left Side Slope	Right Side Slope
10	10
Weir Coefficient (Rectangle)	Topwidth
1.7	11.0
Weir Coefficient (Triangle)	
1.3	

Weir Equation Used: $Q = C_{wb}*L*H^{1.5} + C_{wt}*S*H^{2.5}$

where
- L = bottom width of spillway
- H = head above weir invert
- S = side slopes (ratio of H:V)
- C_{wt} = weir coefficient (triangular)
- C_{wb} = weir coefficient (broad-crested)

Orifice Flow Calculations: Orifice flow equation

$Q = C \cdot A \cdot (2 \cdot g \cdot H)^{0.5}$

where
- C = orifice coefficient
- A = area of orifice
- g = acceleration due to gravity
- H = head above centre line of orifice
- Note: used when water elevation is above 3/4 of the orifice diameter

Sharp crested semi-circular weir equation

$Q=C*D^{2.5}*(H/D)^{1.88}$

where
- C = sharp crested semi-circular weir coefficient
- D = diameter of orifice
- H = head above orifice invert
- Note: used when water elevation is below 3/4 of the orifice diameter

```
      Output File (4.7) 2202YR.OUT   opened 2019-05-22  14:15
      Units used are defined by G =    9.810
         192   533    15.000        are MAXDT MAXHYD & DTMIN values
      Licensee: Paragon Engineering Limited
35    COMMENT
     6     line(s) of comment
      **********************
      1614-13338 220 Arkell
      Stormwater Management Modelling
      2-yr, 48-hour adjusted storm (TCSS)
      Modeller: B.Weersink (March 2019)
      **********************
23    FILE RAINFALL
     1     1=READ: 2=WRITE
    10     2yr48hr.ST           is Filename
 3    IMPERVIOUS
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .013     Manning "n"
       .000     Max.Infiltn. mm/hr
       .000     Min.Infiltn. mm/hr
       .050     Lag const (hours)
      1.500     Dep.Storage mm
35    COMMENT
     3     line(s) of comment
      **********************
      Catchment 200 - Developed Area to SWM
      **********************
 4    CATCHMENT
    200.000     ID No.ó 99999
      2.730     Area in hectares
     20.000     Length (PERV) metres
      2.000     Gradient (%)
     65.000     Per cent Impervious
     47.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .090       .000       .000       .000 c.m/s
            .002       .969       .631     C perv/imperv/total
15    ADD RUNOFF
            .090       .090       .000       .000 c.m/s
 4    CATCHMENT
    203.000     ID No.ó 99999
       .560     Area in hectares
     50.000     Length (PERV) metres
      2.000     Gradient (%)
     15.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .004       .090       .000       .000 c.m/s
            .002       .925       .140     C perv/imperv/total
```



```
15    ADD RUNOFF
            .004       .093       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      **********************
      Dry SWM Stage-storage
      **********************
10    POND
     6 Depth - Discharge - Volume sets
      333.700        .000         .0
      334.200      .00800       867.0
      334.500      .01000      1502.0
      335.100       .0140      3057.0
      335.200       .0940      3358.0
      335.500       1.651      4344.0
      Peak Outflow    =      .010 c.m/s
      Maximum Depth   =   334.430 metres
      Maximum Storage =     1355. c.m
            .004       .093       .010       .000 c.m/s
16    NEXT LINK
            .004       .010       .010       .000 c.m/s
 4    CATCHMENT
    202.000     ID No.ó 99999
       .360     Area in hectares
     50.000     Length (PERV) metres
      2.000     Gradient (%)
     10.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .002       .010       .010       .000 c.m/s
            .002       .925       .094     C perv/imperv/total
15    ADD RUNOFF
            .002       .010       .010       .000 c.m/s
 4    CATCHMENT
    206.000     ID No.ó 99999
       .470     Area in hectares
    100.000     Length (PERV) metres
      2.000     Gradient (%)
     40.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .008       .010       .010       .000 c.m/s
            .002       .925       .371     C perv/imperv/total
15    ADD RUNOFF
            .008       .018       .010       .000 c.m/s
20    MANUAL
```

```
      Output File (4.7) 2205YR.OUT   opened 2019-05-22  14:26
      Units used are defined by G =    9.810
         192   533    15.000        are MAXDT MAXHYD & DTMIN values
      Licensee: Paragon Engineering Limited
35    COMMENT
     6     line(s) of comment
      **********************
      1614-13338 220 Arkell
      Stormwater Management Modelling
      5-yr, 48-hour adjusted storm (TCSS)
      Modeller: B.Weersink (March 2019)
      **********************
23    FILE RAINFALL
     1     1=READ: 2=WRITE
    10     5yr48hr.ST           is Filename
 3    IMPERVIOUS
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .013     Manning "n"
       .000     Max.Infiltn. mm/hr
       .000     Min.Infiltn. mm/hr
       .050     Lag const (hours)
      1.500     Dep.Storage mm
35    COMMENT
     3     line(s) of comment
      **********************
      Catchment 200 - Developed Area to SWM
      **********************
 4    CATCHMENT
    200.000     ID No.ó 99999
      2.730     Area in hectares
     20.000     Length (PERV) metres
      2.000     Gradient (%)
     65.000     Per cent Impervious
     47.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .122       .000       .000       .000 c.m/s
            .063       .976       .657     C perv/imperv/total
15    ADD RUNOFF
            .122       .122       .000       .000 c.m/s
 4    CATCHMENT
    203.000     ID No.ó 99999
       .560     Area in hectares
     50.000     Length (PERV) metres
      2.000     Gradient (%)
     15.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .010       .122       .000       .000 c.m/s
            .063       .919       .192     C perv/imperv/total
```



```
15    ADD RUNOFF
            .010       .130       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      **********************
      Dry SWM Stage-storage
      **********************
10    POND
     6 Depth - Discharge - Volume sets
      333.700        .000         .0
      334.200      .00800       867.0
      334.500      .01000      1502.0
      335.100       .0140      3057.0
      335.200       .0940      3358.0
      335.500       1.651      4344.0
      Peak Outflow    =      .011 c.m/s
      Maximum Depth   =   334.613 metres
      Maximum Storage =     1795. c.m
            .010       .130       .011       .000 c.m/s
16    NEXT LINK
            .010       .011       .011       .000 c.m/s
 4    CATCHMENT
    202.000     ID No.ó 99999
       .360     Area in hectares
     50.000     Length (PERV) metres
      2.000     Gradient (%)
     10.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .006       .011       .011       .000 c.m/s
            .063       .919       .149     C perv/imperv/total
15    ADD RUNOFF
            .006       .016       .011       .000 c.m/s
 4    CATCHMENT
    206.000     ID No.ó 99999
       .470     Area in hectares
    100.000     Length (PERV) metres
      2.000     Gradient (%)
     40.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .011       .016       .011       .000 c.m/s
            .063       .919       .406     C perv/imperv/total
15    ADD RUNOFF
            .011       .027       .011       .000 c.m/s
20    MANUAL
```

```
      Output File (4.7) 220V5.OUT    opened 2019-05-22  14:08
      Units used are defined by G =    9.810
         192   533    15.000        are MAXDT MAXHYD & DTMIN values
      Licensee: Paragon Engineering Limited
35    COMMENT
     6     line(s) of comment
      **********************
      1614-13338 220 Arkell
      Stormwater Management Modelling
      100-yr, 48-hour adjusted storm (TCSS)
      Modeller: B.Weersink (March 2019)
      **********************
23    FILE RAINFALL
     1     1=READ: 2=WRITE
    10     10048h.STM           is Filename
 3    IMPERVIOUS
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .013     Manning "n"
       .000     Max.Infiltn. mm/hr
       .000     Min.Infiltn. mm/hr
       .050     Lag const (hours)
      1.500     Dep.Storage mm
35    COMMENT
     3     line(s) of comment
      **********************
      Catchment 200 - Developed Area to SWM
      **********************
 4    CATCHMENT
    200.000     ID No.ó 99999
      2.730     Area in hectares
     20.000     Length (PERV) metres
      2.000     Gradient (%)
     65.000     Per cent Impervious
     47.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .215       .000       .000       .000 c.m/s
            .153       .981       .691     C perv/imperv/total
15    ADD RUNOFF
            .215       .215       .000       .000 c.m/s
 4    CATCHMENT
    203.000     ID No.ó 99999
       .560     Area in hectares
     50.000     Length (PERV) metres
      2.000     Gradient (%)
     15.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .030       .215       .000       .000 c.m/s
            .152       .906       .265     C perv/imperv/total
```



```
15    ADD RUNOFF
            .030       .245       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      **********************
      Dry SWM Stage-storage
      **********************
10    POND
     6 Depth - Discharge - Volume sets
      333.700        .000         .0
      334.200      .00800       867.0
      334.500      .01000      1502.0
      335.100       .0140      3057.0
      335.200       .0940      3358.0
      335.500       1.651      4344.0
      Peak Outflow    =      .014 c.m/s
      Maximum Depth   =   335.051 metres
      Maximum Storage =     2930. c.m
            .030       .245       .014       .000 c.m/s
16    NEXT LINK
            .030       .014       .014       .000 c.m/s
 4    CATCHMENT
    202.000     ID No.ó 99999
       .360     Area in hectares
     50.000     Length (PERV) metres
      2.000     Gradient (%)
     10.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .019       .014       .014       .000 c.m/s
            .152       .906       .228     C perv/imperv/total
15    ADD RUNOFF
            .019       .031       .014       .000 c.m/s
 4    CATCHMENT
    206.000     ID No.ó 99999
       .470     Area in hectares
    100.000     Length (PERV) metres
      2.000     Gradient (%)
     40.000     Per cent Impervious
     10.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     75.000     Max.Infiltn. mm/hr
     13.000     Min.Infiltn. mm/hr
       .500     Lag const (hours)
      5.000     Dep.Storage mm
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .024       .031       .014       .000 c.m/s
            .153       .906       .454     C perv/imperv/total
15    ADD RUNOFF
            .024       .054       .014       .000 c.m/s
20    MANUAL
```

Brief Stormceptor Sizing Report - 220 Arkell

Project Information & Location			
Project Name	220 Arkell	**Project Number**	1614-13338
City	Guelph	**State/ Province**	Ontario
Country	Canada	**Date**	10/25/2017
Designer Information		**EOR Information (optional)**	
Name	Bryan Weersink	**Name**	
Company	Stantec Consulting Ltd.	**Company**	
Phone #	519-569-4333	**Phone #**	
Email	bryan.weersink@stantec.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	
Target TSS Removal (%)	60
TSS Removal (%) Provided	61
Recommended Stormceptor Model	EF10

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

EF Sizing Summary	
EF Model	**% TSS Removal Provided**
EF4	50
EF6	54
EF8	58
EF10	61
EF12	63
Parallel Units / MAX	Custom

Stormceptor®

FORTERRA

Sizing Details

Drainage Area	
Total Area (ha)	2.73
Imperviousness %	65.0

Rainfall	
Station Name	WATERLOO WELLINGTON A
State/Province	Ontario
Station ID #	9387
Years of Records	34
Latitude	43°27'N
Longitude	80°23'W

Water Quality Objective	
TSS Removal (%)	60.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

CA ETV		
Particle Diameter (microns)	Distribution %	Specific Gravity
2.0	5.0	2.65
5.0	5.0	2.65
8.0	10.0	2.65
20.0	15.0	2.65
50.0	10.0	2.65
75.0	5.0	2.65
100.0	10.0	2.65
150.0	15.0	2.65
250.0	15.0	2.65
500.0	5.0	2.65
1000.0	5.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

STANDARD SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREAMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, designing, maintaining, and constructing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV). Work includes supply and installation of concrete bases, precast sections, and the appropriate precast section with OGS internal components correctly installed within the system, watertight sealed to the precast concrete prior to arrival to the project site.

1.2 REFERENCE STANDARDS

1.2.1 For Canadian projects only, the following reference standards apply:

CAN/CSA-A257.4-14: Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets
CAN/CSA-A257.4-14: Precast Reinforced Circular Concrete Manhole Sections, Catch Basins, and Fittings
CAN/CSA-S6-00: Canadian Highway Bridge Design Code

1.2.2 For ALL projects, the following reference standards apply:

ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 891: Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM D2563: Standard Practice for Classification of Visual Defects in Reinforced Plastics

1.3 SHOP DRAWINGS

1.3.1 Shop drawings shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail the precast concrete components and OGS internal components prior to shipment, including the sequence for installation.

1.3.2 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record. Any and all changes to project cost estimates, bonding amounts, plan check fees for revision of approved documents, or design impacts due to regulatory requirements as a result of a product substitution shall be coordinated by the Contractor with the Engineer of Record.

1.4 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

1.4.1 OGS internal components supplied by the Manufacturer for attachment to the precast concrete vessel shall be pre-fabricated, bolted to the precast and watertight sealed to the precast vessel surface prior to site delivery to ensure Manufacturer's internal assembly process and quality control processes are fully adhered to, and to prevent materials damage on site.

1.4.2 Follow all instructions including the sequence for installation in the shop drawings during installation.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The OGS vessel shall be cylindrical and constructed from precast concrete riser and slab components.

2.1.2 The precast concrete OGS internal components shall include a fiberglass insert bolted and watertight sealed inside the precast concrete vessel, prior to site delivery. Primary internal components that are to be anchored and watertight sealed to the precast concrete vessel shall be done so only by the Manufacturer prior to arrival at the job site to ensure product quality.

2.1.3 The OGS shall be allowed to be specified and have the ability to function as a 240-degree bend structure in the stormwater drainage system, or as a junction structure.

2.1.4 The OGS to be specified shall have the capability to accept influent flow from an inlet grate and an inlet pipe.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be designed and manufactured to meet highway loading conditions per State/Provincial or local requirements.

2.3 GASKETS

Only profile neoprene or nitrile rubber gaskets that are oil resistant shall be accepted. For Canadian projects only, gaskets shall be in accordance to CSA A257.4-14. Mastic sealants, butyl tape/rope or Conseal CS-101 alone are not acceptable gasket materials.

2.4 JOINTS

The concrete joints shall be watertight and meet the design criteria according to ASTM C-990. For projects where joints require gaskets, the concrete joints shall be watertight and oil resistant and meet the design criteria according to ASTM C-443. Mastic sealants or butyl tape/rope alone are not an acceptable alternative.

2.5 FRAMES AND COVERS

Frames and covers shall be manufactured in accordance with State/Provincial or local requirements for inspection and maintenance access purposes. A minimum of one cover, at least 22-inch (560 mm) in diameter, shall be clearly embossed with the OGS manufacturer's product name to properly identify this asset's purpose is for stormwater quality treatment.

2.6 PRECAST CONCRETE

All precast concrete components shall conform to the appropriate CSA or ASTM specifications.

2.7 FIBERGLASS

The fiberglass portion of the OGS device shall be constructed in accordance with ASTM D2563, and in accordance with the PS15-69 manufacturing standard, and shall only be installed, bolted and watertight sealed to the precast concrete by the Manufacturer prior to arrival at the project site to ensure product quality.

2.8 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a fiberglass insert for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The total sediment storage capacity shall be a minimum 40 ft^3 (1.1 m^3). The total petroleum hydrocarbon storage capacity shall be a minimum 50 gallons (189 liters). The access opening to the sump of the OGS device for periodic inspection and maintenance purposes shall be a minimum 16 inches (406 mm) in diameter.

2.9 LADDERS

Ladder rungs shall be provided upon request or to comply with State/Provincial or local requirements.

2.10 INSPECTION

All precast concrete sections shall be level and inspected to ensure dimensions, appearance, integrity of internal components, and quality of the product meets State/Provincial or local specifications and associated standards.

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 HYDROLOGY AND RUNOFF VOLUME

The OGS device shall be engineered, designed and sized to treat a minimum of 90 percent of the average annual runoff volume, unless otherwise stated by the Engineer of Record, using historical rainfall data. Rainfall data sets should be comprised of a minimum 15-years of rainfall data or a longer continuous period if available for a given location, but in all cases a minimum 5-year period of rainfall data.

3.3 ANNUAL (TSS) SEDIMIMENT LOAD AND STORAGE CAPACITY

The OGS device shall be capable of removing and have sufficient storage capacity for the calculated annual total suspended solids (TSS) mass load and volume without scouring previously captured pollutants prior to maintenance being required. The annual (TSS) sediment load and volume transported from the drainage area should be calculated and compared to the OGS device's available storage capacity by the specifying Engineer to ensure adequate capacity between maintenance cycles. Sediment loadings shall be determined by land use and defined as a minimum of 450 kg (992 lb) of sediment (TSS) per impervious hectare of drainage area per year, or greater based on land use, as noted in Table 1 below.

Annual sediment volume calculations shall be performed using the projected average annual treated runoff volume, a typical sediment bulk density of 1602 kg/m^3 (100 lbs/ft^3) and an assumed Event Mean Concentration (EMC) of 125 mg/L TSS in the runoff, or as otherwise determined by the Engineer of Record.

Example calculation for a 1.3-hectares parking lot site:

- 1.28 meters of rainfall depth, per year

- 1.3 hectares of 100% impervious drainage area
- EMC of 125 mg/L TSS in runoff
- Treatment of 90% of the average annual runoff volume
- Target average annual TSS removal rate of 60% by OGS

Annual Runoff Volume:

- 1.28 m rain depth x 1.3 ha x 10,000 m^2/ha= 16,640 m^3 of runoff volume
- 16,640 m^3 x 1000 L/m^3 = 16,640,000 L of runoff volume
- 16,640,000 L x 0.90 = 14,976,000 L to be treated by OGS unit

Annual Sediment Mass and Sediment Volume Load Calculation:

- 14,976,000 L x 125 mg/L x kg/1,000,000 mg = 1,872 kg annual sediment mass
- 1,872 kg x m^3/1602 kg = 1.17 m^3 annual sediment volume
- 1.17 m^3 x 60% TSS removal rate by OGS = 0.70 m^3 minimum expected annual storage requirement in OGS

As a guideline, the U.S. EPA has determined typical annual sediment loads per drainage area for various sites by land use (see Table 1). Certain States, Provinces and local jurisdictions have also established such guidelines.

Table 1 – Annual Mass Sediment Loading by Land Use

	Commercial	Parking Lot	Residential			Highways	Industrial	Shopping Center
			High	Med.	Low			
(lbs/acre/yr)	1,000	400	420	250	10	880	500	440
(kg/hectare/yr)	1,124	450	472	281	11	989	562	494

Source: U.S. EPA Stormwater Best Management Practice Design Guide Volume 1, Appendix D, Table D-1, Burton and Pitt 2002

3.4 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in Table 2, Section 3.5, and based on third-party performance testing conducted in accordance with the Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. Sizing shall be determined using historical rainfall data (as specified in Section 3.2) and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 3.3.

3.4.1 The Peclet Number is not an approved method or model for calculating TSS removal, sizing, or scaling OGS devices.

3.4.2 If an alternate OGS device is proposed, supporting documentation shall be submitted that demonstrates:

- Canadian ETV or ISO 14034 ETV Verification Statement which verifies third-party performance testing conducted in accordance with the **Procedure for Laboratory Testing of Oil-Grit Separators**
- Equal or better sediment (TSS) removal of the PSD specified in Table 2 at equivalent surface loading rates, as compared to the OGS device specified herein.
- Equal or greater sediment storage capacity, as compared to the OGS device specified herein.
- Supporting documentation shall be signed and sealed by a local registered Professional Engineer. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.5 PARTICLE SIZE DISTRIBUTION (PSD) FOR SIZING

The OGS device shall be sized to achieve the Engineer-specified average annual percent sediment (TSS) removal based solely on the test sediment used in the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** This test sediment is comprised of inorganic ground silica with a specific gravity of 2.65, uniformly mixed, and containing a broad range of particle sizes as specified in Table 2. No alternative PSDs or deviations from Table 2 shall be accepted.

Table 2
Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators
Particle Size Distribution (PSD) of Test Sediment

Particle Diameter (Microns)	% by Mass of All Particles	Specific Gravity
1000	5%	2.65
500	5%	2.65
250	15%	2.65
150	15%	2.65
100	10%	2.65
75	5%	2.65
50	10%	2.65
20	15%	2.65
8	10%	2.65
5	5%	2.65
2	5%	2.65

3.6 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. This scour testing is conducted with the device pre-loaded with test sediment comprised of the particle size distribution (PSD) illustrated in Table 2.

3.6.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

Data generated from laboratory scour testing performed with an OGS device pre-loaded with a coarser PSD than in Table 2 (i.e. the coarser PSD has no particles in the 1-micron to 50-micron size range, or the D_{50} of the test sediment exceeds 75 microns) shall not be acceptable for the determination of the device's suitability for on-line installation.

3.7 DESIGN ACCOUNTING FOR BYPASS

3.7.1 The OGS device shall be specified to achieve the TSS removal performance and water quality objectives without washout of previously captured pollutants. The OGS device shall also have sufficient hydraulic conveyance capacity to convey the peak storm event, in accordance with hydraulic conditions per the Engineer of Record. To ensure this is achieved, there are two design options with associated requirements:

3.7.1.1 The OGS device shall be placed **off-line** with an upstream diversion structure (typically in an upstream manhole) that only allows the water quality volume to be diverted to the OGS device, and excessive flows diverted downstream around the OGS device to prevent high flow washout of pollutants previously captured. This design typically incorporates a triangular layout including an upstream bypass manhole with an appropriately engineered weir wall, the OGS device, and a downstream junction manhole, which is connected to both the OGS device and bypass structure. In this case with an external bypass required, the OGS device manufacturer must provide calculations and designs for all structures, piping and any other required material applicable to the proper functioning of the system, stamped by a Professional Engineer.

3.7.1.2 Alternatively, OGS devices in compliance with Section 3.6 shall be acceptable for an **on-line** design configuration, thereby eliminating the requirement for an upstream bypass manhole and downstream junction manhole.

3.7.2 The OGS device shall also have sufficient hydraulic conveyance capacity to convey the peak storm event, in accordance with hydraulic conditions per the Engineer of Record. If an alternate OGS device is proposed, supporting documentation shall be submitted that demonstrates equal or better hydraulic conveyance capacity as compared to the OGS device specified herein. This documentation shall be signed and sealed by a local registered Professional Engineer. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.8 PETROLEUM HYDROCARBONS AND FLOATABLES STORAGE CAPACITY

Petroleum hydrocarbons and floatables storage capacity in the OGS device shall be a minimum 50 gallons (189 Liters), or more as specified.

3.8.1 The OGS device shall have gasketed precast concrete joints that are watertight, and oil resistant and meet the design criteria according to ASTM C-443 to provide safe oil and other hydrocarbon materials storage and ground water protection. Mastic sealants or butyl tape/rope alone are not an acceptable alternative.

3.9 SURFACE LOADING RATE SCALING OF DIFFERENT MODEL SIZES

The reference device for scaling shall be an OGS device that has been third-party tested in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. Other model sizes of the tested device shall only be scaled such that the claimed TSS removal efficiency of the scaled device shall be no greater than the TSS removal efficiency of the tested device at identical **surface loading rates** (flow rate divided by settling surface area). The depth of other model sizes of the tested device shall be scaled in accordance with the depth scaling provisions within Section 6.0 of the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.9.1 The Peclet Number and volumetric scaling are not approved methods for scaling OGS devices.

PART 4 – INSPECTION & MAINTENANCE

The OGS manufacturer shall provide an Owner's Manual upon request.

4.1 A Quality Assurance Plan that provides inspection and maintenance for a minimum of 5 years shall be included with the OGS stormwater quality device, and written into the Environmental Compliance Approval (ECA) or the appropriate State/Provincial or local approval document.

4.2 OGS device inspection shall include determination of sediment depth and presence of petroleum hydrocarbons and floatables below the insert. Inspection shall be easily conducted from finished grade through a Frame and Cover of at least 22 inch (560 mm) in diameter.

4.3 Inspection and pollutant removal from below the OGS's insert shall be conducted as a periodic maintenance practice using a standard maintenance truck and vacuum apparatus, and shall be easily conducted from finished grade through a Frame and Cover of at least 22-inches (560 mm) in diameter, and through an access opening to the OGS device's sump with a minimum 16-inches diameter (406 mm).

4.4 No confined space for sediment removal or inspection of internal components shall be required for normal operation, annual inspection or maintenance activity.

PART 5 – EXECUTION

5.1 PRECAST CONCRETE INSTALLATION

The installation of the precast concrete OGS stormwater quality treatment device shall conform to ASTM C 891, ASTM C 478, ASTM C 443, CAN/CSA-A257.4-14, CAN/CSA-A257.4-14, CAN/CSA-S6-00 and all highway, State/Provincial, or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below. The Contractor shall furnish all labor, equipment and materials necessary to offload, assemble as needed the OGS internal components as specified in the Shop Drawings.

5.2 EXCAVATION

5.2.1 Excavation for the installation of the OGS stormwater quality treatment device shall conform to highway, State/Provincial or local specifications. Topsoil that is removed during the excavation for the OGS stormwater quality treatment device shall be stockpiled in designated areas and not be mixed with subsoil or other materials. Topsoil stockpiles and the general site preparation for the installation of the OGS stormwater quality device shall conform to highway, State/Provincial or local specifications.

5.2.2 The OGS device shall not be installed on frozen ground. Excavation shall extend a minimum of 12 inch (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

5.2.3 In areas with a high water table, continuous dewatering shall be provided to ensure that the excavation is stable and free of water.

5.3 BACKFILLING

Backfill material shall conform to highway, State/Provincial or local specifications. Backfill material shall be placed in uniform layers not exceeding 12 inches (300 mm) in depth and compacted to highway, State/Provincial or local specifications.

5.4 OGS WATER QUALITY DEVICE CONSTRUCTION SEQUENCE

5.4.1 The precast concrete OGS stormwater quality treatment device is installed and leveled in sections in the following sequence:

- aggregate base
- base slab, or base
- riser section(s) (if required)
- riser section w/ pre-installed fiberglass insert
- upper riser section(s)
- internal OGS device components
- connect inlet and outlet pipes
- riser section, top slab and/or transition (if required)
- frame and access cover

5.4.2 The precast concrete base shall be placed level at the specified grade. The entire base shall be in contact with the underlying compacted granular material. Subsequent sections, complete with oil resistant, watertight joint seals, shall be installed in accordance with the precast concrete manufacturer's recommendations.

5.4.3 Adjustment of the OGS stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections.

Damaged sections and gaskets shall be repaired or replaced as necessary. Once the OGS stormwater quality treatment device has been constructed, any lift holes must be plugged with mortar.

5.5 DROP PIPE AND OIL INSPECTION PIPE

Once the upper precast concrete riser has been attached to the lower precast concrete riser section, the OGS device Drop Pipe and Oil Inspection Pipe must be attached, and watertight sealed to the fiberglass insert using Sikaflex 1a. Installation instructions and required materials shall be provided by the OGS manufacturer.

5.6 INLET AND OUTLET PIPES

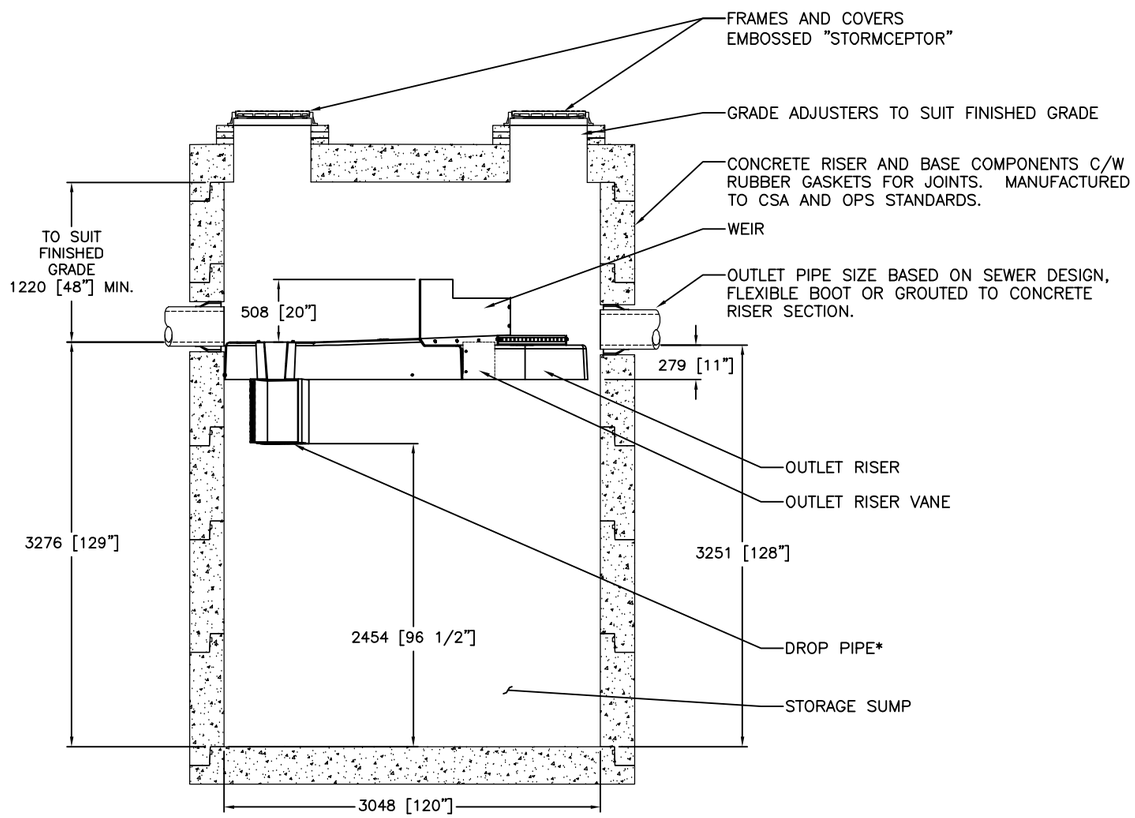
Inlet and outlet pipes shall be securely set using grout or approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight. Non-secure inlets and outlets will result in improper performance.

5.7 FRAME AND COVER OR FRAME AND GRATE INSTALLATION

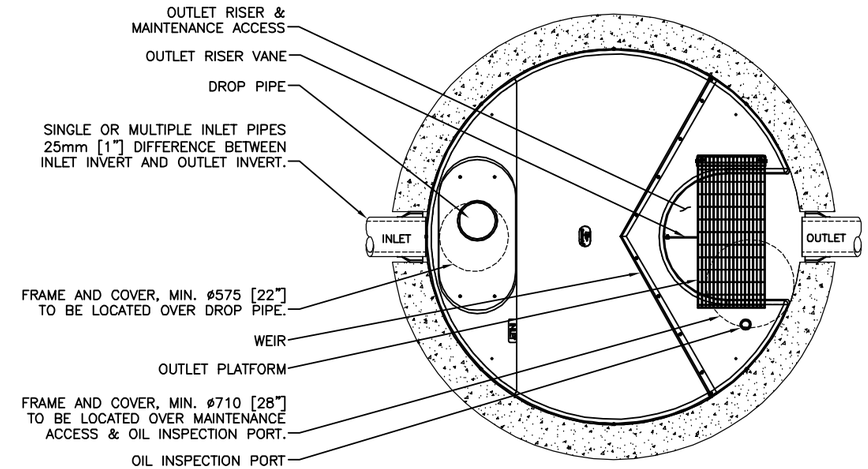
Precast concrete adjustment units shall be installed to set the frame and cover/grate at the required elevation. The adjustment units shall be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover/grate should be set in a full bed of mortar at the elevation specified.

5.7.1 A minimum of one cover, at least 22-inch (560 mm) in diameter, shall be clearly embossed with the OGS device brand or product name to properly identify this asset's purpose is for stormwater quality treatment.

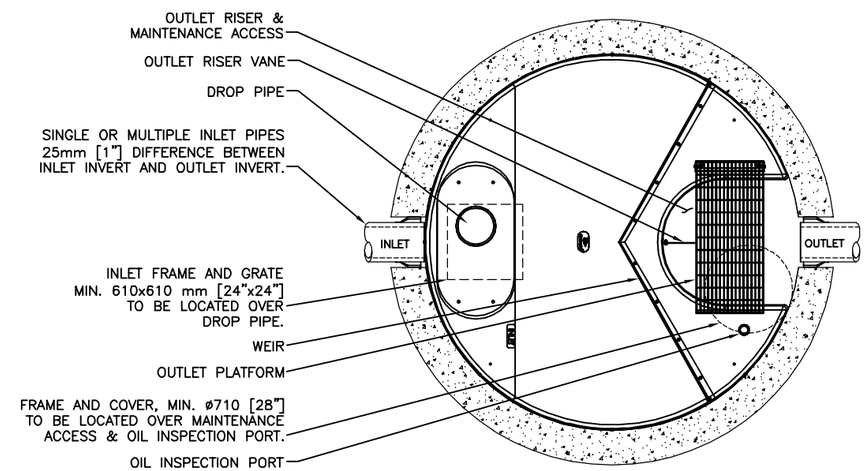
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF10 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO10 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EF10
STRUCTURE ID	*
WATER QUALITY FLOW RATE (L/s)	*
PEAK FLOW RATE (L/s)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
DRAINAGE AREA (HA)	*
DRAINAGE AREA IMPERVIOUSNESS (%)	*

PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
####	####	####	####
####	####	####	####
####	####	####	####
1	6/8/18	OUTLET PLATFORM	JSK
0	5/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium®
7037 RIDGE ROAD, SUITE 350, HANOVER, MD 21076
USA 888-279-8826 CA 800-566-4801 INTL +1-416-960-990

THE STORMCEPTOR SYSTEM IS PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS
Australia Patent No. 693,164 • 707,133 • 729,096 • 779401 | Austrian Patent No. 289,647 | Canadian Patent No. 2,009,280 • 2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 |China Patent No. 1,169,439 | Denmark DK 711,879 | German DE 69,534,021 | Indonesian Patent No 16,688 | Japan Patent No. 9-11476 (Pending) | Korea Patent No. 10-2000-0026101 (Pending) | Malaysia Patent No. PI9701737 (Pending) | New Zealand Patent No. 314646 | United States Patent No. 4,985,148 • 5,498,331 • 5,725,760; 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690

DATE:	5/26/2017
DESIGNED: JSK	DRAWN: JSK
CHECKED: BSF	APPROVED: SP
PROJECT No.: EF10	SEQUENCE No.: *
SHEET: 1 OF 1	

TABLE 5
PRE-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A (pre)	flat, silty sand, woodland (Wetland)
Sub-Area B (pre)	flat to gently rolling, silty sand, pastures and shrubs
Sub-Area C (pre)	rolling, silty sand, cultivated

Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Holdings
Total Site Area (ha) 7.16

Land Description Factors	Sub-Area A (pre)	Sub-Area B (pre)	Sub-Area C (pre)											Total
Topography	0.30	0.25	0.20											
Soils	0.40	0.40	0.40											
Cover	0.20	0.15	0.10											
Sum (Infiltration Factor)†	0.90	0.80	0.70											
Soil Moisture Capacity (mm)	300	150	150											
Site area (ha)	0.83	2.31	4.01											7.16
Imperviousness Coefficient	0.00	0.00	0.15											
Impervious Area (ha)	0.00	0.00	0.60											0.60
Percentage of Total Site Area	0.0%	0.0%	8.4%											8%
Remaining Pervious Area (ha)	0.83	2.31	3.41											6.56
Total Pervious Site Area (ha)	0.83	2.31	3.41											6.56
Percentage of Total Site Area	11.6%	32.3%	47.7%											92%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data ‡													
Average Daily Temperature (°C)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3	**7.0**
Precipitation (mm)	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2	**916**

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.4	4.0	6.7	8.2	7.5	5.0	2.1	0.4	0.0	**35**
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.0	60.8	87.2	99.8	94.0	71.1	39.0	11.1	0.0	**492**
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	32	75	112	126	110	74	36	9	0	**573**
Precipitation - PET (mm)	65	55	61	42	8	-30	-27	-26	14	32	78	71	**343**

Evapotranspiration Analysis													
Sub-Area A (pre)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Precipitation (m^3)													**7,605**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	300	300	300	300	300	272	225	171	185	216	300	300	
Change in Storage	0	0	0	0	0	-28	-47	-54	14	32	84	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	111	145	138	74	36	9	0	**620**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	-6	71	**296**
Potential Infiltration (I)	59	49	55	38	7	0	0	0	0	0	-5	64	267
Potential Direct Surface Water Runoff (R)	7	5	6	4	1	0	0	0	0	0	-1	7	30
Potential Infiltration (mm)	0	0	0	265	7	0	0	0	0	0	-5	0	267
Pervious Evapotranspiration (m^3)	0	0	0	270	620	919	1207	1144	615	297	75	0	5,147
Pervious Runoff (m^3)	54	46	51	35	6	0	0	0	0	0	-5	59	**246**
Pervious Infiltration (m^3)	0	0	0	2199	57	0	0	0	0	0	-43	0	**2,213**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

TABLE 5
PRE-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Evapotranspiration Analysis													
Sub-Area B (pre)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Precipitation (m^3)													**21,191**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	150	150	150	150	150	123	84	49	62	94	150	150	
Change in Storage	0	0	0	0	0	-27	-39	-36	14	32	56	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	109	137	120	74	36	9	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	22	71	**324**
Potential Infiltration (I)	52	44	49	34	6	0	0	0	0	0	18	57	259
Potential Direct Surface Water Runoff (R)	13	11	12	8	2	0	0	0	0	0	4	14	65
Potential Infiltration (mm)	0	0	0	235	6	0	0	0	0	0	18	0	259
Pervious Evapotranspiration (m^3)	0	0	0	751	1728	2529	3177	2764	1714	828	208	0	13,699
Pervious Runoff (m^3)	302	254	282	194	35	0	0	0	0	0	102	329	**1,499**
Pervious Infiltration (m^3)	0	0	0	5445	140	0	0	0	0	0	408	0	**5,994**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Evapotranspiration Analysis													
Sub-Area C (pre)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Precipitation (m^3)													**36,787**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	150	150	150	150	150	123	84	49	62	94	150	150	
Change in Storage	0	0	0	0	0	-27	-39	-36	14	32	56	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	109	137	120	74	36	9	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	22	71	**324**
Potential Infiltration (I)	46	38	43	29	5	0	0	0	0	0	15	50	227
Potential Direct Surface Water Runoff (R)	20	16	18	13	2	0	0	0	0	0	7	21	97
Potential Infiltration (mm)	0	0	0	206	5	0	0	0	0	0	15	0	227
Pervious Evapotranspiration (m^3)	0	0	0	1108	2549	3732	4687	4078	2529	1222	307	0	20,213
Pervious Runoff (m^3)	667	562	624	430	78	0	0	0	0	0	226	729	**3,317**
Pervious Infiltration (m^3)	0	0	0	7031	181	0	0	0	0	0	527	0	**7,739**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Evaporation (m^3)	39	33	37	45	50	50	59	51	53	41	52	43	**552**
Impervious Runoff (m^3)	353	298	331	404	446	447	534	455	476	365	472	386	**4,966**

Pre-Development Infiltration	**15,946**	**(m^3/yr)**	**223**	**mm/yr**	**0.5**	**L/s**
Pre-Development Runoff	10,027	(m^3/yr)	140	mm/yr	0.3	L/s
Pre-Development Evapotranspiration	39,610	(m^3/yr)	553	mm/yr	1.3	L/s
Total	65,584	(m^3/yr)	916	mm/yr	2.1	L/s
Precipitation	65,584	(m^3/yr)	916	mm/yr	2.1	L/s

Notes:
† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2018. Canadian Climate Normals 1981-2010, Waterloo Wellington A Climate Station, Climate ID 6149387. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html

Assumptions:
[1] The monthly average precipitation collected at the Waterloo-Wellington A climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

TABLE 6
POST-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A (post)	flat, silty sand, woodland (Wetland)
Sub-Area B (post)	rolling, silty sand, cultivated
Sub-Area C (post)	rolling, silty sand, cultivated

Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Holdings
Total Site Area (ha) 7.16

Land Description Factors	Sub-Area A (post)	Sub-Area B (post)	Sub-Area C (post)											Total
Topography	0.30	0.25	0.20											
Soils	0.40	0.40	0.40											
Cover	0.20	0.15	0.10											
Sum (Infiltration Factor)†	0.90	0.80	0.70											
Soil Moisture Capacity (mm)	300	150	100											
Site area (ha)	0.83	2.31	4.01											7.16
Imperviousness Coefficient	0.00	0.10	0.65											
Impervious Area (ha)	0.00	0.22	2.60											2.82
Percentage of Total Site Area	0.0%	3.1%	36.3%											39%
Remaining Pervious Area (ha)	0.83	2.09	1.42											4.34
Total Pervious Site Area (ha)	0.83	2.09	1.42											4.34
Percentage of Total Site Area	11.6%	29.2%	19.8%											61%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data ‡													
Average Daily Temperature (°C)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3	**7.0**
Precipitation (mm)	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2	**916**

Potential Evapotranspiration Analysis for Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat Index	0.0	0.0	0.0	1.4	4.0	6.7	8.2	7.5	5.0	2.1	0.4	0.0	**35**
Unadjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	29.0	60.8	87.2	99.8	94.0	71.1	39.0	11.1	0.0	**492**
Potential Evapotranspiration Adjusting Factor for Latitude*	0.77	0.87	0.99	1.12	1.23	1.29	1.26	1.16	1.04	0.92	0.81	0.75	
Adjusted Potential Evapotranspiration (PET)(mm)	0	0	0	32	75	112	126	110	74	36	9	0	**573**
Precipitation - PET (mm)	65	55	61	42	8	-30	-27	-26	14	32	78	71	**343**

Evapotranspiration Analysis													
Sub-Area A (post)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	300	300	300	300	300	272	225	171	185	216	300	300	
Change in Storage	0	0	0	0	0	-28	-47	-54	14	32	84	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	111	145	138	74	36	9	0	**620**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	-6	71	**296**
Potential Infiltration (I)	59	49	55	38	7	0	0	0	0	0	-5	64	267
Potential Direct Surface Water Runoff (R)	7	5	6	4	1	0	0	0	0	0	-1	7	30
Potential Infiltration (mm)	0	0	0	265	7	0	0	0	0	0	-5	0	267
Pervious Evapotranspiration (m^3)	0	0	0	270	620	919	1207	1144	615	297	75	0	5,147
Pervious Runoff (m^3)	54	46	51	35	6	0	0	0	0	0	-5	59	**246**
Pervious Infiltration (m^3)	0	0	0	2199	57	0	0	0	0	0	-43	0	**2,213**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

TABLE 6
POST-DEVELOPMENT MONTHLY WATER BALANCE
220 Arkell Road, Guelph, Ontario

Evapotranspiration Analysis													
Sub-Area B (post)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	150	150	150	150	150	123	84	49	62	94	150	150	
Change in Storage	0	0	0	0	0	-27	-39	-36	14	32	56	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	109	137	120	74	36	9	0	**592**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	22	71	**324**
Potential Infiltration (I)	52	44	49	34	6	0	0	0	0	0	18	57	259
Potential Direct Surface Water Runoff (R)	13	11	12	8	2	0	0	0	0	0	4	14	65
Potential Infiltration (mm)	0	0	0	235	6	0	0	0	0	0	18	0	259
Pervious Evapotranspiration (m^3)	0	0	0	679	1562	2287	2872	2499	1549	749	188	0	12,384
Pervious Runoff (m^3)	273	230	255	176	32	0	0	0	0	0	92	298	**1,355**
Pervious Infiltration (m^3)	0	0	0	4923	127	0	0	0	0	0	369	0	**5,419**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	130	110	122	149	164	165	197	168	175	135	174	142	**1,831**

Evapotranspiration Analysis													
Sub-Area C (post)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Accumulated Potential Water Loss (APWL)	0	0	0	0	0	-30	-57	-82	-69	-37	0	0	
Storage (S)	100	100	100	100	100	74	42	18	32	64	100	100	
Change in Storage	0	0	0	0	0	-26	-32	-24	14	32	36	0	
Actual Evapotranspiration (mm)	0	0	0	32	75	108	131	108	74	36	9	0	**573**
Recharge/Runoff Analysis													
Water Surplus (mm)	65	55	61	42	8	0	0	0	0	0	42	71	**344**
Potential Infiltration (I)	46	38	43	29	5	0	0	0	0	0	29	50	241
Potential Direct Surface Water Runoff (R)	20	16	18	13	2	0	0	0	0	0	13	21	103
Potential Infiltration (mm)	0	0	0	206	5	0	0	0	0	0	29	0	241
Pervious Evapotranspiration (m^3)	0	0	0	460	1057	1530	1851	1522	1049	507	127	0	8,104
Pervious Runoff (m^3)	277	233	259	178	32	0	0	0	0	0	178	302	**1,460**
Pervious Infiltration (m^3)	0	0	0	2916	75	0	0	0	0	0	415	0	**3,406**
Potential Impervious Evaporation (mm)	7	5	6	7	8	8	10	8	9	7	9	7	92
Potential Impervious Runoff (mm)	59	49	55	67	74	74	89	76	79	61	78	64	825
Impervious Runoff (m^3)	1525	1284	1427	1743	1925	1928	2307	1963	2054	1577	2038	1666	**21,435**
Rooftop Recharge	411	346	384	469	518	519	621	528	553	425	549	448	**5,771**
SWMF Recharge						489	586	498	522	400	579		**3,075**

Post-Development Infiltration (no mitigation)	11,038	(m^3/yr)	154	mm/yr	0.3	L/s
Post-Development Runoff (no mitigation)	26,327	(m^3/yr)	368	mm/yr	0.8	L/s
Infiltration Deficit	4,908	(m^3/yr)	69	mm/yr	0.2	L/s
Rooftop Recharge	5,771	(m^3/yr)	81	mm/yr	0.2	L/s
Infiltration Deficit with Rooftop Galleries	-863	(m^3/yr)	-12	mm/yr	0.0	L/s
SWMF Recharge	3,075	(m^3/yr)	43	mm/yr	0.1	L/s
Total Infiltration with Recharge	**19,884**	**(m^3/yr)**	**278**	**mm/yr**	**0.6**	**L/s**
Infiltration Deficit with Rooftop Galleries + SWMF Infiltration	-3,938	(m^3/yr)	-55	mm/yr	-0.1	L/s
Post-Development Runoff (with mitigation)	**17,481**	**(m^3/yr)**	**244**	**mm/yr**	**0.6**	**L/s**
Runoff surplus	7,453	(m^3/yr)	104	mm/yr	0.2	L/s
Post-Development Evapotranspiration	**28,219**	**(m^3/yr)**	**394**	**mm/yr**	**0.9**	**L/s**
Evapotranspiration Deficit	11,391	(m^3/yr)	159	mm/yr	0.4	L/s

Sub-Area Descriptions (topography, soils, cover)	
Sub-Area A (post)	flat, silty sand, woodland (Wetland)
Sub-Area B (post)	rolling, silty sand, cultivated
Sub-Area C (post)	rolling, silty sand, cultivated

Notes:

† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2018. Canadian Climate Normals 1981-2010, Waterloo Wellington A Climate Station, Climate ID 6149387. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html

Assumptions:

[1] The monthly average precipitation collected at the Waterloo-Wellington A climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

Stantec Consulting Ltd.
100-300 Hagey Boulevard, Waterloo ON N2L 0A4

November 5, 2018
File: 161413338/11

Attention: Mr. Jim Hall, P. Eng., Development Infrastructure Engineer
City of Guelph
Engineering and Capital Infrastructure
Services Department
1 Carden Street
Guelph ON N1H 3A1

Dear Mr. Hall,

Reference: 220 Arkell Road – Response to Stormwater Management City Comments Dated July 19, 2018

The purpose of this letter is to respond to City comments dated July 19, 2018, specifically related to the proposed interim stormwater management (SWM) for the development (hereafter referred to as the 'site'). Stantec Consulting Ltd. (Stantec) met with City of Guelph (City) staff on September 10, 2018 to review the comments and to establish a general approach to the response. This letter addresses the analysis that was completed to ensure no negative impacts occur to the SWM design for the neighbouring Subdivision to the south, Arkell Meadows, following construction of the proposed interim access road to the 220 Arkell site.

1.0 BACKGROUND

Following the meeting on September 10, 2018, City staff requested that Stantec analyze the existing infiltration/SWM strategy for Arkell Meadows as the proposed alignment for the interim emergency access road passes over an Open Space Block (Block 20). A copy of the *Arkell Meadows Final Stormwater Management (FSWM) and Servicing Report* (KJ Behm and Associates, 2013) was obtained from the City to determine pre-development and current conditions and should be read in conjunction with this letter.

2.0 PRE-DEVELOPMENT AND CURRENT CONDITIONS

Under pre-development conditions, Block 20 is identified as a 'dead-end drainage' feature and provides additional recharge for the site (consistent with the Torrance Creek Subwatershed Study). The current Arkell Meadows design is illustrated on the attached Drawing H-1. An infiltration gallery receiving runoff from Lots 1-12 and Block 20 stretches along the rearyards of these lots and extends into Block 20. Under current conditions, Block 20 is 'Open Space' with no impervious coverage. According to the Arkell Meadows FSWM design and grading, the majority of Block 20 drains to a catchbasin located in the northwest corner of the Block which is connected to the rearyard infiltration gallery. Block 20 is part of Catchment 13 (from the hydrologic model MIDUSS) from the post-development drainage conditions which also includes parts of Lots 6-12. The hydrologic model presents Catchment 13 as 0.35 ha of residential area with an assumed 70% impervious coverage. The current Drainage Plan is attached and please refer to the original FSWM Report for the MIDUSS model output. Catchment 13 from the MIDUSS model seems to be a combination of Catchments 11, 12, 13, and 14 illustrated on the Drainage Plan. Please note the current MIDUSS parameters and catchment areas do not match the current Drainage Plan; however, the Plan has been included to give a general illustration of current drainage ditch.

The current Arkell Meadows SWM strategy uses a treatment train approach to provide water quality and water quantity control and maintains existing recharge volumes through several design infiltration components:

- Lot Level Controls: infiltration galleries in the rearyards of Lots 1-12
- Conveyance Controls: roadside catchbasins with sumps, oil/grit separator (OGS) units, sand filters, and vegetation at outlet points from the site
- End-of-Pipe Controls: a SWM facility providing polishing of runoff through interaction with vegetation as well as an infiltration system with a sand filter bottom to provide recharge and separate contaminants from runoff

3.0 PROPOSED CONDITIONS

A proposed emergency access road alignment extends from Dawes Avenue through Block 20 to the north, ultimately connecting to the site as illustrated on Drawing C-400. This connection is for emergency access only and regular vehicular traffic is not anticipated to occur.

The interim emergency access road is a 10 m wide asphalt road and extends from Dawes Avenue into the site through Block 20 of the Arkell Meadows Subdivision. Ultimately, the width of the road/trail will be reduced to a 4 m asphalt trail for pedestrian use and maintenance access further north in the park area; however, for the purposes of this assessment it is assumed the 10 m road is the ultimate condition.

As a result of this proposal, the following tasks were completed to ensure the continued functioning of the Arkell Meadows hydrology and SWM system:

- Review the current Arkell Meadows Subdivision infiltration/SWM design for proposed conditions
- Ensure the water quantity control for the site is maintained under proposed conditions
- Ensure water quality treatment is provided for the proposed development

3.1 WATER BALANCE, INFILTRATION AND WATER QUANTITY CONTROL

The Arkell Meadows Subdivision maintains a groundwater recharge water balance by directing rooftop runoff to a rearyard infiltration gallery and all other post-development runoff to a SWM facility for filtration and ultimately infiltration. The drainage strategy also promotes evapotranspiration (ET) in the pond to enhance the post-development ET volumes.

Given the location of the proposed access road, the removal of the existing RYCB 32 receiving drainage from Block 20 (northwest corner of the Block) and connecting into the infiltration gallery is expected. To maintain drainage to the infiltration gallery, the proposed access road is super-elevated on the west side to direct drainage to the east to the grassed swale on the property line between Lot 12 and Block 20. Runoff drains north along this grassed area to a future catchbasin (CB) which will connect to the infiltration gallery. The proposed access road increases the impervious coverage on Block 20; however, as shown on the attached water balance calculation, the change to the ET and recharge components of the balance is negligible.

The table below illustrates the results of the post-development water balance analysis for Arkell Meadows. The full analysis is attached.

Table 1: Summary of 2013 Water Balance for Arkell Meadows Subdivision

Water Balance Component	Pre-Development	Current Conditions	Proposed Access Road
Evapotranspiration (mm/year)	600	419	416
Recharge (mm/year)	300	474	476
Runoff (mm/year)	17	24	25
Total Precipitation (mm/year)	917	917	917

Following construction of the access road, additional drainage is directed to the infiltration system for groundwater recharge; however, the increase in impervious coverage reduces the ET and increases the runoff (as expected). Under these proposed conditions and compared to the current conditions, the design has an ET reduction of 3 mm/year (0.7%), a recharge increase of 2 mm/year (0.4%), and a runoff increase of 1 mm/year (4%). Given

these relatively small changes, no negative impact to the local water balance is anticipated following construction of the proposed access road.

The SWM facility and rearyard infiltration system provide water quantity control for the site. The hydrologic model MIDUSS was used in the FSWM Report and has been recreated for the catchment in which the proposed access road is located (Catchment 13) to illustrate the impact on the gallery capacity. The additional impervious area from the proposed access road increases the impervious area to the infiltration gallery; however, the current design volume of the gallery has sufficient capacity to infiltrate all runoff up to and including the 1:100-year return period design storm. The supporting MIDUSS output is attached for reference.

The future site development at 220 Arkell Road, located north of the Arkell Meadows Subdivision, will also maintain surface water flows to the wetland to the west by installing a culvert under the proposed access road. A low area exists near the property line between 220 Arkell and Arkell Meadows, immediately north of Block 20 and Lot 12. Surface flow from this low area will be directed west under the proposed access road as illustrated on Drawing C-400. The culvert conveys surface water runoff from the future 220 Arkell Road development; however, in the event of overflows from the Arkell Meadows Subdivision, the culvert conveys water away from the existing subdivision and towards the wetland. The specific discharge and volume details flowing to the culvert will be provided at the detailed design stage.

3.2 WATER QUALITY CONTROL

A treatment train approach consisting of lot level controls, conveyance controls, and end-of-pipe controls provides water quality for the site. These controls include vegetation, infiltration, and groundwater recharge. A similar approach is recommended for the proposed access road in the form of conveyance controls and end-of-pipe controls. The proposed access road is super-elevated and drains east to a grassed swale. The swale provides conveyance control as runoff drains north along the property line between Block 20 and Lot 12. Water quality benefits of the proposed grassed swale are also achieved as a result of the runoff / vegetation interaction which slows the velocity of runoff, as compared to a piped system, thereby promoting the sedimentation of particulate matter in the swale. The vegetation also provides nutrient uptake benefits to help reduce biological pollutants such as nitrogen and phosphorous. According to the *Low Impact Development SWM Planning and Design Manual (*CVC/TRCA, 2010), grassed swales provide a median sediment removal rate of 76%. In addition to conveyance control, it is recommended a CB insert (CB Shield or equivalent) is installed in the proposed CB as an end-of-pipe treatment prior to infiltrating in the rearyard gallery. Sediment removal rates for CB Shields range between 25.2 - 64% depending on inflow rates from the Environmental Technology Verification (ETV) testing specifications (please refer to CB Shield Website for details of the ETV Report). The combined minimum sediment removal rate is therefore 82% (76% plus an additional 25.2% of the remaining sediment). In addition, given the proposed access road is for emergency use only and its future use is a Public trail only, limited vehicular traffic is expected. Any water quality treatment strategies are expected to be more than sufficient for the limited sediment and oil/grit build-up on the road itself and in the runoff.

Drawing C-400 illustrates the proposed grading and drainage patterns in Block 20.

4.0 SUMMARY

The following SWM strategies are proposed to maintain the Arkell Meadows hydrologic regime:

- Super-elevate access road to direct all runoff towards a grassed swale conveying runoff north between Block 20 and Lot 12 to a proposed catchbasin at the north property limits of Arkell Meadows
- Maintain water balance for the site by directing access road runoff to the proposed catchbasin which is connected to the existing infiltration gallery
- Install a culvert under the proposed access road near the property line between the future 220 Arkell Road Development and the existing Arkell Meadows Subdivision to maintain surface water flows to the wetland to the west
- Provide water quality treatment through the combination of a grassed swale (conveyance control) and a catchbasin insert (end-of-pipe) prior to infiltration to the existing gallery. Vehicular traffic is expected during emergency situations, only, so the runoff water quality should have limited sediment and oil/grit which is typical of heavily-used roads

No negative impacts to the stormwater management system for Arkell Meadows Subdivision are anticipated from the implementation of the proposed emergency access road.

If you have any questions or would like to clarify anything within this proposal, please do not hesitate to contact the undersigned.

Regards,

Stantec Consulting Ltd.

Trevor Fraser P.Eng.
Surface Water Resources Engineer
Phone: (519) 575-4120
trevor.fraser@stantec.com

Attachment: Arkell Meadows Drawing H-1
Arkell Meadows Current Drainage Plan
Arkell Meadows Current MIDUSS Model
Proposed Drawing C-400
Water Balance – Pre-Development, Current, Proposed
Proposed MIDUSS Model

c. Mr. Carson Reid, Rockpoint Properties Inc.
Mr. Kevin Brousseau / Ms. Melissa Straus, Stantec Consulting Ltd.

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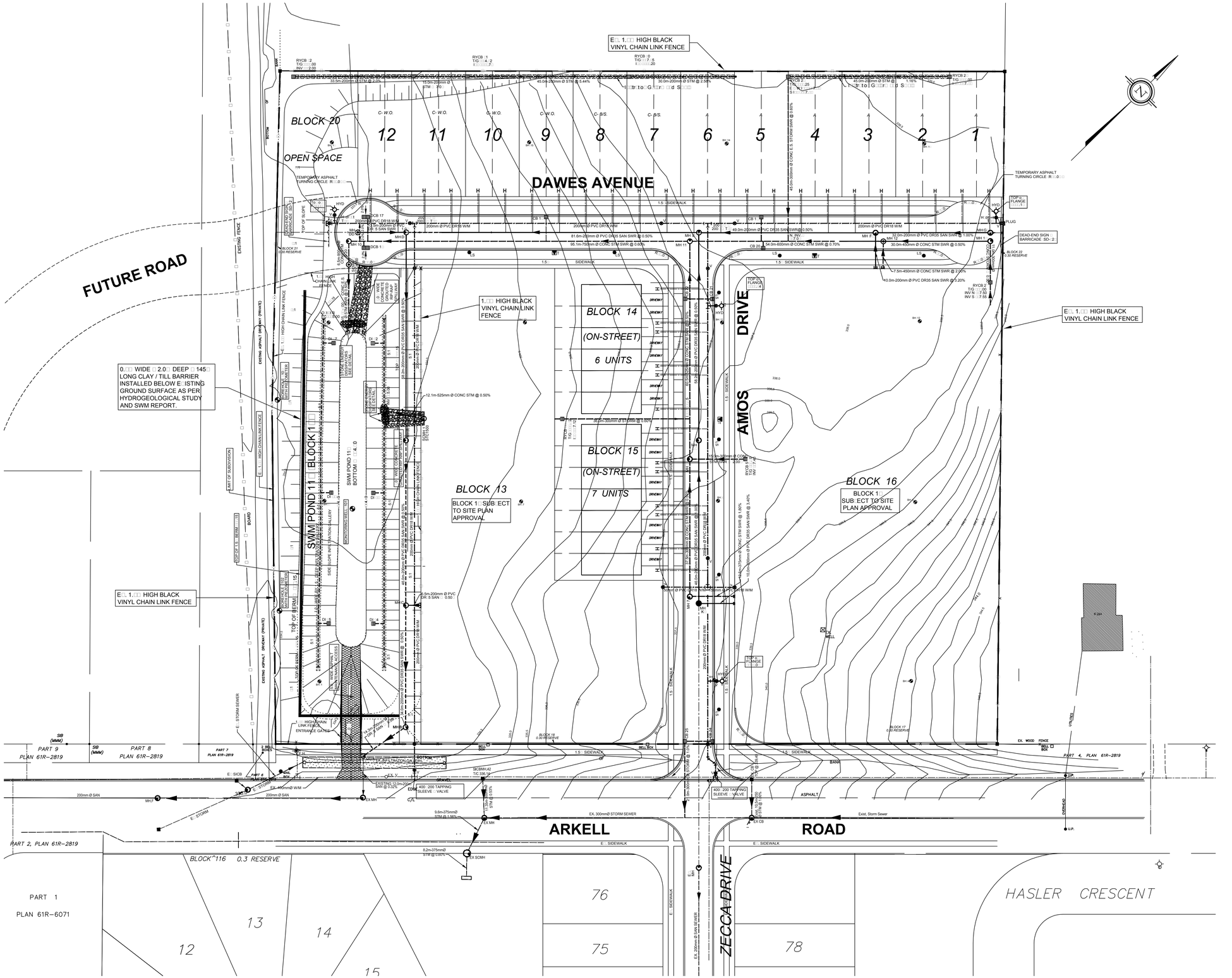
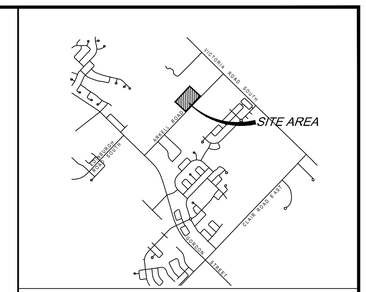




KEY PLAN Scale : NOT TO SCALE

LEGEND

- CB 1□ — CATCH BASIN
- WATERMAIN
- SANITARY SEWER
- STORM SEWER
- VALVE
- LIGHT STANDARD
- TRANSFORMER

THE POSITION OF POLES□LINES□CONDUITS□WATERMAINS□SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS□AND WHERE SHOWN□THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK□THE CONTRACTOR SHALL INFORM HIMSELF OF THE E□ACT LOCATION OF SUCH UTILITIES AND STRUCTURES□AND SHALL ASSUME ALL LIABILITY FROM DAMAGE TO THEM.

GENERAL NOTES:

FIELD NOTES: PLAN REFERENCES:

BENCH MARK: No. □□2 ELEVATION: □□□.245

PLAN REFERENCES: TRAFFIC CONTROL BO□ PAD SW CORNER OF ARKELL AND VICTORIA RD.

No.	DATE	DESCRIPTION	INTL
□	2□/04/14	GENERAL REVISIONS	K□B
5	15/11/1□	MHS C□□F□□2□7□□K RELOCATED	K□B
4	15/07/1□	ISSUED FOR TENDER	K□B
□	0□/0□/1□	GENERAL REVISIONS	K□B
2	2□/04/1□	GENERAL REVISIONS	K□B
1	12/02/1□	GENERAL REVISIONS	K□B

SCHEDULE OF REVISIONS

CITY OF Guelph
Making a Difference

ENGINEERING SERVICES

ARKELL MEADOWS SUBDIVISION GUELPH, ONTARIO

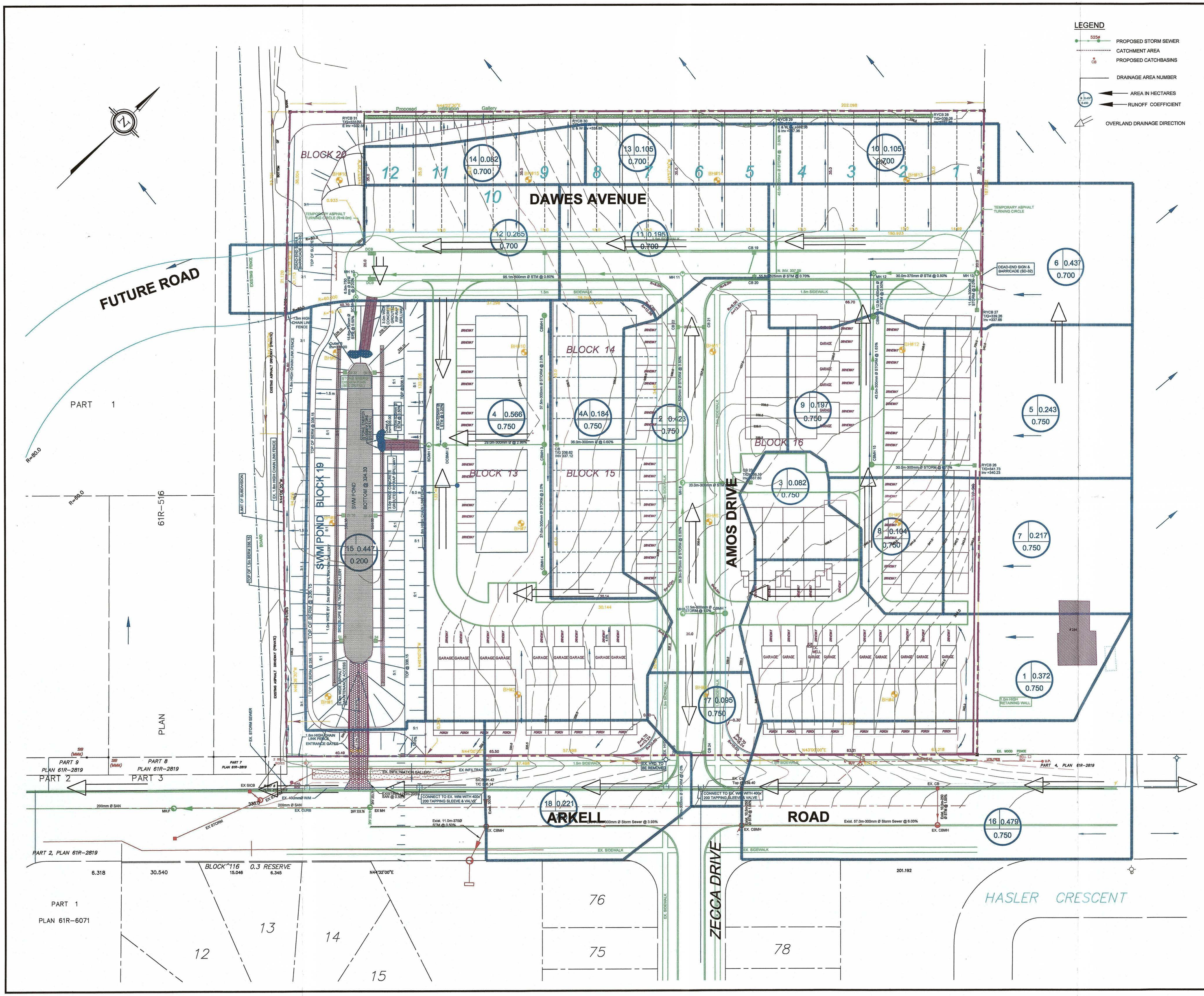
GENERAL SERVICING PLAN

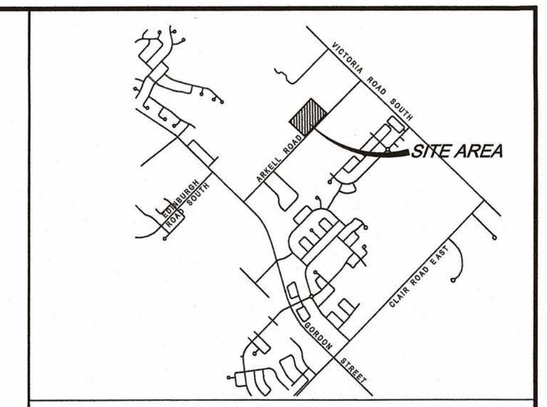
REGISTERED PROFESSIONAL ENGINEER K. J. BEHM 01/05/14 PROVINCE OF ONTARIO

CHECKED: APPROVED:

K. □ BEHM AND ASSOCIATES INC.
CONSULTING ENGINEERS
55 ERB STREET EAST□SUITE □20
WATERLOO□ONTARIO N2□4K□
PHONE □51□742□510 FA□□51□742□4□2

DESIGNED BY: K□B	SCALES Hor.□1:500 V□rt.□1:50	DRAWING. NO.
DRAWN BY: SMS	DATE DRAWN: SEPT 200□	H-1
CHECKED BY: K□B	CONTRACT NO.□ 2-1□□11	





KEY PLAN Scale : NOT TO SCALE

NOTES:

GENERAL NOTES

1. All work to be done in accordance with the standards and specifications of the City of Guelph and the Ontario Provincial standards except where noted.
2. The Contractor shall notify the City of Guelph and the Engineer at least 48 hours prior to commencing construction.
3. All concrete to be 30 MPa in 28 days with 6 +/-1% air entrainment unless otherwise stated.
4. All sewer pipe & watermains to be as per standard Class 'B' bedding (OPSD 802.01 & 802.030).
5. All structures shall allow for an adjustment of between 150-300mm with mini-loc.
6. All manholes shall be as per OPSD 701.010 backfilled with Granular 'B' (100% SPD minimum).
7. All service connections shall be as per City if Guelph SD-65.

SANITARY SEWER SYSTEMS

1. Sanitary sewers shall be 200mm dia. PVC SDR-35 meeting the current ASTM D3034 specifications and CSA 182.2 .
2. Sanitary services shall be 100mm dia. PVC SDR-28 meeting current CSA B182.2 specifications. Service connections shall be to a minimum grade of 2.0%. All connections to new mains shall have manufactured tees. All new connections to existing mains shall use stainless steel straps & saddles.
3. All sanitary stubs including services shall have a wooden 2" x 4" marker painted green.

STORM SEWER SYSTEMS

1. Storm sewers 450mm dia. and less shall be either concrete E.S.(CSA A.257.2) or PVC Ultra-Rib (CSA B.182.4) or PVC SDR-35 (CSA B.182.2. Storm sewers larger than 450mm dia. shall be reinforced concrete. All Rear Yard Catch Basin leads shall be E.S. concrete..
2. Storm Services shall be 125mm dia. PVC SDR-28 meeting the current CSA B.182.2 specifications. Service connections shall be to a minimum grade of 2.0%. All connections to new mains shall be prefabricated manufactured tees or Kor-N Tees.
3. All catch basin leads shall be PVC SDR-35 (250mm dia.-singles & 300mm dia.-paired & doubles)

WATERMAIN SYSTEMS

1. Watermains shall be 150mm dia. C900 PVC Class 1500 as per OPSD 802.010.
2. Water services shall be 25mm dia. Type "K" Soft Copper Tubing meeting ASTM B88 specifications.
3. Watermains shall have a minimum cover of 2.0 vertical metres and vertical separation with other services of 0.50 metres and horizontal separation of 2.5 metres.
4. Water valves shall be located on property line as per City of Guelph SD-54B.
5. All water stubs including services shall have a wooden 2" x 4" marker painted blue.

ROADWORKS & SWM POND/EMERGENCY ACCESS

1. Road cross sections shall be as per drawing D-1.
2. Concrete curb and gutter shall be OPSD 600.040.
3. Curb radii at intersections shall be 9.0m to face of curb (minimum).
4. Driveway access shall be as per SD-47.
5. Boulevard Landscaping shall be with 125mm of Topsoil and No.1 Nursery Sod.
6. Pavement Design for all roads shall be:
   - 350mm Granular 'B' Road Base
   - 175mm Granular 'A' Road Base
   - 50mm HL-8 Binder Asphalt
   - 40mm HL-3 Surface Asphalt
7. Driveways shall be:
   - 150mm Granular 'B' Road Base
   - 150mm Granular 'A' Road Base
   - 50mm HL-3C Binder Asphalt

LEGEND: FOR BORE HOLES

BH#13 ❶
GROUND=338.60
0.0 TOPSOIL to 0.20m 338.50 to 338.30
0.2 SILT to 0.60m 338.30 to 337.90
0.6 SAND to 6.5m 337.90 to 333.00
6.5

THE POSITION OF POLES, LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FROM DAMAGE TO THEM.

GENERAL NOTES:

FIELD NOTES:

PLAN REFERENCES:

BENCH MARK: No. 392 ELEVATION: 336.245

PLAN REFERENCES: TRAFFIC CONTROL BOX PAD SW CORNER OF ARKELL AND VICTORIA RD.

No.	DATE	DESCRIPTION	INTL
3	12/02/13	GENERAL REVISIONS	KJB
2	15/12/12	GENERAL REVISIONS	KJB
1	03/01/12	GENERAL REVISIONS	KJB

SCHEDULE OF REVISIONS

CITY OF Guelph
Making a Difference
ENGINEERING SERVICES

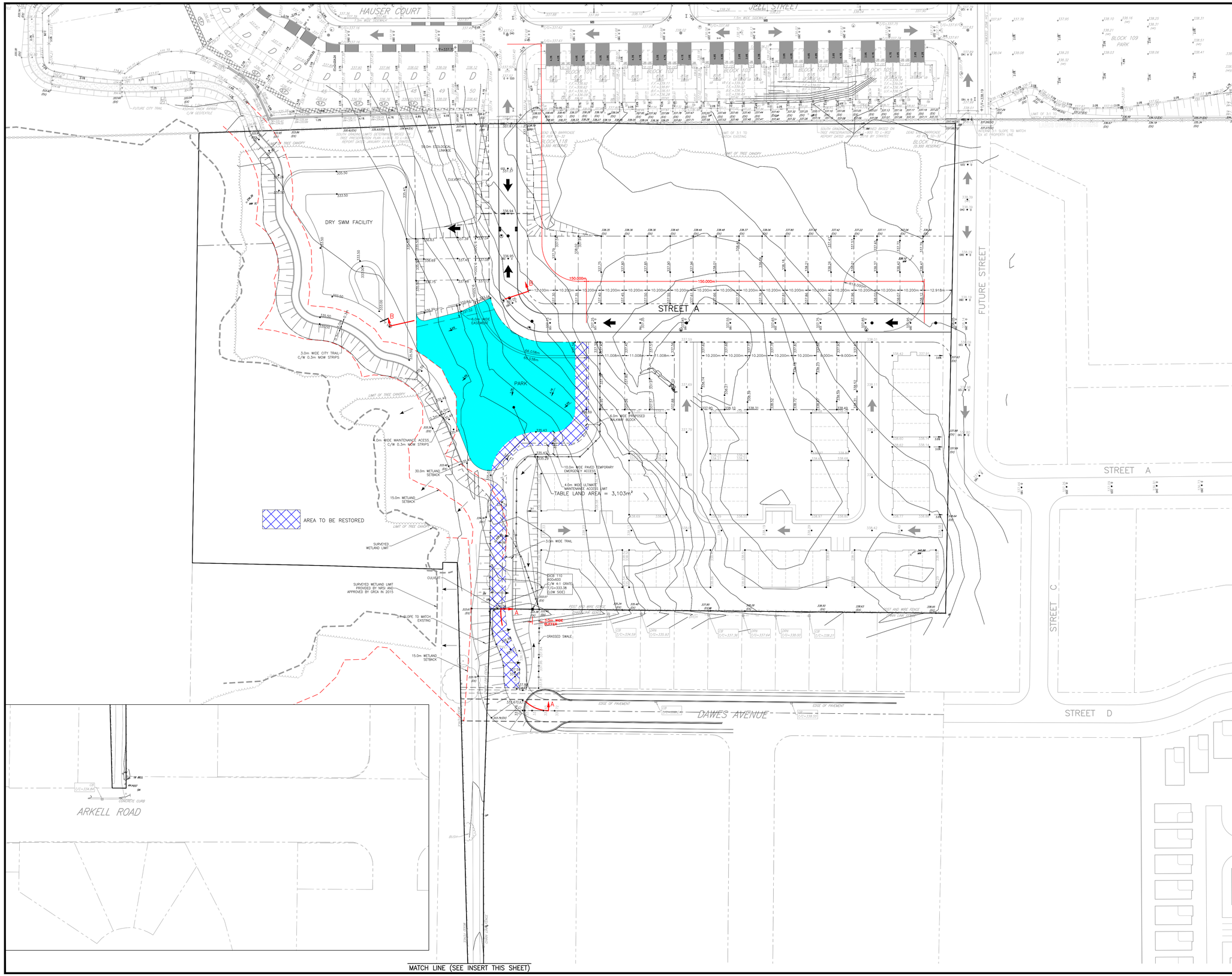
ARKELL MEADOWS SUBDIVISION GUELPH, ONTARIO

POST DEVELOPMENT PLAN

CHECKED: APPROVED:

K. J. BEHM AND ASSOCIATES INC.
CONSULTING ENGINEERS
55 ERB STREET EAST, SUITE 320
WATERLOO, ONTARIO N2J 4K8
PHONE (519) 742 3510 FAX (519) 742 3462

DESIGNED BY: KJB	SCALES Hor.=1:500 Vert.=1:50	DRAWING. NO.	
DRAWN BY: SMS	DATE DRAWN: SEPT 2009	PD-1	
CHECKED BY: KJB	CONTRACT NO.:		



North:

LEGEND:

- PHASE LIMIT
- 352.92 ORIGINAL GROUND ELEVATION
- 352.92 PROPOSED ELEVATION
- 351.91 EXISTING ELEVATIONS
- 352.92 FUTURE PROPOSED ELEVATION
- 2.0% 2.0% FLOW DIRECTION
- 349.00 ORIGINAL GROUND CONTOUR
- PROPOSED STORM MANHOLE
- PROPOSED STORM CATCHBASIN MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED DOUBLE CATCHBASIN
- PROPOSED SANITARY MANHOLE
- PROPOSED VALVE & BOX
- PROPOSED HYDRANT
- EXISTING INTERIM SLOPE (3:1 UNLESS NOTED OTHERWISE)
- PROPOSED SLOPE (3:1 UNLESS NOTED OTHERWISE)
- OVERLAND FLOW DIRECTION
- FUTURE OVERLAND FLOW DIRECTION
- SURFACE FLOW DIRECTION
- BH GWE BORE HOLE GROUND WATER LEVEL

ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.

PIPE SIZES ARE IN MILLIMETRES.

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them. Drawings shall not be used for construction unless sealed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

GENERAL NOTES:

1. BENCHMARK: GUELPH BENCHMARK #91. #493 VICTORIA ROAD NORTH ELEVATION=351.060m
2. LEGAL INFORMATION TAKEN FROM BLACK, SHOEMAKER, ROBINSON & DONALDSON INC. PROJECT #02-4541-3 DATED FEBRUARY 11, 2003.
3. TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED MAY 2000. ADDITIONAL TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED JUNE 2002

SCHEDULE OF REVISIONS

CITY OF Guelph
Making a Difference

ENGINEERING SERVICES

CONCEPTUAL GRADING PLAN

220 ARKELL SUBDIVISION

DESIGNED BY:	APPROVED BY:

Stantec
300 Hagey Blvd., Suite 100, Waterloo, ON, N2L 0A4
Tel. 519.579.4410 www.stantec.com

SCALES: 1:750	CHECKED BY: KRB
DATE DRAWN: OCTOBER 20 / 17	CONTRACT No. X-XXXX
DRAWN BY: MHH	DRAWING No. C-400

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Monthly Water Balance Analysis
161413338 - 220 Arkell Road - Interim Access Road Analysis
Pre-Development Conditions - KJ Behm, 2010 Analysis

Land Cover Descriptions
Pasture and grasses Silt/Sand loam Hilly

Main Site Area (ha)	4.3			
Impervious				
Land Description Factors			**Impervious**	**Perm. Pool**
Topography	0.10		-	-
Soils	0.30		-	-
Cover	0.15		-	-
Sum (Infiltration Factor)	0.55		-	-
Soil Moisture Capacity (mm)	250		-	-
Site Area	4.30		0.00	0
Percentage of Total Site Area	100%		0%	0%

100% OK

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from Waterloo-Wellington Station - Climate Normals from 1966-1990)														
Average Daily Temperature (°C)	-7.3	-6.8	-1.5	5.8	12.5	17.0	19.9	18.7	14.3	8.0	2.5	-4.0		Daily average temperature in each month
Precipitation (mm)	54.3	55.6	72.7	72.6	76.3	79.5	90.4	93.3	89.6	70.4	83.1	79.2	**917.0**	
Evapotranspiration Analysis														
PET (Thornthwaite, 1948) (mm/month)	0.0	0.0	0.0	30.2	75.1	104.7	124.1	107.7	70.8	35.6	9.1	0.0	**557.3**	Expected ET for 917 mm of annual rainfall per unit area of pervious area (zero impervious coverage)
Precipitation - PET (mm)	54.3	55.6	72.7	42.4	1.2	-25.2	-33.7	-14.4	18.8	34.8	74.0	79.2		
Accumulated Water Loss (mm)						-25.20	-58.90	-73.30						
Moisture Retention (mm)	250.0	250.0	250.0	250.0	250.0	226.0	196.0	186.0	204.8	239.6	250.0	250.0		From Table 30 of Thornthwaite and Mather, Instructions and Tables for Computing PET and the Water Balance (1957)
Change in Soil Moisture (mm)	0.0	0.0	0.0	0.0	0.0	-24.0	-30.0	-10.0	18.8	34.8	10.4	0.0		
Actual Evapotranspiration (mm)	**0.0**	**0.0**	**0.0**	**30.2**	**75.1**	**103.5**	**120.4**	**103.3**	**70.8**	**35.6**	**9.1**	**0.0**	**548.0**	

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Precipitation	2,335	2,391	3,126	3,122	3,281	3,419	3,887	4,012	3,853	3,027	3,573	3,406	**39,431**	**917 mm/year**
Evapotranspiration[1]	0	0	0	1,299	3,229	4,451	5,177	4,442	3,044	1,531	391	0	**23,564**	**548 mm/year**
Pervious Runoff	0	0	0	5,886	23	-464	-581	-194	364	673	1,432	0	7,140	166 mm/year
Impervious Runoff	0	0	0	0	0	0	0	0	0	0	0	0	0	0 mm/year
Total Runoff	0	0	0	5,886	23	-464	-581	-194	364	673	1,432	0	**7,140**	**166 mm/year**
Groundwater Recharge	0	0	0	7,194	28	-568	-710	-237	445	823	1,750	0	**8,727**	**203 mm/year**
Recharge/Runoff Analysis														
Surplus/Deficit	54.3	55.6	72.7	42.4	1.2	-24.0	-30.0	-10.0	18.8	34.8	74.0	79.2	**369.0**	
Weighted Infiltration Factor	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		Based on MOE SWM Manual (2003)
Runoff (mm)	**0.0**	**0.0**	**0.0**	**136.9**	**0.5**	**-10.8**	**-13.5**	**-4.5**	**8.5**	**15.7**	**33.3**	**0.0**	**166.1**	Assume no runoff in sub-zero months
Recharge (mm)	**0.0**	**0.0**	**0.0**	**167.3**	**0.7**	**-13.2**	**-16.5**	**-5.5**	**10.3**	**19.1**	**40.7**	**0.0**	**203.0**	
Recharge (mm)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Dead-End Drainage Area[2]	***Split total runoff from site into ET, recharge, runoff due to 'dead-end drainage' feature***													
Adjusted Runoff (10% of runoff)	0	0	0	589	2	-46	-58	-19	36	67	143	0	**714**	**17 mm/year**
Adjusted Recharge (60% of runoff)	0	0	0	10,638	42	-839	-1,049	-350	657	1,217	2,588	0	**12,904**	**300 mm/year**
Adjusted ET (30% of runoff)	0	0	0	3,153	3,237	4,304	4,994	4,381	3,159	1,743	842	0	**25,813**	**600 mm/year**

Monthly Water Balance Analysis
161413338 - 220 Arkell Road - Interim Access Road Analysis
Current Conditions - KJ Behm, 2010 Analysis

Land Cover Descriptions
Pasture and grasses | Silt/Sand loam | Hilly

Main Site Area (ha)	3.5	See notes				
Impervious Cover	50%	See notes				
Land Description Factors			**Impervious**	**Perm. Pool**		
Topography	0.10		-	-		
Soils	0.30		-	-		
Cover	0.15		-	-		
Sum (Infiltration Factor)	0.55		-	-		
Soil Moisture Capacity (mm)	50		-	-		
Site Area	1.75		1.75	0.00		
Percentage of Total Site Area[2]	50%		50%	0%	**100%**	**OK**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from Waterloo-Wellington Station - Climate Normals from 1966-1990)														
Average Daily Temperature (°C)	-7.3	-6.8	-1.5	5.8	12.5	17.0	19.9	18.7	14.3	8.0	2.5	-4.0		Daily average temperature in each month
Precipitation (mm)	54.3	55.6	72.7	72.6	76.3	79.5	90.4	93.3	89.6	70.4	83.1	79.2	**917.0**	
Evapotranspiration Analysis														
PET (Thornthwaite, 1948) (mm/month)	0.00	0.00	0.00	30.20	75.10	104.70	124.10	107.70	70.80	35.60	9.10	0.00	**557.3**	Expected ET for 917 mm of annual rainfall per unit area of pervious area (zero impervious coverage)
Precipitation - PET (mm)	54.3	55.6	72.7	42.4	1.2	-25.2	-33.7	-14.4	18.8	34.8	74.0	79.2		
Accumulated Water Loss (mm)						-25.2	-58.9	-73.3						
Moisture Retention (mm)	250.0	250.0	250.0	250.0	250.0	226.0	196.0	186.0	204.8	239.6	250.0	250.0		From Table 30 of Thornthwaite and Mather, Instructions and Tables for Computing PET and the Water Balance (1957)
Change in Soil Moisture (mm)	0.0	0.0	0.0	0.0	0.0	-24.0	-30.0	-10.0	18.8	34.8	10.4	0.0		
Actual Evapotranspiration (mm)	**0.0**	**0.0**	**0.0**	**30.2**	**75.1**	**103.5**	**120.4**	**103.3**	**70.8**	**35.6**	**9.1**	**0.0**	**548.0**	

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Precipitation	1,901	1,946	2,545	2,541	2,671	2,783	3,164	3,266	3,136	2,464	2,909	2,772	**32,095**	**917 mm/year**
Pervious Evapotranspiration	0	0	0	529	1,314	1,811	2,107	1,808	1,239	623	159	0	9,590	548 mm/year
Pervious Runoff	0	0	0	2,396	9	-189	-236	-79	148	274	583	0	2,906	166 mm/year
Impervious Runoff	0	0	0	5,852	1,335	1,391	1,582	1,633	1,568	1,232	1,454	0	16,048	917 mm/year
Pervious Groundwater Recharge	0	0	0	2,928	12	-231	-289	-96	181	335	712	0	**3,552**	**203 mm/year**
Pervious Runoff to Pond	***Split total runoff from pervious areas into ET, recharge, runoff due to pond retention***													
Adjusted Runoff (5% of runoff)	0	0	0	120	0	-9	-12	-4	7	14	29	0	**145**	**8 mm/year**
Adjusted Recharge (75% of runoff)	0	0	0	1,797	7	-142	-177	-59	111	206	437	0	**2,179**	**125 mm/year**
Adjusted ET (20% of runoff)	0	0	0	479	2	-38	-47	-16	30	55	117	0	**581**	**33 mm/year**
Impervious Runoff to Pond	***Split total runoff from pervious areas into ET, recharge, runoff due to pond retention***													
Adjusted Runoff (90% of runoff)	0	0	0	5,267	1,202	1,252	1,424	1,469	1,411	1,109	1,309	0	**14,443**	**825 mm/year**
Adjusted ET (10% of runoff)	0	0	0	585	134	139	158	163	157	123	145	0	**1,605**	**92 mm/year**
Recharge/Runoff Analysis														
Surplus/Deficit	54.3	55.6	72.7	42.4	1.2	-24.0	-30.0	-10.0	18.8	34.8	74.0	79.2	**369.0**	
Weighted Infiltration Factor	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		Based on MOE SWM Manual (2003)
Runoff (mm)	**0.0**	**0.0**	**0.0**	**136.9**	**0.5**	**-10.8**	**-13.5**	**-4.5**	**8.5**	**15.7**	**33.3**	**0.0**	**166.1**	Assume no runoff in sub-zero months
Recharge (mm)	**0.0**	**0.0**	**0.0**	**167.3**	**0.7**	**-13.2**	**-16.5**	**-5.5**	**10.3**	**19.1**	**40.7**	**0.0**	**203.0**	

Infiltration Augmentation														
Pond Recharge (75% of runoff)	0	0	0	3,950	901	939	1,068	1,102	1,058	832	982	0	10,832	619 mm/year
Pond ET (20% of runoff)	0	0	0	1,053	240	250	285	294	282	222	262	0	2,889	165 mm/year
Pond Runoff (5% of runoff)	0	0	0	263	60	63	71	73	71	55	65	0	722	41 mm/year
Final Recharge	**0**	**0**	**0**	**8,675**	**920**	**566**	**602**	**947**	**1,350**	**1,372**	**2,131**	**0**	**16,563**	**473 mm/year**
Final Runoff	**0**	**0**	**0**	**383**	**61**	**53**	**59**	**70**	**78**	**69**	**95**	**0**	**867**	**25 mm/year**
Final ET	**0**	**0**	**0**	**2,646**	**1,690**	**2,163**	**2,503**	**2,249**	**1,708**	**1,023**	**683**	**0**	**14,664**	**419 mm/year**

Notes:
Site area is 3.5 ha in KJ Behm post-development analysis as it does not include the SWM facility area
Impervious coverage assumed to be 50% based on KJ Behm analysis
Existing and current conditions water balances recreated using water balance spreadsheet from Arkell Meadows Final Stormwater Management and Servicing Report (KJ Behm, 2010)
Moisture retention from Table 30 of Thornthwaite and Mather: Instructions and Tables for Computing PET and the Water Balance (1957)

Monthly Water Balance Analysis
161413338 - 220 Arkell Road Interim
Proposed Conditions

Land Cover Descriptions
Pasture and grasses | Silt/Sand loam | Hilly

Main Site Area (ha)	3.5	See notes
Impervious Cover	51%	See notes

Land Description Factors			**Impervious**	**Perm. Pool**
Topography	0.10		-	-
Soils	0.30		-	-
Cover	0.15		-	-
Sum (Infiltration Factor)	0.55		-	-
Soil Moisture Capacity (mm)	50		-	-
Site Area	1.72		1.79	0.00
Percentage of Total Site Area	49%		51%	0%

100% **OK**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from Waterloo-Wellington Station - Climate Normals from 1966-1990)														
Average Daily Temperature (°C)	-7.3	-6.8	-1.5	5.8	12.5	17.0	19.9	18.7	14.3	8.0	2.5	-4.0		Daily average temperature in each month
Precipitation (mm)	54.3	55.6	72.7	72.6	76.3	79.5	90.4	93.3	89.6	70.4	83.1	79.2	**917.0**	
Evapotranspiration Analysis														
PET (Thornthwaite, 1948) (mm/month)	0.0	0.0	0.0	30.2	75.1	104.7	124.1	107.7	70.8	35.6	9.1	0.0	**557.3**	Expected ET for 917 mm of annual rainfall per unit area of pervious area (zero impervious coverage)
Precipitation - PET (mm)	54.3	55.6	72.7	42.4	1.2	-25.2	-33.7	-14.4	18.8	34.8	74.0	79.2		
Accumulated Water Loss (mm)						-25.2	-58.9	-73.3						
Moisture Retention (mm)	250.0	250.0	250.0	250.0	250.0	226.0	196.0	186.0	204.8	239.6	250.0	250.0		From Table 30 of Thornthwaite and Mather, Instructions and Tables for Computing PET and the Water Balance (1957)
Change in Soil Moisture (mm)	0.0	0.0	0.0	0.0	0.0	-24.0	-30.0	-10.0	18.8	34.8	10.4	0.0		
Actual Evapotranspiration (mm)	**0.0**	**0.0**	**0.0**	**30.2**	**75.1**	**103.5**	**120.4**	**103.3**	**70.8**	**35.6**	**9.1**	**0.0**	**548.0**	

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Precipitation	1,901	1,946	2,545	2,541	2,671	2,783	3,164	3,266	3,136	2,464	2,909	2,772	**32,095**	**917 mm/year**
Pervious Evapotranspiration	0	0	0	518	1,288	1,775	2,065	1,772	1,214	611	156	0	9,398	548 mm/year
Pervious Runoff	0	0	0	2,348	9	-185	-232	-77	145	269	571	0	2,848	166 mm/year
Impervious Runoff	0	0	0	5,969	1,362	1,419	1,614	1,665	1,599	1,257	1,483	0	16,368	917 mm/year
Pervious Groundwater Recharge	0	0	0	2,869	11	-226	-283	-94	177	328	698	0	**3,481**	**203 mm/year**
Pervious Runoff to Pond	***Split total runoff from pervious areas into ET, recharge, runoff due to pond retention***													
Adjusted Runoff (5% of runoff)	0	0	0	117	0	-9	-12	-4	7	13	29	0	**142**	**8 mm/year**
Adjusted Recharge (75% of runoff)	0	0	0	1,761	7	-139	-174	-58	109	201	428	0	**2,136**	**125 mm/year**
Adjusted ET (20% of runoff)	0	0	0	470	2	-37	-46	-15	29	54	114	0	**570**	**33 mm/year**
Impervious Runoff to Pond	***Split total runoff from pervious areas into ET, recharge, runoff due to pond retention***													
Adjusted Runoff (90% of runoff)	0	0	0	5,372	1,226	1,277	1,452	1,499	1,439	1,131	1,335	0	**14,732**	**825 mm/year**
Adjusted ET (10% of runoff)	0	0	0	597	136	142	161	167	160	126	148	0	**1,637**	**92 mm/year**
Recharge/Runoff Analysis														
Surplus/Deficit	54.3	55.6	72.7	42.4	1.2	-24.0	-30.0	-10.0	18.8	34.8	74.0	79.2	**369.0**	
Weighted Infiltration Factor	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		Based on MOE SWM Manual (2003)
Runoff (mm)	**0.0**	**0.0**	**0.0**	**136.9**	**0.5**	**-10.8**	**-13.5**	**-4.5**	**8.5**	**15.7**	**33.3**	**0.0**	**166.1**	Assume no runoff in sub-zero months
Recharge (mm)	**0.0**	**0.0**	**0.0**	**167.3**	**0.7**	**-13.2**	**-16.5**	**-5.5**	**10.3**	**19.1**	**40.7**	**0.0**	**203.0**	

Infiltration Augmentation														
Pond Recharge (75% of runoff)	0	0	0	4,029	919	958	1,089	1,124	1,080	848	1,001	0	11,049	619 mm/year
Pond ET (20% of runoff)	0	0	0	1,074	245	255	290	300	288	226	267	0	2,946	165 mm/year
Pond Runoff (5% of runoff)	0	0	0	269	61	64	73	75	72	57	67	0	737	41 mm/year
Final Recharge	**0**	**0**	**0**	**8,659**	**938**	**593**	**633**	**972**	**1,366**	**1,378**	**2,128**	**0**	**16,665**	**476 mm/year**
Final Runoff	**0**	**0**	**0**	**386**	**62**	**55**	**61**	**71**	**79**	**70**	**95**	**0**	**879**	**25 mm/year**
Final ET	**0**	**0**	**0**	**2,659**	**1,671**	**2,135**	**2,470**	**2,222**	**1,691**	**1,016**	**686**	**0**	**14,551**	**416 mm/year**

Notes:
Impervious coverage based on 400 sq. m of ermgency access road or approximately 50% of Block 20
Current water balance assumes 3.5 ha drainage area and ignores SWM facility area
Overall impervious coverage increases to 51% due to additional 400 sq. m of access road

```
00001>          Output File (4.7) ARK100.OUT   opened 2018-10-26  13:07
00002>          Units used are defined by G =    9.810
00003>              36   300     5.000        are MAXDT MAXHYD & DTMIN values
00004>          Licensee: Paragon Engineering Limited
00005>    35    COMMENT
00006>         6     line(s) of comment
00007>          **********************
00008>          161413338 - 220 Arkell
00009>          Proposed Conditions - SWM Modelling
00010>          100-yr, 3 hour storm event
00011>          Interim access road - T.Fraser (Oct 2018)
00012>          **********************
00013>     2    STORM
00014>              1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
00015>       4688.000     Coefficient  a
00016>         17.000     Constant  b    (min)
00017>           .962     Exponent  c
00018>           .400     Fraction to peak  r
00019>        180.000     Duration ó  180 min
00020>                   87.263 mm     Total depth
00021>     3    IMPERVIOUS
00022>              2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
00023>           .013     Manning "n"
00024>           .000     Max.Infiltn. mm/hr
00025>           .000     Min.Infiltn. mm/hr
00026>           .050     Lag const (hours)
00027>          1.500     Dep.Storage mm
00028>    35    COMMENT
00029>         3     line(s) of comment
00030>          ****************************************
00031>          CURRENT CONDITIONS (KJ Behm parameters)
00032>          ****************************************
00033>    35    COMMENT
00034>         4     line(s) of comment
00035>          ****************************************
00036>          Catchment 101 - check to match Behm results
00037>          Entire Site pre-development
00038>          ****************************************
00039>     4    CATCHMENT
00040>        101.000     ID No.ó 99999
00041>          4.309     Area in hectares
00042>        100.000     Length (PERV) metres
00043>          2.000     Gradient (%)
00044>           .000     Per cent Impervious
00045>        100.000     Length (IMPERV)
00046>           .000     %Imp. with Zero Dpth
00047>              2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
00048>           .250     Manning "n"
00049>        100.000     Max.Infiltn. mm/hr
00050>        100.000     Min.Infiltn. mm/hr
00051>           .250     Lag const (hours)
00052>          5.000     Dep.Storage mm
00053>              1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
00054>                 .297       .000       .000       .000 c.m/s
00055>                 .133       .000       .133     C perv/imperv/total
00056>    15    ADD RUNOFF
00057>                 .297       .297       .000       .000 c.m/s
00058>    14    START
00059>         1     1=Zero; 2=Define
00060>    35    COMMENT
00061>         3     line(s) of comment
00062>          ****************************************
00063>          Catchment 13 - Current Conditions (duplicate)
00064>          ****************************************
00065>     4    CATCHMENT
00066>        201.000     ID No.ó 99999
00067>           .350     Area in hectares
00068>         23.000     Length (PERV) metres
00069>          2.000     Gradient (%)
00070>         70.000     Per cent Impervious
00071>         23.000     Length (IMPERV)
00072>           .000     %Imp. with Zero Dpth
00073>              2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
00074>           .250     Manning "n"
00075>         75.000     Max.Infiltn. mm/hr
00076>         12.500     Min.Infiltn. mm/hr
00077>           .250     Lag const (hours)
00078>          5.000     Dep.Storage mm
00079>              1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
00080>                 .157       .000       .000       .000 c.m/s
00081>                 .514       .963       .828     C perv/imperv/total
00082>    15    ADD RUNOFF
00083>                 .157       .157       .000       .000 c.m/s
00084>    35    COMMENT
00085>         3     line(s) of comment
00086>          ****************************************
00087>          Infiltration Gallery - from Behm Design
00088>          ****************************************
00089>    10    POND
00090>         7 Depth - Discharge - Volume sets
00091>             .000        .000          .0
00092>             .001      .00300          .4
00093>             .200       .0400         8.6
00094>             .400       .0770        16.8
00095>             .600        .114        25.1
00096>             .800        .151        33.3
00097>            1.000        .188        43.4
00098>          Peak Outflow    =      .139 c.m/s
00099>          Maximum Depth   =      .735 metres
00100>          Maximum Storage =       31. c.m
00101>                 .157       .157       .139       .000 c.m/s
00102>    16    NEXT LINK
00103>                 .157       .139       .139       .000 c.m/s
00104>    14    START
00105>         1     1=Zero; 2=Define
00106>    35    COMMENT
00107>         4     line(s) of comment
00108>          ****************************************
00109>          Catchment 13 - Proposed Conditions
00110>          Block 20 with access road; 70% imp.
00111>          ****************************************
00112>     4    CATCHMENT
00113>        301.000     ID No.ó 99999
00114>           .350     Area in hectares
00115>         23.000     Length (PERV) metres
00116>          2.000     Gradient (%)
00117>         81.000     Per cent Impervious
00118>         23.000     Length (IMPERV)
00119>           .000     %Imp. with Zero Dpth
00120>              2     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
00121>           .250     Manning "n"
00122>         75.000     Max.Infiltn. mm/hr
00123>         12.500     Min.Infiltn. mm/hr
00124>           .250     Lag const (hours)
00125>          5.000     Dep.Storage mm
00126>              1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
00127>                 .175       .000       .139       .000 c.m/s
00128>                 .514       .963       .877     C perv/imperv/total
00129>    15    ADD RUNOFF
00130>                 .175       .175       .139       .000 c.m/s
00131>    35    COMMENT
00132>         3     line(s) of comment
00133>          ****************************************
00134>          Infiltration Gallery - from Behm Design
00135>          ****************************************
00136>    10    POND
00137>         7 Depth - Discharge - Volume sets
00138>             .000        .000          .0
00139>             .001      .00300          .4
00140>             .200       .0400         8.6
00141>             .400       .0770        16.8
00142>             .600        .114        25.1
00143>             .800        .151        33.3
00144>            1.000        .188        43.4
00145>          Peak Outflow    =      .148 c.m/s
00146>          Maximum Depth   =      .784 metres
00147>          Maximum Storage =       33. c.m
00148>                 .175       .175       .148       .000 c.m/s
00149>    16    NEXT LINK
00150>                 .175       .148       .148       .000 c.m/s
00151>    20    MANUAL
00152>
```