Dear Monika

RE: Proposed Settlement Boundary Expansion – Arkell and Residential Development (OP-2006-06, P10/2006, 23T-06003).

Please find attached the following documents in support of our proposed settlement boundary expansion and residential development of Arkell. As noted, applications for an Official Plan Amendment (OP-2006-06), Zoning By-law Amendment (P10/2006) and Draft Plan of Subdivision (23T-06003) were previously submitted in 2006.

We have reviewed the comments from the Township's peer review consultants and relevant government agencies. In response to these comments, the development has been revised as follows:

- The lot fabric has been reduced to 41 lots.
- The residential lots have been removed from the onsite plantation. This will reduce the number of trees that will need to be removed and provide a greater setback/buffer from the GJR.
- A secondary access to the north, onto Arkell Road, has been secured by the landowner.
- Options for future parkland along the southern portion of the site exist and the owners would welcome discussions with the Township Council and staff to determine if parklands are deemed essential to this development.

The supporting documents are as follows:

- Conceptual Site Plan (subject to comments from the Township and County, the Site Plan could be used as a basis to revise the Draft Plan of Subdivision).
- Stormwater Management and Functional Servicing Report (Crozier, 2025).
- Updated Traffic Impact Assessment (Crozier, 2025).
- Minimum Distance Separation I Analysis (SAI, 2025).
- Response from ARL (2025) to questions/comments raised from the 2024 submission.
- Water Balance Analysis (Crozier, 2025).
- Archaeological Assessment (LEC, 2024) and Ministry of Citizenship and Multiculturalism Clearance (2024).
- Breeding Bird Assessment (Colville, 2024).
- Additional Test Hole Data (Vander Doelen and Chung, 2024).

The engineering reports from Crozier, 2025 have relied upon recent topographic and legal surveys completed by Van Harten Surveying in 2024.

Previously, the following documents were submitted and these documents remain relevant to the proposal:

- Alternate Site Analysis (SAI, 2023).
- Consideration of Mineral Aggregate Policies (SAI, 2023).
- Water Supply Assessment (ARL, 2023).
- Nitrate Impact Assessment (Crozier, 2024).

In addition, the reporting submitted in 2006 remains relevant and to some extent, the recent studies have relied on these documents:

- Hydrogeological Assessment (RJB, 2006).
- Geotechnical Assessment (V.A. Wood, 2006).
- Traffic Impact Assessment (Richardson Foster Ltd., August 2006).
- Noise and Vibration Study (HGC Engineering, 2006).
- Draft Plan of Subdivision (Van Harten Surveying Inc., 2006).

As the Township and County already have copies of these documents, we have not included these in our submissions.

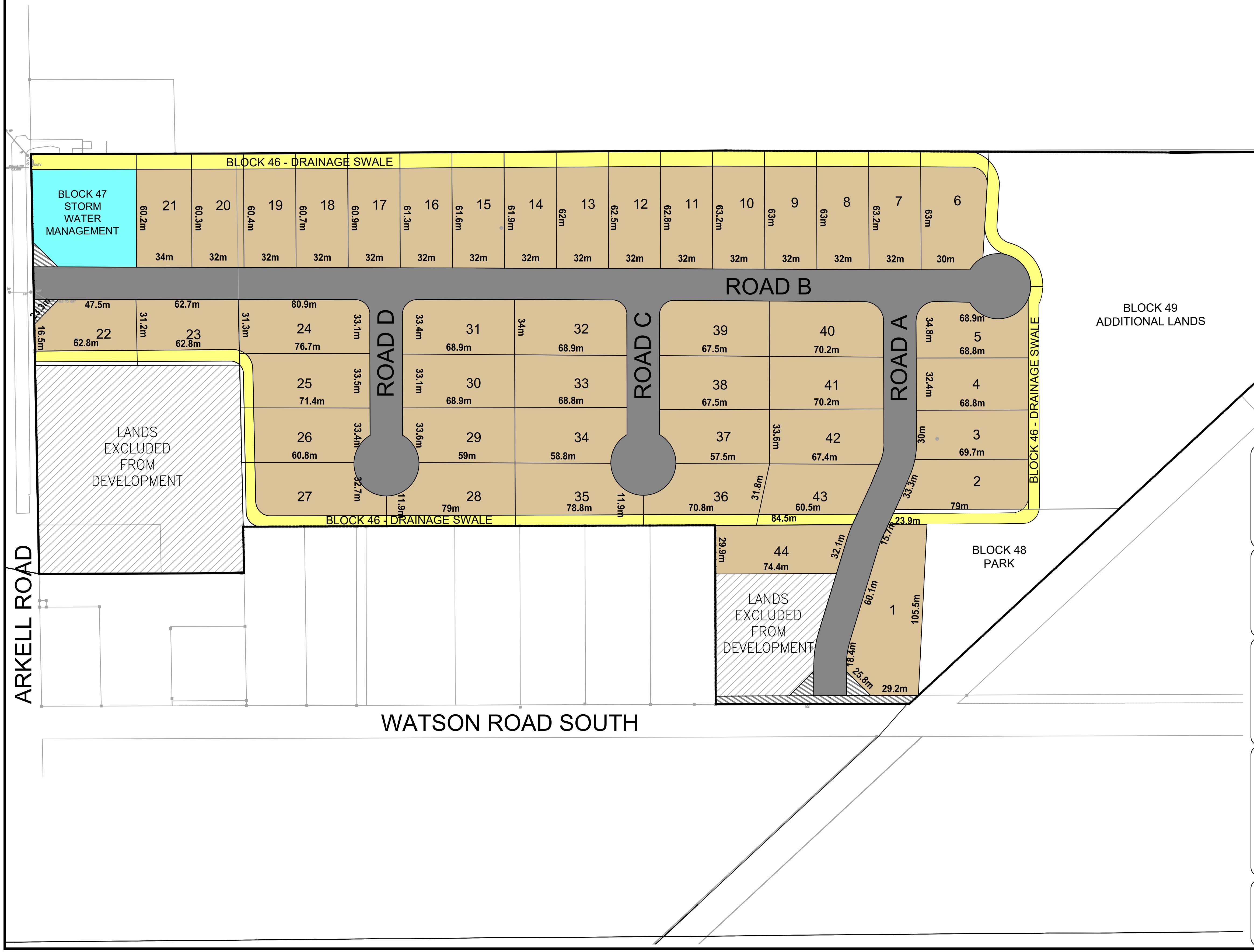
To assist in your review of the proposal, we have included a Matrix of Agency Comments and Responses from our study team. You will note that not all the studies that were requested by the agencies/consulting team were completed. The following items that will be addressed at a later stage in the process are as follows:

- Permit To Take Water for Dewatering – at this stage of the project, we do not think that a PTTW will be required.
- Environmental Compliance Approval (MECP) – we will determine the need for an ECA at the subdivision approvals stage.
- Entrance Permit (Township and County) – these permits will be requested at the subdivision approvals stage.
- Liquid Fuel Handling and Safety Report – to be addressed as a condition of approval.
- Tree Preservation and Maintenance Plan – to be addressed as a condition of approval.
- Well Decommissioning – to be addressed as a condition of approval.
- Excess Soil Management – to be addressed as a condition of approval.
- EIS will not be completed.
- Salt Management Plan – to be addressed as a condition of approval.
- Erosion and Sediment Control Plan – to be addressed as a condition.
- Updated Noise and Vibration Study – to be addressed as a condition.

- Planning Justification Report (and AIA) – to be completed once the technical reporting re: engineering has generally satisfied the Township that development is feasible.

We trust that this information is helpful. Should you have any concerns or questions, please do not hesitate to contact me.

Regards,



Lot No	Frontage (m)	Depth (m)	Area (ha)
1	94.2	44	0.39
2	33.3	79	0.23
3	30	69.7	0.21
4	32.4	68.8	0.21
5	34.8	68.8	0.21
6	37.9	63	0.24
7-20	32	63.2-60.3	0.2
21	34	60.2	0.21
22	47.5	31.2	0.19
23	62.7	31.2	0.19
24	33.1	76.7	0.26
25	33.5	71.4	0.24
26	33.4	60.8	0.23
27	32.7	60.8	0.23
28	32.5	79	0.22
29	33.6	59	0.22
30	33.1	68.9	0.23
31	33.4	68.9	0.23
32	34	68.9	0.22
33	32.5	68.8	0.22
34	33.9	58.8	0.22
35	32.5	78.8	0.22
36	32.5	70.8	0.2
37	33.6	57.5	0.22
38	32.5	67.5	0.22
39	34	67.5	0.23
40	34	70.2	0.24
41	32.5	70.2	0.23
42	33.6	67.4	0.24
43	33.5	60.5	0.2
44	32.1	74.4	0.24

Conceptual Plan

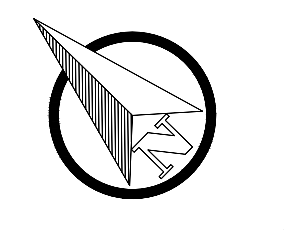
44 Lots

PART OF LOTS 7, 8, & 9, CONCESSION 10
ASSESSMENT ROLL NUMBER 23010000080348000000
ARKELL, ONTARIO

1. This is Not a Plan Of Survey.
2. Locations of Natural Features Have Been Extracted From The Government of Ontario: Land Information Ontario Open Data.
3. Distances Shown on This Plan Are Adjusted Ground Distances and Can Be Converted To Grid Distances by Multiplying by An Averaged Combined Scale Factor of 0.999636.
4. Coordinates on This Plan Are UTM, ZONE 17, NAD83 (CSRS-2010) Adjustment and Are Based on GPS Observations From a Network of Permanent GPS Reference Stations.

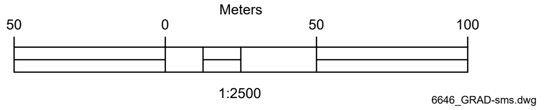
SAI
PLANNING. AGROLOGY. ENVIRONMENTAL.

Stovel and Associates Inc.
651 Orangeville Road,
Fergus ON
N1M 1T9
P: 519-766-8042
E: stovel.associates@outlook.com



DRAFT

July 29, 2025



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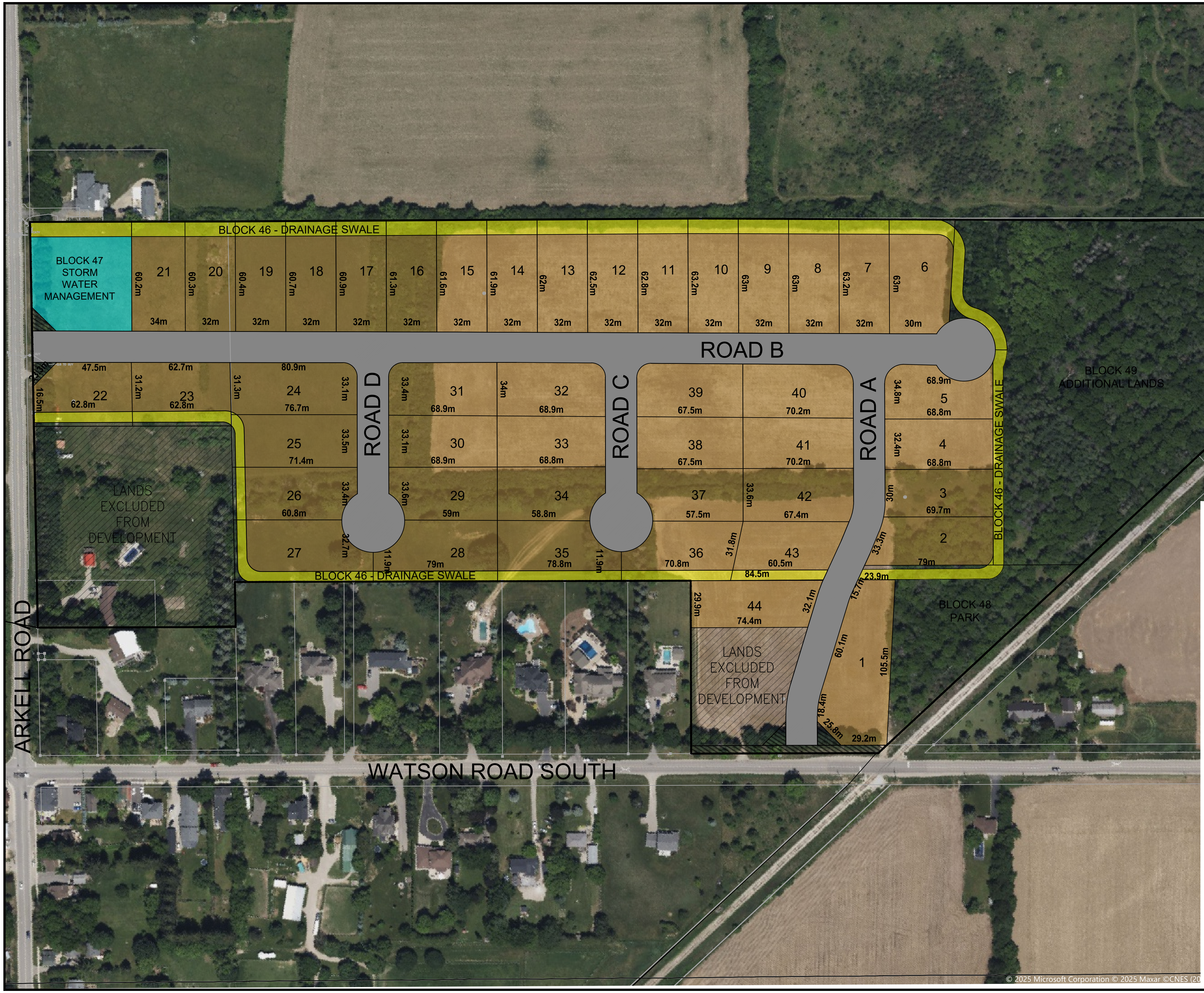

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5	34.8	68.8	0.21
6	37.9	63	0.24
7-20	32	63.2-60.3	0.2
21	34	60.2	0.21
22	47.5	31.2	0.19
23	62.7	31.2	0.19
24	33.1	76.7	0.26
25	33.5	71.4	0.24
26	33.4	60.8	0.23
27	32.7	60.8	0.23
28	32.5	79	0.22
29	33.6	59	0.22
30	33.1	68.9	0.23
31	33.4	68.9	0.23
32	34	68.9	0.22
33	32.5	68.8	0.22
34	33.9	58.8	0.22
35	32.5	78.8	0.22
36	32.5	70.8	0.2
37	33.6	57.5	0.22
38	32.5	67.5	0.22
39	34	67.5	0.23
40	34	70.2	0.24
41	32.5	70.2	0.23
42	33.6	67.4	0.24
43	33.5	60.5	0.2
44	32.1	74.4	0.24

Conceptual Plan

44 Lots

PART OF LOTS 7, 8, & 9, CONCESSION 10
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E: stovel.associates@outlook.com

DRAFT

July 29, 2025

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Stovel and Associates Inc.
Planners, Agrologists and Environmental Consultants

August 13, 2025

Township of Puslinch C/O Lynne Banks and Monika Farncombe
7404 Wellington Rd 34
Puslinch ON
N0B 2J0

RE: Minimum Distance Separation (MDS) Analysis
Part of Lots 7, 8, and 9
Concession 10
Township of Puslinch
County of Wellington

Stovel and Associates Inc. (SAI) was retained by Shawn Marsh of 1000286480 Ontario Inc. to conduct an analysis of the Minimum Distance Separation (MDS) requirements associated with a proposed settlement boundary expansion in Arkell, Township of Puslinch.

Proposals for new or expanded settlement area must be consistent with the Provincial Planning Statement, 2024 (PPS, 2024). Policy 2.3.2.1 e) sets out the requirement to comply with minimum distance separation formulae, as noted below:

> **2.3.2.1 (New Settlement Areas and Settlement Area Boundary Expansions)**
>
> "*In identifying a new settlement area or allowing a settlement area boundary expansion, planning authorities shall consider the following*:
>
> - *a) the need to designate and plan for additional land to accommodate an appropriate range and mix of land uses;*
> - *b) if there is sufficient capacity in existing or planned infrastructure and public service facilities;*
> - *c) whether the applicable lands comprise specialty crop areas;*
> - *d) the evaluation of alternative locations which avoid prime agricultural areas and, where avoidance is not possible, consider reasonable alternatives on lower priority agricultural lands in prime agricultural areas;*
> - *e) <u>whether the new or expanded settlement area complies with the minimum distance separation formulae;</u>*
> - *f) whether impacts on the agricultural system are avoided, or where avoidance is not possible, minimized and mitigated to the extent feasible as determined through an agricultural impact assessment or equivalent*

g) *analysis, based on provincial guidance; and the new or expanded settlement area provides for the phased progression of urban development.”*

Study Methods

To evaluate potential Minimum Distance Separation (MDS) implications for the proposed development, a reconnaissance-level survey of agricultural operations on lands adjacent to the proposed development was completed (Figure 1). Three livestock operations were identified in proximity to the site:

- Farm #1: 857 Watson Road S – existing hobby horse farm in the settlement of Arkell.
- Farm #2: 756 Watson Road S – existing, large horse farm north of Arkell.
- Farm #3: 930 Watson Road S – existing vacant building potentially capable of housing livestock (i.e. horses).

Farm Data Sheets were circulated to these properties. No replies were received.

Background data were reviewed. County Planning Report, May 9th, 2023 – D13/TON provides information related to Farm #3 for an unrelated, prior consent application (Report Attached – Appendix A).

The Minimum Distance Separation (MDS) Formulae - Publication 853

An MDS I assessment is required for settlement expansions into agricultural lands to ensure appropriate separation from livestock operations, prevent land use conflicts, and protect agricultural viability. The following guidelines were determined to be relevant:

Guideline 12 – Existing Non-Conforming Uses:

An MDS I setback is required for new development even if there are existing or approved developments that do not meet the MDS standard. The setback may be reduced if four or more non-agricultural or residential uses, or dwellings, are located closer to the livestock facility than the proposed development, provided they are:

- Located within the 120° intervening field of view,

- On separate lots, and

- Of equal or greater sensitivity (Type A or B usage).

Guideline 36 – Non-Application Within Settlement Areas:

> *MDS I setbacks are not required for proposed land use changes, including severances, rezonings, or redesignations, when they occur within approved settlement areas, as the long-term intent is typically non-agricultural*.

Findings

There are relatively few active livestock operations in proximity to the subject lands. The existing horse farm located at 857 Watson Road S (Operation #1) is within the Hamlet boundary for Arkell. As a result, Guideline 36 applies and no MDS I setback is required.

Operation #2 is an active horse farm north of the site, at 756 Watson Road S. This farm is approximately 570 metres from the site. Given the presence of more than four non-farm residences between this farm and the site, the calculated MDS I setback does not encroach into the subject lands as it would only extend to the fourth closest non-farm residence.

Operation #3 is a small, vacant building (potentially capable of housing horses) located at 930 Watson Road has a calculated MDS I setback of 176 metres (County Planning Report, May 9th, 2023 – D13/TON, see Appendix A). This setback extends 176 metres north of the barn and encroaches into the subject property by about 38.8 metres. The encroached area is not proposed for development and will not affect the project. Figure 2 illustrates the extent of the MDSI arc

No other MDS I setbacks apply to the proposed urban boundary expansion.

Conclusion

In accordance with OMAFRA's Publication 853, the proposed development will not result in any MDS I conflicts with agricultural operations. Based on this, the proposed settlement boundary expansion is consistent with PPS (2024) Policy 2.3.2.1 e). Should you have any concerns or questions, please do not hesitate to contact me.

Yours truly,

[redacted]

Robert P. Stovel, M.Sc., M.C.I.P., R.P.P., P. Ag.

[redacted]

Robert L. Stovel, B.Sc.

Figure 1 – Agricultural Operations Surrounding Site

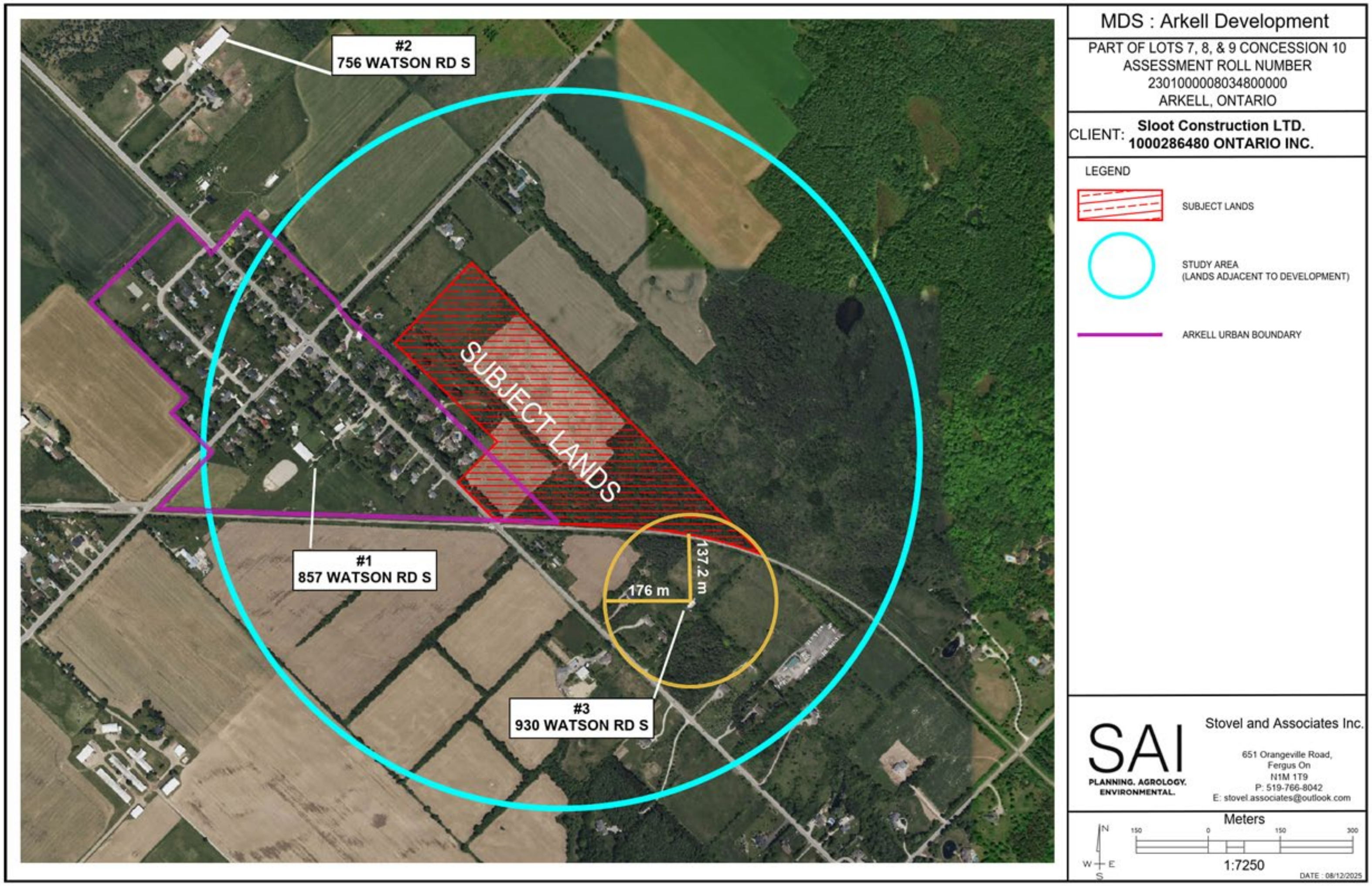
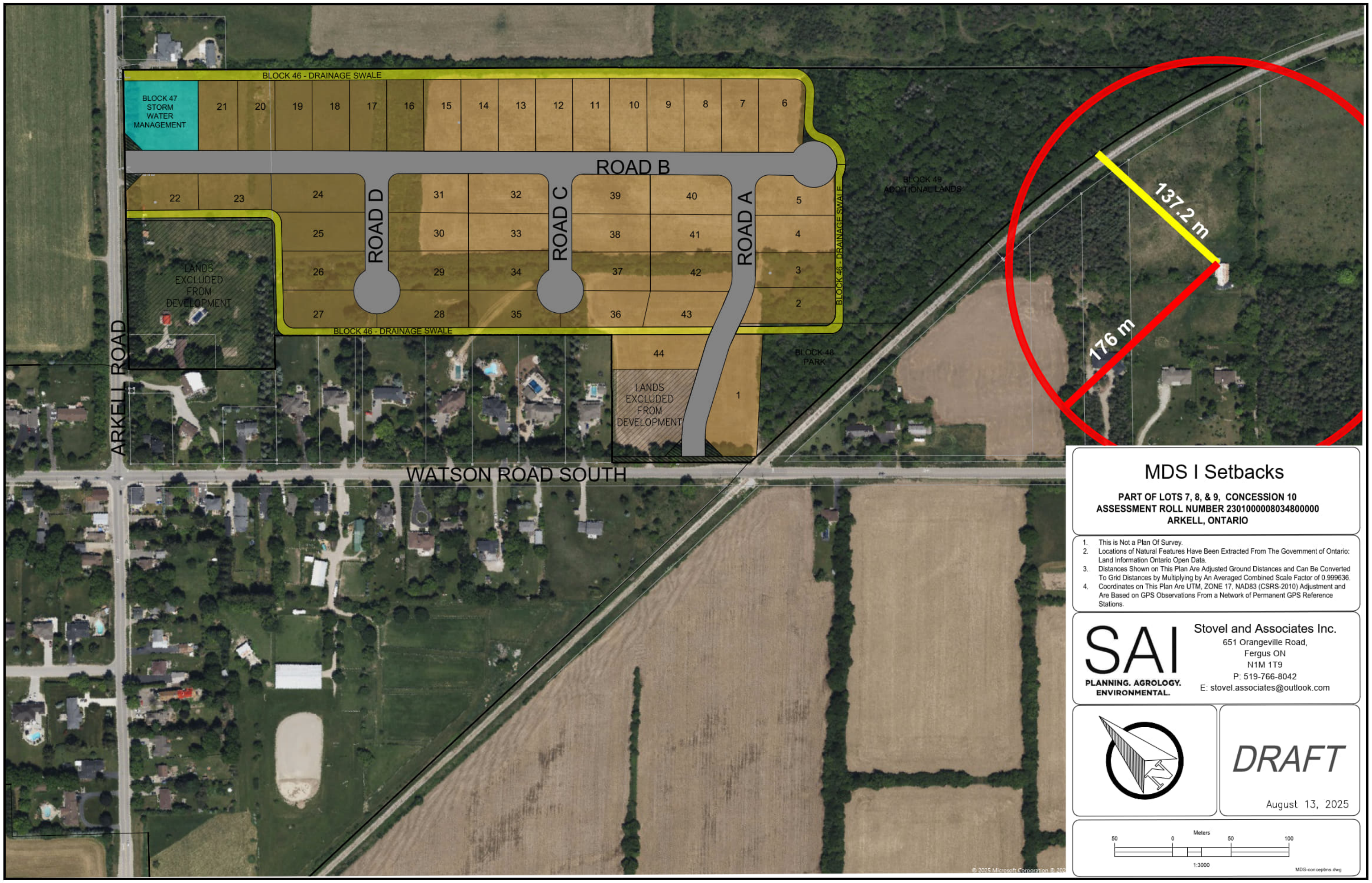


Figure 2: MDS Map



MDS I Setbacks

PART OF LOTS 7, 8, & 9, CONCESSION 10
ASSESSMENT ROLL NUMBER 2301000008034800000
ARKELL, ONTARIO

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August 13, 2025

Appendix A: County Planning Report

Appendix A

PLANNING REPORT
for the TOWNSHIP OF PUSLINCH

Prepared by the County of Wellington Planning and Development Department

MEETING DATE: May 9th, 2023
TO: Lynne Banks, Development and Legislative Coordinator
Township of Puslinch
FROM: Zach Prince, Senior Planner
County of Wellington
SUBJECT: **MINOR VARIANCE APPLICATION D13/TON (Tonin)**
Louis Tonin
900 Watson Rd S
Part Lots 8 and 9, Concession 10
SCHEDULES: **1 – Applicant's Sketch**

We have reviewed the application for minor variance and provide the following comments. These comments are offered without the benefit of a site visit.

Planning Opinion

The purpose of this application is for relief from Minimum Distance Separation Formula (MDS I) requirements to meet a condition of consent application B01/03 which was conditionally granted by the County of Wellington Land Division Committee in March 2023. The consent application would sever a 0.93 ha (2.29 ac) vacant parcel and a 1.97 ha (4.87 ac) lot with an existing dwelling and barn would be retained. As part of the related consent application, MDS I was reviewed by Planning staff and it was determined that relief would be required to the existing barns in the area. Due to the number of lots within the area, the proposal has been calculated as a Type B land use under Guideline #34.

With respects to the MDS relief, planning staff notes that the setback from the barn located on the retained lands is based on the farm data sheet provided on a neighbouring severance application indicating the capacity for 8 medium sized horses. The barn located at 935 Watson Rd S is based on the unoccupied barn requirements and similarily is being used in a recent consent application (B48/22). The barn located at 930 Watson Rd S is based on information provided by the owner that indicates there are 9 horse stalls in the building and is currently unoccupied. The surrounding area includes the adjacent Guelph Junction Rail Line, existing agricultural parcels and rural residential lots as seen in **Figure 1**.

This minor variance application would maintain the general intent and purpose of the Official Plan and Zoning By-law, and is desirable and appropriate for the development of the subject property. We consider the request minor and have no concerns with the application.

Section of the By-law	**Requirements**	**Proposed**	**Relief Requested**
Section 4.16.2 - General Provisions MDS II New or Expanding Livestock Facilities and Manure Storage facilities. **935 Watson Road S**	305 m (1,000 ft)	105 m (344 ft)	200 m (656 ft)
Section 4.16.2 - General Provisions MDS II New or Expanding Livestock Facilities and Manure Storage facilities. **930 Watson Road S**	176 m (577 ft)	115 m (377 ft)	61 m (200 ft)
Section 4.16.2 - General Provisions MDS II New or Expanding Livestock Facilities and Manure Storage facilities. **900 Watson Road S**	173 m (567 ft)	85 m (279 ft)	88 m (288 ft)

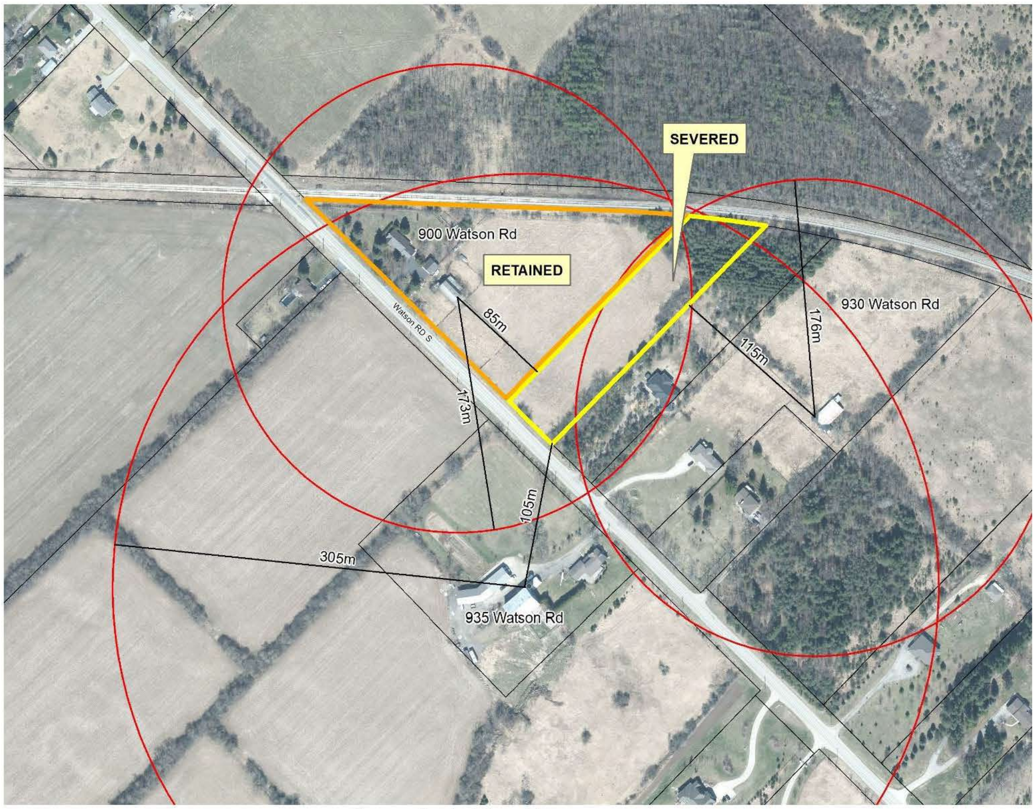


Figure 1 - Subject Property

Our discussion of this application relative to the four tests under the Planning Act is as follows:

Four Tests	Discussion
That the requested variance is **minor** in nature	• Consent application B01/23 was conditionally approved by the County of Wellington in March 2023 and this application is to satisfy a condition for MDS I relief. • There is a conditionally approved vacant lot located across the road from the proposed lot which requires the same MDS I relief, farm data sheets were provided for this application (B47/22). • The applicant has indicated the existing barn located on the retained lands (900 Watson) is vacant and have received a demolition permit to remove the structure. The owners of the neighbouring barns at 930 and 935 Watson Rd S have indicated the barn on their lands are vacant as well. • Due to the number of residential lots in the immediate area the proposed lot has been considered a Type B land use.
That the intent and purpose of the **Zoning By-law** is maintained	• The subject property is zoned Agricultural (A). The agricultural zone allows for residential uses. • The intent of the MDS I setback is to provide a minimum distance between livestock facilities and sensitive lands uses (i.e. dwellings). MDS setbacks are intended to promote and protect agricultural uses while also reducing odour complaints and land use incompatibility. • There are existing rural residential uses in the area which would impact the potential for future expansions to existing livestock buildings and new livestock buildings.
That the general intent and purpose of the **Official Plan** is maintained	• The property is designated Prime Agricultural, and Secondary Agricultural. • The Guelph Junction Rail line is an active rail line to the North of the property. • Rural residential uses and agricultural uses are permitted in the Official Plan. • The retained lands are adjacent to the Arkell Hamlet area • Local zoning by-laws implement MDS I requirements
That the variance is **desirable** and **appropriate** development and use of the land, building or structure	• The subject property is adjacent to existing rural residential uses and in close proxmility to the Arkell Hamlet Area. • We do not anticipate that a new residential use in this location would hinder or preclude the present use or future potential for the agricultural operations in question given that a number of existing rural residential uses are existing in the immediate area.

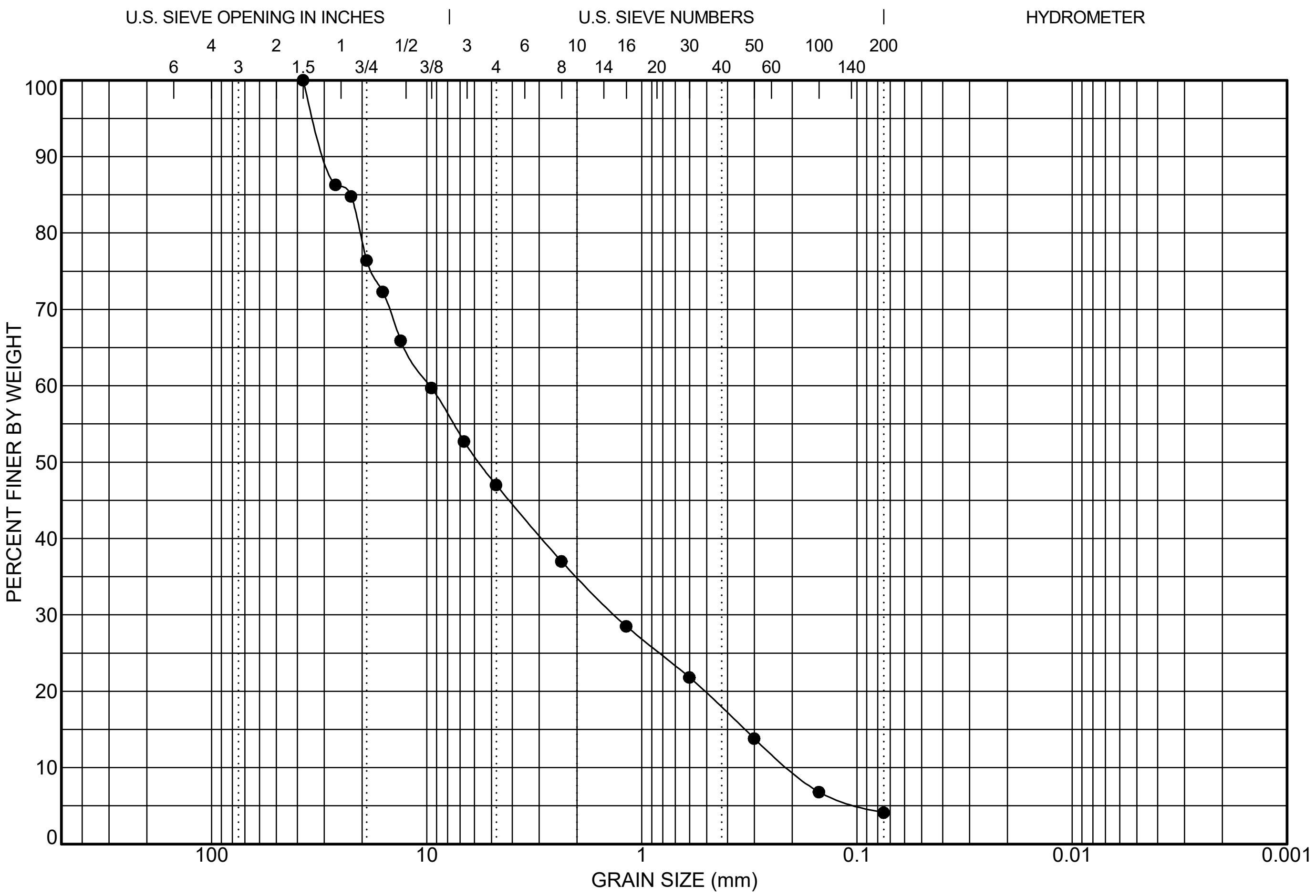
Additional Comments

All 3 of the above noted barns are currently not housing livestock. Since the initial application the owner of 900 Watson Road S has applied for and received a demolition permit for the barn located on the retained lands. The owners of 935 Watson Road S have a conditionally approved severance on their lands in which MDS will also need to be addressed, through disucssions with the owner this barn may be demolished or rezoned to no longer house livestock. The owner of the barn at 930 Watson Road South indicating they do not intend to have livestock in the future.

I trust that these comments will be of assistance to the Committee in their consideration of this matter. We would appreciate a copy of the Committee's decision with respect to this application.

Respectfully submitted
[redacted]lanning and Development Department

Zach Prince, RPP MCIP, Senior Planner



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			0.89	46.87	37.5	9.652	1.334	0.206	53.0	42.9	4.1	

Date: Jan. 04 - 2024
Client: Timberworx Custom Homes
Contractor:
Source:
Sampled From: TP 3 - SA 1; 1.10 to 1.25 m depth
Sample No.: 3-1
Date Sampled: Dec. 19 - 2023
Sampled By: BC
Lab No.: 1711
Date Tested: Dec. 27 - 2023
Type of Material: Sand and Gravel, trace silt

Sieve Size (mm)	**Percent Passing**	**No Specifications**

CHUNG & VANDER DOELEN
ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

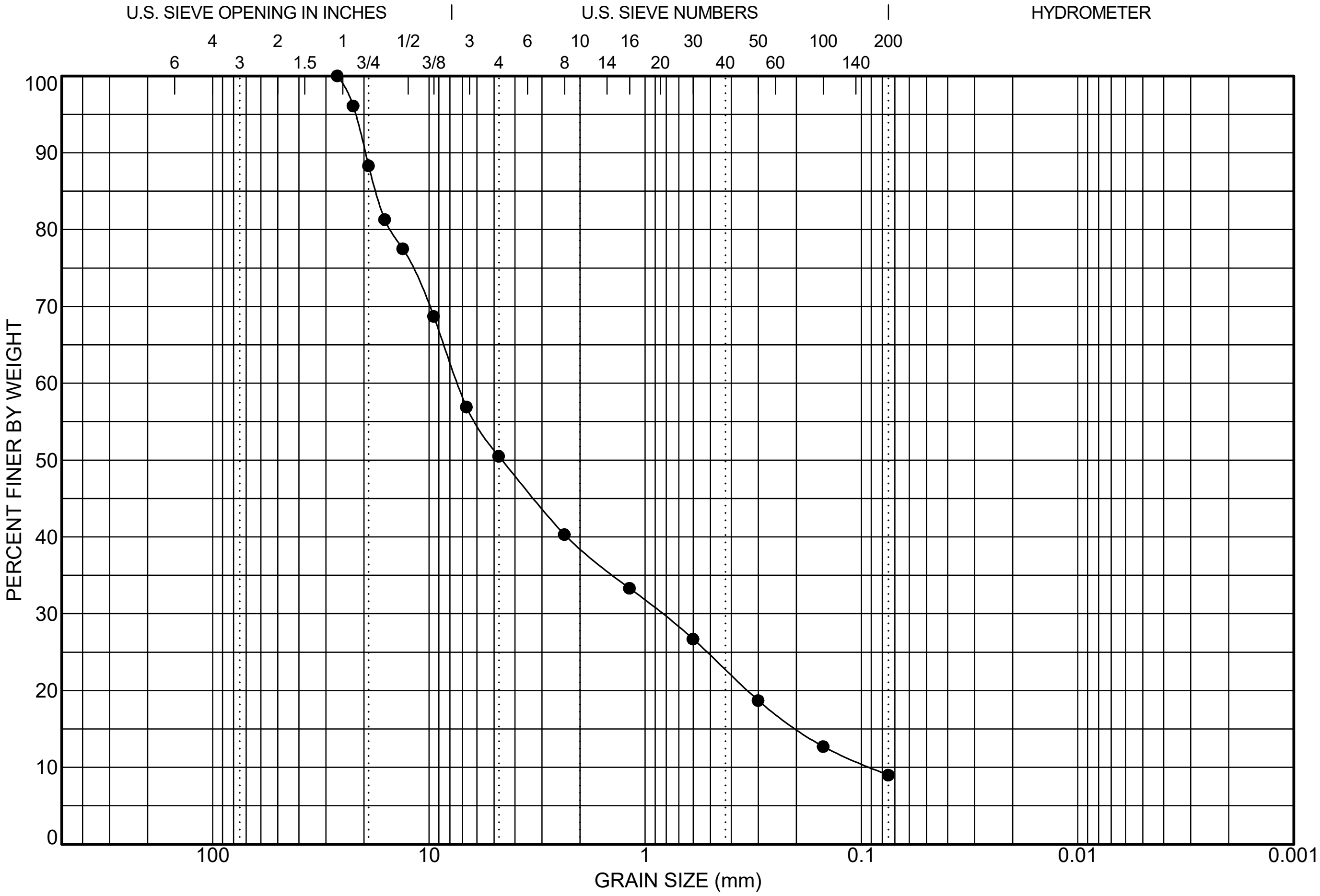
Project: Arkell Subdivision

Location: Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario

File No.: 1669

Enclosure No.: 13

DM - NO SPECIFICATIONS 1669 ARKELL SUBDIVISON - TEST PITS.GPJ LAW LNDN.GDT 24-1-5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.07	81.19	26.5	7.344	0.841	0.09	49.5	41.5	9.0	

Date: Jan. 04 - 2024
Client: Timberworx Custom Homes
Contractor:
Source:
Sampled From: TP 5 - SA 2; 0.90 to 1.05 m depth
Sample No.: 5-2
Date Sampled: Dec. 19 - 2023
Sampled By: BC
Lab No.: 1712
Date Tested: Dec. 27 - 2023
Type of Material: Sand and Gravel, trace silt

Sieve Size (mm)	Percent Passing	No Specifications

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Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

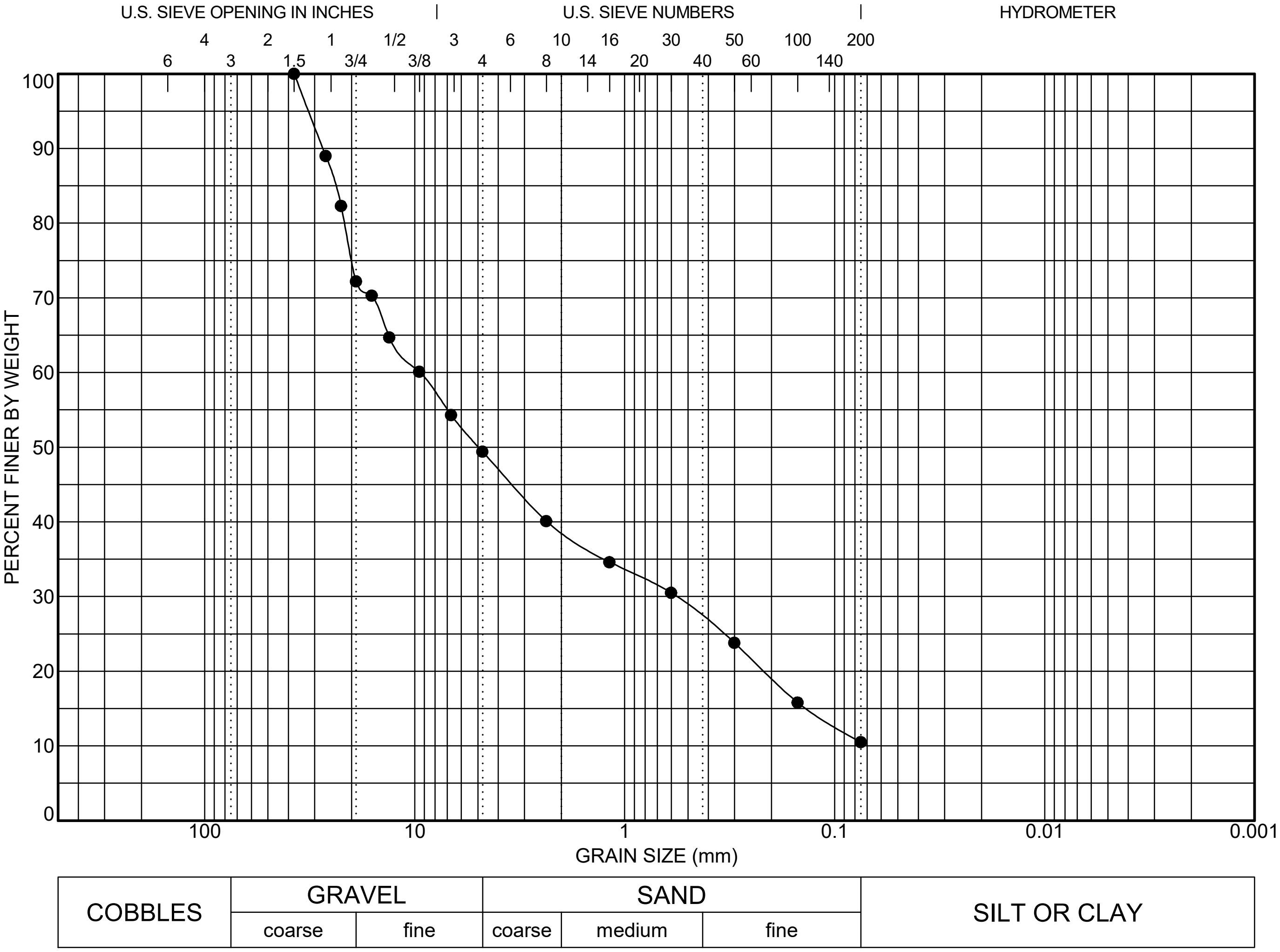
Project: Arkell Subdivision

Location: Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario

File No.: 1669

Enclosure No.: 14

DM - NO SPECIFICATIONS 1669 ARKELL SUBDIVISON - TEST PITS.GPJ LAW LNDN.GDT 24-1-5



LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			0.49	134.41	37.5	9.443	0.57		50.6	38.9	10.5	

Date: Jan. 04 - 2024
Client: Timberworx Custom Homes
Contractor:
Source:
Sampled From: TP 7 - SA 2; 0.90 to 1.05 m depth
Sample No.: 7-2
Date Sampled: Dec. 19 - 2023
Sampled By: BC
Lab No.: 1713
Date Tested: Dec. 27 - 2023
Type of Material: Sand and Gravel, some silt

Sieve Size (mm)	Percent Passing	No Specifications

CHUNG & VANDER DOELEN ENGINEERING LTD.
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Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

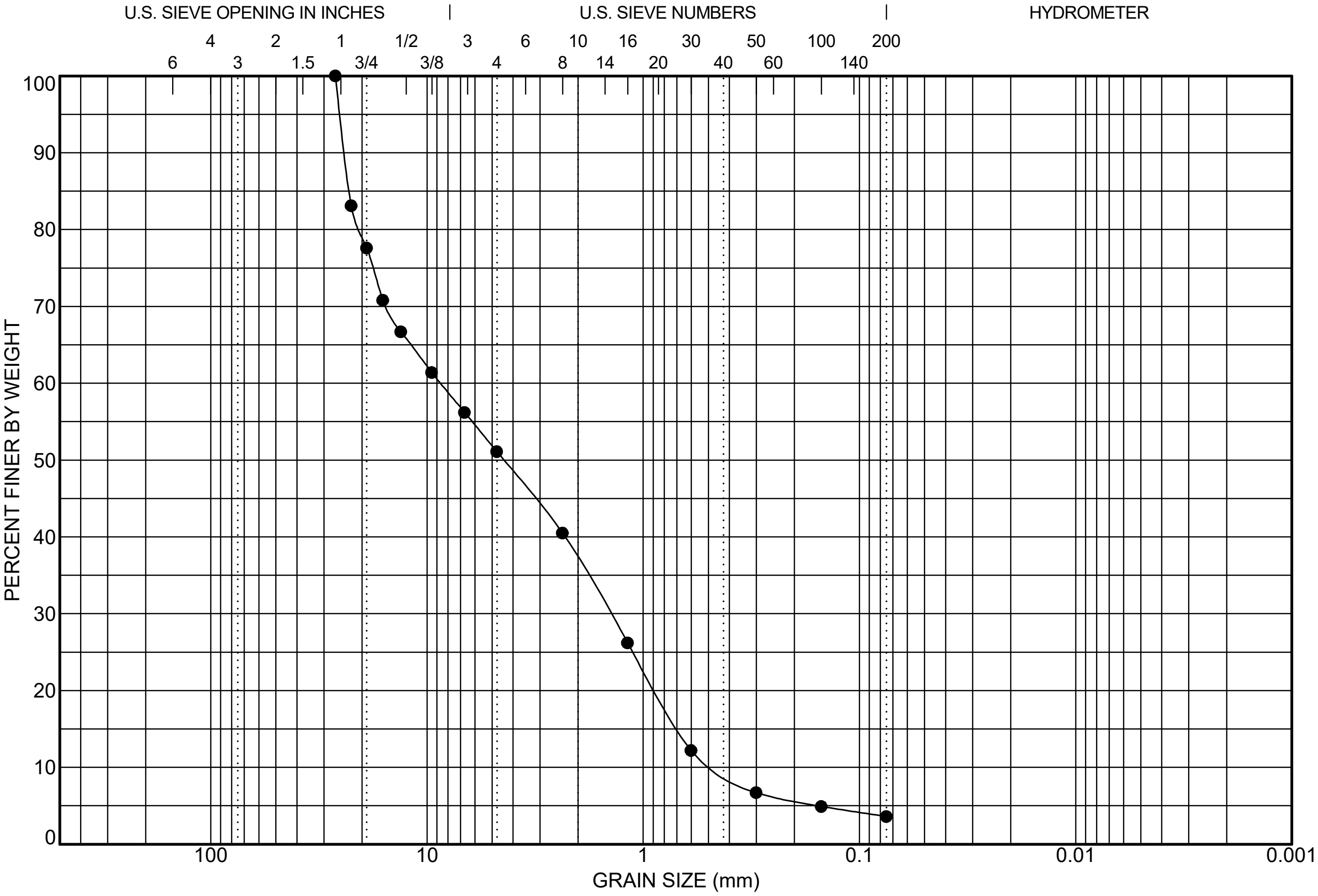
GRAIN SIZE DISTRIBUTION

Project: Arkell Subdivision

Location: Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario

File No.: 1669

Enclosure No.: 15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			0.51	19.02	26.5	8.648	1.419	0.455	48.9	47.5	3.6	

Date: Jan. 04 - 2024
Client: Timberworx Custom Homes
Contractor:
Source:
Sampled From: TP 9 - SA 2; 1.10 to 1.25 m depth
Sample No.: 9-2
Date Sampled: Dec. 19 - 2023
Sampled By: BC
Lab No.: 1714
Date Tested: Dec. 27 - 2023
Type of Material: Sand and Gravel, trace silt

Sieve Size (mm)	Percent Passing	No Specifications

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e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

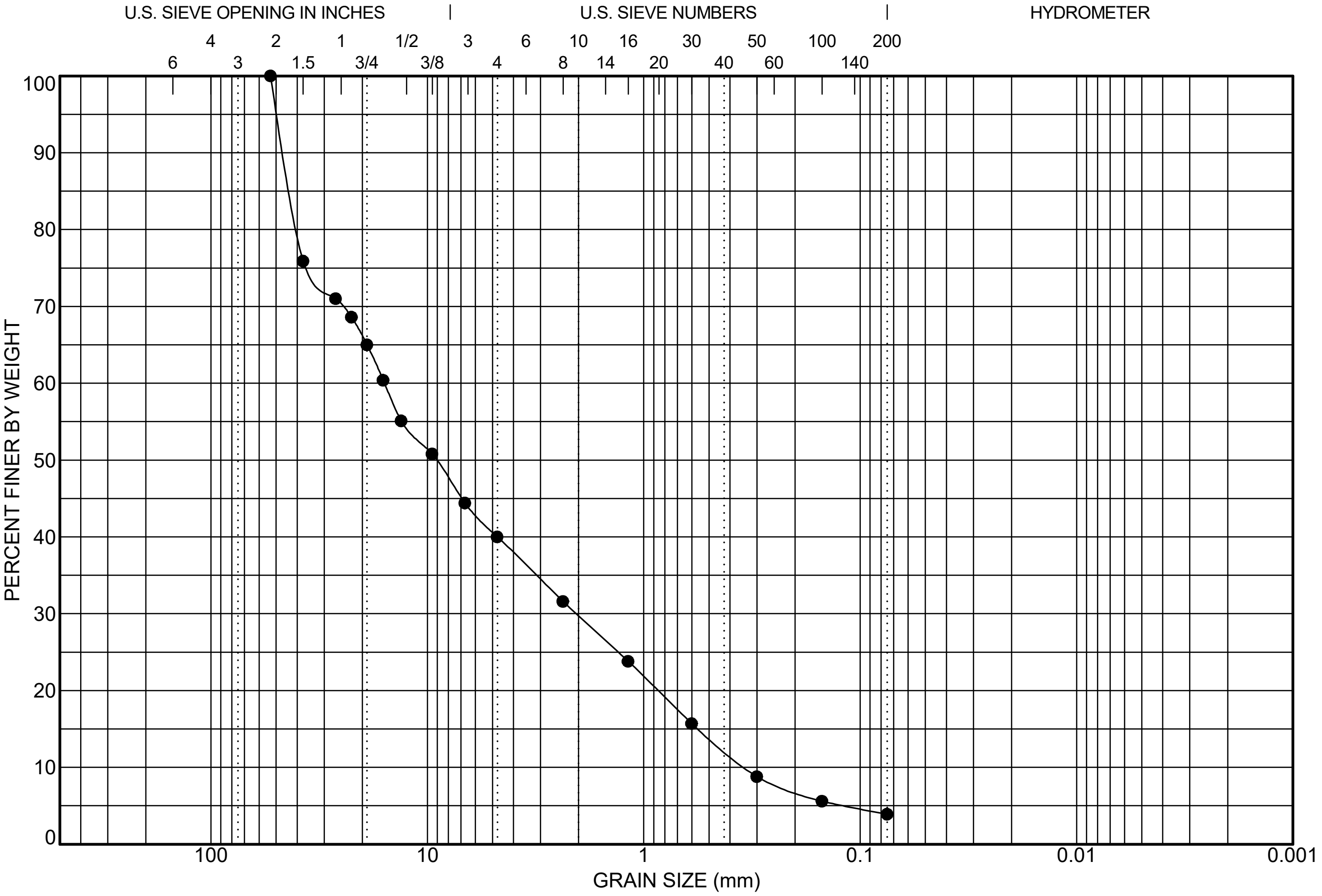
Project: Arkell Subdivision

Location: Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario

File No.: 1669

Enclosure No.: 16

DM - NO SPECIFICATIONS 1669 ARKELL SUBDIVISON - TEST PITS.GPJ LAW LNDN.GDT 24-1-5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			0.79	46.60	53	15.769	2.047	0.338	60.0	36.1	3.9	

Date:	Jan. 04 - 2024
Client:	Timberworx Custom Homes
Contractor:	
Source:	
Sampled From:	TP 11 - SA 3; 3.70 to 3.85 m depth
Sample No.:	11-3
Date Sampled:	Dec. 19 - 2023
Sampled By:	BC
Lab No.:	1715
Date Tested:	Dec. 27 - 2023
Type of Material:	Sand and Gravel, trace silt

Sieve Size (mm)	Percent Passing	No Specifications

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GRAIN SIZE DISTRIBUTION

Project: Arkell Subdivision

Location: Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario

File No.: 1669

Enclosure No.: 17

DM - NO SPECIFICATIONS 1669 ARKELL SUBDIVISON - TEST PITS.GPJ LAW LNDN.GDT 24-1-5

Enclosure No.: 1
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 1

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION Ground Elevation:	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE					
	250 mm TOPSOIL										
0.25	trace topsoil ------ compact, brown SAND AND GRAVEL trace silt occ. to frequent cobbles and boulders damp to moist	0.5 1.0 1.5								0.5 1.0 1.5	minor collapsing of sidewalls during test pit advancement
	------ dense	2.0 2.5		1	BS			○		2.0 2.5	
3.00	End of Test Pit	3.0 3.5 4.0 4.5 5.0 5.5 6.0								3.0 3.5 4.0 4.5 5.0 5.5 6.0	test pit dry at completion

PROJECT MANAGER: **RVD**

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CVD TEST PIT 1669 ARKELL SUBDIVISON - TEST PITS.GPJ CVD_ENG.GDT 24-1-5

Enclosure No.: 2
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 2

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY

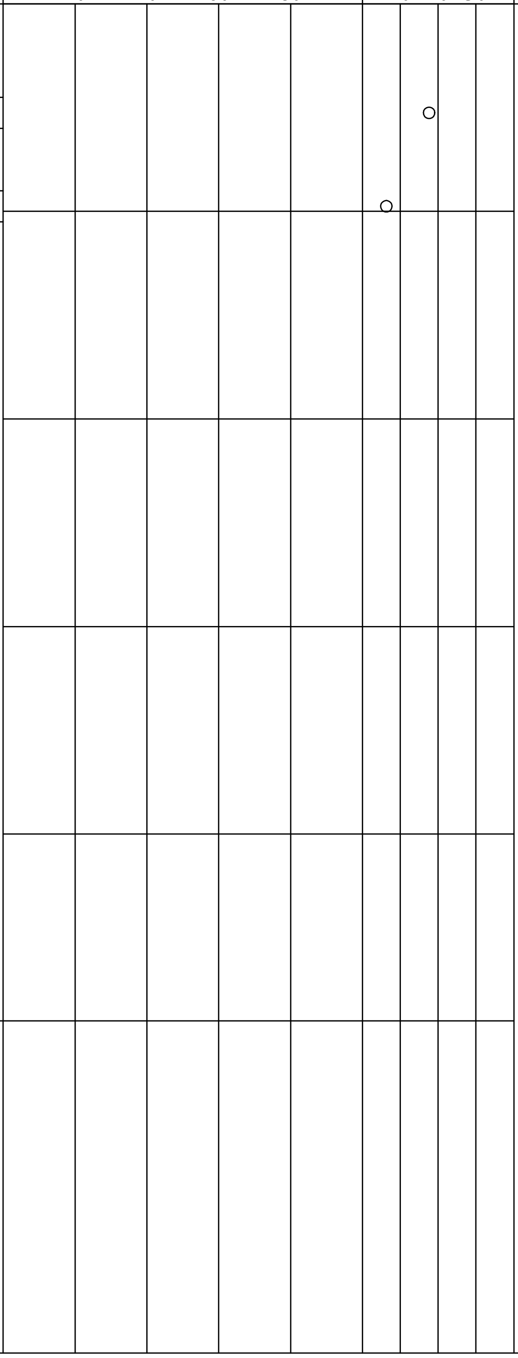
Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	450 mm TOPSOIL				
0.45	loose, brown, SILT, trace sand, trace clay, trace topsoil moist	1	BS		minor collapsing of sidewalls during test pit advancement
0.75	compact, brown SAND AND GRAVEL trace silt occ. cobbles damp to moist ------ occ. boulders ------ dense	2	BS		
4.90	End of Test Pit				test pit dry at completion

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. ☐
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA



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Enclosure No.: 3
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 3

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY — SAMPLE — SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. × ; LAB TEST: Unc. ■ P.P. □ ; 50 100 150 200 — PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ ; 20 40 60 80 — WATER CONTENT (%): W_P W W_L ; 10 20 30 — WELL DATA — DEPTH (m) — REMARKS

Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	330 mm TOPSOIL				
0.33	trace topsoil ------ compact, brown SAND AND GRAVEL trace silt occ. cobbles damp to moist ------ dense occ. boulders	1 (at approx. 1.1–1.2 m) 2 (at approx. 3.7–3.8 m)	BS BS		occasional to frequent collapsing of sidewalls during test pit advancement (at approx. 0.5 m)
4.30	End of Borehole				test pit dry at completion

Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0

PROJECT MANAGER: **RVD**

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Enclosure No.: 4
Sheet 1 of 1

FILE No: 1669 TEST PIT No. 4

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

ELEV./ DEPTH (m)	SOIL LITHOLOGY DESCRIPTION Ground Elevation:	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	DEPTH (m)	REMARKS
	330 mm TOPSOIL										
0.33	trace topsoil	0.5								0.5	
	------ compact, brown										
	SAND AND GRAVEL trace silt	1.0								1.0	
				1	BS			○			
	occ. cobbles										
	damp to moist	1.5								1.5	
		2.0								2.0	
	------ occ. boulders	2.5								2.5	frequent collapsing of sidewalls during test pit advancement
	------ silt seam ------										
		3.0								3.0	
		3.5								3.5	
				2	BS			○			
		4.0								4.0	
		4.5								4.5	
		5.0								5.0	
		5.5								5.5	
		6.0								6.0	
6.10	End of Borehole										test pit dry at completion

PROJECT MANAGER: **RVD**

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Enclosure No.: 5
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 5

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

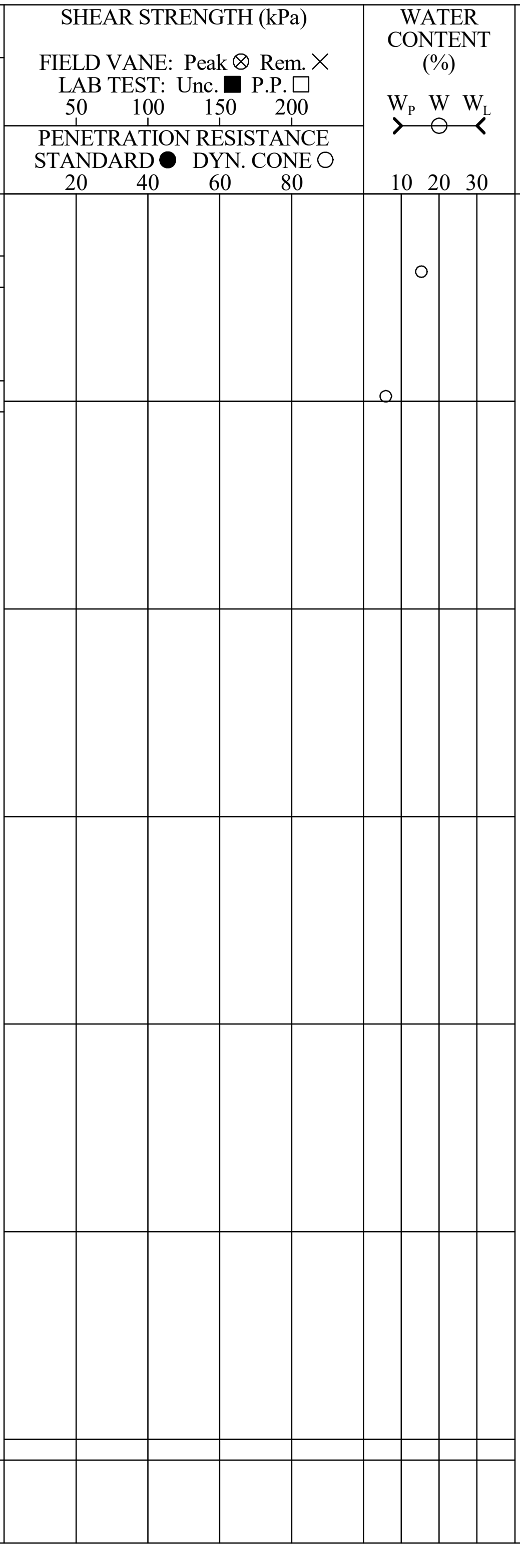
EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY

Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	300 mm TOPSOIL				
0.30	loose, brown SILT, some sand, trace clay moist	1	BS		frequent collapsing of sidewalls during test pit advancement
0.60	compact to dense brown SAND AND GRAVEL trace silt occ. to frequent cobbles and boulders damp to moist	2	BS		
6.10	End of Test Pit				test pit dry at completion



WELL DATA

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0

PROJECT MANAGER: **RVD**

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CVD TEST PIT 1669 ARKELL SUBDIVISON - TEST PITS.GPJ CVD_ENG.GDT 24-1-5

Enclosure No.: 6
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 6

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

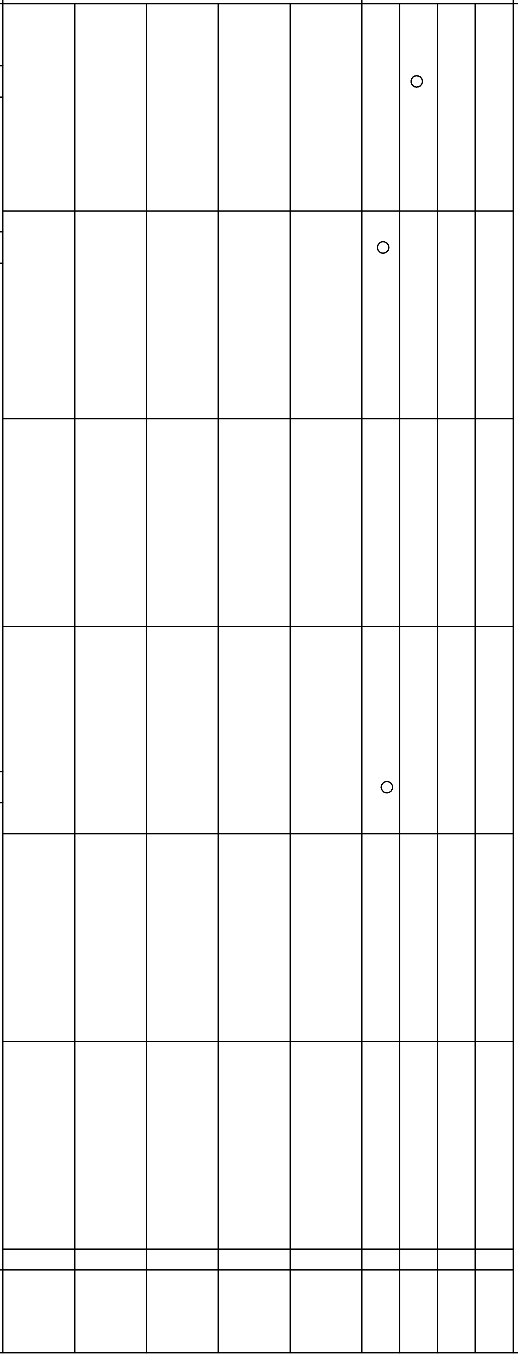
SOIL LITHOLOGY

Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	350 mm TOPSOIL				
0.35	compact to dense brown SAND AND GRAVEL trace silt occ. cobbles damp to moist ------ silt seam ------ occ. boulders	1 2 3	BS BS BS		occasional collapsing of sidewalls during test pit advancement
6.10	End of Borehole				test pit dry at completion

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30



WELL DATA

PROJECT MANAGER: **RVD**

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Enclosure No.: 7
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 7

Client: **Timberworx Custom Homes**

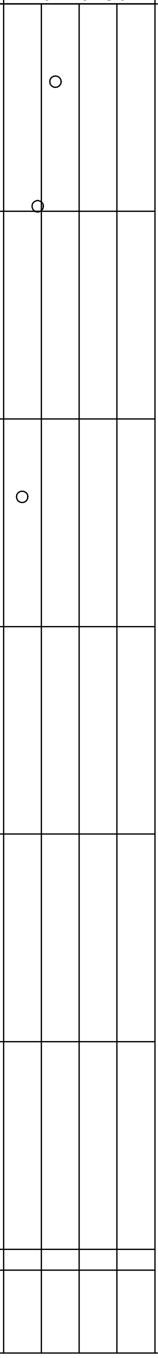
Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY		SAMPLE			SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 / PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION Ground Elevation:	SAMPLE ID	TYPE	N-VALUE				
	300 mm TOPSOIL							
0.30	trace topsoil ------ compact, brown SAND AND GRAVEL trace to some silt frequent cobbles and boulders damp to moist	1	BS			○		frequent collapsing of sidewalls during test pit advancement (0.5 m)
		2	BS			○		
		3	BS			○		
6.10	End of Test Pit							test pit dry at completion



PROJECT MANAGER: **RVD**

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Enclosure No.: 8
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 8

Client: **Timberworx Custom Homes**

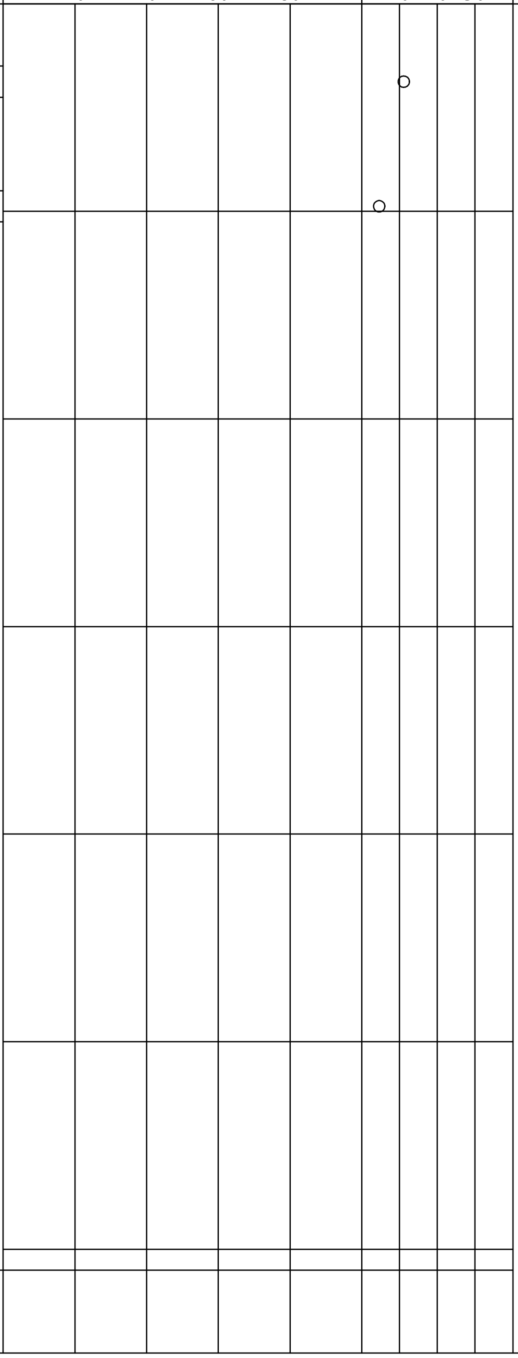
Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY			SAMPLE						
ELEV./ DEPTH (m)	DESCRIPTION Ground Elevation:	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	REMARKS
	300 mm TOPSOIL								
0.30	some silt to silty trace topsoil ------ compact, brown SAND AND GRAVEL trace silt frequent cobbles and boulders damp to moist	0.4	1	BS					
		0.5							frequent collapsing of sidewalls during test pit advancement
		1.0	2	BS					
	------ dense								
6.10	End of Test Pit								test pit dry at completion



PROJECT MANAGER: **RVD**

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Enclosure No.: 9
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 9

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY

Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION
	250 mm TOPSOIL
0.25	some silt to silty trace topsoil ------ compact to dense brown SAND AND GRAVEL trace silt occ. cobbles and boulders damp to moist
6.10	End of Test Pit

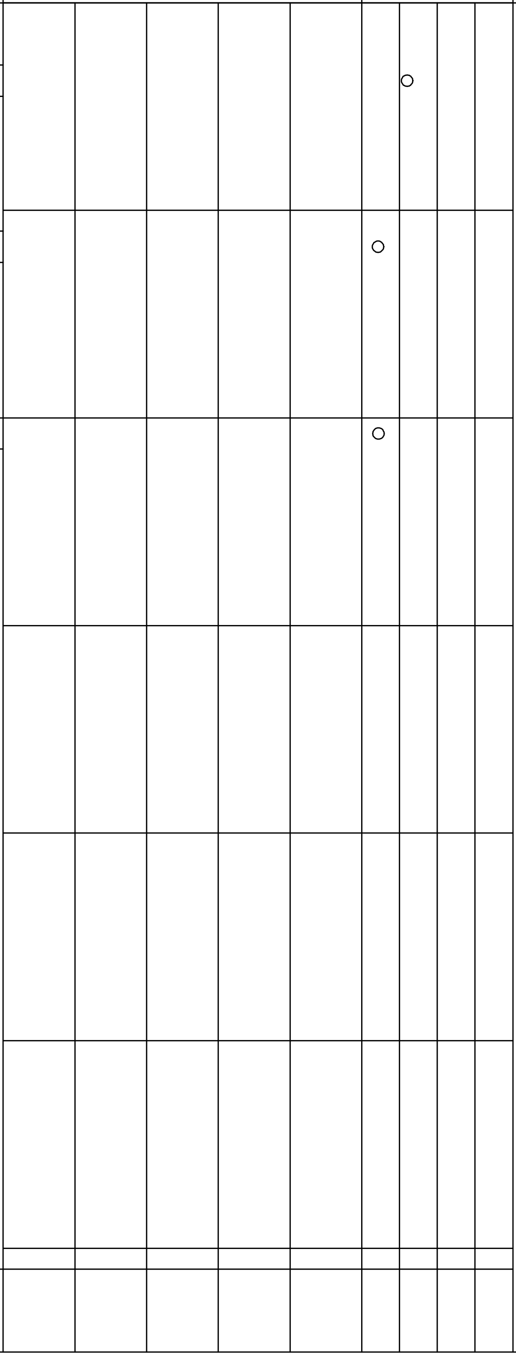
SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	BS	
2	BS	
3	BS	

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200

PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30



WELL DATA

DEPTH (m)	REMARKS
0.6	occasional collapsing of sidewalls during test pit advancement
6.1	test pit dry at completion

PROJECT MANAGER: **RVD**

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Enclosure No.: 10
Sheet 1 of 1

FILE No: 1669 TEST PIT No. 10

Client:	**Timberworx Custom Homes**
Project:	**Arkell Subdivision**
Location:	**Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

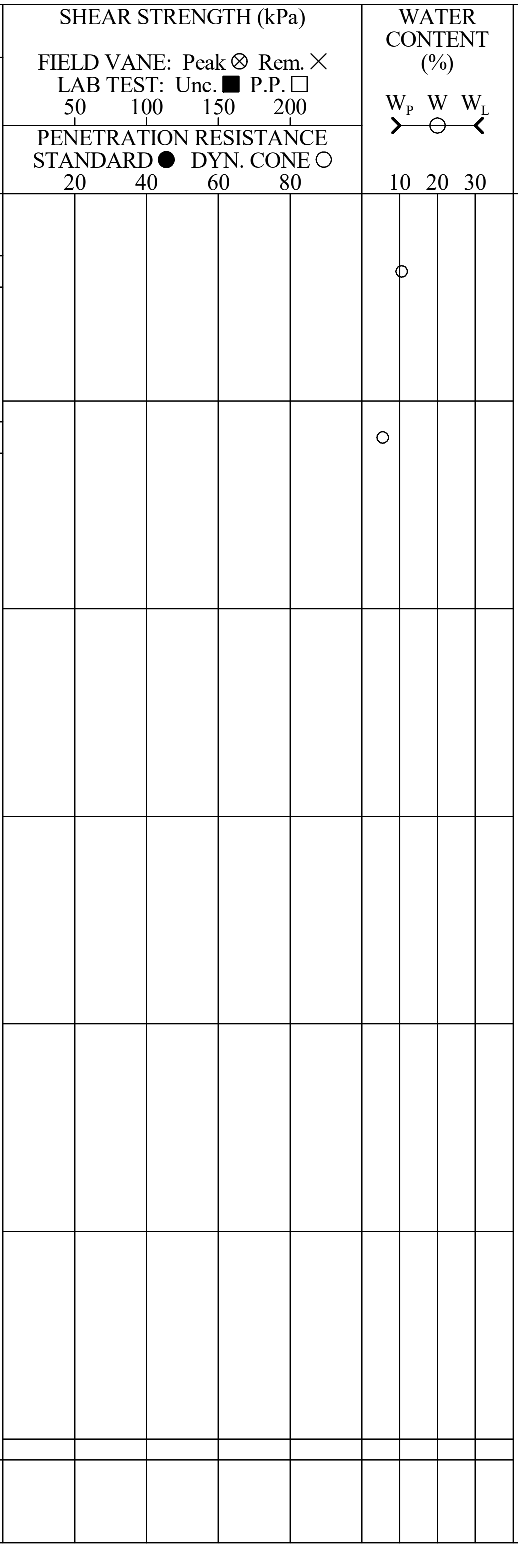
EQUIPMENT DATA

Machine:	**Excavator**
Method:	**Excavator**
Size:	
Date:	**Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY

Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	300 mm TOPSOIL				
0.30	some silt to silty, trace topsoil ------ compact to dense brown SAND AND GRAVEL trace silt occ. to frequent cobbles and boulders damp to moist	1	BS		occasional collapsing of sidewalls during test pit advancement (0.6 m)
		2	BS		
6.10	End of Test Pit				test pit dry at completion



DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0

WELL DATA

PROJECT MANAGER: **RVD**

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Enclosure No.: 11
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 11

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

SOIL LITHOLOGY

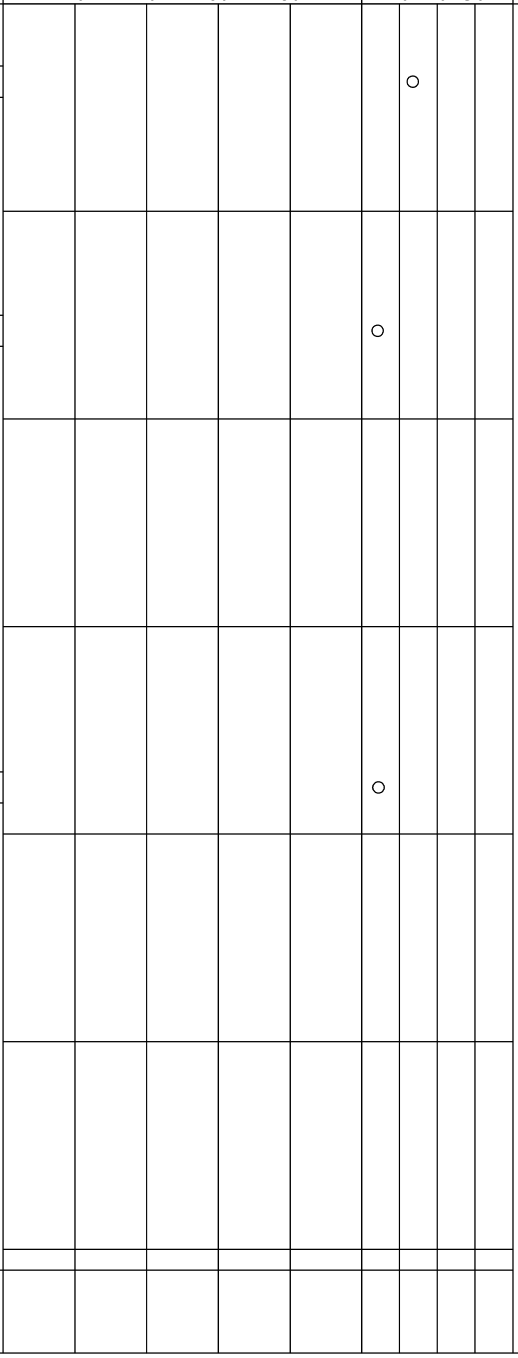
Ground Elevation:

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	300 mm TOPSOIL				
0.30	some silt to silty trace topsoil/rootlets ------ compact, brown SAND AND GRAVEL trace silt occ. cobbles and boulders damp to moist	1	BS		occasional collapsing of sidewalls during test pit advancement
		2	BS		
		3	BS		
6.10	End of Test Pit				test pit dry at completion

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200
PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA



PROJECT MANAGER: **RVD**

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Enclosure No.: 12
Sheet 1 of 1

FILE No: 1669

TEST PIT No. 12

Client: **Timberworx Custom Homes**

Project: **Arkell Subdivision**

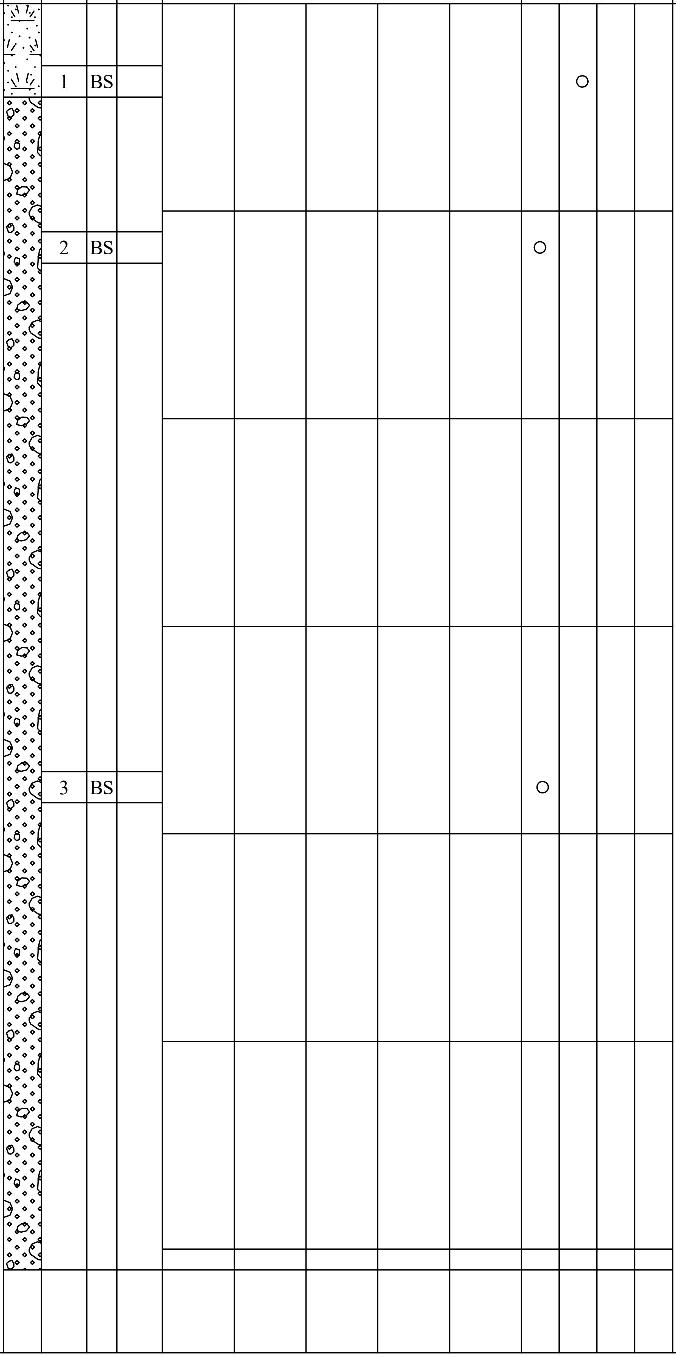
Location: **Pt of Lots 7, 8 and 9, Conc. 10, Arkell, Ontario**

EQUIPMENT DATA

Machine: **Excavator**
Method: **Excavator**
Size:
Date: **Dec 19 23** TO **Dec 19 23**

Ground Elevation:

ELEV./ DEPTH (m)	SOIL LITHOLOGY – DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	DEPTH (m)	REMARKS
	450 mm TOPSOIL	1	BS			
0.45	trace topsoil/rootlets ------ compact to dense brown SAND AND GRAVEL trace silt occ. to frequent cobbles and boulders damp to moist	2 3	BS BS		0.5	occasional collapsing of sidewalls during test pit advancement
6.10	End of Test Pit				6.0	test pit dry at completion



WELL DATA

PROJECT MANAGER: **RVD**

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ARKELL DEVELOPMENT MATRIX

Colour Code	**Description**
🟦	Resolved
▨	- Resolved subject to additional information being provided to Reviewers (e.g, Report Addendums, Condition of Draft Plan Approval)
(no colour)	Response provided, but no further action taken or required by Project Team

	Township **Initial Comments (May 18, 2023)**	**Page / Section**	**Applicant Response (Date)**	**Township Response (April 02, 2024)**	**Applicant Response (August 14, 2025)**	**Township Response (Date)**	**Applicant Response**
Report: Hydrogeology and Nitrate							
1.	We have reviewed The Water Supply Report for the proposed Residential Development in Arkell prepared by ARL Groundwater Resource in March 2023. The report describes three pumping and water quality tests conducted in newly drilled wells at the site. We concur with the findings of the report in that the pumping tests confirm that there is adequate water available on a well-by-well basis. The three individual wells were able to provide enough water for single family homes. The water quality tests also conclude that potable water is available from the aquifer. The proposed development includes up to fifty wells on the site. Given the relative density of private wells, ARL Groundwater Resources recommends that monitoring for turbidity occur during drilling and development phases and that water level monitoring occur for new water supply wells. These are reasonable recommendations. We have the following comments in regard to information provided in the reports and request the following. 1) The report does not report on interference between test wells during the pumping tests nor does it address potential interference between future wells and existing wells in the Hamlet. Although there are recommendations for monitoring of future water supply wells, we recommend that one or more water supply wells for lots adjacent to existing homes be		•	Hydrogeological study: A hydrogeological assessment must demonstrate that the proposed development will not negatively impact the hydrological and hydrogeological regime as part of Site Plan Approval. The hydrogeological study must determine groundwater levels, groundwater flow and baseline groundwater quality on the development property. At least one year of onsite shallow groundwater level monitoring should be included, including the spring groundwater high. The hydrogeological study should address the comments provided within this review. Note that the previous Hydrogeological Assessment completed for the site by R.J. Burnside & Associates Ltd. (2006) was not provided for review as part of the current submission.	• The applicant submitted a Hydrogeological Assessment (2006). The ARL Groundwater Supply Assessment study builds upon this prior work. • We have monitored the one remaining well. Test pits were excavated to a depth of 4-6 m. No evidence of groundwater was identified. • Baseline water quality of water to be used for domestic purposes was provided. • Number 1 has been addressed by ARL Groundwater Resources Ltd. in their response letter dated June 25, 2024 (Agree that water supply well to be monitored). This can be implemented via a condition of development.		

	Township **Initial Comments (May 18, 2023)**	**Page / Section**	**Applicant Response (Date)**	**Township Response (April 02, 2024)**	**Applicant Response (August 14, 2025)**	**Township Response (Date)**	**Applicant Response**
	constructed early in the development time line and dedicated to monitor the aquifer between the proposed development and existing homes.						
2.			•	Wellington County Official Plan: The southeast corner of the site (which is not currently proposed for development) is located within the Paris Galt Moraine Policy Area under Schedule B7 of the County of Wellington Official Plan. The majority of the site is outside of the Paris Galt Moraine Policy Area. Section 4.9.7 Policies and Objectives will apply for any development within the Paris Galt Moraine Policy Area. The development must adhere to Sections 4.9.3 (Groundwater), 4.9.4 (Policy Direction) and 4.9.5 (Source Water Protection).	• Based on a review of background mapping, it appears that no portion of the residential development is located in the Paris Galt Moraine. ARL addresses the Paris Galt Moraine in their letter report dated June 24, 2024.		
3.			•	Source protection: The site is within the Grand River Source Protection Area and is mapped within a wellhead protection area (WHPA)-B for quality. The site is also within a draft wellhead protection area (WHPA)-Q for quantity and a significant groundwater recharge area (SGRA). Groundwater recharge policies in the Source Water Protection Plan apply to this site. The proposed design must infiltrate as much clean runoff as possible to maintain or enhance existing recharge conditions as part of Site Plan Approval.	• ARL discusses Source Water Protection in their June 24, 2025 response letter. The requirement for tertiary treatment septic systems can be included as a condition of development approval.		
4.			•	Water supply: A groundwater supply assessment was completed by ARL Groundwater Resources Ltd. in 2023, which included installation of O. Reg. 903 wells onsite in the aquifer targeted for water supply, a pumping test and water quality analyses. Our previous comments included the following: “The report does not report on interference between test wells during the pumping tests nor does it address potential interference between future wells and existing wells in the Hamlet. Although	• ARL addresses this in their June 24, 2025 letter.		

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				there are recommendations for monitoring of future water supply wells, we recommend that one or more water supply wells for lots adjacent to existing homes be constructed early in the development timeline and dedicated to monitor the aquifer between the proposed development and existing homes." The project hydrogeologist should also comment on whether there could be an overall impact on groundwater and surface water levels due to groundwater removal from the aquifer and infiltration at surface. The assessment should consider long-term impacts at both the local (i.e., hamlet of Arkell) and regional scale. In alignment with other proposed multi-lot developments in Puslinch, a fulsome analysis of the aquifer water quality by analyzing all parameters in Tables 1 and 2 of Ontario Regulation 169/03 is requested.			
5.			•	Supply well construction: The site is underlain by the Guelph Formation and the Goat Island / Gasport Formation aquifer separated by a regional aquitard. Wells that connect these two aquifers (i.e., multiaquifer wells) are not permitted on any lot as part of the development. The onsite supply wells constructed in 2022 were noted to be cased into the Gasport Formation. Newly constructed supply wells for the site should be either installed in the upper bedrock aquifer or appropriately cased into the Gasport aquifer, in accordance with R.R.O. 1990, Reg. 903: Wells, to minimize potential groundwater movement between the upper and lower bedrock aquifers.	• Understood. Agreed.		
6.			•	Nitrate impact assessment: The development proposes individual onsite septic systems for each lot. The daily design flow was estimated at 4,575 L/day per lot (Crozier, 2024a). The D-5-4 analysis completed by Crozier (2024b) determined that nitrate-nitrogen loading would exceed the Ontario	• Crozier Response: The total daily design sanitary sewage flow of 4,575 L/day was calculated in accordance with the Ontario Building Code and is generally accepted to be a maximum day flow. Typical peaking factors for maximum to average days range		

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				Drinking Water Quality Standard of 10 mg/L at the property boundary if conventional septic systems were used for each lot, even if only 35 lots were included. Advanced treatment systems with minimum 50% nitrogen removal are required to meet 10 mg/L nitrate-nitrogen at the property boundary, allowing for up to 50 lots with this technology. Waterloo biofilter systems are proposed for each lot. We generally concur with Crozier's assessment and recommendation for advanced treatment systems; however, the design flows for the proposed homes exceed the standard 1,000 L/day (the recommended standard flow used within D-5-4). The nitrate loading calculations should be revised to reflect the increase in nitrogen inputs to groundwater based on higher daily flows. In addition to the degree of nitrogen reduction, the proponent must also demonstrate the effectiveness and longevity of the proposed tertiary treatment systems. Maintenance agreements or registration on land title may be required to ensure that advanced treatment systems are adequately maintained.	from 2 – 5 (Crites & Tchobanoglous, 1998). The recommended standard of 1000 L/day within D-5-4 is generally viewed as an average or actual flow expected to be generated from each home, not the theoretical maximum. The peaking factor for this particular application is 4.5, which is within the range suggested by the literature. The nitrate loading calculations have been updated to reflect 1,525 L/day/home which represents a peaking factor of 3 for 44 lots which can achieve a concentration of 9.85 mg/L with an effluent concentration of 20 mg/L. If the effluent concentration is reduced to 10mg/L, the resulting downgradient concentration is 6.10 mg/L. • Maintenance agreement with Waterloo Biofilter is required. We could make this a requirement as part of satisfaction of Building Permit if this is what the Township wants. • Maintenance Agreement is not required to be registered on title.		
7.			•	Water balance: A water balance assessment is required to demonstrate that infiltration can be maintained or enhanced as part of the proposed development. Low impact development (LID) measures should be included as part of the design to infiltrate as much clean runoff (i.e., roof runoff) as possible. In-situ infiltration testing is recommended at the locations/depths of proposed infiltration LIDs	• Water balance was provided by Crozier (August 14, 2025).		
8.			•	Construction dewatering: Crozier (2024a) indicated that basements are expected to be above the static water table. Proposed foundation and	• No dewatering anticipated as groundwater is well below the surface.		

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				servicing depths (i.e., SWM facilities and onsite sewage systems) must be evaluated for potential construction dewatering requirements. Groundwater table fluctuations and the spring groundwater high should be considered as part of this assessment.			
9.			•	Well decommissioning: Any unused wells must be abandoned by a licensed well contractor in accordance with R.R.O. 1990, Reg. 903: Wells.	• Understood and agreed. This can be a condition of development.		
10.			•	Excess soil management: Any import/export of fill/soil from the site must be conducted in accordance with O. Reg. 406/19: On-Site and Excess Soil Management, the Rules for Soil Management and Excess Soil Quality Standards (Soil Rules) and O. Reg. 153/04, as amended.	• Understood. The need for additional fill/soil will be addressed as at a later stage in the process. At this point, no excess fill is anticipated.		
Report: EIS							
1.	Based on the information provided and background mapping, Azimuth is providing the following recommendations to the Township. The background information summarized above suggests the potential for several natural heritage features and functions to be associated with the property and/or adjacent lands. As per Ontario's Provincial Policy Statement (MMAH, 2020b), development or site alteration is not permitted in Significant Woodlands (Ecoregions 6E or 7E), Significant Wildlife Habitat or on lands adjacent to Significant Woodlands or Significant Wildlife Habitat unless it can be demonstrated [e.g. through an Environmental Impact Study (EIS)] that there will be no negative impacts to the natural heritage features and functions. Development in habitat of ESA-protected species may require authorizations issued under the ESA if the activity is deemed damaging or destructive to habitat and/or poses a direct impact to the species. Local OPs also outline policies governing natural heritage features and their ecological functions, including setbacks and Vegetation Protection Zones. It is recommended that the Township consider an EIS be undertaken to identify natural heritage features and functions associated with the property and/or adjacent lands, and assess the potential for			Azimuth has received these second submission documents for the Timberworx Homes development proposal (Arkell Road and Watson Road South). Azimuth provided a pre-consultation letter on May 11, 2023 (from an ecology/arborist perspective) that provided recommendations for an EIS. The documents attached in your second submission peer review request pertain to archaeology, a Traffic Impact Study, Functional Servicing and Stormwater Management. Do you know whether or not an EIS is also forthcoming?	• An EIS is not forthcoming as no development is proposed in the plantation. It is important to note that the plantation is not mapped as a Greenland and is not a significant natural heritage feature. This conclusion is consistent with the direction provided by the Township's original ecological peer review consultant. It is our opinion that the onsite plantation is in poor condition and should be managed, including the removal of dead or dying trees. • Breeding bird surveys were conducted (see Colville memo report). No onsite grassland species identified as fields were in common field crop production. No development proposed in the plantation. • Tree Preservation and Maintenance Plan to be prepared as a condition of Draft Plan Approval. Included with this		

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	impact in relation to the development under consideration. At minimum, the following EIS scope is recommended: • Evaluate/map vegetation communities based on provincial Ecological Land Classification (ELC) methods for Southern Ontario; • Two (2) vascular plant inventories with regard for SAR plants including Butternut and Black Ash (spring and summer); • Three (3) dawn breeding bird surveys with consideration for SAR grassland birds; • SAR bat snag mapping (e.g. density plot method) during leaf-off conditions. Should the 46-lot Conceptual Plan be selected, potential impacts to the woodland would be anticipated to be reduced. Under this development option, detailed bat snag mapping instead of density plots may be more appropriate for the smaller area of tree removals; • Assessment of potential SAR habitat on and/or adjacent to the property; • Assessment of potential Significant Wildlife Habitat on and/or adjacent to the property, including possible presence of habitat for Special Concern species; and, • Observations of incidental wildlife while on the property for other surveys. Azimuth recommends this typical EIS approach to assist the Township in their decision-making process pertaining to the proposed development. If the snag mapping survey identifies candidate SAR bat habitat on the property, consultation with the Ministry of the Environment, Conservation and Parks (MECP) may be warranted to confirm appropriateness of acoustic monitoring to determine habitat use by SAR bats (given the extent of proposed tree removals under either Conceptual Plan option). Due to the woodlands in the eastern half of the property and potential for the feature to be part of a regional Significant Woodland, the Township may wish to also consider that the proponent provide a Tree Inventory and Tree Preservation Plan (prepared by a Certified Arborist). An Edge Management Plan may be suitable to "soften" the hard woodland edges created by tree removals. If the proponent wishes to remove trees/vegetation to accommodate the proposed development, removals				condition could be the requirement for a snag survey for any trees in proximity to the development that may be required to be removed (along the edge of the plantation). The condition could also address timing of any potential removals. • The Tree Plan will also set out the requirement to plant native trees and shrubs. The number and species to be planted will be documented in this Plan.		

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	should be completed outside of the migratory breeding bird window and active SAR bat window (i.e. outside April 1 to September 30 of a given year) to avoid potential impacts to migratory breeding birds protected under the Migratory Birds Convention Act, 1994 and/or Ontario's Fish and Wildlife Conservation Act, 1997. This recommended window would also avoid accidental contravention of Ontario's Endangered Species Act, 2007 (ESA) in regards to SAR bats.						
Report: Township of Puslinch Fire Department – Brent Smith							
1.	1. is there any requirements from the Township or Region regarding the number of lots that can be developed in a dead end portion of a subdivision before a second access is required? In the Waterloo Region for example, the maximum number of lots was set at 26 before an additional emergency access was required. 2. Water tanks and dry hydrants will be required in this subdivision. We will need to see the location, size of tanks etc. on the plans. Please find attached the township's requirements for the tanks and connections.			The department has the following comments: 1. Please show the location of the firefighting water tanks 2. The fire department's specification of the connections / tanks are attached.	• We understand from the Township engineer that there is no longer a concern with the need for an addition emergency access. The servicing plan illustrates the location of the water tanks. Additional information will be provided as part of the final engineering plans as a condition of draft plan approval.		
Report: Source Water Protection							
1.	Permitting a future planning application is approved, Wellington Source Water Protection recommends that the following conditions be fulfilled to the satisfaction of the Township's Risk Management Official, prior to the applications approval. The below conditions and recommendations are suggested based on a review of the Preconsultation documents submitted by the applicant and could be included as conditions in a Zoning By-Law Amendment or Draft Plan of Subdivision Agreement. a. That the Drinking Water Threats Screening Form be completed and submitted. b. That the applicant provide a liquid fuel handling / storage and spill response procedure for construction, to the satisfaction of the Risk Management Official. c. That the applicant clearly identify all Provincial Instruments, such as Permits to Take Water, Environmental Compliance Approvals, and Environmental Activity and Sector Registrations			1) The completion of the Drinking Water Threats Screening Form; 2) A Salt Management Plan to manage winter maintenance activities until the roads are assumed by the Township; 3) The submission of a water balance assessment report that evaluates pre and post development hydrogeological conditions and includes Low Impact Development recharge infiltration measures; 4) A liquid fuel handling/ storage and spill response procedure for construction if more than 250L of fuel will be on site at any point during construction. Please confirm that the items below are not proposed to occur on the property. If any are proposed, please provide	• Source Water Protection Form was signed and emailed to sourcewater@centrewellington.ca on May 22, 2024. • Salt Management Plan to be submitted as a condition of approval. • Water balance was provided by Crozier (August 14, 2025). • Liquid fuel handling/storage and spill response procedure to be provided as a condition of approval. • At this point, we do not anticipate the need for a PTTW. We will evaluate the need for an ECA later in the process. • Unused wells will be decommissioned as per O. Reg		

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	(EASRs) that will be required for the proposal and provide any necessary technical details. d. That the applicant provide details on water usage (consumptive and non-consumptive). e. That the applicant confirm and address mitigation of any transport pathways proposed for this development. f. That the applicant implement best management practices, such as LID measures, with the goal to maintain predevelopment recharge. g. That all private water wells be properly maintained or decommissioned in accordance with Ontario Regulation 903 and that documentation be submitted to the Township Risk Management Official. h. That the applicant submit the Record of Site Condition for the property, if applicable, to the Risk Management Official. Recommendations: That the Township Hydrogeologist review and provide comment on the proposed septic system design and proper construction of drilled wells, in relation to nitrate loading. It is further recommended that the Township Hydrogeologist review and provide comment on the Nitrate Assessment report, once submitted by Crozier b. That Best Management practices for winter maintenance activities be followed during construction, until the roads are assumed by the Township. See attached guidance. The following sections are provided for rationale and further information to the reader pertaining to the Clean Water Act requirements and recommended Planning Act approval conditions listed above. The following sections do provide any additional requirements. The subject property is located in: a) a Wellhead Protection Area B (WHPA-B), 2 year time of travel, with a high vulnerability score of 8; b) a draft Wellhead Protection Area Q (WHPA-Q); and c) a Significant Groundwater Recharge Area (SGRA). Attachments show the relevant mapping. Please note the subject property is not located in a Highly			additional detail or documentation in future submissions. 1) Documentation of any Provincial Approvals (ECA, PTTW, etc.) subject to the proposal; 2) That any unused wells, including unused monitoring wells, are decommissioned as per Ontario Regulation 903 and that this documentation is submitted; 3) Documentation of any transport pathways proposed for the development.	903. A condition of approval will state this as a requirement.		

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	Vulnerable Aquifer (HVA), or Issue Contributing Area (ICA).						
Report: Traffic – April 25 2024							
1.	No Comments Received from Traffic Consultant. See Public works Column at rear of Matrix.		•	Salvini Consulting: - I am in agreement with the existing traffic and the background traffic along with the analyses completed for those scenarios. I am also in agreement with the trip generation estimates for the site. - The translation between the TTS analysis and the site traffic assignment is not clear. The majority of the site traffic has been assigned to and from the southeast on Watson Road South when the TTS analysis suggests most traffic is destined to and from the northwest, the southwest and the west. However, it is my opinion that changing the assignment of traffic would not materially change the capacity analyses and would not change the recommendations in the report. The two study area intersections are forecast to operate at good levels of service and the traffic volumes generated by the proposal are low. - A new public road connection is proposed to Watson Road South, which is a Township road. The consultant has provided a sight distance assessment indicating that the available sight distance exceeds the TAC requirements. I would like to have the consultant confirm how the available sight distances were determined – were they measured in the field or calculated based on a review of base mapping? - The proposed new road connection is located near the level railway crossing of Watson Road South. We will need to receive confirmation from Guelph Junction Railway that they are in agreement with the new road connection. The capacity analysis indicates that there is no queuing expected from the new intersection toward the railway.	• Noted. • Noted. Given that changing the assignment of traffic would not materially change the capacity analyses and would not change the recommendations in the report, no revisions were made. • Noted. Sight distance assessments were calculated based on a review of base mapping and aerial images. • Noted		

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				- The County and their consultant may have additional comments based on their review of the emergency access and the Watson/Arkell intersection.	- Noted		
Report: GRCA							
1.	As the subject lands do not contain areas regulated by the GRCA, we will not be providing comment for this pre-consultation application.			As the subject property does not contain any watercourses, floodplains, shorelines, wetlands, valley slopes, or other natural hazard features of interest to the GRCA, the property is not subject to Ontario Regulation 150/06 (see attached map). The GRCA will not be providing comments on this submission.	- No response needed.		
Report: GM Blueplan				**May 21 2024**			
1.	We defer review of the following to Wellington Source water Protection and the Township Hydrogeologist: • Groundwater Supply Assessment prepared by ARL Groundwater Resources Ltd., dated March 2023. • Water Well Records and various excerpts from the Hydrogeological Assessment completed by R.J. Burnside & Associates Ltd., 2006. We defer commenting on the requirement for a secondary emergency site access to the County Planner. Therefore, we provide the following requirements in support of Zoning By-law Amendment and Official Plan Amendment: • Site Plan, provide confirmation which concept plan will form part of the future applications (i.e. 39 or 47 lots) and ensure that the relevant studies support the proposed concept plan. • Stormwater Management Brief prepared by a Professional Engineer confirming that the proposed use of the lands will not have a significant impact on stormwater management and drainage on the property, including water quantity, water quality, water balance and drainage flow routes. Should infiltration be proposed, the stormwater management brief must demonstrate that a minimum separation distance of 1.0m is maintained between the bottom of the infiltration structures and the seasonal high groundwater levels. Confirmation of site legal outlet is required. We acknowledge that the proponent has provided a Stormwater Management Report from			1) Secondary Access and Adjacent Lands - Grading and Servicing Plan: Please confirm inclusion of the secondary access road. If the secondary access is not to be included, a cul-de-sac may be required per the latest Township of Puslinch Municipal Development Standards. Additionally, please confirm ownership of the lands adjacent to the possible secondary access (lots 922 and 923). An easement may be required for the proposed bypass swale through these lands. 2) Existing Culverts: Grading and Servicing Plan - The Functional Servicing and Stormwater Management Report mentions existing culverts at the Guelph Junction Railway and Arkell Road as part of the proposed stormwater management strategy. Please indicate the location, size and grade of the existing culverts. 3) Rainfall Parameters: FSSWM Report: The Functional Servicing and Stormwater Management Report appears to use outdated rainfall parameters. Please use IDF data from the latest City of Guelph Development Engineering Manual (October 2023)	1. The revised Site Plan illustrates a secondary access, although we understand that one is not required. 2. Existing culverts were observed on-site by Van Haarten. Crozier drawings updated with the information observed by Van Harten. 3. FSSWM Report has been revised to use the IDF data from the latest City of Guelph Development Engineering Manual. 4. An OGS unit is proposed at each outlet into the dry pond and bioswale. 5. Both the north swale and south swale are intended to promote infiltration. The north swale will have a shallow grade and will receive pre-treatment of runoff from the future municipal roads through an OGS system. We expect that any inspection/ maintenance can be conducted via easements which are proposed for each storm sewer outlet.		

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	2006, however the findings of the 2006 report need to be updated to reflect the current concept and latest Township of Puslinch Municipal Development Standards as the concept plan put forward is very different from what was proposed in 2006 and the Township of Puslinch Municipal Development Standards have been updated since then. The 2006 stormwater management report stipulates that quality pre-treatment of runoff will be provided by roadside ditches prior to infiltrating in the stormwater management pond. Roadside ditches are no longer supported in the Township of Puslinch and a standard urban cross section must be used per the latest Town of Puslinch Municipal Development Manual. The 2006 stormwater management report assumed 14% imperviousness for the proposed development and that the stormwater management pond will outlet to the existing roadside ditches on Arkell Road. While these assumptions might have been appropriate for the previous concept plan where the stormwater management pond was located adjacent to Arkell Road and a similar number of lots were proposed for a larger area, the percent imperviousness and legal outlet for the proposed development concept must be confirmed as the area adjacent to Arkell Road is no longer part of the development concept. • Site Grading Plan, generally showing the site grading and drainage patterns on the subject lands and confirming legal outlet. • Traffic Impact Study, due to the proximity and potential impacts to Watson Road South, an updated Traffic Impact Study is required to support the development. We acknowledge that the applicant has provided a Traffic Impact Study from 2006, however this needs to be updated to reflect current traffic volumes and the revised development concept. The new concept proposes a single entrance from Watson Road South where as the previous traffic study included two entrances to the site. • Noise and Vibration Study, due to the proximity of the existing railway, an updated Noise and Vibration Study is required to support the development. We acknowledge that the applicant has provided a Noise and Vibration Study from 2006, however this needs to be updated to reflect the revised development concept, current rail volume data and to			4) Stormwater Quality Control: FSSWM Report: The proposed treatment train includes bioswales and a dry pond. However, a significant portion of the road network appears to drain directly to the pond. Please consider inclusion of an oil-grit separator at the end of the internal storm sewer network, prior to the dry pond, for treatment of road runoff and easy maintenance / clean-out. The FSSWM report states that the bioswale system falls short of the volume required for 80% TSS removal, and the outstanding treatment capacity will be provided by the dry pond. Furthermore, in addition to providing quality and quantity control for the site, the swales convey drainage from large external areas. Please provide additional discussion on stormwater quantity and quality control, ensuring that Enhanced level of protection is met (detention time, % TSS removal calculations, etc.) 5) Bypass Swales Maintenance: Grading and Servicing Plan: Given that the proposed roads drain to the bypass swales, the Township would own and maintain the swales. Also, the bypass swales appear to be part of the proposed lots. Please indicate easements for the swales and access roads on the drawings for maintenance purposes. 6) Sediment Control Pond: FSSWM Report: Given the large area of the site, please include a pond as one of the erosion and sediment controls, to be sized per the Erosion and Sediment Control Guideline for Urban Construction. 7) Fire Water Storage: Grading and Servicing Plan: Please indicate the proposed location of fire water storage on the engineering drawings. 8) Noise and Vibration Study: Per our review letter dated May 15, 2023,	Similarly, the south (by-pass) swale will promote infiltration, but its primary function is to convey clean runoff from upstream lands safely through the subject property. The by-pass channel will be heavily vegetated and is not expected to erode due to its very shallow longitudinal slope. As such, construction of maintenance access roads should not be required. Our experience with trying to dry sediment is that it can take weeks and a lot of machine effort. Rather than a dedicated drying area, our preferred method is to use a vac truck with hoses that can reach remote locations. The sediment is then transported in a sealed unit to avoid any spillage. 6. A detailed ESC plan, including temporary sediment ponds, can be provided as the detailed design progresses. 7. Fire Storage tanks have been identified on the servicing plan. Tanks are to be located within the future ROW. 8. An updated Noise and Vibration Study can be provided as a condition of approval. It is important to get the lot layout finalized before this study is completed as the recommendations will apply to the closest proposed receptors.		

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	confirm berm and setback requirements from the existing railway.			please provide an updated Noise and Vibration Study to reflect the revised development concept, current rail volume data and to confirm berm and setback requirements from the existing railway.			
Report: County of Wellington (Planning)							
1.	General note – It is noted that the Province has prepared a draft proposed Provincial Planning Statement. The new PPS combines the PPS and Growth into one document; however, this document is still under review. Any comments made as part of these preliminary planning notes have been made under the current policy framework. The applicant may wish to consider the timing of their resubmission in relation to the implementation of the new PPS. It's understood that the applicant has submitted some studies to the County in 2022; however, it is requested that a formal complete resubmission with all studies (including the ones identified as already being submitted separately) are provided under one cover with an accompanying cover letter to the County and the Township for formal review. • Planning staff would request that the Draft Plan be reviewed concurrently with the Official Plan and Zoning By-law amendment. However, additional discussion regarding process may be helpful. • Public Engagement – It is understood that these applications did not progress to a Public Meeting. Due to the time that has passed since the original proposal, the Township may want to consider hosting an Open House in advance of a statutory Public Meeting. The applicant has proposed a "public participation program" which has the owner meeting with land owners that abut the subject lands. If this approach is accepted by the Township, it is suggested that written documentation of this engagement strategy and comments received by the Public be provided to the Township in a singular package to form part of the planning file.				• The applicant is not re-submitting all of the documents from 2006. The Township has a system available to include all documents from the applicant and agencies. • The applicant wants to hold the Public Meeting as soon as possible. • Additional discussion with the Township regarding Parks will be much appreciated. • Additional discussion with the Township regarding sign requirements will be much appreciated. • It is noted that the provincial policies were updated in 2024 re: no MCR. • As previously noted, the re-design of the proposed development has avoided any significant removal of trees in the plantation. • If a park is desired by the Township, a park site in the plantation is an option. We look forward to discussing options with Township staff/Council.		

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	• The proposal does not include any parks or open space. Additional discussion on need for park space within the Township and within this development will be required. • Additional discussion regarding the different sign options would be helpful. County planning staff would like to explore preserving the trees on site, the lot configurations, the lot configuration off of Watson Road S, location of the storm pond, transition to the rural area etc. • Current provincial policies – Expansion to a rural settlement area is only permitted through the Municipal Comprehensive Review (MCR) process; however, Section 2.2.9.7 allows "minor" adjustments. Generally, the inclusion of 39 plus lots would not be considered minor. Additional justification through a Planning Justification Report would be required to demonstrate that this proposal could meet Provincial policy; however, consideration of the County's MCR process and also the updated Provincial Planning Statement is pertinent.						
2.	**Re-Submission Requirements for Existing Official Plan Amendment, Draft Plan of Subdivision and Zoning By-law Amendment:** Included below is a preliminary list of potential supporting studies that are required for the resubmission of these applications: • Planning Justification Report – including a draft by-law for the proposed Official Plan and Zoning Amendment including schedules; an MDS review; summary of all supporting studies; overview of how this development is considered "minor" or moderate in scale, a review of Section 4.8 of the Official Plan, assessment of impacts to mineral aggregate resources in the area etc. • Environmental Impact Assessment, Arborist Report, Tree Inventory and Preservation Plan. The scoping of the EIS can be a topic of discussion. • Agricultural Impact Assessment • Alternative Site Evaluation Study				• A PJR has not been submitted at this time. This report will be forthcoming once the Township's comments on the technical reports have been received. • Letter reports addressing: Alternative Locations for the expansion of Arkell, Mineral Aggregate Resources and MDSI impacts have been provided. The MDS I report is part of the recent submission. • A Source Water Protection Form was submitted. • An updated Noise/Vibration Study can be provided as a condition of approval. The proposed development has been designed to be well setback from the GJR and the recommendations for a acoustic berm can be included as a condition of draft plan approval.		

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	- Source Water Protection Form and/or any other additional items as requested by Source Water Protection staff. - Updated Noise/Vibration Study - Update Traffic Impact Study – separate comments from the County's Roads Department are anticipated. - Any other studies and/or plans as identified by the Township's consultants are required as part of the future resubmission. This includes any requests for specific existing studies to be updated. - The Hydrogeological Study should also address the Paris Galt Moraine policies of the Official Plan (i.e. 4.9.7). A review of servicing options that addresses Section 11.2.3 should also be undertaken. - The subdivision application will require all Plans, including existing topographical surveys, as identified in the Township's Municipal Development Standard (Puslinch Municipal Development Standards) unless the Township's consultants requiring something different. All studies are to meet the requirements of the County Official Plan, including Section 4.6 Impact Assessment.				- An updated Traffic Impact Study has been prepared and is included in the recent submission. The applicant's consultants attempted to pre-consult with County Roads Department but staff denied this request. - As previously noted, the residential development is not located in the Paris Galt Moraine (Schedule C7). - The applicant will provide all Plans as part of the Draft Plan of Subdivision application.		
Report: Township of Puslinch Building Department							
1.	No comments at this stage from a building code perspective						
Report: Township of Puslinch By-law Enforcement							
1.	By-law has no comments or concerns at this time.						
Report: Township of Puslinch Public Works							
1.	No concerns, sight lines are good				- Noted.		
GJR							
				Traffic Impact Study Possibility of additional signals required for new driveway entrance to the development.	Noted. Given the traffic volumes generated by the proposed development are low and as detailed in Section 6.1 of the Addendum Traffic Impact Study, the proposed Access Connection at Watson Road South is forecast to operate below		

	Township Initial Comments (May 18, 2023)	Page / Section	Applicant Response (Date)	Township Response (April 02, 2024)	Applicant Response (August 14, 2025)	Township Response (Date)	Applicant Response
					capacity at a LOS "A" and LOS "B" during the a.m. and p.m. peak hours respectively. Accordingly, signals are not warranted at this intersection and therefore not recommended.		
				39 Residential Lots - Fire pond preferred at lot 11 closer to tree canopy. - No planting of tree canopies lots adjacent to the GJR within 8 meters of the railway property for fire safety reason	- The revised development concept has been redesigned to provide for 44 lots. - No tree planting within 8 m of the GJR is proposed.		
				46 Residential Lots - Fire pond preferred 3.1 ha open lot near tree canopy - No planting of tree canopies lots adjacent to the GJR within 8 meters of the railway property for fire safety reason	- No tree planting within 8 m of the GJR is proposed.		
				Noise and vibration study - May 17, 2006. Report is obsolete. Development standards adjacent to railways have changed. Up to date test 2024 required. The GJR has grown the business considerably since this report was completed. There is no By-Law in place to eliminate train horn use on approaching railway crossing at Watson Rd. Railway gates would be required to even consider the cessation By-Law. This By-Law would need to be approved by Puslinch counsel, insurance coverage increased to list GJR and City of Guelph and its railway operator as additional insured. Warning clauses need to be updated to today's	- An updated Noise and Vibration Study can be completed as a condition of draft plan approval.		

	Township **Initial Comments (May 18, 2023)**	**Page / Section**	**Applicant Response (Date)**	**Township Response (April 02, 2024)**	**Applicant Response (August 14, 2025)**	**Township Response (Date)**	**Applicant Response**
				standards, In no way or form can residents/owners of the development oppose or form complaints against the GJR, City of Guelph and its operator regarding the operations or planned growth projects within the GJR ROW. Letter from GJR dated March 29, 2005 is obsolete and no longer valid.			
				Traffic Site Lines No planting of tree canopies lots adjacent to GJR within 8 meters of the railway property for fire safety reason Possibility of additional signals required for new driveway entrance to the development.	• An updated Traffic Impact Assessment was completed. This study addressed sight lines and requirements for infrastructure improvements. • No tree planting within 8 m of the GJR is proposed.		

ADDENDUM TRAFFIC IMPACT STUDY

SECTION OF LOTS 7,8 AND 9, CONCESSION 10
TOWNSHIP OF PUSLINCH
COUNTY OF WELLINGTON

PREPARED FOR:

**TIMBERWORX CUSTOM HOMES INC., SLOOT
CONSTRUCTION LTD., JOHN SLOOT
INVESTMENTS LTD.**

PREPARED BY:

**C.F. CROZIER & ASSOCIATES INC.
211 YONGE STREET, SUITE 600
TORONTO, ON M5B 1M4**

AUGUST 2025

CFCA FILE NO. 2433-6646

CROZIER
CONSULTING ENGINEERS

Revision Number	Date	Comments
Rev.0	March 2024	Issued for 1st Submission
Rev.1	August 2025	Issued for 2nd Submission

EXECUTIVE SUMMARY

C.F. Crozier & Associates Inc. (Crozier) was retained by Timberworx Custom Homes Inc., Sloot Construction Ltd., John Sloot Investments Ltd. to undertake a Traffic Impact Study in support of the Zoning By-Law Amendment application for the property located on sections of Lots 7, 8 and 9 of Concession 10, in the Township of Puslinch, County of Wellington. The purpose of the study is to assess the impacts of the proposed development on the boundary road network and to recommend required mitigation measures, if warranted. This study has been completed in accordance with the County of Wellington's Traffic Impact Study Guidelines (2021).

A Traffic Impact Study was previously prepared in March 2024. The addendum herein, addresses the Town staff comments on first submission.

As illustrated on the conceptual site plan prepared by Stovel and Associates Inc. dated February 2024, the development proposal includes the following:

- Forty-four (44) Single detached residential properties.
- Associated internal roads.
- Proposed Site Accesses via Watson Road South and Arkell Road

The trip generation and traffic operations analysis summarized herein are based on an older site plan which had 50 residential properties. However, this was conservatively maintained as no material change in transportation operations or recommendations is expected.

Under 2023 existing traffic conditions, the study intersection of Arkell Road and Watson Road South is operating below capacity with minimal delay during both weekday a.m. and p.m. peak hours. The study intersections include Arkell Road and Watson Road South and the proposed access connection to Watson Road South.

The proposed development is expected to generate 40 and 52 two-way primary trips in the a.m. and p.m. peak hours, respectively.

Under the ultimate 2031 future total conditions,

- the all-way stop-controlled intersection of Arkell Road and Watson Road South is projected to operate below capacity at a LOS "A" and "B" during the weekday a.m. and p.m. peak hours, respectively. Average intersection control delays of 9.5 and 14.3 seconds in the a.m. and p.m. peak hours, respectively and maximum volume-to-capacity ratios of 0.27 (EB) and 0.54 (NB) are expected in the weekday a.m. and p.m. peak hours, respectively.

- The proposed site access connection at Watson Road South is forecast to operate at a LOS "A" and "B" during the a.m. and p.m. peak hours, respectively.

- Overall, the nearby road network is projected to operate adequately without any capacity constraints under the ultimate 2031 future total scenario. The nearby road network is expected to operate similarly or better under the 2026 horizon year.

- These operations are similar to the 2031 and 2026 Future Background traffic operations. Therefore, operations are expected to be similar with or without the proposed development.

The proposed access connections to Watson Road South and Arkell Road are satisfactory per the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR) with regards to sight distance, access spacing, corner clearance and Transport Canada's Grade Crossing Standards with regards to access spacing.

Based on the study findings, the development application can be supported from a traffic operations perspective as the nearby road network can accommodate the increase in traffic volumes attributable to the proposed development located on sections of Lots 7, 8 and 9 of Concession 10, in the Township of Puslinch, County of Wellington.

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LIST OF APPENDICES

1.0 INTRODUCTION

C.F. Crozier & Associates Inc. (Crozier) was retained by Timberworx Custom Homes Inc., Sloot Construction Ltd., John Sloot Investments Ltd. to undertake a Traffic Impact Study in support of the Zoning By-Law Amendment application for the property located on sections of Lots 7,8 and 9 of Concession 10, in the Township of Puslinch, County of Wellington. The purpose of the study is to assess the impacts of the proposed development on the boundary road network and to recommend required mitigation measures, if warranted.

The Traffic Impact Study assesses the impacts of the proposed development on the boundary road network and recommends required mitigation measures as warranted. In accordance with the procedures set out in the County of Wellington's Traffic Impact Study Guidelines (2021, a Traffic Impact Study was previously prepared in March 2024. The addendum herein, addresses the Town staff comments on first submission. The terms of reference correspondence and Town staff comments on first submission are included in **Appendix A**.

2.0 DEVELOPMENT PROPOSAL

As illustrated on the conceptual site plan prepared by Stovel and Associates Inc. dated February 2024, the development proposal includes the following:

- Forty-four (44) Single detached residential properties.
- Associated internal roads.
- Proposed Site Accesses via Watson Road South and Arkell Road

It is noted that the site access off Arkell Road is for emergency purposes only hence vehicular traffic was not assigned to it. Refer to **Appendix B** for the Site Plan.

3.0 EXISTING CONDITIONS

This section outlines the current conditions of the transportation network in the vicinity of the subject site. Details of the study road network, including traffic controls, lane configurations, speed limits, active transportation infrastructure and other relevant transportation elements are identified.

3.1 Development Lands

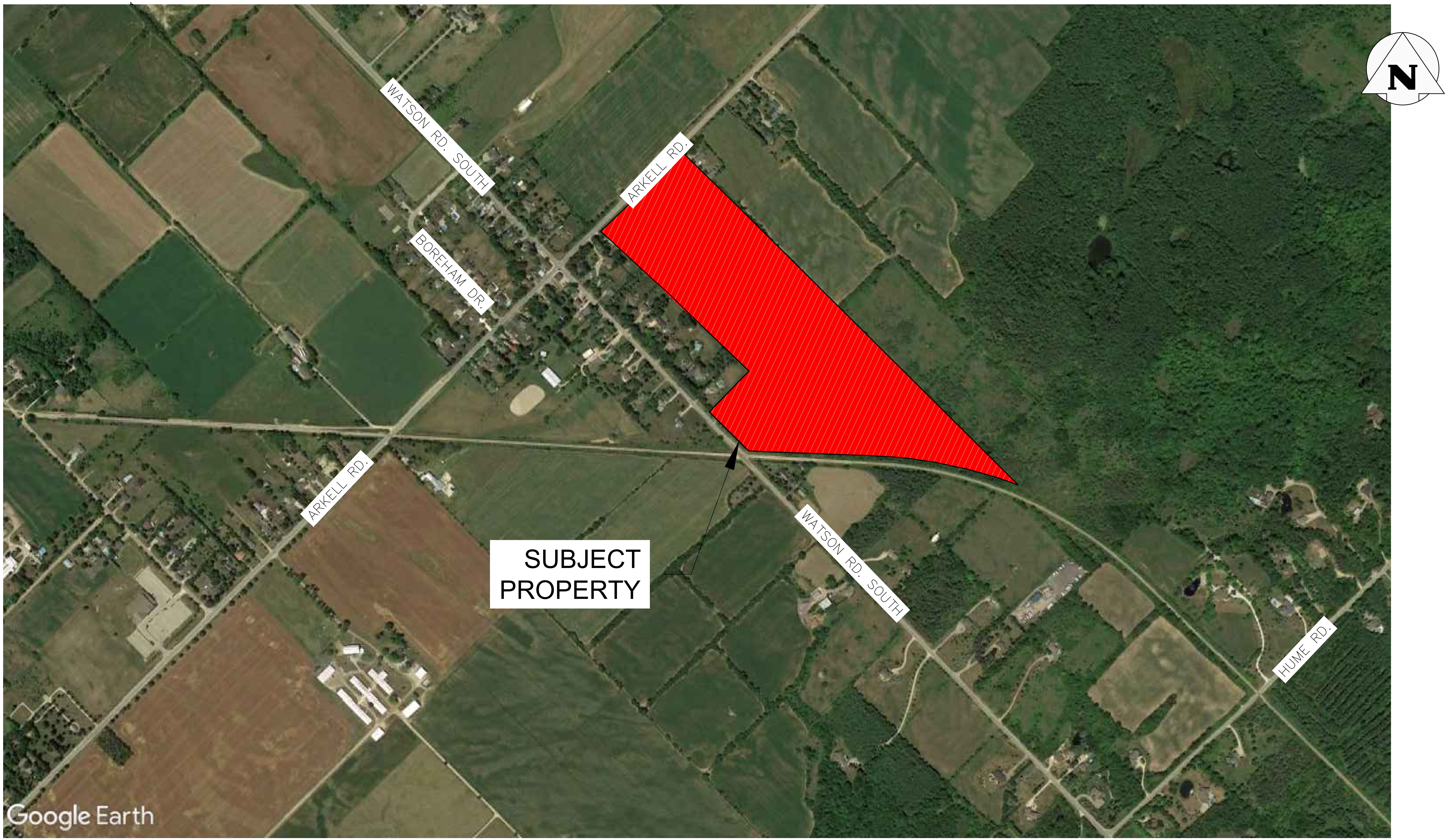
The subject lands cover an area of approximately 17 ha and currently consists of agricultural/vegetated land. The property, located on the northeast corner of the intersection at Arkell Road and Watson Road South, is bounded by a residential property to the west, agricultural/vegetated lands to the north, the Guelph Junction Railway to the east, and Watson Road/residential properties to the south. The site location and surrounding area are illustrated in **Figure 1.**

3.2 Study Area

The Traffic Impact Study analyzes the following study intersections as confirmed with Town of Puslinch and County of Wellington staff (refer to **Appendix A**).

- Watson Road South and Arkell Road
- Proposed Site Access via Watson Road South

Details of the boundary road network is provided in **Section 3.3.**



TIMBERWORX CUSTOM HOMES
PARTS OF LOTS 7 & 8, CONCESSION 10
TOWNSHIP OF PUSLINCH

SITE LOCATION

CROZIER
CONSULTING ENGINEERS

211 YONGE STREET
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TORONTO, ON M5B 1M4
416-477-3392 T
WWW.CFCROZIER.CA

Drawn	Design	Project No.	
R.L.		2433–6646	
Date	Check	Scale	Dwg.
08/05/2025	M.I.	N.T.S	FIG. 1

3.3 Boundary Road Network

The boundary road network is described in **Table 1** below.

Table 1: Boundary Road Network

Feature	Roadway	
	Arkell Road	**Watson Road South**
Alignment	Two-Way (North-South)	Two-Way (East-West)
Classification[1]	Collector	Collector
Jurisdiction	County of Wellington	Town of Puslinch
Speed Limit	50 km/h	50 km/h
Pedestrian Facilities	Yes (Only available on the east side, north of Watson Road)	None
Cycling Facilities	None	None

Table 2 outlines the existing traffic control, configurations, at the study intersections on the boundary road network.

Table 2: Study Intersections

Intersection	Control	App.[1]	Major Street	Lane Configurations
Arkell Road and Watson Road South	All-Way Stop	4	Arkell Road	EBLTR; WBLTR; NBLTR; SBLTR

Note 1: App. - number of approaches for a given intersection.

Figure 2 illustrates the existing boundary road network, including lane configurations, lane storage lengths, and intersection control.

3.4 Existing Active Transportation Network

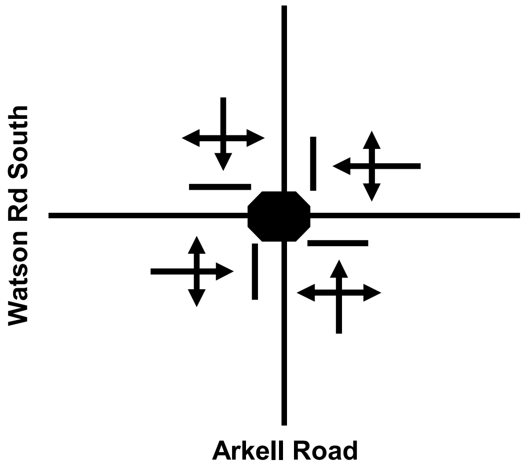
Sidewalks are available on the east side of Arkell Road, south of the intersection of Arkell Road and Watson Road, no cycling facilities exist on the boundary roads near the site.

3.5 Existing Transit Services

Given the rural nature and largely undeveloped surrounding lands, there are no transit services available within the study area currently.

3.6 Traffic Data

Turning movement counts (TMC) were collected at the study intersection from 7:00 a.m. to 7:00 p.m. on Thursday, July 28, 2022, by Wellington County. The traffic count data is summarized in **Appendix C.** 2023 existing traffic volumes were derived by applying annual growth rate of 2% to 2022 volumes. **Figure 3** illustrates the 2023 existing traffic volumes.



Legend

xx	A.M. Peak Hour Traffic Volumes
(xx)	P.M. Peak Hour Traffic Volumes
{xx}	Weekend Peak Hour Traffic Volumes

Arkell Developments

Boundary Road Network

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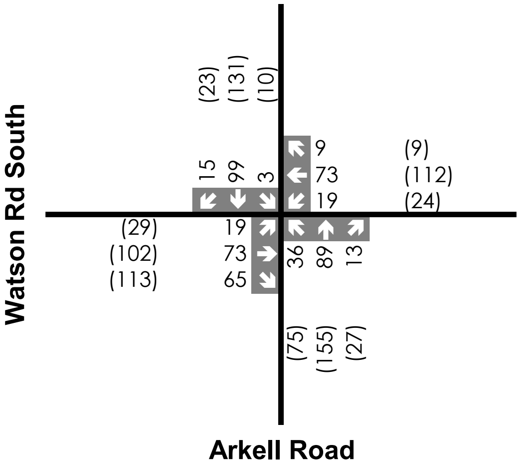
Figure 2

Project No. 2433-6646
Date. 45321
Analyst. Parth Bhatt



Legend

xx A.M. Peak Hour Traffic Volumes
(xx) P.M. Peak Hour Traffic Volumes
{xx} Weekend Peak Hour Traffic Volumes

Arkell Developments

Existing Traffic Volumes

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Figure 3

Project No. 2433-6646
Date. 45321
Analyst. Parth Bhatt

3.7 Traffic Modeling

Synchro software (Version 11) was used for the intersection capacity and queueing analysis. Capacity Analysis per the general guidelines from the County and Town were used for the study intersections. All parameters for the intersection analysis were based on the Synchro default values.

The intersection assessment is based on the method outlined in the "Highway Capacity Manual, 2010" using Synchro modelling software. Intersections are assessed using a Level of Service metric, with ranges of delay assigned a letter from "A" to "F." For stop-controlled intersections, a Level of Service "A" or "B" would typically be measured during off-peak hours when lesser traffic volumes are on the roadways. Levels of Service "C" through "F" would typically be measured in the commuter peak hours when more significant vehicle volumes cause longer travel times. The Level of Service (LOS) definitions for signalized and stop control intersections are included in **Appendix D**.

3.8 Intersection Operations

The traffic operations at the study intersections were analyzed based on the 2023 existing traffic volumes illustrated in **Figure 3**. Detailed capacity analysis worksheets are included in **Appendix E**. **Table 4** outlines the 2023 existing traffic operations.

Table 4: 2023 Existing Traffic Operations Summary

Intersection	Control	Peak Hour	Level of Service[1]	Control Delay	v/c ratio[2]	95th Percentile Queue Length > Storage Length
Arkell Road and Watson Road South	All-Way Stop	A.M.	A	8.8s	0.21(EB)	None
		P.M.	B	11.4s	0.42(NB)	None

Note 1: Level of Service – The Level of Service (LOS) of a signalized intersection is based on the average control delay per vehicle. The LOS of unsignalized intersection is based on the critical control delay per approach.
Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection where the maximum v/c ratio does not exceed the critical thresholds.

As outlined in **Table 4**, under the 2023 existing conditions scenario, the all-way stop-controlled intersection of Arkell Road and Watson Road South is operating below capacity at a Level of Service (LOS) “A” and “B” during the weekday a.m. and p.m. peak hours, respectively. The average intersection control delay is 8.8s and 11.4s in the weekday a.m. and p.m. peak hours, respectively, and the maximum volume-to-capacity ratios are 0.21 (EB) and 0.42 (NB) in the weekday a.m. and p.m. peak hours, respectively.

4.0 FUTURE BACKGROUND CONDITIONS

This section summarizes the future background conditions of the study road network and provides details relating to growth rates, future transportation network improvements, and background developments within the study area.

4.1 Study Horizons

As confirmed through Terms of Reference correspondence, the full buildout year as well as five years beyond buildout is required, consistent with the County guidelines. Therefore, the 2026 horizon year (anticipated full buildout year) as well as 2031 were selected to assess future operations of the boundary road network.

4.2 Future Roadway Improvements

Currently, there are no planned improvements to roadway network within the study area. Therefore, the future background and future total analysis herein assumes the existing roadway configurations in the 2026 and 2031 horizon years.

4.3 Growth Rate

The Town recommended annual growth rate of 2%, compounded annually, was applied to all movements.

4.4 Background Developments

As confirmed by Town's staff, no background developments were identified in the vicinity of the site.

4.5 Intersection Operations

The traffic operations at the study intersections were analyzed based on the 2026 and 2031 future background traffic volumes illustrated in **Figures 4 and 5**. Detailed capacity analysis worksheets are included in **Appendix E**. **Tables 6 and 7** outline the 2026 and 2031 future background traffic operations.

Table 6: 2026 Future Background Traffic Operations

Intersection	Control	Peak Hour	Level of Service[1]	Control Delay	v/c ratio[2]	95th Percentile Queue Length > Storage Length
Arkell Road and Watson Road South	All-Way Stop	A.M.	A	9.0s	0.24(EB)	None
		P.M.	B	12.1s	0.46(NB)	None

Note 1: Level of Service – The Level of Service (LOS) of a signalized intersection is based on the average control delay per vehicle. The LOS of unsignalized intersection is based on the critical control delay per approach.
Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection where the maximum v/c ratio does not exceed the critical thresholds.

Table 7: 2031 Future Background Operations Summary

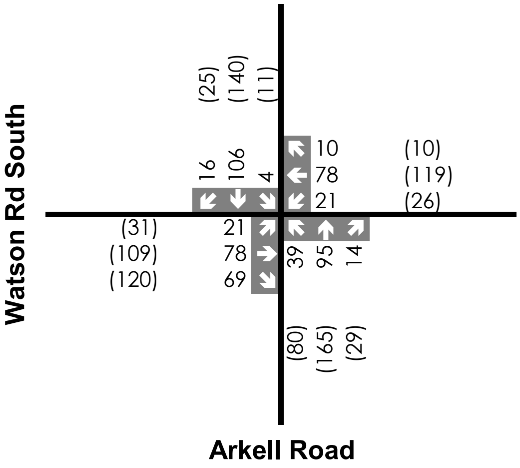
Intersection	Control	Peak Hour	Level of Service[1]	Control Delay	v/c ratio[2]	95th Percentile Queue Length > Storage Length
Arkell Road and Watson Road South	All-Way Stop	A.M.	A	9.3s	0.27(EB)	None
		P.M.	B	13.7s	0.53(NB)	None

Note 1: Level of Service – The Level of Service (LOS) of a signalized intersection is based on the average control delay per vehicle. The LOS of unsignalized intersection is based on the critical control delay per approach.

Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection where the maximum v/c ratio does not exceed the critical thresholds.

As shown in **Table 7**, under 2031 future background conditions, the all-way stop-controlled intersection of Arkell Road and Watson Road South is projected to operate below capacity at a LOS "A" and "B" during the weekday a.m. and p.m. peak hours, respectively. Average intersection control delays of 9.3 and 13.7 seconds in the a.m. and p.m. peak hours, respectively and maximum volume-to-capacity ratios of 0.27 (EB) and 0.53 (NB) are expected in the weekday a.m. and p.m. peak hours, respectively. The intersection is forecast to operate efficiently with reserve capacity to accommodate future increases in traffic volumes.

The study intersection is forecast to operate similarly or better under the 2026 future background compared to the 2031 future background. No traffic operation issues are forecast on the boundary road network.



Legend

xx A.M. Peak Hour Traffic Volumes
(xx) P.M. Peak Hour Traffic Volumes
{xx} Weekend Peak Hour Traffic Volumes

Arkell Developments

2026 Future Background Traffic Volumes

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Figure 4

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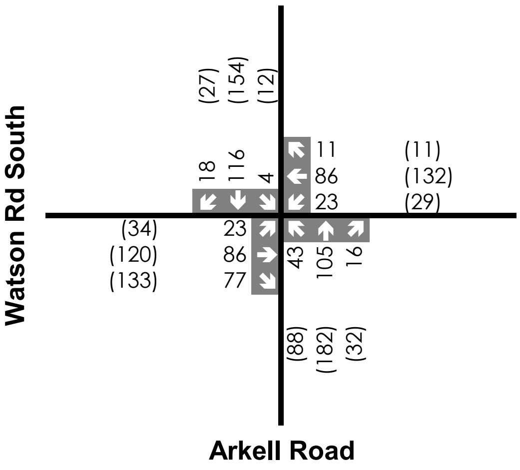
Analyst. Parth Bhatt



Legend

xx A.M. Peak Hour Traffic Volumes
(xx) P.M. Peak Hour Traffic Volumes
{xx} Weekend Peak Hour Traffic Volumes

Arkell Developments

2031 Future Background Traffic Volumes

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Figure 5

Project No. 2433-6646
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5.0 SITE GENERATED TRAFFIC

The proposed development will result in new traffic turning movements on the boundary road network that would otherwise not exist. This section presents the generated trips and trip assignment through the study intersections.

5.1 ITE Trip Generation

To forecast the trips generated by the development, the ITE Trip Generation Manual, 11th Edition was used. The ITE Trip Generation Manual is a compendium of industry collected trip generation data across North America for a variety of land uses and is used industry wide as a source for trip generation forecasts. Given the site location, the general urban/suburban setting was used; fitted curve estimates were used if available and deemed statistically valid per the ITE Trip Generation Manual (i.e., more than 20 data points and coefficient of determination R2 > 0.75). The trips generated by the proposed development are presented in **Table 8**. It is noted that the trip generation is based on an older site plan which had 50 residential units. This was conservatively maintained as no material change in traffic operations or recommendations is expected.

Table 8: Total Site Generated Traffic

Land Use	Units	Peak Hour	Equation Used	Inbound	Outbound	Total
Single-Family Detached Housing (LUC 210)	50	A.M.	Ln(T)=0.91*Ln(X)+0.12	10 (25%)	30 (75%)	40
		P.M.	Ln(T)=0.94*Ln(X)+0.27	33 (63%)	19 (37%)	52

As shown in **Table 8**, the proposed residential development is expected to generate a total of 40 and 52 two-way trips in the a.m. and p.m. peak hours, respectively.

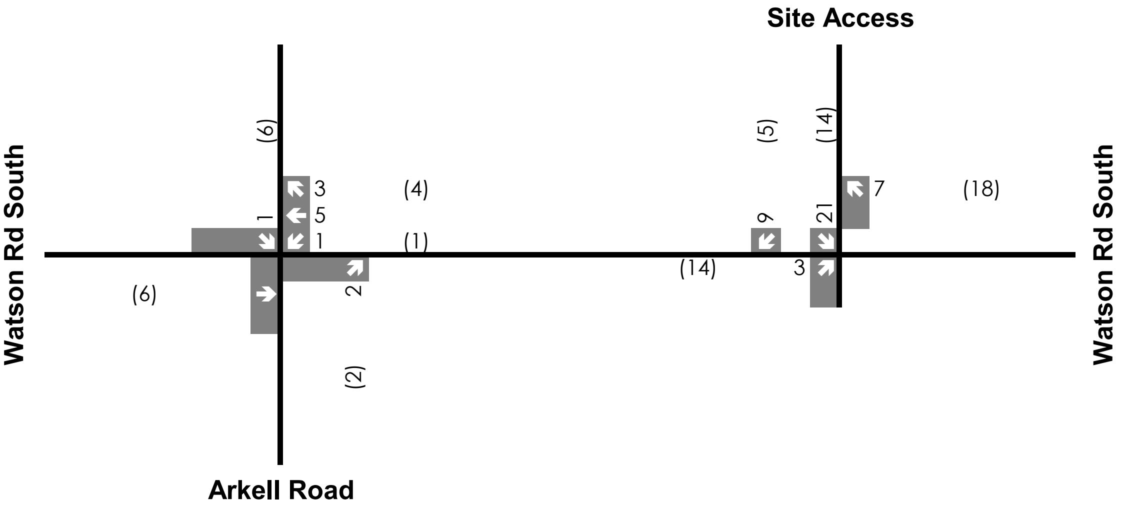
5.2 Trip Distribution and Assignment

The Transportation Tomorrow Survey (TTS) is a comprehensive travel data survey conducted in the Greater Toronto and Hamilton Area. Data from the 2016 TTS was used to determine the peak hour trip distribution at the site for the residential land use proposed at the site.

The inbound and outbound trip distributions were derived by filtering TTS data with a trip purpose of “Home”, destined to and originating from the subject GTA Zone 8303. The A.M. and P.M. distributions were determined by filtering for trips starting during the periods of 6:30 A.M. – 9:30 A.M. and 3:30 P.M. – 6:30 P.M., respectively. **Appendix F** provides the TTS query used to determine the site trip distribution. **Table 9** summarizes the trip distribution at the site. **Figure 6** illustrates the trip assignment for the proposed development.

Table 9: Trip Distribution

Direction	A.M. Inbound	A.M. Outbound	P.M. Inbound	P.M. Outbound
Northwest	24%	18%	32%	40%
North	0%	0%	0%	0%
Northeast	0%	0%	7%	0%
East	0%	18%	15%	0%
Southeast	0%	0%	0%	0%
South	0%	0%	0%	0%
Southwest	38%	7%	12%	13%
West	38%	58%	35%	47%
Total	**100%**	**100%**	**100%**	**100%**



Legend

xx	A.M. Peak Hour Traffic Volumes
(xx)	P.M. Peak Hour Traffic Volumes
{xx}	Weekend Peak Hour Traffic Volumes

Arkell Developments

Trip Assignment

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Figure 6

Project No. 2433-6646
Date. 45321
Analyst. Parth Bhatt

6.0 TOTAL TRAFFIC CONDITIONS

This section discusses the traffic operations of the study intersections with the addition of the new site generated trips. It's noted the future total analysis outlined herein is based on the trips generated for an older site plan with 50 residential units. This was conservatively maintained as no material change in traffic operations or recommendations is expected.

6.1 Intersection Operations

Traffic operations at the study intersections were assessed with the addition of the new site generated trips to the future background traffic volumes. The 2026 and 2031 future total traffic volumes are illustrated in **Figures 7 and 8**. **Tables 10 and 11** outline the future total traffic operations for the 2026 and 2031 horizon years, respectively. Detailed capacity analysis worksheets are included in **Appendix E.**

Table 10: 2026 Future Total Traffic Operations Summary

Intersection	Control	Peak Hour	Level of Service[1]	Control Delay	v/c ratio[2]	95th Percentile Queue Length > Storage Length
Arkell Road and Watson Road South	All-Way Stop	A.M.	A	9.1s	0.24(EB)	None
		P.M.	B	12.4s	0.47(NB)	None
Site Access via Watson Road South	Stop (Minor Street)	A.M.	A(SB)	9.6s	0.07(WB)	None
		P.M.	B(SB)	10.3s	0.11(WB)	None

Note 1: Level of Service – The Level of Service (LOS) of a signalized intersection is based on the average control delay per vehicle. The LOS of unsignalized intersection is based on the critical control delay per approach.
Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection where the maximum v/c ratio does not exceed the critical thresholds.

Table 11: 2031 Future Total Operations Summary

Intersection	Control	Peak Hour	Level of Service[1]	Control Delay	v/c ratio[2]	95th Percentile Queue Length > Storage Length
Arkell Road and Watson Road South	All-Way Stop	A.M.	A	9.5s	0.27(EB)	None
		P.M.	B	14.3s	0.54(NB)	None
Site Access via Watson Road South	Stop (Minor Street)	A.M.	A(SB)	9.6s	0.07(WB)	None
		P.M.	B(SB)	10.3s	0.11(WB)	None

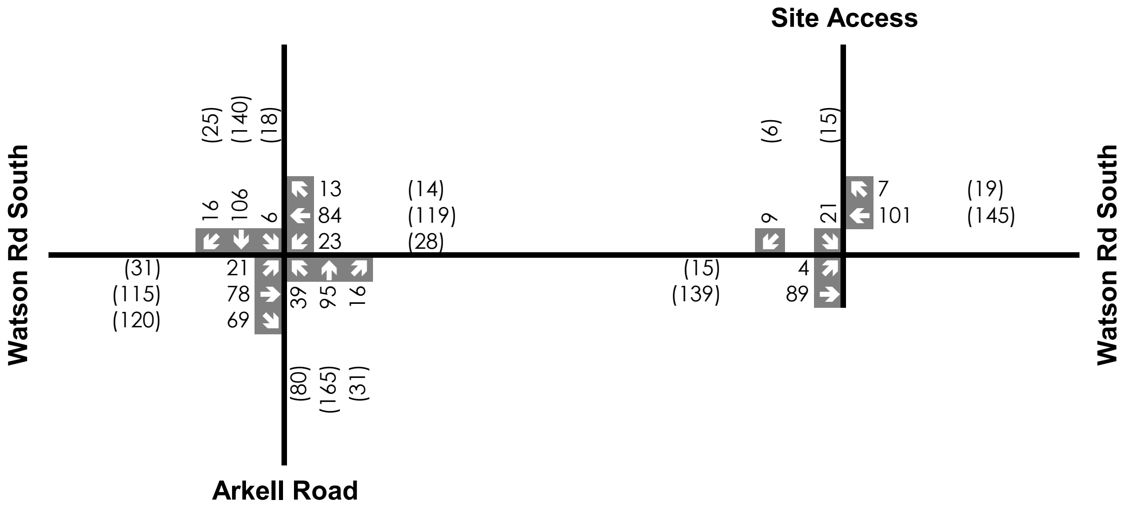
Note 1: Level of Service – The Level of Service (LOS) of a signalized intersection is based on the average control delay per vehicle. The LOS of unsignalized intersection is based on the critical control delay per approach.
Note 2: The critical v/c ratio is considered to be the maximum v/c ratio for movements at the intersection where the maximum v/c ratio does not exceed the critical thresholds.

Under the ultimate 2031 future total conditions, the study intersections are projected to operate similarly compared to the corresponding 2031 future background scenario, with minor additional delays attributable to the proposed development traffic.

As shown in **Table 11**, under 2031 future total conditions, the all-way stop-controlled intersection of Arkell Road and Watson Road South is projected to operate below capacity at a LOS "A" and "B" during the weekday a.m. and p.m. peak hours, respectively. Average intersection control delays of 9.5 and 14.3 seconds in the a.m. and p.m. peak hours, respectively and maximum volume-to-capacity ratios of 0.27 (EB) and 0.54 (NB) are expected in the weekday a.m. and p.m. peak hours, respectively.

The proposed Access Connection at Watson Road South is forecast to operate below capacity at a LOS "A" and LOS "B" during the a.m. and p.m. peak hours respectively.
Overall, the boundary road network is projected to operate adequately without any capacity constraints under the ultimate 2031 future total scenario. The boundary road network is expected to operate similarly or better under the 2026 horizon year.

Based on the analysis herein, the proposed development is not expected to significantly alter the traffic operations of the study intersections. The proposed development can be supported from a traffic operations perspective.



Legend

xx	A.M. Peak Hour Traffic Volumes
(xx)	P.M. Peak Hour Traffic Volumes
{xx}	Weekend Peak Hour Traffic Volumes

Arkell Developments

2026 Total Traffic Volumes

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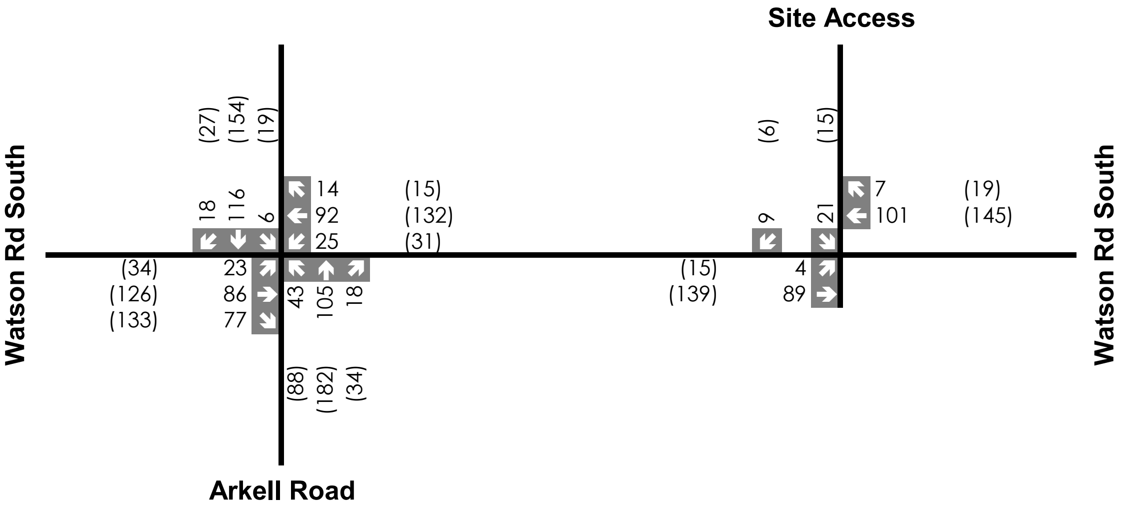
Figure 7

Project No. 2433-6646
Date. 45321
Analyst. Parth Bhatt



Legend

xx	A.M. Peak Hour Traffic Volumes
(xx)	P.M. Peak Hour Traffic Volumes
{xx}	Weekend Peak Hour Traffic Volumes

Arkell Developments

2031 Total Traffic Volumes

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Figure 8

Project No. 2433-6646
Date. 45321
Analyst. Parth Bhatt

7.0 SITE ACCESS SAFETY REVIEW

In the following section, the geometrics of the proposed site accesses were reviewed against the guidelines provided in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR).

7.1 Sight Distance Assessment

The available sightlines at the site access connections to Watson Road South and Arkell Road were measured and compared to the standards set out in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR). Sight distance was measured from the proposed site accesses using the following assumptions:

- A standard driver eye height of 1.08 metres for a passenger car, and
- A 4.4 metre setback from the approximate extension of the outer curb to represent a vehicle waiting to exit the site.

Intersection sight distance is calculated using equation 9.9.1 from the GDGCR as outlined below:

*ISD = 0.278 * V major * tg*

Where;
ISD = Intersection Sight Distance
V major = design speed of roadway (km/h)
tg = assumed time gap for vehicles to turn from stop onto roadway (s)

The design speed of a Collector Road in a suburban environment is typically 10-20 km/h greater than posted speed limit. The posted speed limit on Watson Road South and Arkell Road at the site frontages are both 50 km/h. Therefore, design speed of 60 km/h was assumed for both. **Table 12** outlines the sight distance analysis for the proposed site accesses.

Table 12: Sight Distance Analysis

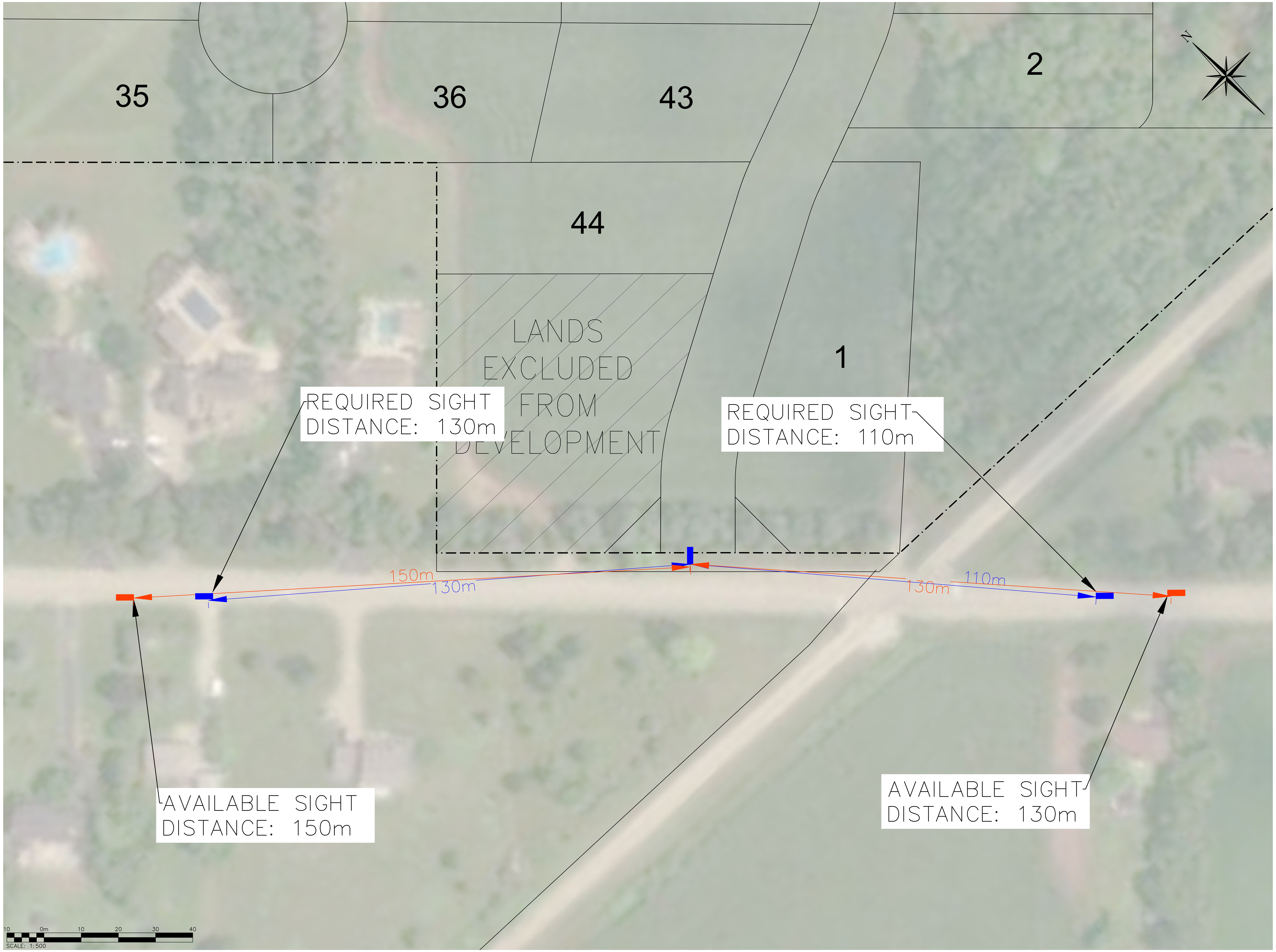
Feature	Site Access at Watson Road South	Emergency Site Access at Arkell Road
Access Type	Full moves	Only Emergency Access
Intersection Control	Stop Control on Minor Road	Stop Control on Minor Road
Speed Limit of Roadway	50 km/h	50 km/h
Assumed Design Speed	60 km/h	60 km/h
Design Vehicle	Passenger Car	Passenger Car
Base Time Gap	6.5 s (for right-turn) [1] 7.5 s (for left turn) [2]	6.5 s (for right-turn) [1] 7.5 s (for left turn) [2]
Vertical Alignment of Roadway	Fairly flat	Fairly flat
Grade of Roadway	Less than 3%	Less than 3%
Horizontal Alignment of Roadway	Straight	Straight
Sight Distance Required [3]	110 m (right turn) 130 m (left turn)	110 m (right turn) 130 m (left turn)
Measured Sight Distance	> 130 m (looking right) > 110 m (looking left)	> 130 m (looking right) > 110 m (looking left)
Minimum Sight Distance Satisfied?	Yes	Yes

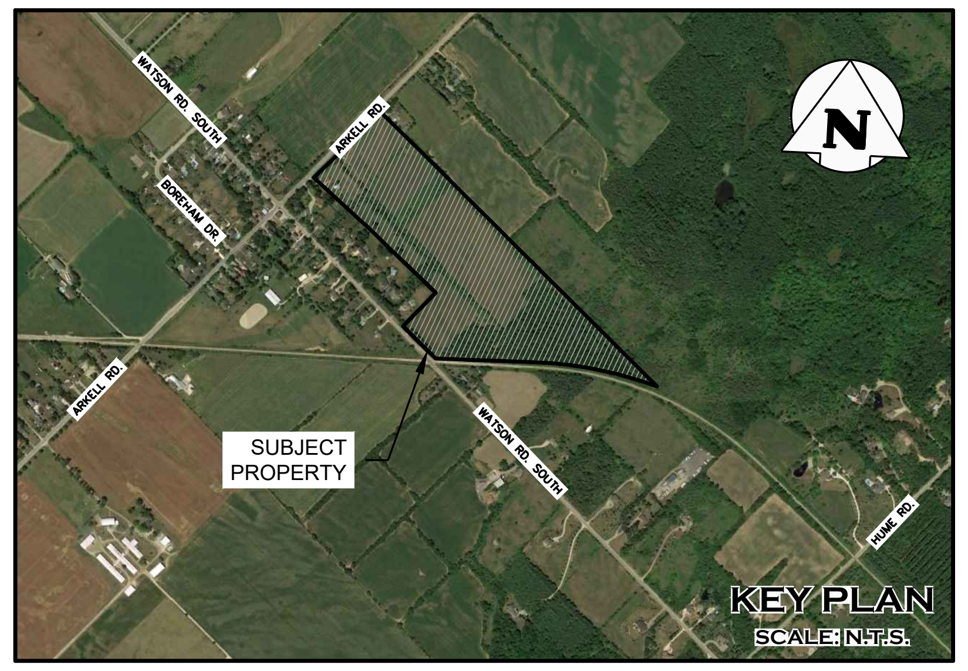
Note 1: Time gap for right-turning passenger cars from a stop onto a two-lane highway with no median and with a grade less than 3%. Value from Table 9.9.5 in the GDGCR.

Note 2: Time gap for left-turning passenger cars from a stop onto a two-lane highway with no median and with a grade less than 3%. Value from Table 9.9.3 in the GDGCR.

Note 3: Sight distance value calculated from Intersection Sight Distance equation 9.9.1 in the GDGCR.

As outlined in **Table 12**, minimum sight distance requirements are satisfied at the location of the access connections to Watson Road South and Arkell Road. **Figure 9** contains Sight Distance Assessment Drawings.





KEY PLAN
SCALE: N.T.S.

No.	ISSUE	DATE: MM/DD/YYYY
1	ISSUED FOR 1st SUBMISSION	03/08/2024
2	ISSUED FOR 2nd SUBMISSION	08/05/2025

Project

TIMBERWORX CUSTOM HOMES
PARTS OF LOTS 7 & 8, CONCESSION 10
TOWNSHIP OF PUSLINCH

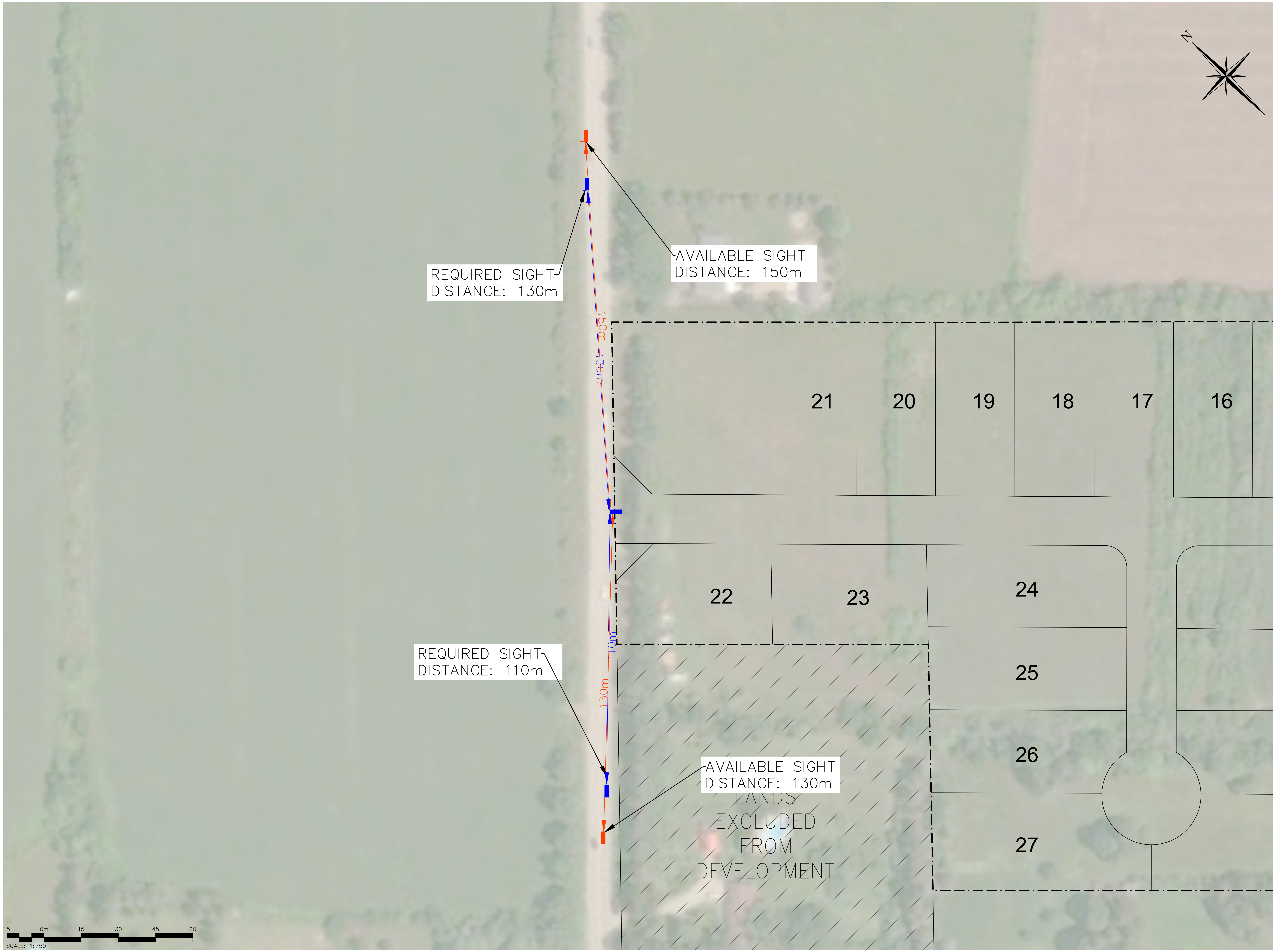
Drawing

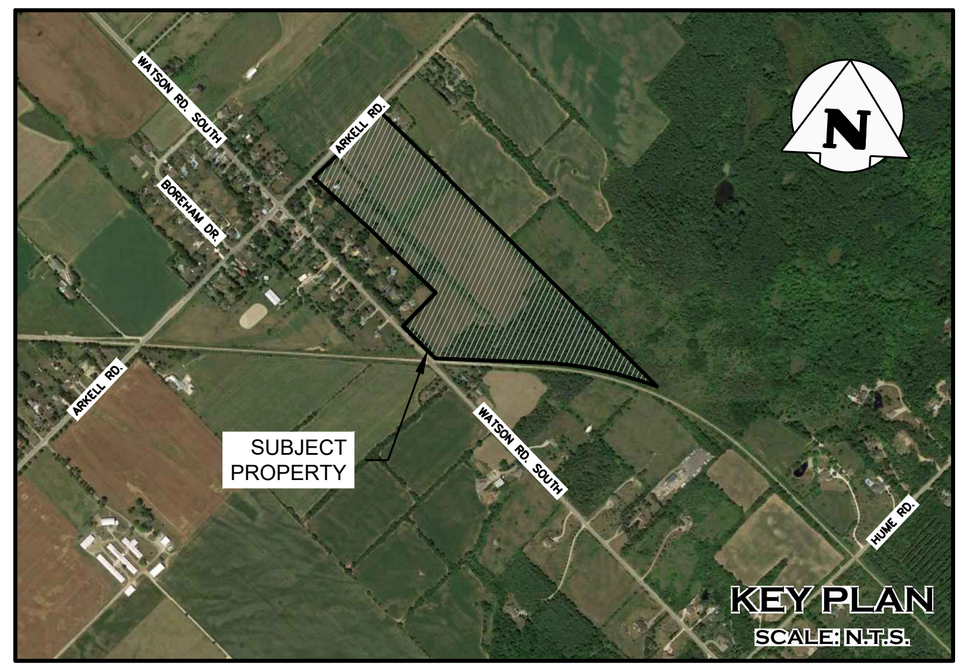
SIGHT DISTANCE ASSESSMENT
ACCESS TO WATSON RD. S

CROZIER
CONSULTING ENGINEERS

211 YONGE STREET
SUITE 600
TORONTO, ON, M5B 1M4
416-477-3392 T
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By R.L.	Design By	Project 2433–6646	
Check By M.I.	Check By	Scale 1:500	Drawing FIG. 9





KEY PLAN
SCALE: N.T.S.

No.	ISSUE	DATE: MM/DD/YYYY
1	ISSUED FOR 1st SUBMISSION	03/08/2024
2	ISSUED FOR 2nd SUBMISSION	08/05/2025

Project
TIMBERWORX CUSTOM HOMES
PARTS OF LOTS 7 & 8, CONCESSION 10
TOWNSHIP OF PUSLINCH

Drawing
SIGHT DISTANCE ASSESSMENT
ACCESS TO ARKELL RD.

CROZIER
CONSULTING ENGINEERS

211 YONGE STREET
SUITE 600
TORONTO, ON, M5B 1M4
416-477-3392 T
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By R.L.	Design By	Project 2433-6646	
Check By M.I.	Check By	Scale 1: 750	Drawing FIG. 10

7.2 Access Location and Spacing Review

The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR) and Transport Canada's Grade Crossing Standards were used to review access spacing and corner clearance for the proposed site access connections to Watson Road South and Arkell Road. The site access spacing requirements and proposed spacings are presented in **Table 13**.

Table 13: Access Spacing Review

Site Access	Available Spacing	Minimum Spacing Requirements	Evaluation	Source
Private Access connection to Watson Road South	Approximately 500 m (to Arkell Road and Watson Road South Intersection)	Minimum 60m spacing between adjacent intersections along a collector road	Satisfied	TAC-GDGCR Section 9.4.2.2
Private Access connection to Arkell Road	Approximately 250 m (to Arkell Road and Watson Road South Intersection)	Minimum 60m spacing between adjacent intersections along a collector road	Satisfied	TAC-GDGCR Section 9.4.2.2

The site corner clearance requirements, Transport Canada's Grade Crossing requirements and proposed clearances are presented in **Table 14**.

Table 14: Corner Clearance and distance from Grade Crossing Review

Site Access	Available Corner Clearance	Minimum Corner Clearance Requirements	Evaluation	Source
Private Access connection to Watson Road South	Approximately 500 m (to Arkell Road and Watson Road South Intersection)	Minimum 25m corner clearance from stop-controlled intersection	Satisfied	TAC-GDGCR Figure 8.8.2
	Approximately 50 m (to Grade Crossing)	Minimum 30m distance from Grade Crossing	Satisfied	Transport Canada's Grade Crossing Standards
Private Access connection to Arkell Road	Approximately 250 m (to Arkell Road and Watson Road South Intersection)	Minimum 25m corner clearance from stop-controlled intersection	Satisfied	TAC-GDGCR Figure 8.8.2

As presented in **Tables 13 and 14**, the proposed accesses are satisfactory compared to the minimum spacing and corner clearance requirements of the TAC-GDGCR and Transport Canada's Grade Crossing Standards.

8.0 PARKING REVIEW

The Township of Puslinch's Zoning By-Law No. 023-18, section 5.2.2 identifies a requirement of 2 parking spaces per unit for the proposed development. As part of the subdivision plan, the parking supply identified in the By-Law will be provided along with potential on-street visitor parking as applicable.

9.0 CONCLUSIONS AND RECOMMENDATIONS

This study has assessed the transportation impacts of the proposed residential development located on sections of Lots 7, 8 and 9 of Concession 10, in the Township of Puslinch, County of Wellington. It is noted that the trip generation and traffic operations analysis were based on an older site plan which had 50 residential units. This was conservatively maintained as no material change in traffic operations or recommendations is expected. The detailed analysis contained within this report has resulted in the following key findings:

- Under 2023 existing traffic conditions, the study intersection of Arkell Road and Watson Road South is operating below capacity with minimal delay during both weekday a.m. and p.m. peak hours.

- The proposed development is expected to generate 40 and 52 two-way primary trips in the a.m. and p.m. peak hours, respectively.

- Under the ultimate 2031 future total conditions:

    - The all-way stop-controlled intersection of Arkell Road and Watson Road South is projected to operate below capacity at a LOS "A" and "B" during the weekday a.m. and p.m. peak hours, respectively. Average intersection control delays of 9.5 and 14.3 seconds in the a.m. and p.m. peak hours, respectively and maximum volume-to-capacity ratios of 0.27 (EB) and 0.54 (NB) are expected in the weekday a.m. and p.m. peak hours, respectively.

    - The proposed site access connection at Watson Road South is forecast to operate at a LOS "A" and "B" during the a.m. and p.m. peak hours respectively.

    - Overall, the nearby road network is projected to operate adequately without any capacity constraints under the ultimate 2031 future total scenario. The nearby road network is expected to operate similarly or better under the 2026 horizon year.

    - These operations are similar to the 2031 and 2026 Future Background traffic operations. Therefore, operations are expected to be similar with or without the proposed development.

- The proposed access connections to Watson Road South and Arkell Road are satisfactory per the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR) with regards to sight distance, access spacing, corner clarance and Transport Canada's Grade Crossing Standards with regards to access spacing.

Based on the study findings, the development application can be supported from a traffic operations perspective as the boundary road network can accommodate the increase in traffic volumes attributable to the proposed development located on sections of Lots 7, 8 and 9 of Concession 10, in the Township of Puslinch, County of Wellington. Further, the proposed accesses are forecast to be functionally adequate with immaterial impacts to the study intersections.

Prepared by,

C.F. CROZIER & ASSOCIATES INC.	**C.F. CROZIER & ASSOCIATES INC.**
[redacted]	
Masoud Imaniboossejin Engineering Intern	Brandon Bradt, M.Eng. CEM, P.Eng. Manager, Transportation Planning

J:\2400\2433 - Timberworx Custom Homes\6646 - Arkell Developments\Reports\Traffic\2024.01.30_Arkell Developments TIS (DRAFT)-MI - Copy.Docx

APPENDIX A

Correspondence

Township of Puslinch (April 02, 2024)	C.F. Crozier & Associates Inc. Comment Responses
Traffic	
- I am in agreement with the existing traffic and the background traffic along with the analyses completed for those scenarios. I am also in agreement with the trip generation estimates for the site.	Noted.
- The translation between the TTS analysis and the site traffic assignment is not clear. The majority of the site traffic has been assigned to and from the southeast on Watson Road South when the TTS analysis suggests most traffic is destined to and from the northwest, the southwest and the west. However, it is my opinion that changing the assignment of traffic would not materially change the capacity analyses and would not change the recommendations in the report. The two study area intersections are forecast to operate at good levels of service and the traffic volumes generated by the proposal are low.	Noted. Given that changing the assignment of traffic would not materially change the capacity analyses and would not change the recommendations in the report, no revisions were made.
- A new public road connection is proposed to Watson Road South, which is a Township road. The consultant has provided a sight distance assessment indicating that the available sight distance exceeds the TAC requirements. I would like to have the consultant confirm how the available sight distances were determined – were they measured in the field or calculated based on a review of base mapping?	Noted. Sight distance assessments were calculated based on a review of base mapping and aerial images.
- The proposed new road connection is located near the level railway crossing of Watson Road South. We will need to receive confirmation from Guelph Junction Railway that they are in agreement with the new road connection. The capacity analysis indicates that there is no queuing expected from the new intersection toward the railway.	Noted.

- The County and their consultant may have additional comments based on their review of the emergency access and the Watson/Arkell intersection.	Noted.
Township of Puslinch Public Works	
No concerns, sight lines are good	Noted.
Guelph Junction Railway (GJR)	
-Possibility of additional signals required for new driveway entrance to the development.	Noted. Given the traffic volumes generated by the proposed development are low and as detailed in **Section 6.1** of the Addendum Traffic Impact Study, the proposed Access Connection at Watson Road South is forecast to operate below capacity at a LOS “A” and LOS “B” during the a.m. and p.m. peak hours respectively. Accordingly, signals are not warranted at this intersection and therefore not recommended.

Archived: September 19, 2023 1:46:22 PM
From: julia@salviniconsulting.com
Sent: Mon, 18 Sep 2023 14:41:57 +0000Received: from YT3PR01CA0145.CANPRD01.PROD.OUTLOOK.COM (2603:10b6:b01:83::14) by MN2PR03MB4992.namprd03.prod.outlook.com (2603:10b6:208:1aa::15) with Microsoft SMTP Server (version=TLS1_2, cipher=TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384) id 15.20.6792.26; Mon, 18 Sep 2023 14:41:54 +0000Received: from YT3CAN01FT019.eop
To: 'Lynne Banks'; Parth Bhatt
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington
Importance: Normal

Hi Parth,

Generally I'm okay with the Terms of Reference you've proposed. We will also be circulating to the rail authority to get their comments – I'll be curious to see how the new road connection works relative to the rail crossing.

There are no active developments in the area for you to include specifically so we are okay with the background growth rates recommended by the County.

I look forward to reviewing your study and feel free to reach out with any other questions.
Julia

____

Julia Salvini (she, her), PEng, FITE
President
julia@salviniconsulting.com
519-591-0426

[redacted]

From: Lynne Banks <lbanks@puslinch.ca>
Sent: Monday, September 18, 2023 10:33 AM
To: Parth Bhatt <pbhatt@cfcrozier.ca>
Cc: julia@salviniconsulting.com
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Parth –

I can confirm that Julia Salvini of Salvini Consulting will be reaching out to you directly regarding the TOR.

Thanks –

Lynne

Lynne Banks
Development and Legislative Coordinator
Township of Puslinch
7404 Wellington Rd 34, Puslinch ON N0B 2J0
519-763-1226 ext. 226 Fax 519-736-5846 www.puslinch.ca

From: Parth Bhatt <pbhatt@cfcrozier.ca>
Sent: Thursday, September 7, 2023 9:42 AM
To: Lynne Banks <lbanks@puslinch.ca>; Mike Fowler <mfowler@puslinch.ca>
Cc: Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Lynne,

Hope you are doing well. I am following up for the background development information. Did you hear anything ? Let us know

Thanks

Parth

Parth Bhatt, M.Eng., P.Eng.
Project Engineer, Transportation
Office: 416.477.3392
Collingwood | Milton | Toronto | Bradford | Guelph

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From: Lynne Banks <lbanks@puslinch.ca>
Sent: Tuesday, August 29, 2023 2:09 PM
To: Parth Bhatt <pbhatt@cfcrozier.ca>; Mike Fowler <mfowler@puslinch.ca>
Cc: Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>

Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Parth –

Our consultant was on vacation for 2 weeks, but is reviewing your proposal now that she is back. I will forward comments to you once I receive them.

Regards –

Lynne

Lynne Banks
Development and Legislative Coordinator
Township of Puslinch
7404 Wellington Rd 34, Puslinch ON N0B 2J0
519-763-1226 ext. 226 Fax 519-736-5846 www.puslinch.ca

From: Parth Bhatt <pbhatt@cfcrozier.ca>
Sent: Thursday, August 24, 2023 10:04 AM
To: Lynne Banks <lbanks@puslinch.ca>; Mike Fowler <mfowler@puslinch.ca>
Cc: Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Lynne,

Hope you are doing well. I am following up with this email for my request on background development information. Did you hear anything ? Let us know.

Thanks

Parth

Parth Bhatt, M.Eng., P.Eng.
Project Engineer, Transportation
Office: 416.477.3392
Collingwood | Milton | Toronto | Bradford | Guelph

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From: Parth Bhatt
Sent: Friday, August 18, 2023 4:24 PM
To: Lynne Banks <lbanks@puslinch.ca>; Mike Fowler <mfowler@puslinch.ca>
Cc: Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Lynne,

Please find the draft plan of subdivision attached. Thanks

Parth

From: Lynne Banks <lbanks@puslinch.ca>
Sent: Friday, August 18, 2023 3:54 PM
To: Parth Bhatt <pbhatt@cfcrozier.ca>; Mike Fowler <mfowler@puslinch.ca>
Cc: Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Parth –

Can you please provide me with a copy of the draft plan of subdivision and I will forward it, and the information below, to the Township's traffic consultant for review and comments regarding anything else that should be considered.

Thanks –

Lynne

Lynne Banks
Development and Legislative Coordinator
Township of Puslinch
7404 Wellington Rd 34, Puslinch ON N0B 2J0
519-763-1226 ext. 226 Fax 519-736-5846 www.puslinch.ca

From: Parth Bhatt <pbhatt@cfcrozier.ca>
Sent: Friday, August 18, 2023 3:19 PM
To: Mike Fowler <mfowler@puslinch.ca>; Lynne Banks <lbanks@puslinch.ca>
Cc: Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Mike and Lynne,
Can you please advise if any background developments should be accounted for in our analysis based on email chain below and also let us know if there are any comments on our Terms of Reference ? Thanks
Parth

Parth Bhatt, M.Eng., P.Eng.
Project Engineer, Transportation
Office: 416.477.3392
Collingwood | Milton | Toronto | Bradford | Guelph

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From: Pasquale Costanzo <pasqualec@wellington.ca>
Sent: Friday, August 18, 2023 1:49 PM
To: Parth Bhatt <pbhatt@cfcrozier.ca>; Kooistra, Tim <tkooistra@dillon.ca>
Cc: mfowler@puslinch.ca; Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>; Meagan Ferris <meaganf@wellington.ca>; Lynne Banks <lbanks@puslinch.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Parth,

The Township would be your contact to provide you background developments for your study.

Pasquale Costanzo, C.E.T., CMMII Infrastructure Specialist
Technical Services Supervisor
County of Wellington, Roads Division
T 519.837.2601 x 2250
E pasqualec@wellington.ca

From: Parth Bhatt <pbhatt@cfcrozier.ca>
Sent: Friday, August 18, 2023 12:24 PM
To: Kooistra, Tim <tkooistra@dillon.ca>
Cc: mfowler@puslinch.ca; Pasquale Costanzo <pasqualec@wellington.ca>; Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Tim,

Hope you are doing well. I am following up regarding my email below for the background developments. Let us know if you have the information. Thanks

Parth

Parth Bhatt, M.Eng., P.Eng.
Project Engineer, Transportation
Office: 416.477.3392
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From: Parth Bhatt
Sent: Tuesday, August 15, 2023 11:21 AM
To: Kooistra, Tim <tkooistra@dillon.ca>
Cc: mfowler@puslinch.ca; pasqualec@wellington.ca; Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: RE: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Hi Tim,

Thanks for your feedback and TMC, can you please let us know the background developments that needs to be accounted and provide us with the respective traffic impact studies.

Parth

From: Kooistra, Tim <tkooistra@dillon.ca>
Sent: Tuesday, August 15, 2023 10:47 AM
To: Parth Bhatt <pbhatt@cfcrozier.ca>

Cc: mfowler@puslinch.ca; pasqualec@wellington.ca; Brandon Bradt <bbradt@cfcrozier.ca>; Masoud Imaniboossejin <mimaniboossejin@cfcrozier.ca>
Subject: Re: Terms of Reference for residential development on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington

Good morning Parth,

Thank you for reaching out regarding the planned Transportation Impact Assessment you are looking to prepare for a proposed residential subdivision found within the community of Arkell in the Township of Puslinch. As you are aware, Dillon Consulting Limited has been retained by the County of Wellington to review the proposed scope of work for various traffic impact studies that may impact the County road network and associated intersections. As a result, this response is being provided on behalf of the County of Wellington for your consideration.

The scope you have identified is generally acceptable from the County's perspective, noting that the following needs to be considered in the study:

- Rather than having to collect a new turning movement count (TMC) at the Wellington Road 37 and Wellington Road 41 intersection in Arkell, you may be pleased to know that a TMC was completed at this intersection in 2022. This TMC is attached for your reference.
- A 2.0% per annum growth rate is required within the study area.
- The Township of Puslinch will need to identify any other background developments and/or associated traffic impact studies that have been previously submitted that may impact the future traffic volumes that need to be considered in the study.

Thank you,

Tim

Tim Kooistra, C.E.T.
Dillon Consulting Limited
130 Dufferin Avenue Suite 1400
London, Ontario, N6A 5R2
T - 519.438.1288 ext. 1330
F - 519.672.8209
M - 519.851.5403

TKooistra@dillon.ca
www.dillon.ca

On Fri, Aug 11, 2023 at 12:32\u8239 PM Parth Bhatt <pbhatt@cfcrozier.ca> wrote:

> Good Evening Mike, Tim and Pasquale,
>
> C.F. Crozier has been retained to complete a Traffic Impact Study (TIS) for a proposed residential development located on sections of Lots 7 and 8 of Concession 10, in the Township of Puslinch, County of Wellington. The subject lands cover an area of approximately 17 ha and currently consist of agricultural/vegetated land. The property, located on the southeast corner of the intersection at Arkell Road and Watson Road South, is bounded by a residential property to the north, agricultural/vegetated lands to the east, the Guelph Junction Railway to the south, and Watson Road/residential properties to the west.
>
> The elements envisioned for this development include:
>
> - Forty (40) Single detached residential properties (each lot will be 0.2 ha or larger).
> - Associated internal public road network.
> - Proposed Site Accesses via Watson Road South
>
> For additional detail please refer to the preliminary Draft Plan of Subdivision attached here but note that it is subject to change prior to the submission.
> Below are the proposed terms of reference for this developments Traffic impact Study (TIS). The TIS will be completed as per the County of Wellington's Traffic Impact Study Guidelines with the following assumptions:
> Please provide feedback at the earliest possible. Should you have any questions or concerns, please feel free to contact us, we would be happy to discuss.
> Thanks,
> Parth
>
> ---
>
> Based on the preliminary ITE Trip Generation estimates, approximately 32 and 42 new two-way a.m. and p.m. peak hour trips, respectively, are generated by the development.
> The TIS will evaluate the potential impacts of traffic generated by the proposed development during the weekday a.m. and p.m. peak hours. The study will consider the existing 2023, full build-out year (2026 assumed) as well as five years (2031) beyond full build-out in accordance with the County of Wellington's Traffic Impact Study Guidelines.
> The following intersections will be analyzed.
>
>   - Watson Road South and Arkell Road
>   - Proposed Site Accesses via Watson Road South
>
> - Existing, future background and future total traffic operations will be analyzed using Synchro 11. Standard traffic operations metrics for signalized and unsignalized intersections including delays, volume-to-capacity ratios, and 95th percentile queue length will be analyzed and reported on.
> - Existing counts will be undertaken to establish the 2023 existing traffic volumes.
> - Based on AADT data; otherwise please advise the appropriate growth rates for the roadways listed above.
> - Please advise if any background developments should be accounted for in our analysis.
> - Trip distribution will be derived from a combination of 2016 Transportation Tomorrow Survey (TTS) data and existing travel patterns.
> - Future total traffic operations will be compared to future background traffic operations under the future study horizon(s) to determine what mitigation measures are required on the boundary road network to accommodate the development. These mitigation measures may include auxiliary turn lanes, signalization, etc. as warranted.
> - The proposed site accesses will be reviewed from a safety perspective with regards to design vehicle maneuverability (ie. waste vehicles and fire trucks), driver sight lines, intersection spacing and access configuration. The safety assessment will be based on the standards set out by the Transportation Associates of Canada (TAC) Geometric Design Guide for Canadians Roads (GDGCR) and the Transport Canada Grade Crossing Standards.
> - The minimum vehicle parking requirements will be reviewed per the Township of Puslinch Zoning By-law 023-18 and compare with the proposed supply.
> - The study findings regarding traffic operations, recommendations and conclusions will all be compiled for review.
>
> **Confirmation regarding traffic counts survey**
> We would like to confirm regarding traffic counts survey, as we are currently in month of August, does Township of Puslinch / County of Wellington permit traffic counts done in August as schools are currently closed and usually opens in September ?
>
> **Parth Bhatt**, M.Eng., P.Eng.
> Project Engineer, Transportation
> Office: 416.477.3392
> Collingwood | Milton | Toronto | Bradford | Guelph
>
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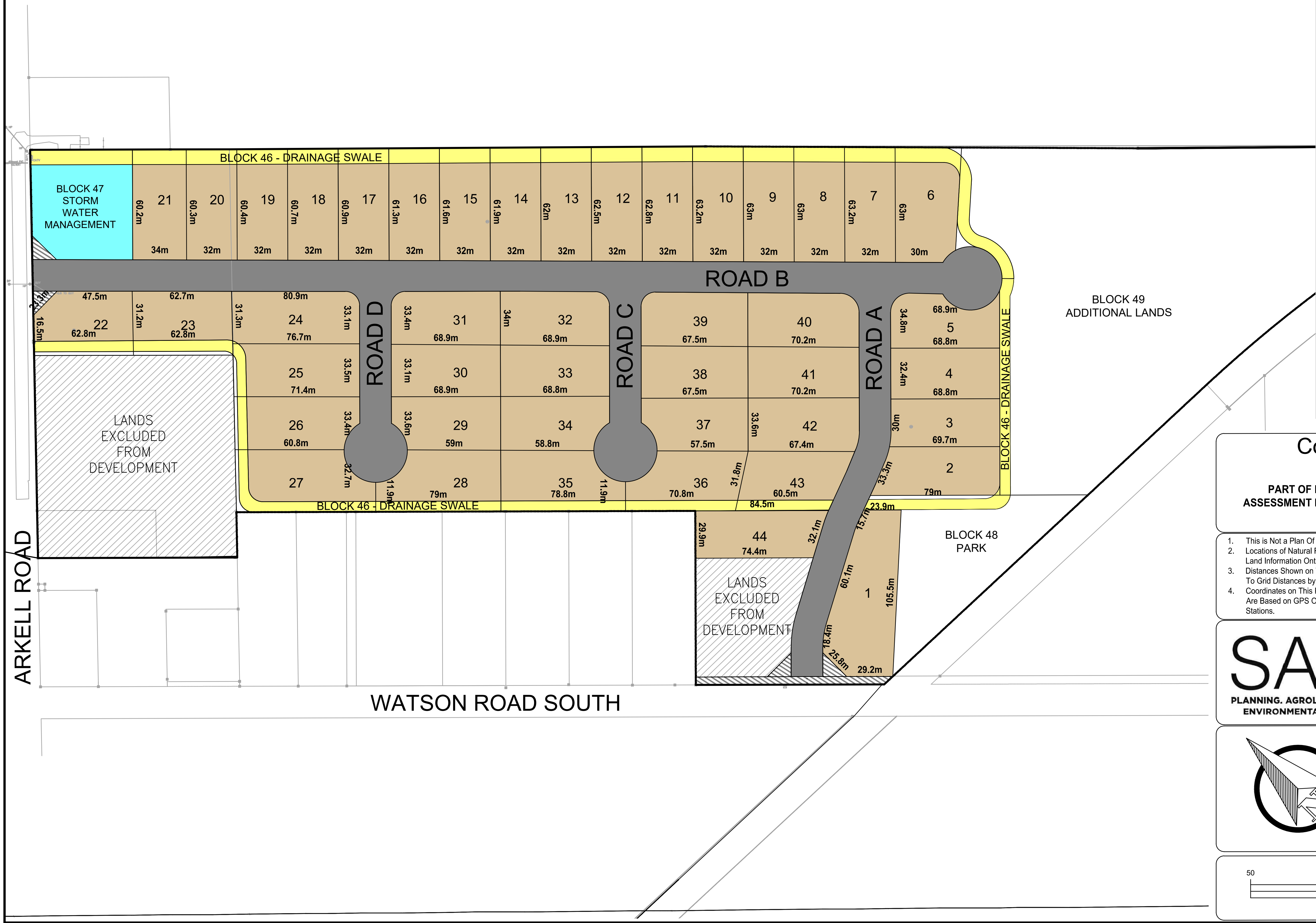
APPENDIX B

Site Plan



Lot No	Frontage (m)	Depth (m)	Area (ha)
1	94.2	44	0.39
2	33.3	79	0.23
3	30	69.7	0.21
4	32.4	68.8	0.21
5	34.8	68.8	0.21
6	37.9	63	0.24
7-20	32	63.2-60.3	0.2
21	34	60.2	0.21
22	47.5	31.2	0.19
23	62.7	31.2	0.19
24	33.1	76.7	0.26
25	33.5	71.4	0.24
26	33.4	60.8	0.23
27	32.7	60.8	0.23
28	32.5	79	0.22
29	33.6	59	0.22
30	33.1	68.9	0.23
31	33.4	68.9	0.23
32	34	68.9	0.22
33	32.5	68.8	0.22
34	33.9	58.8	0.22
35	32.5	78.8	0.22
36	32.5	70.8	0.2
37	33.6	57.5	0.22
38	32.5	67.5	0.22
39	34	67.5	0.23
40	34	70.2	0.24
41	32.5	70.2	0.23
42	33.6	67.4	0.24
43	33.5	60.5	0.2
44	32.1	74.4	0.24

Conceptual Plan

44 Lots

PART OF LOTS 7, 8, & 9, CONCESSION 10
ASSESSMENT ROLL NUMBER 23010000080348000000
ARKELL, ONTARIO

1. This is Not a Plan Of Survey.
2. Locations of Natural Features Have Been Extracted From The Government of Ontario: Land Information Ontario Open Data.
3. Distances Shown on This Plan Are Adjusted Ground Distances and Can Be Converted To Grid Distances by Multiplying by An Averaged Combined Scale Factor of 0.999636.
4. Coordinates on This Plan Are UTM, ZONE 17, NAD83 (CSRS-2010) Adjustment and Are Based on GPS Observations From a Network of Permanent GPS Reference Stations.

SAI
PLANNING. AGROLOGY. ENVIRONMENTAL.

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E: stovel.associates@outlook.com

DRAFT

July 29, 2025

Meters
50 0 50 100
1:2500

6646_GRAD-sms.dwg

APPENDIX C

Traffic Data

WELLINGTON COUNTY TRAFFIC COUNT SUMMARY

Intersection: WR 37 at WR 41 (Puslinch)
Site code: 00004137
Count date: 07/28/2022
Counted by: Shayna - student

North approach:	**WR 37 (major)**				**N/S**	**South approach:**	**WR 37 (major)**			
Hour	Right	Thru	Left	Peds	**totals**	Hour	Right	Thru	Left	Peds
7:00	10	72	6	8	207	7:00	11	81	27	0
8:00	15	97	3	1	250	8:00	13	87	35	1
9:00	0	0	0	0	0	9:00	0	0	0	0
10:00	0	0	0	0	0	10:00	0	0	0	0
11:00	9	62	4	2	207	11:00	22	75	35	1
12:00	21	74	7	1	251	12:00	33	75	41	2
13:00	18	76	4	0	244	13:00	25	88	33	1
14:00	0	0	0	0	0	14:00	0	0	0	0
15:00	0	0	0	0	0	15:00	0	0	0	0
16:00	23	128	10	2	413	16:00	26	152	74	2
17:00	14	122	12	6	352	17:00	22	136	46	3
18:00	18	100	6	1	303	18:00	28	89	62	3
Totals	**128**	**731**	**52**	**21**		**Totals**	**180**	**783**	**353**	**13**

East approach:	**WR 41 (minor)**				**E/W**	**West approach:**	**WR 41 (minor)**			
Hour	Right	Thru	Left	Peds	**totals**	Hour	Right	Thru	Left	Peds
7:00	3	43	9	3	176	7:00	42	65	14	1
8:00	9	72	19	2	255	8:00	64	72	19	1
9:00	0	0	0	0	0	9:00	0	0	0	0
10:00	0	0	0	0	0	10:00	0	0	0	0
11:00	11	49	25	5	182	11:00	39	41	17	4
12:00	7	60	25	3	199	12:00	41	44	22	1
13:00	13	70	21	0	209	13:00	40	47	18	2
14:00	0	0	0	0	0	14:00	0	0	0	0
15:00	0	0	0	0	0	15:00	0	0	0	0
16:00	9	110	24	0	382	16:00	111	100	28	1
17:00	9	87	27	0	300	17:00	66	83	28	6
18:00	8	79	29	4	219	18:00	41	47	15	26
Totals	**69**	**570**	**179**	**17**		**Totals**	**444**	**499**	**161**	**42**

Calculated values for traffic crossing major street

Hour:	7:00	8:00			11:00	12:00	13:00			16:00	17:00	18:00
Value:	186	222			176	197	201			364	316	257

WR 37 at WR 41 (Puslinch)

Count date: 07/28/2022
Intersection: WR 37 at WR 41
Major road: WR 37
Major road runs: north/south (one lane each way)
Speed of major road: 80 km/h
Operating conditions: Free flow

WARRANT #1 MINIMUM VEHICULAR VOLUMES **SATISFIED**

A. All approaches

No. of lanes	Minimum requirements													
	1 lane each way		2 lanes each way		3+ lanes	Hours								
Flow cond'n	f. flow (code 1)	r. flow (code 2)	f. flow (code 3)	r. flow (code 4)	r. flow (code 5)	7:00	8:00	11:00	12:00	13:00	16:00	17:00	18:00	Percentage warrant
100%	480	720	600	900	1125	383	505	389	450	453	795	652	522	100%
80%	385	575	480	720	900									NO
All approaches	100% fulfilled					0	100	0	0	0	100	100	100	400
	80% fulfilled					0	0	80	80	80	0	0	0	240
	Actual % if below 80%					80	0	0	0	0	0	0	0	80
										Total:				720
										Actual average (total/8):				90

B. Minor street both approaches

100%	120	170	120	170	170	176	255	182	199	209	382	300	219	100%
80%	95	135	95	135	135									YES
Both approaches	100% fulfilled					100	100	100	100	100	100	100	100	800
	80% fulfilled					0	0	0	0	0	0	0	0	0
	Actual % if below 80%					0	0	0	0	0	0	0	0	0
										Total:				800
										Actual average (total/8):				100

WR 37 at WR 41 (Puslinch)

Count date:	07/28/2022
Intersection:	WR 37 at WR 41
Major road:	WR 37
Major road runs:	north/south (one lane each way)
Speed of major road:	80 km/h
Operating conditions:	Free flow

WARRANT #2 DELAY TO CROSS TRAFFIC **NOT SATISFIED**

A. Major street both approaches

No. of lanes	Minimum requirements													
	1 lane each way		2 lanes each way		3+ lanes	Hours								
Flow cond'n	f. flow (code 1)	r. flow (code 2)	f. flow (code 3)	r. flow (code 4)	r. flow (code 5)	7:00	8:00	11:00	12:00	13:00	16:00	17:00	18:00	Percentage warrant
100%	480	720	600	900	1125	207	250	207	251	244	413	352	303	100%
80%	385	575	480	720	900									NO
All approaches	100% fulfilled					0	0	0	0	0	0	0	0	0
	80% fulfilled					0	0	0	0	0	80	0	0	80
	Actual % if below 80%					43	52	43	52	51	0	73	63	378
										Total:				458
										Actual average (total/8):				57

B. Traffic crossing major street

100%	50	75	50	75	75	186	222	176	197	201	364	316	257	100%
80%	40	60	40	60	60									YES
All approaches	100% fulfilled					100	100	100	100	100	100	100	100	800
	80% fulfilled					0	0	0	0	0	0	0	0	0
	Actual % if below 80%					0	0	0	0	0	0	0	0	0
										Total:				800
										Actual average (total/8):				100

WR 37 at WR 41 (Puslinch)	
Count date:	07/28/2022
Intersection:	WR 37 at WR 41
Major road:	WR 37
Major road runs:	north/south (one lane each way)
Speed of major road:	80 km/h
Operating conditions:	Free flow

WARRANT #3 ACCIDENT EXPERIENCE

A. Reportable accidents within a 12 month period averaged over 36 consecutive months susceptible to correction by a traffic signal			
Minimum requirements per year	Actual number of accidents in 36 months	Average number of accidents per year	Fulfilled
5	2	0.67	13%
B. Adequate trial of less restrictive remedies has failed to reduce accident frequency			No
C. Either Warrant 1 or Warrant 2 satisfied 80% or more			Yes

WARRANT #4 COMBINATION WARRANT (used if no warrant satisfied 100%)

Minimum requirements	Warrant satisfied 80% or more	Fulfilled
At least two warrants satisfied 80%	Warrant 1 (Minimum Vehicular Volume)	Yes
	Warrant 2 (Delay to Cross Traffic)	No
	Warrant 3 (Accident Experience)	No

CONCLUSION

Traffic signal is not warranted

APPENDIX D

Level of Service Definitions

Level of Service Definitions

Two-Way Stop Controlled Intersections

Level of Service	Control Delay per Vehicle (seconds)	Interpretation
A	≤ 10	EXCELLENT. Large and frequent gaps in traffic on the main roadway. Queuing on the minor street is rare.
B	> 10 and ≤ 15	VERY GOOD. Many gaps exist in traffic on the main roadway. Queuing on the minor street is minimal.
C	> 15 and ≤ 25	GOOD. Fewer gaps exist in traffic on the main roadway. Delay on minor approach becomes more noticeable.
D	> 25 and ≤ 35	FAIR. Infrequent and shorter gaps in traffic on the main roadway. Queue lengths develop on the minor street.
E	> 35 and ≤ 50	POOR. Very infrequent gaps in traffic on the main roadway. Queue lengths become noticeable.
F	> 50	UNSATISFACTORY. Very few gaps in traffic on the main roadway. Excessive delay with significant queue lengths on the minor street.

Adapted from Highway Capacity Manual 2000, Transportation Research Board

Signalized Intersections

Level of Service	**Control Delay per Vehicle (seconds)**	**Interpretation**
A	≤ 10	EXCELLENT. Extremely favourable progression with most vehicles arriving during the green phase. Most vehicles do not stop and short cycle lengths may contribute to low delay.
B	> 10 and ≤ 20	VERY GOOD. Very good progression and/or short cycle lengths with slightly more vehicles stopping than LOS "A" causing slightly higher levels of average delay.
C	> 20 and ≤ 35	GOOD. Fair progression and longer cycle lengths lead to a greater number of vehicles stopping than LOS "B".
D	> 35 and ≤ 55	FAIR. Congestion becomes noticeable with higher average delays resulting from a combination of long cycle lengths, high volume-to-capacity ratios and unfavourable progression.
E	> 55 and ≤ 80	POOR. Lengthy delays values are indicative of poor progression, long cycle lengths and high volume-to-capacity ratios. Individual cycle failures are common with individual movement failures also common.
F	> 80	UNSATISFACTORY. Indicative of oversaturated conditions with vehicular demand greater than the capacity of the intersection.

Adapted from Highway Capacity Manual 2000, Transportation Research Board

APPENDIX E

Detailed Capacity Analysis Reports

1: Arkell Road (WR 37) & Watson Road S. (WR 41)

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	19	73	65	19	73	9	36	89	13	3	99	15
Future Volume (vph)	19	73	65	19	73	9	36	89	13	3	99	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.944			0.988			0.987			0.983	
Flt Protected		0.994			0.991			0.987			0.999	
Satd. Flow (prot)	0	1748	0	0	1824	0	0	1815	0	0	1829	0
Flt Permitted		0.994			0.991			0.987			0.999	
Satd. Flow (perm)	0	1748	0	0	1824	0	0	1815	0	0	1829	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			515.6			455.7			424.1	
Travel Time (s)		29.9			37.1			32.8			30.5	
Confl. Peds. (#/hr)	2		1	1		2	1		1	1		1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	21	79	71	21	79	10	39	97	14	3	108	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	171	0	0	110	0	0	150	0	0	127	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 31.6%	ICU Level of Service A
Analysis Period (min) 15	

1: Arkell Road (WR 37) & Watson Road S. (WR 41)

Intersection	
Intersection Delay, s/veh	8.8
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	19	73	65	19	73	9	36	89	13	3	99	15
Future Vol, veh/h	19	73	65	19	73	9	36	89	13	3	99	15
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	79	71	21	79	10	39	97	14	3	108	16
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	8.8	8.6	9	8.7
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	26%	12%	19%	3%
Vol Thru, %	64%	46%	72%	85%
Vol Right, %	9%	41%	9%	13%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	138	157	101	117
LT Vol	36	19	19	3
Through Vol	89	73	73	99
RT Vol	13	65	9	15
Lane Flow Rate	150	171	110	127
Geometry Grp	1	1	1	1
Degree of Util (X)	0.197	0.214	0.146	0.166
Departure Headway (Hd)	4.738	4.506	4.781	4.7
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	755	795	748	760
Service Time	2.783	2.546	2.826	2.747
HCM Lane V/C Ratio	0.199	0.215	0.147	0.167
HCM Control Delay	9	8.8	8.6	8.7
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.7	0.8	0.5	0.6

1: Arkell Road (WR 37) & Watson Road S. (WR 41)

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	29	102	113	24	112	9	75	155	27	10	131	23
Future Volume (vph)	29	102	113	24	112	9	75	155	27	10	131	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.938			0.991			0.986			0.981	
Flt Protected		0.994			0.992			0.986			0.997	
Satd. Flow (prot)	0	1737	0	0	1831	0	0	1811	0	0	1822	0
Flt Permitted		0.994			0.992			0.986			0.997	
Satd. Flow (perm)	0	1737	0	0	1831	0	0	1811	0	0	1822	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			513.9			455.7			424.1	
Travel Time (s)		29.9			37.0			32.8			30.5	
Confl. Peds. (#/hr)			1	1			2		2	2		2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	32	111	123	26	122	10	82	168	29	11	142	25
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	266	0	0	158	0	0	279	0	0	178	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 50.2%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	11.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	29	102	113	24	112	9	75	155	27	10	131	23
Future Vol, veh/h	29	102	113	24	112	9	75	155	27	10	131	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	32	111	123	26	122	10	82	168	29	11	142	25
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	11.5	10.5	12.3	10.6
HCM LOS	B	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	29%	12%	17%	6%
Vol Thru, %	60%	42%	77%	80%
Vol Right, %	11%	46%	6%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	257	244	145	164
LT Vol	75	29	24	10
Through Vol	155	102	112	131
RT Vol	27	113	9	23
Lane Flow Rate	279	265	158	178
Geometry Grp	1	1	1	1
Degree of Util (X)	0.418	0.384	0.247	0.272
Departure Headway (Hd)	5.383	5.211	5.631	5.484
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	668	690	635	652
Service Time	3.427	3.258	3.682	3.534
HCM Lane V/C Ratio	0.418	0.384	0.249	0.273
HCM Control Delay	12.3	11.5	10.5	10.6
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	2.1	1.8	1	1.1

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	21	78	69	21	78	10	39	95	14	4	106	16
Future Volume (vph)	21	78	69	21	78	10	39	95	14	4	106	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.945			0.988			0.987			0.983	
Flt Protected		0.994			0.990			0.987			0.999	
Satd. Flow (prot)	0	1750	0	0	1822	0	0	1815	0	0	1829	0
Flt Permitted		0.994			0.990			0.987			0.999	
Satd. Flow (perm)	0	1750	0	0	1822	0	0	1815	0	0	1829	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			515.6			455.7			424.1	
Travel Time (s)		29.9			37.1			32.8			30.5	
Confl. Peds. (#/hr)	2		1	1		2	1		1	1		1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	85	75	23	85	11	42	103	15	4	115	17
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	183	0	0	119	0	0	160	0	0	136	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 36.7% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	9
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	21	78	69	21	78	10	39	95	14	4	106	16
Future Vol, veh/h	21	78	69	21	78	10	39	95	14	4	106	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	23	85	75	23	85	11	42	103	15	4	115	17
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9	8.8	9.2	8.9
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	26%	12%	19%	3%
Vol Thru, %	64%	46%	72%	84%
Vol Right, %	9%	41%	9%	13%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	148	168	109	126
LT Vol	39	21	21	4
Through Vol	95	78	78	106
RT Vol	14	69	10	16
Lane Flow Rate	161	183	118	137
Geometry Grp	1	1	1	1
Degree of Util (X)	0.215	0.232	0.16	0.182
Departure Headway (Hd)	4.809	4.579	4.856	4.775
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	743	780	735	748
Service Time	2.862	2.629	2.911	2.83
HCM Lane V/C Ratio	0.217	0.235	0.161	0.183
HCM Control Delay	9.2	9	8.8	8.9
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.8	0.9	0.6	0.7

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	31	109	120	26	119	10	80	165	29	11	140	25
Future Volume (vph)	31	109	120	26	119	10	80	165	29	11	140	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.938			0.991			0.986			0.981	
Flt Protected		0.994			0.992			0.986			0.997	
Satd. Flow (prot)	0	1737	0	0	1831	0	0	1811	0	0	1822	0
Flt Permitted		0.994			0.992			0.986			0.997	
Satd. Flow (perm)	0	1737	0	0	1831	0	0	1811	0	0	1822	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			513.9			455.7			424.1	
Travel Time (s)		29.9			37.0			32.8			30.5	
Confl. Peds. (#/hr)			1	1			2		2	2		2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	118	130	28	129	11	87	179	32	12	152	27
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	282	0	0	168	0	0	298	0	0	191	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 52.8% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	12.1
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	31	109	120	26	119	10	80	165	29	11	140	25
Future Vol, veh/h	31	109	120	26	119	10	80	165	29	11	140	25
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	34	118	130	28	129	11	87	179	32	12	152	27
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	12.3	11	13.2	11.1
HCM LOS	B	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	29%	12%	17%	6%
Vol Thru, %	60%	42%	77%	80%
Vol Right, %	11%	46%	6%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	274	260	155	176
LT Vol	80	31	26	11
Through Vol	165	109	119	140
RT Vol	29	120	10	25
Lane Flow Rate	298	283	168	191
Geometry Grp	1	1	1	1
Degree of Util (X)	0.457	0.421	0.271	0.3
Departure Headway (Hd)	5.525	5.36	5.798	5.644
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	649	670	617	633
Service Time	3.58	3.417	3.863	3.707
HCM Lane V/C Ratio	0.459	0.422	0.272	0.302
HCM Control Delay	13.2	12.3	11	11.1
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	2.4	2.1	1.1	1.3

1: Arkell Road (WR 37) & Watson Road S. (WR 41)

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	23	86	77	23	86	11	43	105	16	4	116	18
Future Volume (vph)	23	86	77	23	86	11	43	105	16	4	116	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.944			0.988			0.987			0.982	
Flt Protected		0.994			0.990			0.987			0.999	
Satd. Flow (prot)	0	1748	0	0	1822	0	0	1815	0	0	1827	0
Flt Permitted		0.994			0.990			0.987			0.999	
Satd. Flow (perm)	0	1748	0	0	1822	0	0	1815	0	0	1827	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			515.6			455.7			424.1	
Travel Time (s)		29.9			37.1			32.8			30.5	
Confl. Peds. (#/hr)	2		1	1		2	1		1	1		1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	93	84	25	93	12	47	114	17	4	126	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	202	0	0	130	0	0	178	0	0	150	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 39.3% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	23	86	77	23	86	11	43	105	16	4	116	18
Future Vol, veh/h	23	86	77	23	86	11	43	105	16	4	116	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	25	93	84	25	93	12	47	114	17	4	126	20
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.4	9.1	9.6	9.2
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	26%	12%	19%	3%
Vol Thru, %	64%	46%	72%	84%
Vol Right, %	10%	41%	9%	13%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	164	186	120	138
LT Vol	43	23	23	4
Through Vol	105	86	86	116
RT Vol	16	77	11	18
Lane Flow Rate	178	202	130	150
Geometry Grp	1	1	1	1
Degree of Util (X)	0.243	0.263	0.18	0.204
Departure Headway (Hd)	4.912	4.679	4.971	4.885
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	726	762	716	729
Service Time	2.982	2.744	3.042	2.957
HCM Lane V/C Ratio	0.245	0.265	0.182	0.206
HCM Control Delay	9.6	9.4	9.1	9.2
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.9	1.1	0.7	0.8

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	34	120	133	29	132	11	88	182	32	12	154	27
Future Volume (vph)	34	120	133	29	132	11	88	182	32	12	154	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.937			0.991			0.986			0.981	
Flt Protected		0.994			0.992			0.986			0.997	
Satd. Flow (prot)	0	1735	0	0	1831	0	0	1811	0	0	1822	0
Flt Permitted		0.994			0.992			0.986			0.997	
Satd. Flow (perm)	0	1735	0	0	1831	0	0	1811	0	0	1822	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			513.9			455.7			424.1	
Travel Time (s)		29.9			37.0			32.8			30.5	
Confl. Peds. (#/hr)			1	1			2		2	2		2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	130	145	32	143	12	96	198	35	13	167	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	312	0	0	187	0	0	329	0	0	209	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 57.0% ICU Level of Service B

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	13.7
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	34	120	133	29	132	11	88	182	32	12	154	27
Future Vol, veh/h	34	120	133	29	132	11	88	182	32	12	154	27
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	130	145	32	143	12	96	198	35	13	167	29
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	14	12	15.2	12.2
HCM LOS	B	B	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	29%	12%	17%	6%
Vol Thru, %	60%	42%	77%	80%
Vol Right, %	11%	46%	6%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	302	287	172	193
LT Vol	88	34	29	12
Through Vol	182	120	132	154
RT Vol	32	133	11	27
Lane Flow Rate	328	312	187	210
Geometry Grp	1	1	1	1
Degree of Util (X)	0.526	0.486	0.316	0.346
Departure Headway (Hd)	5.772	5.612	6.089	5.933
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	620	636	585	600
Service Time	3.855	3.697	4.188	4.027
HCM Lane V/C Ratio	0.529	0.491	0.32	0.35
HCM Control Delay	15.2	14	12	12.2
HCM Lane LOS	C	B	B	B
HCM 95th-tile Q	3.1	2.7	1.3	1.5

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	21	78	69	23	84	13	39	95	16	6	106	16
Future Volume (vph)	21	78	69	23	84	13	39	95	16	6	106	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.945			0.985			0.986			0.983	
Flt Protected		0.994			0.990			0.987			0.997	
Satd. Flow (prot)	0	1750	0	0	1816	0	0	1813	0	0	1826	0
Flt Permitted		0.994			0.990			0.987			0.997	
Satd. Flow (perm)	0	1750	0	0	1816	0	0	1813	0	0	1826	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			515.6			455.7			424.1	
Travel Time (s)		29.9			37.1			32.8			30.5	
Confl. Peds. (#/hr)	2		1	1		2	1		1	1		1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	85	75	25	91	14	42	103	17	7	115	17
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	183	0	0	130	0	0	162	0	0	139	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 36.9% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	9.1
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	21	78	69	23	84	13	39	95	16	6	106	16
Future Vol, veh/h	21	78	69	23	84	13	39	95	16	6	106	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	23	85	75	25	91	14	42	103	17	7	115	17
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.1	9	9.3	9
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	26%	12%	19%	5%
Vol Thru, %	63%	46%	70%	83%
Vol Right, %	11%	41%	11%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	150	168	120	128
LT Vol	39	21	23	6
Through Vol	95	78	84	106
RT Vol	16	69	13	16
Lane Flow Rate	163	183	130	139
Geometry Grp	1	1	1	1
Degree of Util (X)	0.219	0.234	0.176	0.186
Departure Headway (Hd)	4.835	4.606	4.859	4.814
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	739	774	734	740
Service Time	2.893	2.661	2.918	2.873
HCM Lane V/C Ratio	0.221	0.236	0.177	0.188
HCM Control Delay	9.3	9.1	9	9
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.8	0.9	0.6	0.7

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	4	89	101	7	21	9
Future Volume (vph)	4	89	101	7	21	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.959	
Flt Protected		0.998			0.966	
Satd. Flow (prot)	0	1859	1846	0	1726	0
Flt Permitted		0.998			0.966	
Satd. Flow (perm)	0	1859	1846	0	1726	0
Link Speed (k/h)		50	50		30	
Link Distance (m)		515.6	23.5		109.1	
Travel Time (s)		37.1	1.7		13.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	97	110	8	23	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	101	118	0	33	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 17.9% ICU Level of Service A

Analysis Period (min) 15

2: Watson Road S. (WR 41) & Site Access 1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋎	
Traffic Volume (veh/h)	4	89	101	7	21	9
Future Volume (Veh/h)	4	89	101	7	21	9
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	97	110	8	23	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	118				219	114
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	118				219	114
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	99
cM capacity (veh/h)	1470				767	939

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	101	118	33
Volume Left	4	0	23
Volume Right	0	8	10
cSH	1470	1700	812
Volume to Capacity	0.00	0.07	0.04
Queue Length 95th (m)	0.1	0.0	1.0
Control Delay (s)	0.3	0.0	9.6
Lane LOS	A		A
Approach Delay (s)	0.3	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	17.9%	ICU Level of Service	A
Analysis Period (min)	15		

1: Arkell Road (WR 37) & Watson Road S. (WR 41)

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	31	115	120	28	119	14	80	165	31	18	140	25
Future Volume (vph)	31	115	120	28	119	14	80	165	31	18	140	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.939			0.988			0.985			0.982	
Flt Protected		0.994			0.991			0.986			0.995	
Satd. Flow (prot)	0	1739	0	0	1824	0	0	1809	0	0	1820	0
Flt Permitted		0.994			0.991			0.986			0.995	
Satd. Flow (perm)	0	1739	0	0	1824	0	0	1809	0	0	1820	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			513.9			455.7			424.1	
Travel Time (s)		29.9			37.0			32.8			30.5	
Confl. Peds. (#/hr)			1	1			2		2	2		2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	125	130	30	129	15	87	179	34	20	152	27
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	289	0	0	174	0	0	300	0	0	199	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 53.5%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	31	115	120	28	119	14	80	165	31	18	140	25
Future Vol, veh/h	31	115	120	28	119	14	80	165	31	18	140	25
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	34	125	130	30	129	15	87	179	34	20	152	27
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	12.7	11.3	13.5	11.4
HCM LOS	B	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	29%	12%	17%	10%
Vol Thru, %	60%	43%	74%	77%
Vol Right, %	11%	45%	9%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	276	266	161	183
LT Vol	80	31	28	18
Through Vol	165	115	119	140
RT Vol	31	120	14	25
Lane Flow Rate	300	289	175	199
Geometry Grp	1	1	1	1
Degree of Util (X)	0.466	0.436	0.284	0.316
Departure Headway (Hd)	5.588	5.425	5.849	5.716
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	642	659	611	625
Service Time	3.651	3.488	3.921	3.787
HCM Lane V/C Ratio	0.467	0.439	0.286	0.318
HCM Control Delay	13.5	12.7	11.3	11.4
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	2.5	2.2	1.2	1.4

	↗	→	←	↖	↘	↙
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (vph)	15	139	145	19	15	6
Future Volume (vph)	15	139	145	19	15	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.984		0.959	
Flt Protected		0.995			0.966	
Satd. Flow (prot)	0	1853	1833	0	1726	0
Flt Permitted		0.995			0.966	
Satd. Flow (perm)	0	1853	1833	0	1726	0
Link Speed (k/h)		50	50		30	
Link Distance (m)		513.9	23.5		109.1	
Travel Time (s)		37.0	1.7		13.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	151	158	21	16	7
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	167	179	0	23	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 29.8% ICU Level of Service A

Analysis Period (min) 15

2: Watson Road S. (WR 41) & Site Access 1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	15	139	145	19	15	6
Future Volume (Veh/h)	15	139	145	19	15	6
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	151	158	21	16	7
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	179				352	168
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	179				352	168
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	99
cM capacity (veh/h)	1397				639	876

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	167	179	23
Volume Left	16	0	16
Volume Right	0	21	7
cSH	1397	1700	696
Volume to Capacity	0.01	0.11	0.03
Queue Length 95th (m)	0.3	0.0	0.8
Control Delay (s)	0.8	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	0.8	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	29.8%	ICU Level of Service	A
Analysis Period (min)	15		

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Volume (vph)	23	86	77	25	92	14	43	105	18	6	116	18
Future Volume (vph)	23	86	77	25	92	14	43	105	18	6	116	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.944			0.986			0.985			0.982	
Flt Protected		0.994			0.991			0.987			0.998	
Satd. Flow (prot)	0	1748	0	0	1820	0	0	1811	0	0	1826	0
Flt Permitted		0.994			0.991			0.987			0.998	
Satd. Flow (perm)	0	1748	0	0	1820	0	0	1811	0	0	1826	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			515.6			455.7			424.1	
Travel Time (s)		29.9			37.1			32.8			30.5	
Confl. Peds. (#/hr)	2		1	1		2	1		1	1		1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	93	84	27	100	15	47	114	20	7	126	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	202	0	0	142	0	0	181	0	0	153	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 39.5% ICU Level of Service A

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	9.5
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	23	86	77	25	92	14	43	105	18	6	116	18
Future Vol, veh/h	23	86	77	25	92	14	43	105	18	6	116	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	25	93	84	27	100	15	47	114	20	7	126	20
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.5	9.3	9.7	9.3
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	26%	12%	19%	4%
Vol Thru, %	63%	46%	70%	83%
Vol Right, %	11%	41%	11%	13%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	166	186	131	140
LT Vol	43	23	25	6
Through Vol	105	86	92	116
RT Vol	18	77	14	18
Lane Flow Rate	180	202	142	152
Geometry Grp	1	1	1	1
Degree of Util (X)	0.248	0.265	0.197	0.208
Departure Headway (Hd)	4.942	4.712	4.978	4.926
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	720	756	715	721
Service Time	3.016	2.78	3.053	3.003
HCM Lane V/C Ratio	0.25	0.267	0.199	0.211
HCM Control Delay	9.7	9.5	9.3	9.3
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	1	1.1	0.7	0.8

	↗	→	←	↖	↘	↙
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋎	
Traffic Volume (vph)	4	89	101	7	21	9
Future Volume (vph)	4	89	101	7	21	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.959	
Flt Protected		0.998			0.966	
Satd. Flow (prot)	0	1859	1846	0	1726	0
Flt Permitted		0.998			0.966	
Satd. Flow (perm)	0	1859	1846	0	1726	0
Link Speed (k/h)		50	50		30	
Link Distance (m)		515.6	23.5		109.1	
Travel Time (s)		37.1	1.7		13.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	97	110	8	23	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	101	118	0	33	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 17.9% ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

2: Watson Road S. (WR 41) & Site Access 1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
	↗	→	←	↖	↘	↙
Lane Configurations		↰	↱		↲↳	
Traffic Volume (veh/h)	4	89	101	7	21	9
Future Volume (Veh/h)	4	89	101	7	21	9
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	97	110	8	23	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	118				219	114
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	118				219	114
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	99
cM capacity (veh/h)	1470				767	939

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	101	118	33
Volume Left	4	0	23
Volume Right	0	8	10
cSH	1470	1700	812
Volume to Capacity	0.00	0.07	0.04
Queue Length 95th (m)	0.1	0.0	1.0
Control Delay (s)	0.3	0.0	9.6
Lane LOS	A		A
Approach Delay (s)	0.3	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	17.9%	ICU Level of Service	A
Analysis Period (min)	15		

1: Arkell Road (WR 37) & Watson Road S. (WR 41)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (vph)	34	126	133	31	132	15	88	182	34	19	154	27
Future Volume (vph)	34	126	133	31	132	15	88	182	34	19	154	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.939			0.989			0.985			0.982	
Flt Protected		0.994			0.991			0.986			0.995	
Satd. Flow (prot)	0	1739	0	0	1826	0	0	1809	0	0	1820	0
Flt Permitted		0.994			0.991			0.986			0.995	
Satd. Flow (perm)	0	1739	0	0	1826	0	0	1809	0	0	1820	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		415.4			513.9			455.7			424.1	
Travel Time (s)		29.9			37.0			32.8			30.5	
Confl. Peds. (#/hr)			1	1			2		2	2		2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	137	145	34	143	16	96	198	37	21	167	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	319	0	0	193	0	0	331	0	0	217	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 57.7% ICU Level of Service B

Analysis Period (min) 15

Intersection	
Intersection Delay, s/veh	14.3
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	34	126	133	31	132	15	88	182	34	19	154	27
Future Vol, veh/h	34	126	133	31	132	15	88	182	34	19	154	27
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	137	145	34	143	16	96	198	37	21	167	29
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	14.8	12.5	15.9	12.7
HCM LOS	B	B	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	29%	12%	17%	10%
Vol Thru, %	60%	43%	74%	77%
Vol Right, %	11%	45%	8%	14%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	304	293	178	200
LT Vol	88	34	31	19
Through Vol	182	126	132	154
RT Vol	34	133	15	27
Lane Flow Rate	330	318	193	217
Geometry Grp	1	1	1	1
Degree of Util (X)	0.546	0.513	0.336	0.369
Departure Headway (Hd)	5.953	5.794	6.255	6.114
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	608	624	575	587
Service Time	3.975	3.814	4.304	4.164
HCM Lane V/C Ratio	0.543	0.51	0.336	0.37
HCM Control Delay	15.9	14.8	12.5	12.7
HCM Lane LOS	C	B	B	B
HCM 95th-tile Q	3.3	2.9	1.5	1.7

2: Watson Road S. (WR 41) & Site Access 1

	↗	→	←	↖	↘	↙
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		Y	
Traffic Volume (vph)	15	139	145	19	15	6
Future Volume (vph)	15	139	145	19	15	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.984		0.959	
Flt Protected		0.995			0.966	
Satd. Flow (prot)	0	1853	1833	0	1726	0
Flt Permitted		0.995			0.966	
Satd. Flow (perm)	0	1853	1833	0	1726	0
Link Speed (k/h)		50	50		30	
Link Distance (m)		513.9	23.5		109.1	
Travel Time (s)		37.0	1.7		13.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	151	158	21	16	7
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	167	179	0	23	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 29.8% ICU Level of Service A

Analysis Period (min) 15

2: Watson Road S. (WR 41) & Site Access 1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		↲↳	
Traffic Volume (veh/h)	15	139	145	19	15	6
Future Volume (Veh/h)	15	139	145	19	15	6
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	151	158	21	16	7
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	179				352	168
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	179				352	168
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	99
cM capacity (veh/h)	1397				639	876

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	167	179	23
Volume Left	16	0	16
Volume Right	0	21	7
cSH	1397	1700	696
Volume to Capacity	0.01	0.11	0.03
Queue Length 95th (m)	0.3	0.0	0.8
Control Delay (s)	0.8	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	0.8	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	29.8%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX F

TTS Data

Wed Aug 16 2023 22:26:10 GMT-0400 (Eastern Daylight Time) - Run Time: 2393ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of origin - gta06_orig
Column: 2006 GTA zone of destination - gta06_dest

Filters:
2006 GTA zone of destination - gta06_dest In 8303
and
Start time of trip - start_time In 0630-0930
and
Trip purpose of destination - purp_dest In H

Trip 2016
Table:

	8303
8057	15
8171	24
8195	24

Wed Aug 16 2023 22:42:01 GMT-0400 (Eastern Daylight Time) - Run Time: 2432ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of destination - gta06_dest
Column: 2006 GTA zone of origin - gta06_orig

Filters:
2006 GTA zone of origin - gta06_orig In 8303
and
Start time of trip - start_time In 0630-0930
and
Trip purpose of origin - purp_orig In H

Trip 2016
Table:

	8303
52	12
3357	36
4126	13
7016	24
8035	12
8057	36
8086	24
8091	12
8092	22
8107	36
8151	12
8165	30
8195	24
8199	49

Wed Aug 16 2023 22:56:15 GMT-0400 (Eastern Daylight Time) - Run Time: 2512ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of origin - gta06_orig
Column: 2006 GTA zone of destination - gta06_dest

Filters:
2006 GTA zone of destination - gta06_dest In 8303
and
Start time of trip - start_time In 1530-1830
and
Trip purpose of destination - purp_dest In H

Trip 2016
Table:

	8303
52	12
3357	36
4143	24
7016	24
8029	36
8035	12
8048	21
8057	36
8086	24
8107	36
8165	30
8195	24
8307	15

Wed Aug 16 2023 23:15:50 GMT-0400 (Eastern Daylight Time) - Run Time: 2427ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of destination - gta06_dest
Column: 2006 GTA zone of origin - gta06_orig

Filters:
2006 GTA zone of origin - gta06_orig In 8303
and
Start time of trip - start_time In 1530-1830
and
Trip purpose of origin - purp_orig In H

Trip 2016
Table:

	8303
8029	36
8048	21
8057	15
8082	72
8169	12
8195	24

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

ARKELL SUBDIVISION RESIDENTIAL DEVELOPMENT

TOWNSHIP OF PUSLINCH

PREPARED FOR:

TIMBERWORX CUSTOM HOMES, SLOOT CONSTRUCTION, JOHN SLOOT INVESTMENTS

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
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GUELPH, ON N1H 7T8

AUGUST 2025

CFCA FILE NO. 2433-6646

CROZIER

Revision Number	Date	Comments
Rev. 0	March 2024	Issued for First Submission (ZBA)
Rev. 1	May 2024	Re-Issued for First Submission (ZBA)
Rev. 2	August 2025	Issued for Second Submission (ZBA)

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1.0 Introduction

C.F. Crozier & Associates Inc. (Crozier) was retained by Timberworx Custom Homes, Sloot Construction, and John Sloot Investments (Owners) to prepare a Functional Servicing and Stormwater Management Report in support of the Zoning By-Law Amendment Application for the residential development located at lots 7, 8, 9, Concession 10, Township of Puslinch, County of Wellington (Site; see Figure 1). The purpose of this report is to demonstrate that the proposed development is feasible from a functional servicing and stormwater management perspective and conforms with the requirements of the Township of Puslinch (Township), Wellington County (County), and the Grand River Conservation Authority (GRCA).

The relevant background studies and reports include:

- Township of Puslinch Municipal Development Standards (September 2019)
- Hydrogeological and Predictive Nitrate Assessment prepared by R.J. Burnside & Associates Ltd. (July 2006)
- Preliminary Stormwater Management Report prepared by Richardson Foster Ltd. (August 2006)
- Groundwater Supply Assessment prepared by ARL Groundwater Resources Ltd. (March 2023)
- 1669 tp Logs – Arkell prepared by Chung & Vander Doelen Engineering Ltd (December 2023)
- The Ontario Building Code (OBC) (2012)
- Ministry of Transportation Drainage Management Manual (1997)
- Ministry of Environment Stormwater Management Planning and Design Manual (March 2003)
- Golden Horseshoe CA Erosion and Sediment Control Guideline for Urban Construction (2006)
- TRCA/CVC Low Impact Development Stormwater Management Planning and Design Guide (2010)
- City of Guelph Development Engineering Manual (October 2023)

This report has been prepared to support the second submission of the Zoning By-Law Amendment Application for the proposed residential development.

2.0 Site Description

The Site encompasses an area of 20.45 ha with a developable area of approximately 17.45 ha. The Site currently consists of a single detached dwelling, garage, existing woodlot, and agricultural fields. The Site is bounded by agricultural fields to the north, Arkell Road to the West, Guelph Junction Railway (GJR) to the East, Watson Road, and existing detached homes to the South.

According to the Conceptual Plan prepared by Stovel and Associates Inc. (July 29, 2025) included in Appendix A, it is understood that the Site will consist of the following elements:

- Forty-Four (44) residential lots with associated onsite sewage systems and private wells.
- One (1) stormwater management facility for flood control.
- One (1) bioswale to act as a bypass for drainage external to the Site and one (1) bioswale to infiltrate and convey Site stormwater during minor and major storm events.
- A half (0.5) hectare of land to remain undeveloped.
- An access road connecting to Watson Road in the southwest and a secondary access road connecting to Arkell Road in the northwest.

3.0 Soil and Groundwater Conditions

Chung & Vander Doelen Engineering Limited (CVD) was retained by the Owners to excavate test pits across the property. Ten (10) test pits were excavated in December 2023 to depths of up to 6.10m below ground surface (mbgs). According to CVD's test pit logs, subsurface conditions generally consisted of 250 to 450 mm of topsoil underlain by a thin layer of silt to silty sand and gravel followed by sand and gravel with trace silt to the maximum depth of investigation (6.10 mbgs). All test pits were dry at completion.

The sand and gravel is expected to be the receiving soil for the onsite sewage systems. Based on the grain size analysis of the sand and gravel, this material is classified a GP soil per the Unified Soil Classification System (USCS). According to Supplementary Standard SB-6 of the OBC, GP soils are described as poorly graded gravels and gravel-sand mixtures with little to no fines with a percolation rate of less than 1 min/cm. A conservative percolation rate of 15 min/cm was assigned for the onsite sewage system design.

In 2006, R.J. Burnside & Associates Limited (R.J. Burnside) completed a hydrogeological assessment on the property. As part of this assessment, ten (10) boreholes were advanced, two (2) of which were installed as groundwater monitoring wells. The stratigraphy encountered was similar to CVD's observations during the 2023 test pitting program, which was described as a later of topsoil (200 to 400 mm thick, or up to 1.5 mbgs in some locations), underlain by sandy gravel or sand and gravel. Groundwater was encountered between 7.43 and 10.37 mbgs, or 333.02 to 334.53 masl in January 2006. Refer to the Hydrogeological and Predictive Nitrate Assessment (R.J. Burnside, 2006) for additional details.

4.0 Water Servicing

4.1 Existing Water Servicing

There are no municipal water services available in the vicinity of the Site. Surrounding properties are serviced by private water supply wells.

4.2 Proposed Water Servicing

Each lot will be serviced an individual water supply well. A groundwater supply assessment was completed by ARL Groundwater Resources Ltd. (ARL) to assess the suitability of servicing each lot by a water supply well and to meet the requirements of MECP Guideline D-5-5 (provided under separate cover). ARL concluded that the Gasport formation aquifer can support the water quantity requirements for the development. Refer to the Groundwater Supply Assessment Report (ARL, 2003) for additional details.

Conceptual well locations have been included on the Onsite Sewage Servicing Schematic (Drawing C102). However, the depth, size, and location of the wells will be determined during detailed design of each individual lot.

Required fire flow calculations will be completed following zoning approvals. However, preliminary calculations were completed to estimate the required fire storage volume for the proposed development. The fire storage volume was calculated using the Ontario Fire Marshalls Fire Protection Water Supply Guideline (1999), as required in the OBC.

The fire storage volume was calculated assuming a house footprint of 240 m^2 and a height of 6 m, Group C (residential) occupancy. Table 1 summarizes the preliminary fire storage volumes calculated for the proposed development.

Table 1: Fire Storage Volume Requirements

Lot	**Total Area** (m^2)	**Height** (m)	**Volume** (m^3)	**K**[1]	**S_{side}**[2]	**Required Fire Storage Volume, Q** (L)
35	240	6	1440	23	1.4	81,000

1. K values represent the water supply coefficient based upon building occupancy.
2. S_{side} values determined from distance to other structures using Figure 1 in Section A-3.2.5.7 of the OBC.

A storage volume of 81,000L is the required minimum fire storage volume that must be supplied at a rate of 45 L/s for a duration of 0.5 hour. The fire flows determined from the OBC fire flow method is a conservative estimate and is for comparison purposes.

5.0 Sanitary Servicing

There are no municipal sanitary services available in the vicinity of the Site. Surrounding properties are privately serviced via onsite sewage systems. Therefore, each lot within the proposed development will be serviced by individual onsite sewage systems.

5.1 Sanitary Design Calculations

The proposed development will consist of forty-four (44) residential lots with private servicing. It is Crozier's understanding that the proposed residential dwellings will be three (3) to four (4) bedrooms with the possibility of two (2) bedrooms in the basement. For the purposes of this assessment, preliminary sewage system design flows were calculated for a six (6) bedroom dwelling with 240m² of finished floor area, four (4) bathroom groups, two (2) powder rooms, two (2) basement rough-ins and additional fixtures for a total of 62 fixture units.

The preliminary sewage system design flows were calculated in accordance with OBC, Part 8 and are presented below in the Table 2.

Table 2: Preliminary Sewage System Daily Design Flows

Unit Type	**Number of Bedrooms**	**Floor Area** (m²)	**Number of Fixture Units**	**Base Flow** (L/day)	**Additional Flow – Floor Area** (L/day)	**Additional Flow – Fixture Units** (L/day)	**Total Flow Per Unit** (L/day)
240 m² Residential Dwelling	6	240	62	2,500	400	2,075	4,575

As shown, the preliminary sewage system design flows are 4,575 L/day per lot. These flows were calculated based on the information provided at the time of this report. If details of the proposed dwellings change (e.g., number of bedrooms, fixtures, and floor area) during detailed design, the sewage system design flows may change, which may affect the size of the onsite sewage systems and the serviceability of the development.

Properties with a total daily design sanitary sewage flow exceeding 10,000 L/day are subject to Section 53 of the Ontario Water Resources Act and require an Environmental Compliance Approval (ECA) issued by the Ministry of Environment, Conservation and Parks (MECP). Given the preliminary sewage system design flow is less than 10,000 L/day per individual lot, an ECA is not required. Building permits will be required for each sewage system prior to construction.

5.2 Proposed Sanitary Servicing

Sanitary servicing for the proposed development will be provided through individual Class 4 onsite sewage systems. The onsite sewage system will consist of an advanced treatment unit discharging to a leaching bed constructed as a Type A dispersal bed.

5.3 Proposed Sewage System

Crozier prepared nitrate loading calculations to determine the effluent concentration of nitrate-nitrogen each sewage system must achieve for the proposed development to meet MECP Guideline D-5-4 and are provided under separate cover. At least a 50% reduction of nitrate-nitrogen (effluent concentration of 20 mg/L) is required to meet 10 mg/L of nitrate-nitrogen at the downgradient property boundary. A typical conventional onsite sewage system produces an effluent concentration of nitrate-nitrogen of approximately 40 mg/L. This is insufficient to meet D-5-4 requirements, therefore, advanced treatment with denitrification will be required.

The proposed sewage system will consist of a Level IV treatment unit meeting the CAN/BNQ 3680-600 standard with 50% nitrate-nitrogen reduction, discharging treated effluent to a Type A dispersal bed. A Waterloo Biofilter system (or equivalent) with recirculation is proposed. Sewage will flow from the dwelling to a Waterloo Biofilter anaerobic digester tank. Effluent from the digester tank is pumped to the Waterloo Biofilter basket tank, which is equipped with a patented foam media that effectively treats wastewater prior to discharge to the leaching bed. A portion of the treated effluent is recirculated to the anaerobic digester, effecting 50% nitrate-nitrogen reduction.

Treated effluent from the Waterloo Biofilter will be discharged to a Type A dispersal bed sized in accordance with Section 8.7.7. of the OBC. The Type A dispersal bed consists of a stone layer equipped with perforated distribution pipe, underlain by a sand layer. Table 3 below summarizes the preliminary sizing of the Type A Dispersal Bed.

Table 3: Preliminary Type A Dispersal Bed Sizing

Unit Type	**Total Flow Per Unit** (L/day)	**Minimum Stone Area** (m^2)	**Provided Stone Area** (m^2)	**Minimum Sand Area** (m^2)	**Provided Sand Area** (m^2)
240 m^2 Residential Dwelling	4,575	91.5	104	80.74	104

The Onsite Sewage Servicing Schematic (Drawing C102) illustrates the proposed onsite sewage servicing for the proposed development. The conceptual figure illustrates a Waterloo Biofilter configuration; however, it is noted that any treatment unit meeting CAN/BNQ certification requirements with 50% nitrate-nitrogen removal may be considered. The details, size, and location of the onsite sewage systems will be determined once individual home designs and building permit applications are prepared.

6.0 Drainage Conditions

The following sections detail the drainage conditions of the Site under both pre-development and post-development scenarios.

6.1 Existing Drainage Conditions

The Site currently consists of an existing detached residential dwelling and accessory buildings, vacant grassed agricultural fields, and forested areas. The Site generally slopes from south to north and drains from Guelph Junction Railway (GJR) towards Arkell Road and ultimately outlets to a culvert on Arkell Road. The ultimate receiving watercourse of Site drainage is the Eramosa River.

As discussed in Section 3, test pits have been completed by CVD site suggesting that native soils are very coarse, and groundwater elevations are well below anticipated basement levels. These preliminary findings are consistent with other building sites in the area.

Additional monitoring is required, but initial indications suggest that soil conditions are conducive to the type of development proposed and that infiltration measures should be considered as part of the stormwater management strategy.

The site is divided into four (4) catchments under pre-development drainage conditions, as indicated on the Pre-development Drainage Plan (Figure 2).

The majority of the catchment area contributing to the Site outlet is external to the site and runoff from the external catchment area enters the Site from the lands north and south of the GJR. The external drainage primarily consists of agricultural fields and woodlot areas. Catchment Ext. 1 located north of the railroad is known as Starky Hill Conservation Area. Runoff from Starkey Hill concentrates at the toe of the embankment adjacent to GJR. This runoff continues to drain overland across the subject property before reaching the outlet at Arkell Road. Catchment Ext. 2 located south of the railroad consists of woodlot and agricultural fields. The drainage flows from the southeast to the northwest before entering a rectangular culvert situated underneath the railroad to the south of the property. Catchment Ext. 2, much like catchment Ext. 1, continues to drain overland across the subject property before reaching the culvert at Arkell Road.

Catchment 101 encompasses the Site itself and consists of grassed agricultural lands, and woodlot. Catchment 101 drains overland from south to north of the property before reaching the outlet at Arkell Road.

Table 4 describes the pre-development catchment areas and land-uses as illustrated in Figure 2.

Table 4: Pre-Development Hydrologic Parameters

Catchment ID	**Land-Use Description**	**Impervious Area** (ha)	**Pervious Area** (ha)	**Total Area** (ha)	**Percent Impervious** (%)	**Outlet**
Ext. 1	Conservation lands and residential	0.03	24.37	24.40	0.1	300 mm dia. Culvert on Arkell Road
Ext. 2	Woodlot, agriculture, and residential	1.43	19.21	20.64	6.9	
Ext. 3	Vacant grassed agricultural fields, residential, and grassed lands	1.17	5.63	6.8	17.2	
101	Vacant grassed agricultural fields, residential, and grassed lands	0.08	18.82	18.9	0.45	
Total Area (ha) = 70.74		**2.71**	**68.03**	**70.74**	**3.8**	

Considering the size of the study area (70.74 ha), a preliminary hydrologic model was prepared to determine the peak flows from each catchment and establish a target release rate to govern the site following development. The peak flow rates for the 2 through to 100-year City of Guelph 3 Hour Chicago Storm events under pre-development conditions can be seen in Table 5 below.

Table 5: Pre-Development Peak Flows

Catchment ID	Outlet	Peak Flow Rates (L/s)					
		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Ext. 1	Arkell Road (Culvert)	29.9	62.6	92.7	143.5	185.3	232.9
Ext. 2	Arkell Road (Culvert)	60.5	122.5	177.8	268.5	341.5	422.8
Ext. 3	Arkell Road (Culvert)	68.2	136.4	193.9	283.7	354.3	430.1
101	Arkell Road (Culvert)	26.4	51.3	73.7	111.1	141.4	175.9

The peak flow from the combined hydrograph of catchments in Table 5 represents the target peak flow at the outlet of the Site under post-development conditions. The target release rates are summarized in Table 6 below.

Table 6: Target Flow Rates

Location	Target Flow Rates (L/s)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Arkell Road (Culvert)	141.7	282.8	408.2	614.9	781.4	967.9

6.2 Proposed Drainage Conditions

Based on the Conceptual Plan prepared by Stovel and Associates Inc, dated February 6, 2024, the proposed development will consist of forty-four (44) single detached residential lots, paved internal roadways (Road A, B, C & D), a stormwater management facility, and undeveloped land. Access to the site will be provided from the proposed entrances on Arkell Road and Watson Road South.

6.2.1 Post-development Drainage Catchment Areas

The proposed Site grading divides the Site into three (3) drainage catchment areas and three (3) external drainage areas to the north and south of GJR which are unaffected by the proposed development. All drainage culminates at the same outlet (Arkell Road). Referring to the Post-Development Drainage Plan (Figure 3), the catchment areas are described as follows:

- Catchment Ext. 1(A = 24.40) consists of drainage from Starky Hill conservation lands and woodlots. Runoff generated within this catchment is directed to the north of GJR where it concentrates at the toe of railroad embankment and continues south before entering the subject property where it will be collected by a bypass swale. The flow follows the swale along the western property line flowing from south to north before reaching the outlet culvert on Arkell Road.

- Catchment Ext. 2 (A = 20.64) consists of drainage from the existing cultivated lands and woodlot. Runoff drains to the south of the GJR draining before passing through the rectangular culvert crossing underneath GJR and then being picked up by the bypass swale. The flow follows the swale along the western property line flowing from south to north before reaching the outlet culvert on Arkell Road.

- Catchment Ext. 3 (A=6.8) consists of drainage form existing residential lots and Watson Road South. All the runoff generated in this catchment will be conveyed into the bioswale along the southwest property line before reaching the outlet culvert located at Arkell Road.

- Catchment 201 (A = 13.72) consists of drainage from proposed residential lots and internal roads (roads A, B, C, D). Runoff from the residential lots and internal roadways are conveyed to storm sewers before being directed to the northeastern bioswale.

- Catchment UC01 (A = 2.8) consists of drainage from the existing woodlot east of the development. Runoff generated in this catchment drains east to west before being intercepted by the proposed bypass swale.

- Catchment UC02 (A = 2.38) consists of drainage from the existing woodlot east of the development. Runoff generated in this catchment drains east to west before being intercepted by the proposed bypass swale.

The post-development catchments, land use descriptions, and respective percent imperviousness are shown in Table 7 below.

Table 7: Post-Development Hydrologic Parameters

Catchment ID	**Description**	**Impervious Area** (ha)	**Pervious Area** (ha)	**Total Area** (ha)	**Percent Impervious** (%)	**Outlet**
EXT 1	Conservation lands and existing residential	0.03	24.37	24.40	0.1	300 mm dia. Culvert on Arkell Road
EXT 2	Woodlot, agriculture, and existing residential	1.43	19.21	20.64	6.9	
201	Internal roadway, residential, SWMF, and undeveloped land	3.44	10.28	13.72	25.1	
EXT 3	Existing residential dwelling and Watson Road South	1.17	5.63	6.80	17.2	
UC01	Existing woodlot	0.00	2.80	2.80	0.0	
UC02	Existing woodlot	0.00	2.38	2.38	0.0	
Total Area (ha) = 70.74		**6.07**	**64.65**	**70.74**	**8.6**	

Drainage from Catchments Ext. 1, Ext. 2, UC01, UC02, and Ext. 3 will discharge to the bypass swale in the southwest before leaving the site via the outlet culvert at Arkell Road. Any minor land use changes within these catchments will be naturally attenuated and mitigated in the long bypass swale (approximately 830 m long) which exhibits excellent infiltration capacity due to sandy soils and gradual slope.

Finally, drainage from Catchment 201 will be controlled via a storm sewer network, swale system with a series of control weirs, and a stormwater management facility (SWMF) in the form of a dry pond. The post-development peak flows from Catchment 201 will be controlled to pre-development peak flows or less. Uncontrolled post-development peak flows for the 2 through to the 100-year City of Guelph 3 Hour Chicago Storm events are summarized in Table 8 below.

Table 8: Post-Development Peak Flows (Unmitigated)

Catchment ID	**Outlet**	**Peak Flow Rates** (L/s)					
		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Ext. 1	Bypass Swale	29.9	62.6	92.7	143.5	185.3	232.9
Ext. 2	Bypass Swale	60.5	122.5	177.8	268.5	341.4	422.7
201	Bioswale	434.9	586.4	685.0	814.6	913.5	1003.1
Ext. 3	Bypass Swale	68.2	136.4	193.9	283.7	354.3	430.1
UC01	Bypass Swale	3.7	8.3	12.6	19.7	25.7	32.4
UC02	Bypass Swale	3.5	7.9	11.9	18.8	24.4	30.8
Total	**Arkell Road (Culvert)**	**439.6**	**597.9**	**703.1**	**845.4**	**956.3**	**1162.3**
Target (Pre-Development)	**Arkell Road (Culvert)**	**141.7**	**282.8**	**408.2**	**614.9**	**781.4**	**967.9**

7.0 Stormwater Management

Stormwater management and Site drainage for the proposed development must adhere to the policies and standards of the Township of Puslinch, Grand River Conservation Authority (GRCA), and Ministry of Environment and Climate Change (MECP, formerly MOE). It is important to note that efforts have been made to preserve and maintain the rural character of the property. As such, passive stormwater management practices have been incorporated throughout the design.

The stormwater management criteria for the development are summarized below:

Water Quality Control

The Puslinch Municipal Development requires as a minimum the “Enhanced” level of protection (I.e. 80% TSS removal) as described in the Ministry of Environment Stormwater Management Planning and Design Manual (2003).

Water Balance

According to the Puslinch Municipal Development Standards an annual water budget shall be prepared for the development site as described in the MOE SWMPD Manual (March 2003).

Low impact development best management practices shall be designed in accordance with the MOE SWMPD Manual, and the TRCA/CVC Low Impact Development Stormwater Management Planning and Design Guide (2010).

Erosion Control

According to the Puslinch Municipal Development Standards an Erosion and Sediment Control Plan will be provided, showing sediment and erosion control measures proposed to mitigate the effect of the construction on surrounding areas and infrastructure.

Water Quantity Control

According to the Township of Puslinch Municipal Development Standards Manual (2019), water quantity controls are required for the Site. The water quantity requirements include controlling the post-development peak flow event to the pre-development peak flow event for design storms up to and including the 100-year event.

Upon development, all runoff generated within the internal roadway or runoff that mixes with the roadway runoff will be conveyed to proposed bioswales and a dry pond for quantity and quality control. The bioswales have been designed based on a hydraulic conductivity of 255 mm/hr for hydrologic soil group A (low runoff potential), which was derived from: Table 9.6; Hydrology of Floods in Canada: A Guide to Planning and Design (National Research Council of Canada, 1989).

7.1 Stormwater Quality Control

Stormwater quality controls for the proposed development will be achieved by retaining, treating, and infiltrating runoff in a treatment train consisting of an Oil and Grit Separator (OGS), a bioswale system, and a dry pond. Runoff from the proposed development will be conveyed overland to one of four (4) storm sewer networks, each including an OGS within the downstream-most maintenance hole. The storm sewer networks outlet to the proposed bioswale that conveys the drainage to the dry pond. Runoff from the remainder of the site consists of natural heritage and landscaped areas and is therefore not subject to water quality treatment requirements.

The bioswale system treating runoff from the proposed development was sized to maximize the storage provided for quantity control while facilitating infiltration in the swale.

Table 9 summarizes the water quality storage required for enhanced 80% long term suspended solids removal and the water quality storage provided in the proposed bioswale system.

Table 9: Provided Water Quality Storage to Achieve Enhanced Water Quality Protection

Catchment	**Catchment Area** (ha)	**25 mm Runoff Volume** (mm)	**25 mm Runoff Required Treatment Volume** (m^3)	**MOE Table 3.2 Enhanced Water Quality Storage Requirements** (m^3)	**Total Provided Treatment Volume** (m^3)
201	13.72	4.19	575	407	610

At a minimum, a total of 575 m^3 of runoff is required to be treated and infiltrated to remove 80% of TSS and achieve "Enhanced Protection". The proposed bioswale system provides sufficient treatment for this volume in addition to the pre-treatment provided in the OGS units. Additional treatment capacity will be provided downstream of the bioswale system in the form of a dry pond.

The bioswale system accepts runoff from the internal storm sewer network. To optimize the amount of runoff infiltrating into the water table, runoff is retained behind weir structures (0.7 m tall) and spaced at varying intervals that are dictated based on the existing slope/gradient. The ponded runoff behind the control weirs will infiltrate into the water table in accordance with the CVC/TRCA Low Impact Development SWM Planning Design Guide (Version 1.0, 2010).

The bioswale system treatment capacity is governed by the surface ponding volume within the various control weirs. Further calculations and details regarding the control weirs will be provided as the site designs continue to advance.

7.2 Water Balance

Water balance and erosion control measures will be designed to satisfy all relevant criteria and constraints. The above will be demonstrated and discussed at the detailed design stage.

7.3 Stormwater Quantity Controls

Design Storm – 3-hour Chicago

The City of Guelph IDF parameters (October 2023) were used to generate a 3-hour Chicago design storm, per Puslinch Municipal Development Standards. The quantity volume modeled only includes the proposed dry pond, though the bioswale could also provide additional stormwater quantity storage. An orifice size of 135mm was used for the preliminary outfall design.

The required preliminary storage volumes and uncontrolled peak flow rates are presented in Table 10.

Table 10: Preliminary Storage Volume Requirements (3-hour Chicago)

Storm (3-hour Chicago)	Pre-Dev. Uncontrolled Peak Flow Rate[1] (L/s)	Post-Dev. Uncontrolled Peak Flow Rate[2] (L/s)	Post-Dev. Controlled Peak Flow Rate[2] (L/s)	Total Preliminary Storage Volume Required (m^3)
2-year	141.7	439.6	140.9	515
5-year	282.8	597.9	269.9	838
10-year	408.2	703.1	385.9	1106
25-year	614.9	845.4	575.1	1529
50-year	781.4	956.3	727.3	1860
100-year	967.9	1162.3	899.3	2218

1. Includes runoff directed to outlet culvert located at Arkell Road (Catchment 101, EXT 1, 2, & 3)
2. Includes runoff directed to outlet culvert located at Arkell Road (Catchment 201, EXT 1, 2, & 3, UC01, UC02).

The maximum storage required for the 3-hour Chicago storm distribution is roughly 2218 m^3 during the 100-year storm event and the quantity control will be provided for the required storage volume using the proposed dry pond.

8.0 Erosion and Sediment Controls During Construction

Erosion and sediment controls will be implemented prior to the commencement of any site servicing works for the development and will be maintained throughout construction until the Site is stabilized or as directed by the Site Engineer and/or Township of Puslinch. It will be critical for sediment to be controlled, and proper measures put in place to ensure the integrity of any site infiltration measures and bio-swales are maintained during construction.

Controls will be inspected after each significant rainfall event and maintained in proper working condition. A formal Erosion and Sediment Control Plan outlining the site-specific erosion and sediment controls will be prepared and provided to applicable review agencies during subsequent design submissions. This plan will include silt fencing, a mud mat, and more robust measures, such as check dams, in areas of concentrated flow.

Further details on the erosion and control measures to be included have been summarized below:

<u>Sediment Control Silt Fence</u>

Sediment Control Silt Fence will be installed on the perimeter of the Site where sheet flow can be identified. Additional Sediment Control Silt Fence may be added based on field decisions by the Site Engineer and Owner prior to, during, and following construction.

<u>Mud Mat</u>

A rock mud mat will be installed at the entrance to the Site off Watson Road South. The rock mud mat will help to prevent mud tracking. The primary construction entrance will have to be verified prior to construction commencing.

<u>Rock Check Dams</u>

Rock check dams installed according to OPSD 219.210 should be installed in the proposed swale to protect from erosion conveyance during construction.

9.0 Conclusions & Recommendations

This report was prepared in support of the Zoning By-Law Amendment Application for the property located at lots 7, 8, 9, Concession 10, Township of Puslinch, County of Wellington. The proposed development can be serviced for water, sanitary, and stormwater management in accordance with the Township of Puslinch, Wellington County, and the Grand River Conservation Authority requirements and standards. Our conclusions and recommendations include:

Proposed Water and Sanitary Servicing

1. Municipal servicing infrastructure is not available in the vicinity of the site, and therefore the proposed development will be serviced by individual onsite sewage systems and water supply wells.

2. The preliminary sewage system design flows are expected to be approximately 4,575 L/d for each lot. Given the preliminary sewage system design flow is less than 10,000 L/day per individual lot, an ECA issued by the MECP will not be required. Each onsite sewage system will consist of an advanced treatment unit discharging to a leaching bed constructed as a Type A dispersal bed with a footprint of approximately 368 m^2. The advanced treatment system will consist of a Level IV treatment unit meeting the CAN/BNQ 3680-600 standard and must achieve the denitrification requirement of at least 50% nitrate-nitrogen reduction to meet MECP Guideline D-5-4.

3. Individual lots will be serviced with private drilled wells in accordance with O. Reg. 903 for potable water supply.

Stormwater Management

1. A passive stormwater management approach is proposed to preserve and maintain the rural character of the property using bioswale systems to control and infiltrate stormwater runoff.

2. Water quality controls, erosion protection, and water balance for the proposed development will be provided by the proposed bioswale systems pretreated by OGS units within the municipal roadway storm system. The bioswale system with OGS pretreatment and dry pond treatment train will provide water quality treatment that exceeds the “Enhanced Protection” criteria by retaining, treating, and infiltrating runoff volume equal to, or greater than, the runoff volume generated during a 25 mm rainfall event. The water quality storage provided in the bioswale system and dry pond provides active storage to simultaneously provide the necessary quantity controls for the Site.

3. No additional water quantity storage is required beyond what is provided in the bioswale system and dry pond. The post-development peak flows will be controlled to less than pre-development peak flows at outlet culvert located at Arkell Road for the 2-year to 100-year design storm events.

4. Runoff generated from catchments Ext. 1, Ext. 2, Ext. 3, UC01, and UC02 will drain uncontrolled overland before being intercepted by the proposed conveyance bypass swale that safely directs in towards the outlet culvert located at Arkell Road. This flow routing will maintain the existing drainage conditions of the subject property.

5. Water balance and erosion control measures will be designed to satisfy all relevant criteria and constraints. The above will be demonstrated and discussed at the detailed design stage.

Based on the above conclusions, we recommend the approval of the Zoning By-Law Amendment Application from the perspective of functional servicing and stormwater management.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

[redacted]

Jordan Bieri, P.Eng.
Project Engineer, Land Development

C.F. CROZIER & ASSOCIATES INC.

[redacted]

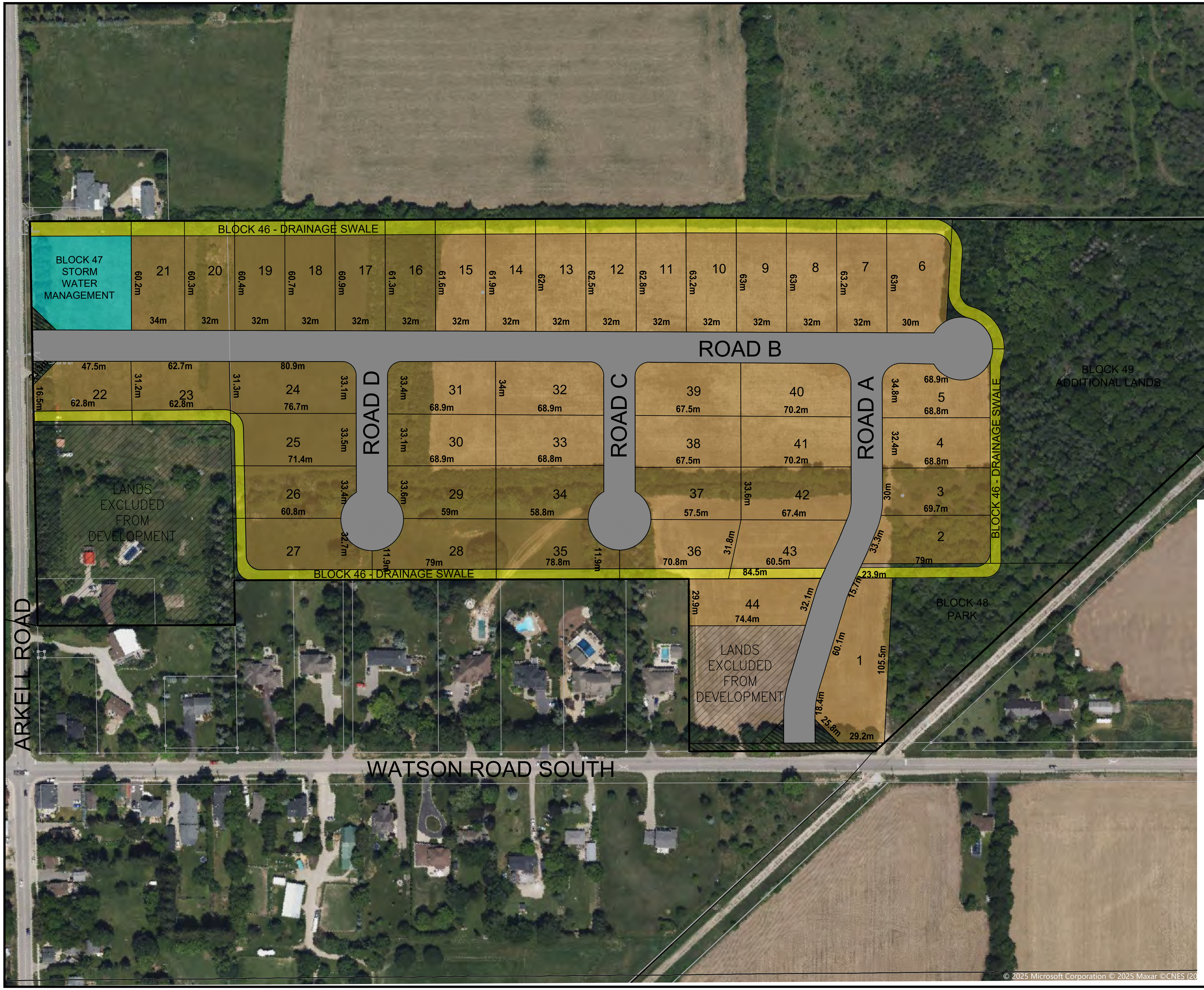
Jurgen Koehler, P.Eng.
Partner, Guelph Manager

DC/tc

J:\2400\2433 - Timberworx Custom Homes\6646 - Arkell Developments\Reports\2025.03.XX_2nd SPA\2025.08.08_(2433-6646)_ FSRSWM.docx

APPENDIX A

Background Information



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Lot No	Frontage (m)	Depth (m)	Area (ha)
1	94.2	44	0.39
2	33.3	79	0.23
3	30	69.7	0.21
4	32.4	68.8	0.21
5	34.8	68.8	0.21
6	37.9	63	0.24
7-20	32	63.2-60.3	0.2
21	34	60.2	0.21
22	47.5	31.2	0.19
23	62.7	31.2	0.19
24	33.1	76.7	0.26
25	33.5	71.4	0.24
26	33.4	60.8	0.23
27	32.7	60.8	0.23
28	32.5	79	0.22
29	33.6	59	0.22
30	33.1	68.9	0.23
31	33.4	68.9	0.23
32	34	68.9	0.22
33	32.5	68.8	0.22
34	33.9	58.8	0.22
35	32.5	78.8	0.22
36	32.5	70.8	0.2
37	33.6	57.5	0.22
38	32.5	67.5	0.22
39	34	67.5	0.23
40	34	70.2	0.24
41	32.5	70.2	0.23
42	33.6	67.4	0.24
43	33.5	60.5	0.2
44	32.1	74.4	0.24

Conceptual Plan

44 Lots

PART OF LOTS 7, 8, & 9, CONCESSION 10
ASSESSMENT ROLL NUMBER 2301000008034800000
ARKELL, ONTARIO

1. This is Not a Plan Of Survey.
2. Locations of Natural Features Have Been Extracted From The Government of Ontario: Land Information Ontario Open Data.
3. Distances Shown on This Plan Are Adjusted Ground Distances and Can Be Converted To Grid Distances by Multiplying by An Averaged Combined Scale Factor of 0.999636.
4. Coordinates on This Plan Are UTM, ZONE 17, NAD83 (CSRS-2010) Adjustment and Are Based on GPS Observations From a Network of Permanent GPS Reference Stations.

SAI
PLANNING. AGROLOGY. ENVIRONMENTAL.

Stovel and Associates Inc.
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Fergus ON
N1M 1T9
P: 519-766-8042
E: stovel.associates@outlook.com

DRAFT

July 29, 2025

Meters
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1:2500

6646_GRAD-sms.dwg

APPENDIX B

Design Calculations

CROZIER
CONSULTING ENGINEERS

ONSITE SEWAGE SYSTEM RESIDENTIAL CALCULATION SHEET

Project Name: Arkell Development
Project Number: 2433-6646
Date: 2025-08-01
Designed By: ZS
Checked By: KR

input required

References

House Details: 6 bedroom
240.00 m2

Description		Number of Units	Additional Flow per Unit (L)	Total Flow (L/day)
Base Flow				2500
Additional Flow				
i) Each bedroom over 5		1	500	500
ii) Area over 200m^{2,}				
A) Each 10m^2 over 200m^2 to 400m^2		4	100	400
B) Each 10m^2 over 400m^2 to 600m^2		0	75	0
C) Each 10m^2 over 600m^2		0	50	0
	Total Additional Sewage Flow from Area			400
iii) Fixture Units over 20		42	50	2075
Addition flow (greatest of i,ii,iii)				**2075**
Total Daily Design Sanitary Sewage Flow (L/day):				**4575**

Pre-Treatment Options

Required septic tank size = 9150 L minimum

Propose Level IV Treatment (Y/N): Y

Native Percolation time, T = 15 min/cm

Imported Sand Percolation time = 10 min/cm

Option #1 - Type A Dispersal Bed

	Required			Provided
Stone area =	92 m^2	(Q/50)		104 m^2
Sand area =	81 m^2	(QT/400)		104 m^2

Treatment: **WBP Model AD35**, 3500 L/d
Treatment: **ADIPC-9000**
Basket Biofilter Tank: **BT-9000**
Orangeville Precast Concrete Ltd.

T-time estimated by Crozier

Proposed By-Pass Swale (North)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00300	m/m
Normal Depth	1.00	m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Bottom Width	1.50	m

Results

Discharge	5.68	m³/s
Flow Area	4.50	m²
Wetted Perimeter	7.82	m
Hydraulic Radius	0.58	m
Top Width	7.50	m
Critical Depth	0.73	m
Critical Slope	0.01208	m/m
Velocity	1.26	m/s
Velocity Head	0.08	m
Specific Energy	1.08	m
Froude Number	0.52	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	1.00	m
Critical Depth	0.73	m
Channel Slope	0.00300	m/m

Proposed By-Pass Swale (North)

GVF Output Data

Critical Slope	0.01208	m/m

Proposed By-Pass Swale (South)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00300	m/m
Normal Depth	0.85	m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Bottom Width	1.50	m

Results

Discharge	3.96	m³/s
Flow Area	3.44	m²
Wetted Perimeter	6.88	m
Hydraulic Radius	0.50	m
Top Width	6.60	m
Critical Depth	0.61	m
Critical Slope	0.01268	m/m
Velocity	1.15	m/s
Velocity Head	0.07	m
Specific Energy	0.92	m
Froude Number	0.51	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.85	m
Critical Depth	0.61	m
Channel Slope	0.00300	m/m

Proposed By-Pass Swale (South)

GVF Output Data

Critical Slope	0.01268	m/m

CROZIER
CONSULTING ENGINEERS

Project:	Arkell Subdivision	**Date:**	2024-01-22
Project No.:	2433-6743	**Revised:**	2025-08-08
Description:	Catchment 201 Water Quality Storage Requirements	**Designed By:**	AO
		Checked By:	NOC

Catchment 201 Water Quality Storage Requirements

Bioswale Catchment Area (ha):	13.72	Catchment 201
Imperviousness Level (%):	25.10	
MOE Table 3.2		
Storage Volume for enhanced 80% long term SS removal (m^3/ha):	25	
Design Storage Volume per MOE Table 3.2 (m^3):	343	= Bioswale Catchment Area * 25
VO Results Volume:		
25 mm Runoff (mm):	4.19	
Design Storage Volume per VO Results (m^3):	575	
Design Storage Required (m^3):	**575**	
Design Storage Provided (m^3):	**672**	See Weir Control Sizing Calculation Sheet

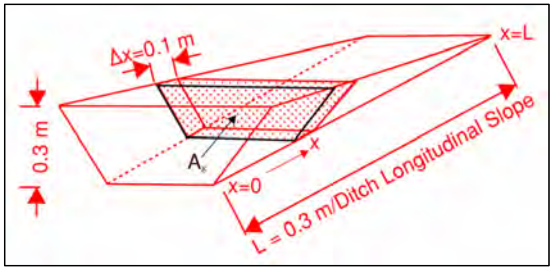
CROZIER
CONSULTING ENGINEERS

Project: Arkell Subdivision
Project No.: 2433-6743
Description: Bioswale Control Weir Sizing
Date: 2024-01-22
Revised: 2025-08-08
Designed By: AO
Checked By: TE

Bioswale Weir Control Sizing - Catchment 201

Ditch Bottom Width =	1.5	m
Ditch Top Width =	7.50	m
Roadside Ditch Side Slope =	3:1	
Lot Line Ditch Slope =	3:1	
Ditch Height =	1.00	m
Proposed Control Weir Height =	0.70	m
Road Segment Length =	100	
Proposed Longitudinal Ditch Slope =	4%	
Control Weir Spacing =	14	m
Number of Control Weir Ponding Areas =	7	
Weir Control Ponding Storage per Area (V) =	17.43	m^3/area
Surface Ponding Volume Provided =	**121.99**	**m^3**

Catchment 201



$$V = \int_{x=0}^{x=L} dV \cong A_{x=\Delta x}\Delta x + A_{x=2\Delta x}\Delta x + A_{x=3\Delta x}\Delta x + \ldots + A_{x=L}\Delta x$$

where $\Delta x = 0.1 \text{ m and } A_x = \textit{Cross sectional area of retained water @ } x$

CROZIER
CONSULTING ENGINEERS

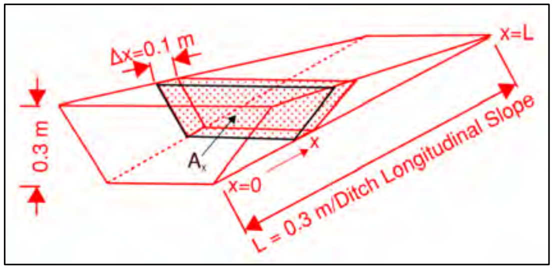
Project: Arkell Subdivision
Project No.: 2433-6743
Description: Bioswale Control Weir Sizing

Date: 2024-01-22
Revised: 2025-08-08
Designed By: AO
Checked By: TE

Bioswale Weir Control Sizing - Catchment 201

Ditch Bottom Width =	1.5	m
Ditch Top Width =	7.50	m
Roadside Ditch Side Slope =	3:1	
Lot Line Ditch Slope =	3:1	
Ditch Height =	1.00	m
Proposed Control Weir Height =	0.70	m
Road Segment Length =	100	
Proposed Longitudinal Ditch Slope =	3%	
Control Weir Spacing =	20	m
Number of Control Weir Ponding Areas =	5	
Weir Control Ponding Storage per Area (V) =	23.27	m^3/area
Surface Ponding Volume Provided =	**116.36**	**m^3**

Catchment 201



$$V = \int_{x=0}^{x=L} dV \cong A_{x=\Delta x}\Delta x + A_{x=2\Delta x}\Delta x + A_{x=3\Delta x}\Delta x + \dots + A_{x=L}\Delta x$$

where $\Delta x = 0.1\ \mathrm{m}$ and $A_x = Cross\ sectional\ area\ of\ retained\ water\ @\ x$

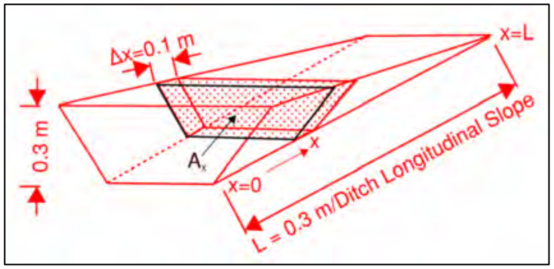
CROZIER
CONSULTING ENGINEERS

Project:	Arkell Subdivision	**Date:**	2024-01-22
Project No.:	2433-6743	**Revised:**	2025-08-08
Description:	Bioswale Control Weir Sizing	**Designed By:**	AO
		Checked By:	TE

Bioswale Weir Control Sizing - Catchment 201

Ditch Bottom Width =	1.5	m
Ditch Top Width =	7.50	m
Roadside Ditch Side Slope =	3:1	
Lot Line Ditch Slope =	3:1	
Ditch Height =	1.00	m
Proposed Control Weir Height =	0.70	m
Road Segment Length =	100	
Proposed Longitudinal Ditch Slope =	1%	
Control Weir Spacing =	50	m
Number of Control Weir Ponding Areas =	2	
Weir Control Ponding Storage per Area (V) =	99.17	m^3/area
Surface Ponding Volume Provided =	**99.17**	**m^3**

Catchment 201



$$V = \int_{x=0}^{x=L} dV \cong A_{x=\Delta x}\Delta x + A_{x=2\Delta x}\Delta x + A_{x=3\Delta x}\Delta x + \ldots + A_{x=L}\Delta x$$

where $\Delta x = 0.1$ m and $A_x = \textit{Cross sectional area of retained water @ } x$

CROZIER
CONSULTING ENGINEERS

Project: Arkell Subdivision
Project No.: 2433-6743
Description: Bioswale Control Weir Sizing

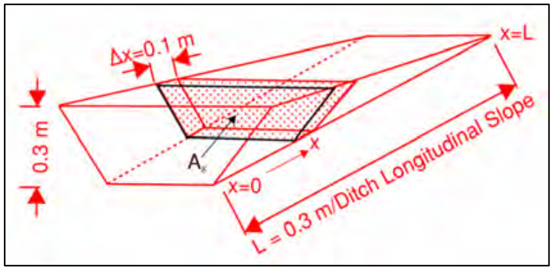
Date: 2024-01-22
Revised: 2025-08-08
Designed By: AO
Checked By: TE

Bioswale Weir Control Sizing - Catchment 201

Ditch Bottom Width = 1.5 m
Ditch Top Width = 7.50 m
Roadside Ditch Side Slope = 3:1
Lot Line Ditch Slope = 3:1
Ditch Height = 1.00 m
Proposed Control Weir Height = 0.70 m

Road Segment Length = 100
Proposed Longitudinal Ditch Slope = 1%
Control Weir Spacing = 0 m
Number of Control Weir Ponding Areas = 1
Weir Control Ponding Storage per Area (V) = 83.88 m^3/area
Surface Ponding Volume Provided = 83.88 m^3

Catchment 201



$$V = \int_{x=0}^{x=L} dV \cong A_{x=\Delta x}\Delta x + A_{x=2\Delta x}\Delta x + A_{x=3\Delta x}\Delta x + \ldots + A_{x=L}\Delta x$$

where $\Delta x = 0.1$ m and $A_x = \textit{Cross sectional area of retained water @ } x$

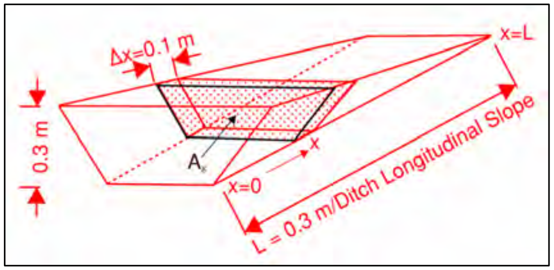
CROZIER
CONSULTING ENGINEERS

Project:	Arkell Subdivision	**Date:**	2024-01-22
Project No.:	2433-6743	**Revised:**	2025-08-08
Description:	Bioswale Control Weir Sizing	**Designed By:**	AO
		Checked By:	TE

Bioswale Weir Control Sizing - Catchment 201

Ditch Bottom Width =	1.5	m
Ditch Top Width =	7.50	m
Roadside Ditch Side Slope =	3:1	
Lot Line Ditch Slope =	3:1	
Ditch Height =	1.00	m
Proposed Control Weir Height =	0.70	m
Road Segment Length =	100	
Proposed Longitudinal Ditch Slope =	0.31%	
Control Weir Spacing =	0	m
Number of Control Weir Ponding Areas =	1	
Weir Control Ponding Storage per Area (V) =	174.00	m^3/area
Surface Ponding Volume Provided =	**174.00**	**m^3**

Catchment 201



$$V = \int_{x=0}^{x=L} dV \cong A_{x=\Delta x}\Delta x + A_{x=2\Delta x}\Delta x + A_{x=3\Delta x}\Delta x + \ldots + A_{x=L}\Delta x$$

where $\Delta x = 0.1\ \mathrm{m}$ and $A_x = \mathit{Cross\ sectional\ area\ of\ retained\ water\ @\ x}$

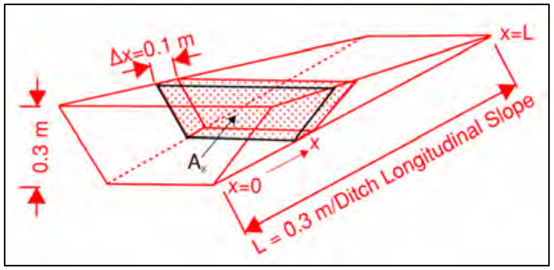
CROZIER
CONSULTING ENGINEERS

Project:	Arkell Subdivision	**Date:**	2024-01-22
Project No.:	2433-6743	**Revised:**	2025-08-08
Description:	Bioswale Control Weir Sizing	**Designed By:**	AO
		Checked By:	TE

Bioswale Weir Control Sizing - Catchment 201

Ditch Bottom Width =	1.5	m
Ditch Top Width =	7.50	m
Roadside Ditch Side Slope =	3:1	
Lot Line Ditch Slope =	3:1	
Ditch Height =	1.00	m
Proposed Control Weir Height =	0.70	m
Road Segment Length =	100	
Proposed Longitudinal Ditch Slope =	1%	
Control Weir Spacing =	0	m
Number of Control Weir Ponding Areas =	1	
Weir Control Ponding Storage per Area (V) =	76.85	m^3/area
Surface Ponding Volume Provided =	**76.85**	**m^3**

Catchment 201



$$V = \int_{x=0}^{x=L} dV \cong A_{x=\Delta x}\Delta x + A_{x=2\Delta x}\Delta x + A_{x=3\Delta x}\Delta x + \dots + A_{x=L}\Delta x$$

where $\Delta x = 0.1\ \mathrm{m}$ and $A_x = Cross\ sectional\ area\ of\ retained\ water\ @\ x$

Project:	Arkell Subdivision	**Date:**	2024-01-22
Project No.:	2433-6743	**Revised:**	2025-08-08
Description:	Bioswale Sizing	**Designed By:**	AO
		Checked By:	TE

Roadside Bioswale Sizing - Catchment 201

Parameter	Value	Units	Catchment 201		
Provided Bioswale Design Parameters					
Surface Ponding Volume Provided Behind Weir Control Structures =	**672**	**m^3**			
Percolation Rate =	255.0	mm/hr	Table 9.6; Hydrology of Floods in Canada: A Guide to Planning and Design (National Research Council of Canada, 1989)		
Safety Correction Factor =	2.00				
Design Percolation Rate **(P)** =	127.50	mm/hr			
LID Length =	**600**	**m**			
LID Width =	**1.5**	**m**			
Provided footprint **(A)** =	**900**	**m^2**	= Length * width		
Gravel Storage Depth =	0.40	m	**A = 1000 * V / [P*n* t]** Equation 4.3 (MOE SWM Planning and Design Manual, 2003)		
Void Space Ratio **(n)** =	0.40				
Total Bioswale Gravel Storage Volume Provided (V) =	**144**	m^3	≥ Surface Ponding Storage =	**672**	**m^3**
Infiltration Rate =	**45.9**	m^3/hr			
Retention Time (t) =	**3**	hours			

NOTES:

1. Surface storage and filter media storage not included in bioswale volume calculation to be conservative.

CROZIER
CONSULTING ENGINEERS

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: August 8, 2025
Completed By: NOC

Dry Pond Facility

Orifice 1

Orifice 1 Coefficient:	0.620
Orifice 1 Diameter:	0.135 m
Orifice 1 Invert Elevation:	338.50 m
Orifice 1 Centroid Elevation:	338.57 m

Emergency Weir

Weir Coefficient:	1.6
Emergency Spill Elev:	339.6 m
Em. Spill Bot. Width:	24 m
Trap. Side Slopes:	15 :1 H:V

Operating Level	**Elev.**	**Depth Above Bottom of Pond**	**Depth Above PP / ED Orifice**	**Area**	**Total Storage Volume**	**Storage Volume Above PP**	**Discharge Orifice 1**	**Emerg. Weir Avg. Width**	**Emerg. Weir Discharge**	**Total Discharge**
	(m)	(m)	(m)	(sq.m)	(cu.m)	(cu.m)	(cu.m/s)	(m)	(cu.m/s)	(cu.m/s)
Bottom of Pond	338.50	0.00	338.37	0	0	**0**	0.000			0.000
	338.60	0.10	338.47	650	32	**32**	0.007			0.007
	338.70	0.20	338.57	1,493	140	**140**	0.014			0.014
	338.80	0.30	338.67	2,069	318	**318**	0.019			0.019
	338.90	0.40	338.77	2,147	529	**529**	0.023			0.023
	339.00	0.50	338.87	2,227	747	**747**	0.026			0.026
	339.10	0.60	338.97	2,309	974	**974**	0.029			0.029
	339.20	0.70	339.07	2,392	1,209	**1209**	0.031			0.031
	339.30	0.80	339.17	2,474	1,452	**1452**	0.034			0.034
	339.40	0.90	339.27	2,559	1,704	**1704**	0.036			0.036
	339.50	1.00	339.37	2,645	1,964	**1964**	0.038			0.038
Emergency Weir Sill	339.60	1.10	339.47	2,727	2,233	**2233**	0.040	24.000		0.040
	339.70	1.20	339.57	2,807	2,509	**2509**	0.042	25.483	1.257	1.299
	339.80	1.30	339.67	2,886	2,794	**2794**	0.044	26.966	3.763	3.806
Top of Pond	339.90	1.40	339.77	2,965	3,087	**3087**	0.045	28.449	7.292	7.338

CROZIER
CONSULTING ENGINEERS

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: HL

D.A. NAME **EXT1**
D.A. AREA (ha) **24.40**

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment EXT1

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	24.40
				0
				0
				0
Total Area				24.40

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	0.029	96	0	96	0	96	0	96		50	0.029	2.75
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
Subtotal	0.029		0		0		0		0			

Pervious Landuses Present:												
	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	20.06	38					4.31	41			24.37	939.06
0		38					0	41			0.00	0.00
0		38					0	41			0.00	0.00
0		38					0	41			0.00	0.00
Subtotal			0		0		4.31		0			

	Composite Area Calculations	Total Pervious Area	24.37
		Total Impervious Area	0.03
		% Impervious	0.12%
		Composite Curve Number	38.6
		Total Area Check	24.40

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
Landuse	IA (mm)	Area (ha)	A * IA	Gravelly Sand		0		0		0		
				RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	20.06	200.57	0.25	20		0		0		0	5.01
Meadow	8	0.00	0.00		0		0		0		0	0.00
Wetland	16	0.00	0.00		0		0		0		0	0.00
Lawn	5	4.31	21.57	0.25	4		0		0		0	1.08
Cultivated	7	0.00	0.00		0		0		0		0	0.00
Impervious	2	0.03	0.06	0.90	0		0		0		0	0.03
Composite		24.40	9.11	Composite Runoff Coefficient								0.25

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Sheet Flow	939.8	20.5	2.2%	-	-	-	-	-	0.55	0.37	1.09	0.73

Appropriate calculated time to peak:	0.73	Appropriate Method:	Airport

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: HL

D.A. NAME EXT2
D.A. AREA (ha) 20.64

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment EXT2

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	20.64
				0
				0
				0
Total Area				20.64

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	1.30	96		96		96	0.12	96		50	1.426	136.86
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
Subtotal	1.30		0.00		0.00		0.12		0.00			

Pervious Landuses Present:												
	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	9.98	38						41	9.23	65	19.21	979.38
0		38						41		65	0.00	0.00
0		38						41		65	0.00	0.00
0		38						41		65	0.00	0.00
Subtotal	9.98		0		0		0.00		9.23			

	Composite Area Calculations	Total Pervious Area	19.21
		Total Impervious Area	1.43
		% Impervious	6.91%
		Composite Curve Number	54.1
		Total Area Check	20.64

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
Landuse	IA (mm)	Area (ha)	A * IA	Gravelly Sand		0		0		0		
				RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	9.98	99.83	0.25	10		0		0		0	2.50
Meadow	8	0.00	0.00		0		0		0		0	0.00
Wetland	16	0.00	0.00		0		0		0		0	0.00
Lawn	5	0.00	0.00	0.25	0		0		0		0	0.00
Cultivated	7	9.23	64.62		9		0		0		0	0.00
Impervious	2	1.43	2.85	0.90	1		0		0		0	1.28
Composite		20.64	8.11	Composite Runoff Coefficient								0.18

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Sheet Flow	642.6	19	3.0%	-	-	-	-	-	0.36	0.24	0.88	0.59

Appropriate calculated time to peak:	0.59	Appropriate Method:	Airport

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: NOC

D.A. NAME **EXT3**
D.A. AREA (ha) **6.80**

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment EXT3

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	6.80
				0
				0
				0
Total Area				6.80

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	0.56	96		96		96	0.61	96		50	1.17	112.26
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
Subtotal	0.56		0.00		0.00		0.61		0.00			

Pervious Landuses Present:												
	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	1.08	38						41	4.55	65	5.63	336.86
0		38						41		65	0.00	0.00
0		38						41		65	0.00	0.00
0		38						41		65	0.00	0.00
Subtotal	1.08		0		0		0.00		4.55			

	Composite Area Calculations	Total Pervious Area	5.63
		Total Impervious Area	1.17
		% Impervious	17.20%
		Composite Curve Number	66.0
		Total Area Check	6.80

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
Landuse	IA (mm)	Area (ha)	A * IA	Gravelly Sand		0		0		0		
				RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	1.08	10.79	0.25	1		0		0		0	0.27
Meadow	8	0.00	0.00		0		0		0		0	0.00
Wetland	16	0.00	0.00		0		0		0		0	0.00
Lawn	5	0.00	0.00	0.25	0		0		0		0	0.00
Cultivated	7	4.55	31.86	0.25	5		0		0		0	1.14
Impervious	2	1.17	2.34	0.90	1		0		0		0	1.05
Composite		6.80	6.62	Composite Runoff Coefficient								0.36

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Sheet Flow	131.9	3.83	2.9%	-	-	-	-	-	0.08	0.06	0.32	0.22

Appropriate calculated time to peak:	0.22	Appropriate Method:	Airport

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CONSULTING ENGINEERS

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: NOC

D.A. NAME **101**
D.A. AREA (ha) **18.90**

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment 101

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	18.90
				0
				0
				0
Total Area				18.90

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS		96		96		96	0.08	96		50	0.085	8.12
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
Subtotal	0.00		0.00		0.00		0.08		0.00			

Pervious Landuses Present:												
	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	6.47	38					12.35	41		65	18.82	752.02
0		38						41		65	0.00	0.00
0		38						41		65	0.00	0.00
0		38						41		65	0.00	0.00
Subtotal	6.47		0		0		12.35		0.00			

Composite Area Calculations	Total Pervious Area	18.82
	Total Impervious Area	0.08
	% Impervious	0.45%
	Composite Curve Number	40.2
	Total Area Check	18.90

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
				Gravelly Sand		0		0		0		
Landuse	IA (mm)	Area (ha)	A * IA	RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	6.47	64.69	0.25	6		0		0		0	1.62
Meadow	8	0.00	0.00		0		0		0		0	0.00
Wetland	16	0.00	0.00		0		0		0		0	0.00
Lawn	5	12.35	61.73	0.25	12		0		0		0	3.09
Cultivated	7	0.00	0.00		0		0		0		0	0.00
Impervious	2	0.08	0.17	0.90	0		0		0		0	0.08
Composite		18.90	6.70	Composite Runoff Coefficient								0.25

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Sheet Flow	907.4	11.03	1.2%	-	-	-	-	-	0.62	0.41	1.30	0.87

Appropriate calculated time to peak:	0.87	Appropriate Method:	Airport

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: NOC

D.A. NAME 201
D.A. AREA (ha) 13.72

Hydrologic Parameters: CALIB STANHYD Command

Post Development
Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	13.72
				0
				0
				0
Total Area Check				13.72

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	1.87	98		98		98	1.57	98		98	3.444	337.51
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	1.87		0.00		0.00		1.57		0.00			

Pervious Landuses Present:												
	Woodland		Meadow		Permeable Pavers		Lawn		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS							10.28	41			10.28	421.32
0								41			0	0
0								41			0	0
0								41			0	0
Subtotal Area	0.00		0		0		10.28		0.00			

Pervious Area Calculations	Total Pervious Area	10.28
	Composite Pervious Curve Number	41
Impervious Area Calculations	Total Directly Connected Area	1.87
	Total Indirectly Connected Area	1.57
	Total Impervious Area	3.44
	% X imp	13.6
	% T imp	25.1
	Total Area Check	13.72

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Permeable Pavers	16	0	0
Lawn	5	10.28	51.38
SWMF	5	0	0
Composite IA		10.28	5.00

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.00	2.00%	81	0.25
Impervious	2.00	0.50%	104	0.013

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CONSULTING ENGINEERS

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: HL

D.A. NAME	**UC01**
D.A. AREA (ha)	**2.80**

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment UC01

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	2.80
				0
				0
				0
Total Area				2.80

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS		96		96		96		96		50	0.00	0.00
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
Subtotal	0.00		0.00		0.00		0.00		0.00			

Pervious Landuses Present:												
	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	2.80	38						41			2.80	106.40
0		38						41			0.0	0.0
0		38						41			0.0	0.0
0		38						41			0.0	0.0
Subtotal	2.80		0.00		0.00		0.00		0.00			

Composite Area Calculations	Total Pervious Area	2.80
	Total Impervious Area	0.00
	% Impervious	0.00%
	Composite Curve Number	38.0
	Total Area Check	2.80

Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
Landuse	IA (mm)	Area (ha)	A * IA	Gravelly Sand		0		0		0		
				RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	2.80	28.00	0.25	3		0		0		0	0.70
Meadow	8	0.00	0.00		0		0		0		0	0.00
Wetland	16	0.00	0.00		0		0		0		0	0.00
Lawn	5	0.00	0.00	0.25	0		0		0		0	0.00
Cultivated	7	0.00	0.00		0		0		0		0	0.00
Impervious	2	0.00	0.00	0.90	0		0		0		0	0.00
Composite		2.80	10.00	Composite Runoff Coefficient								0.25

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Sheet Flow	394.4	8.9	2.3%	-	-	-	-	-	0.29	0.19	0.70	0.47

Appropriate calculated time to peak:	0.47	Appropriate Method:	Airport

Project Name: Arkell Subdivision
Project Number: 2433-6646
Date: 2025-08-06
Completed By: HL

D.A. NAME UC02
D.A. AREA (ha) 2.38

Hydrologic Parameters: CALIB NASHYD Command
Post Development Drainage Area: Catchment UC02

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Gravelly Sand	GS	A	100	2.38
				0
				0
				0
Total Area				2.38

Impervious Landuses Present:												
	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS		96		96		96		96		50	0.00	0.00
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
0		96		96		96		96		50	0	0
Subtotal	0.00		0.00		0.00		0.00		0.00			

Pervious Landuses Present:												
	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
GS	2.38	38						41			2.38	90.44
0		38						41			0.0	0.0
0		38						41			0.0	0.0
0		38						41			0.0	0.0
Subtotal	2.38		0.00		0.00		0.00		0.00			

	Composite Area Calculations	Total Pervious Area	2.38
		Total Impervious Area	0.00
		% Impervious	0.00%
		Composite Curve Number	38.0
		Total Area Check	2.38

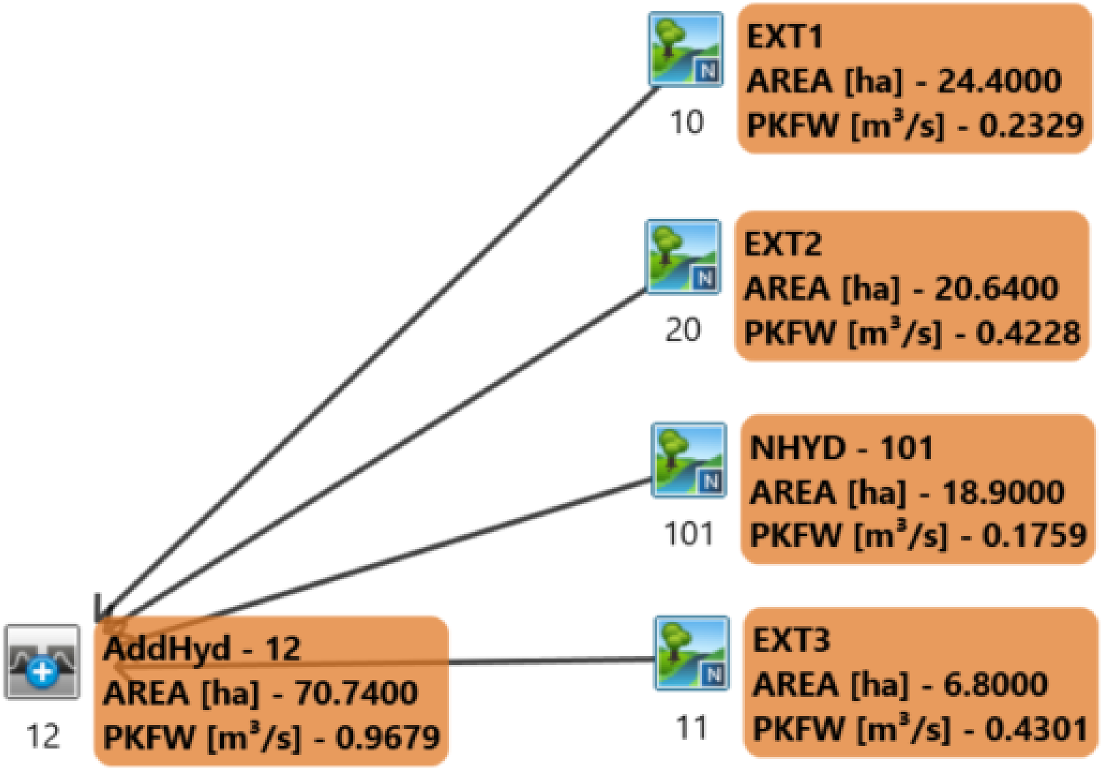
Initial Abstraction and Tp Calculations

Initial Abstraction				Composite Runoff Coefficient								
Landuse	IA (mm)	Area (ha)	A * IA	Gravelly Sand		0		0		0		
				RC	Area	RC	Area	RC	Area	RC	Area	A*RC
Woodland	10	2.38	23.80	0.25	2		0		0		0	0.60
Meadow	8	0.00	0.00		0		0		0		0	0.00
Wetland	16	0.00	0.00		0		0		0		0	0.00
Lawn	5	0.00	0.00	0.25	0		0		0		0	0.00
Cultivated	7	0.00	0.00		0		0		0		0	0.00
Impervious	2	0.00	0.00	0.90	0		0		0		0	0.00
Composite		2.38	10.00	Composite Runoff Coefficient								0.25

Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Tc (hr)	Tp(hr)	TOTAL Tp (hr)	Tc (hr)	Tp(hr)	Tc (hr)	Tp(hr)
Sheet Flow	274.4	6.3	2.3%	-	-	-	-	-	0.20	0.14	0.58	0.39

Appropriate calculated time to peak:	0.39	Appropriate Method:	Airport

Existing Conditions - VO Model Schematic



```
===========================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\ed73249b-c7
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\ed73249b-c7


DATE: 08-08-2025                           TIME: 09:19:24

USER:


COMMENTS: ____________________________________________________________


-----------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 1 - 2yr 3hr 10min Chicago     **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 475.610
| Ptotal= 30.88 mm |                          B=   0.000
--------------------                          C=   0.738
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    3.17 |  0.83   86.95 |  1.67    5.04 |  2.50    3.05
                 0.17    3.77 |  1.00   15.73 |  1.83    4.42 |  2.67    2.85
                 0.33    4.72 |  1.17    9.66 |  2.00    3.95 |  2.83    2.67
                 0.50    6.58 |  1.33    7.25 |  2.17    3.59 |
                 0.67   12.69 |  1.50    5.91 |  2.33    3.30 |


-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW      (cms)=   0.030 (i)
```

```
     TIME TO PEAK    (hrs)=   2.083
     RUNOFF VOLUME    (mm)=   1.001
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.032

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW      (cms)=   0.061 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=   2.091
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.068

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW      (cms)=   0.026 (i)
     TIME TO PEAK    (hrs)=   2.250
     RUNOFF VOLUME    (mm)=   1.229
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.040

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
```

```
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.068 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   3.790
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.123

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0010):    24.40   0.030     2.08     1.00
      + ID2= 2 (  0101):    18.90   0.026     2.25     1.23
        ===============================================
        ID = 3 (  0012):    43.30   0.056     2.17     1.10

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0012):    43.30   0.056     2.17     1.10
      + ID2= 2 (  0011):     6.80   0.068     1.17     3.79
        ===============================================
        ID = 1 (  0012):    50.10   0.087     1.33     1.47

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0012):    50.10   0.087     1.33     1.47
      + ID2= 2 (  0020):    20.64   0.061     1.83     2.09
        ===============================================
        ID = 3 (  0012):    70.74   0.142     1.83     1.65

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\a31cda9d-b6
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\a31cda9d-b6
```

```
DATE: 08-08-2025                           TIME: 09:19:24

USER:



COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 2 - 5yr 3hr 10min Chicago     **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 632.750
| Ptotal= 40.45 mm |                          B=   0.000
--------------------                          C=   0.741
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    4.11 |  0.83  114.88 |  1.67    6.54 |  2.50    3.95
                 0.17    4.88 |  1.00   20.52 |  1.83    5.73 |  2.67    3.69
                 0.33    6.13 |  1.17   12.57 |  2.00    5.13 |  2.83    3.46
                 0.50    8.55 |  1.33    9.43 |  2.17    4.65 |
                 0.67   16.54 |  1.50    7.68 |  2.33    4.27 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.063 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   2.034
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.050

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
```

```
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.123 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=   4.060
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.100

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW       (cms)=   0.051 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   2.347
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.058

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.136 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   6.941
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.172

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
```

```
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0010):    24.40   0.063     2.00     2.03
      + ID2= 2 (  0101):    18.90   0.051     2.17     2.35
        ===================================================
        ID = 3 (  0012):    43.30   0.113     2.08     2.17

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0012):    43.30   0.113     2.08     2.17
      + ID2= 2 (  0011):     6.80   0.136     1.17     6.94
        ===================================================
        ID = 1 (  0012):    50.10   0.174     1.25     2.82

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0012):    50.10   0.174     1.25     2.82
      + ID2= 2 (  0020):    20.64   0.123     1.75     4.06
        ===================================================
        ID = 3 (  0012):    70.74   0.283     1.75     3.18

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
===========================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\d3846a76-ab
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\d3846a76-ab


DATE: 08-08-2025                           TIME: 09:19:24

USER:


COMMENTS: ____________________________________________________________


-----------------------------------------------------------------------------------------------------------
  **************************************************
  ** SIMULATION : 3 - 10yr 3hr 10min Chicago    **
  **************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 721.920
| Ptotal= 47.37 mm |                          B=   0.000
--------------------                          C=   0.736
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
```

```
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    4.90 |  0.83  132.58 |  1.67    7.77 |  2.50    4.72
                0.17    5.82 |  1.00   24.19 |  1.83    6.82 |  2.67    4.40
                0.33    7.29 |  1.17   14.88 |  2.00    6.10 |  2.83    4.13
                0.50   10.14 |  1.33   11.18 |  2.17    5.54 |
                0.67   19.52 |  1.50    9.12 |  2.33    5.09 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.093 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   2.988
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.063

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.178 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=   5.826
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.123

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW       (cms)=   0.074 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   3.360
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.071

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.194 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   9.662
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.204

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (  0010):    24.40   0.093     2.00     2.99
        + ID2= 2 (  0101):    18.90   0.074     2.17     3.36
          ==================================================
          ID = 3 (  0012):    43.30   0.166     2.08     3.15

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0012)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (  0012):    43.30   0.166     2.08     3.15
        + ID2= 2 (  0011):     6.80   0.194     1.17     9.66
          ==================================================
          ID = 1 (  0012):    50.10   0.249     1.25     4.03

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0012)|
```

```
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0012):    50.10   0.249     1.25     4.03
     + ID2= 2 (  0020):    20.64   0.178     1.75     5.83
       ====================================================
       ID = 3 (  0012):    70.74   0.408     1.67     4.56

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\d996b755-4b
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\d996b755-4b


DATE: 08-08-2025                           TIME: 09:19:24

USER:


COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 4 - 25yr 3hr 10min Chicago    **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 822.740
| Ptotal= 57.15 mm |                          B=   0.000
--------------------                          C=   0.725
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    6.14 |  0.83  154.98 |  1.67    9.68 |  2.50    5.92
                 0.17    7.28 |  1.00   29.61 |  1.83    8.51 |  2.67    5.53
                 0.33    9.09 |  1.17   18.34 |  2.00    7.63 |  2.83    5.19
                 0.50   12.58 |  1.33   13.85 |  2.17    6.94 |
                 0.67   23.97 |  1.50   11.32 |  2.33    6.38 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
```

```
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW      (cms)=   0.144 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   4.620
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.081

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW      (cms)=   0.269 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=   8.769
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.153

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW      (cms)=   0.111 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   5.071
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.089

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```
| CALIB              |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.284 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  14.060
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.246

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0010):    24.40   0.144     2.00     4.62
      + ID2= 2 (  0101):    18.90   0.111     2.17     5.07
        ===================================================
        ID = 3 (  0012):    43.30   0.253     2.08     4.82

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0012):    43.30   0.253     2.08     4.82
      + ID2= 2 (  0011):     6.80   0.284     1.17    14.06
        ===================================================
        ID = 1 (  0012):    50.10   0.369     1.33     6.07

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0012):    50.10   0.369     1.33     6.07
      + ID2= 2 (  0020):    20.64   0.269     1.75     8.77
        ===================================================
        ID = 3 (  0012):    70.74   0.615     1.67     6.86

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO     TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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```

```
                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\dea0f33f-e7
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\dea0f33f-e7


DATE: 08-08-2025                           TIME: 09:19:24

USER:



COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 5 - 50yr 3hr 10min Chicago    **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 893.800
| Ptotal= 64.05 mm |                          B=   0.000
--------------------                          C=   0.719
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    7.02 |  0.83  170.70 |  1.67   11.03 |  2.50    6.77
                 0.17    8.31 |  1.00   33.42 |  1.83    9.71 |  2.67    6.33
                 0.33   10.36 |  1.17   20.79 |  2.00    8.71 |  2.83    5.95
                 0.50   14.30 |  1.33   15.73 |  2.17    7.93 |
                 0.67   27.09 |  1.50   12.89 |  2.33    7.29 |


--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.185 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   5.960
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.093

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                         ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
              0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
              0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
              0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
              0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
              0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
              0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
              0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
              0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.341 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=  11.130
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.174

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                         ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
              0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
              0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
              0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
              0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
              0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
              0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
              0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
              0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW       (cms)=   0.141 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   6.464
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.101

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                         ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
              0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
              0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
              0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
              0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
              0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
              0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
              0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
              0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.354 (i)
     TIME TO PEAK    (hrs)=   1.167
```

```
     RUNOFF VOLUME    (mm)=  17.497
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.273

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0010):    24.40   0.185     2.00     5.96
      + ID2= 2 (  0101):    18.90   0.141     2.17     6.46
        ===============================================
        ID = 3 (  0012):    43.30   0.325     2.08     6.18

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0012):    43.30   0.325     2.08     6.18
      + ID2= 2 (  0011):     6.80   0.354     1.17    17.50
        ===============================================
        ID = 1 (  0012):    50.10   0.465     1.33     7.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0012):    50.10   0.465     1.33     7.72
      + ID2= 2 (  0020):    20.64   0.341     1.75    11.13
        ===============================================
        ID = 3 (  0012):    70.74   0.781     1.67     8.71

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
==============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO    TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\55c89b47-39
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\55c89b47-39


DATE: 08-08-2025                           TIME: 09:19:24

USER:



COMMENTS: ____________________________________________________________


--------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 6 - 100yr 3hr 10min Chicago   **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 953.290
```

```
| Ptotal= 71.21 mm |                          B=   0.000
--------------------                          C=   0.711
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                    0.00    8.02 |  0.83  185.45 |  1.67   12.53 |  2.50    7.73
                    0.17    9.47 |  1.00   37.49 |  1.83   11.04 |  2.67    7.23
                    0.33   11.77 |  1.17   23.45 |  2.00    9.92 |  2.83    6.80
                    0.50   16.19 |  1.33   17.80 |  2.17    9.04 |
                    0.67   30.45 |  1.50   14.61 |  2.33    8.32 |


--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                   0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                   0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                   0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                   0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                   0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                   0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                   0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                   0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                   0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.233 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   7.509
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.105

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                   0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                   0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                   0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                   0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                   0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                   0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                   0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                   0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                   0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.423 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=  13.810
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.194

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
```

```
--------------------
| CALIB             |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                   0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                   0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                   0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                   0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                   0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                   0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                   0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                   0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                   0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW       (cms)=   0.176 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   8.065
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.113

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                   0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                   0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                   0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                   0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                   0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                   0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                   0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                   0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                   0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.430 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  21.320
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.299

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0010):    24.40   0.233     2.00     7.51
      + ID2= 2 (  0101):    18.90   0.176     2.17     8.06
        ===============================================
        ID = 3 (  0012):    43.30   0.406     2.08     7.75

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0012):    43.30   0.406     2.08     7.75
```

```
      + ID2= 2 (  0011):     6.80   0.430     1.17    21.32
        ==================================================
        ID = 1 (  0012):    50.10   0.571     1.33     9.59

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0012):    50.10   0.571     1.33     9.59
      + ID2= 2 (  0020):    20.64   0.423     1.75    13.81
        ==================================================
        ID = 3 (  0012):    70.74   0.968     1.75    10.82

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
=============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\fcfd4b67-90
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\fcfd4b67-90


DATE: 08-08-2025                           TIME: 09:19:24

USER:



COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 7 - 25mm                      **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\cmartin\AppD
|                  |              ata\Local\Temp\
|                  |              9450682e-e653-4aea-bde1-2ba14b43f5d4\1e3bc16b
| Ptotal= 24.99 mm |    Comments: 25MM_S~1
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    0.44 |  6.00    0.77 | 12.00    1.20 | 18.00    0.60
                 0.17    0.44 |  6.17    0.77 | 12.17    1.20 | 18.17    0.60
                 0.33    0.44 |  6.33    0.77 | 12.33    1.20 | 18.33    0.60
                 0.50    0.44 |  6.50    0.77 | 12.50    1.05 | 18.50    0.60
                 0.67    0.44 |  6.67    0.78 | 12.67    1.05 | 18.67    0.60
                 0.83    0.44 |  6.83    0.77 | 12.83    1.05 | 18.83    0.60
                 1.00    0.44 |  7.00    0.95 | 13.00    1.05 | 19.00    0.60
                 1.17    0.44 |  7.17    0.95 | 13.17    1.05 | 19.17    0.60
                 1.33    0.44 |  7.33    0.95 | 13.33    1.05 | 19.33    0.60
                 1.50    0.44 |  7.50    0.95 | 13.50    0.95 | 19.50    0.60
                 1.67    0.44 |  7.67    0.95 | 13.67    0.95 | 19.67    0.60
                 1.83    0.44 |  7.83    0.95 | 13.83    0.95 | 19.83    0.60
                 2.00    0.51 |  8.00    1.25 | 14.00    0.79 | 20.00    0.46
                 2.17    0.51 |  8.17    1.25 | 14.17    0.79 | 20.17    0.46
                 2.33    0.51 |  8.33    1.25 | 14.33    0.79 | 20.33    0.46
                 2.50    0.51 |  8.50    1.75 | 14.50    0.79 | 20.50    0.46
                 2.67    0.51 |  8.67    1.75 | 14.67    0.79 | 20.67    0.46
                 2.83    0.51 |  8.83    1.75 | 14.83    0.79 | 20.83    0.46
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                 3.00    0.51 |  9.00    2.45 | 15.00    0.79 | 21.00    0.46
                 3.17    0.51 |  9.17    2.45 | 15.17    0.79 | 21.17    0.46
                 3.33    0.51 |  9.33    2.45 | 15.33    0.79 | 21.33    0.46
                 3.50    0.51 |  9.50    5.90 | 15.50    0.79 | 21.50    0.46
                 3.67    0.51 |  9.67   10.60 | 15.67    0.79 | 21.67    0.46
                 3.83    0.51 |  9.83   15.30 | 15.83    0.79 | 21.83    0.46
                 4.00    0.61 | 10.00    3.40 | 16.00    0.60 | 22.00    0.46
                 4.17    0.61 | 10.17    3.40 | 16.17    0.60 | 22.17    0.46
                 4.33    0.61 | 10.33    3.40 | 16.33    0.60 | 22.33    0.46
                 4.50    0.61 | 10.50    2.05 | 16.50    0.60 | 22.50    0.46
                 4.67    0.61 | 10.67    2.05 | 16.67    0.60 | 22.67    0.46
                 4.83    0.61 | 10.83    2.05 | 16.83    0.60 | 22.83    0.46
                 5.00    0.61 | 11.00    1.50 | 17.00    0.60 | 23.00    0.46
                 5.17    0.61 | 11.17    1.50 | 17.17    0.60 | 23.17    0.46
                 5.33    0.61 | 11.33    1.50 | 17.33    0.60 | 23.33    0.46
                 5.50    0.61 | 11.50    1.50 | 17.50    0.60 | 23.50    0.46
                 5.67    0.61 | 11.67    1.40 | 17.67    0.60 | 23.67    0.46
                 5.83    0.61 | 11.83    1.30 | 17.83    0.60 | 23.83    0.46

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| CALIB            |
| NASHYD   (  0010)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

          NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                             ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
                0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
                0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
                0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
                0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
                0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
                0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
                0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
                0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
                0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
                0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
                1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
                1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
                1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
                1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
                1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
                1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
                1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
                1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
                1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
                1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
                1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
                1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
                2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
                2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
                2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
                2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
                2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
                2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
                2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
                2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
                2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
                2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
                2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
                2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
                3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
                3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
                3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
                3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
                3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
                3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
                3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
                3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
                3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
                3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
                3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
                3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
                4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
                4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
                4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
                4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
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              4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
              4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
              4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
              4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
              4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
              4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
              4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
              4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
              5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
              5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
              5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
              5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
              5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
              5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
              5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
              5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
              5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
              5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
              5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
              5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
              6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

    Unit Hyd Qpeak  (cms)=   1.277

    PEAK FLOW       (cms)=   0.004 (i)
    TIME TO PEAK    (hrs)=  11.333
    RUNOFF VOLUME    (mm)=   0.539
    TOTAL RAINFALL   (mm)=  24.987
    RUNOFF COEFFICIENT   =   0.022

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB             |
| NASHYD   (  0020)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                             ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
              0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
              0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
              0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
              0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
              0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
              0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
              0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
              0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
              0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
              0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
              1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
              1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
              1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
              1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
              1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
              1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
              1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
              1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
              1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
              1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
              1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
              1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
              2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
              2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
              2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
              2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
              2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
              2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
              2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
              2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
              2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
              2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
              2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
              2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
              3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
              3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
              3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
              3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
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              3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
              3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
              3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
              3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
              3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
              3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
              3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
              3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
              4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
              4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
              4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
              4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
              4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
              4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
              4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
              4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
              4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
              4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
              4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
              4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
              5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
              5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
              5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
              5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
              5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
              5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
              5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
              5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
              5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
              5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
              5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
              5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
              6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

    Unit Hyd Qpeak  (cms)=   1.336

    PEAK FLOW       (cms)=   0.009 (i)
    TIME TO PEAK    (hrs)=  10.833
    RUNOFF VOLUME    (mm)=   1.176
    TOTAL RAINFALL   (mm)=  24.987
    RUNOFF COEFFICIENT   =   0.047

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB             |
| NASHYD   (  0101)|   Area    (ha)=  18.90   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.87

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                             ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
              0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
              0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
              0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
              0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
              0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
              0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
              0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
              0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
              0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
              0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
              1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
              1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
              1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
              1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
              1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
              1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
              1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
              1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
              1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
              1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
              1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
              1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
              2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
              2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
              2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
              2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
```

```
              2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
              2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
              2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
              2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
              2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
              2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
              2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
              2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
              3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
              3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
              3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
              3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
              3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
              3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
              3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
              3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
              3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
              3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
              3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
              3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
              4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
              4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
              4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
              4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
              4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
              4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
              4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
              4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
              4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
              4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
              4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
              4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
              5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
              5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
              5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
              5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
              5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
              5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
              5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
              5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
              5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
              5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
              5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
              5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
              6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   0.830

     PEAK FLOW       (cms)=   0.005 (i)
     TIME TO PEAK    (hrs)=  11.250
     RUNOFF VOLUME    (mm)=   0.712
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.028

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                         ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
              0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
              0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
              0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
              0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
              0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
              0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
              0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
              0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
              0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
              0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
              1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
              1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
              1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
              1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
```

```
              1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
              1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
              1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
              1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
              1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
              1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
              1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
              1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
              2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
              2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
              2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
              2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
              2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
              2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
              2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
              2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
              2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
              2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
              2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
              2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
              3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
              3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
              3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
              3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
              3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
              3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
              3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
              3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
              3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
              3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
              3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
              3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
              4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
              4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
              4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
              4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
              4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
              4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
              4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
              4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
              4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
              4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
              4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
              4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
              5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
              5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
              5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
              5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
              5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
              5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
              5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
              5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
              5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
              5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
              5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
              5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
              6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.012 (i)
     TIME TO PEAK    (hrs)=  10.083
     RUNOFF VOLUME    (mm)=   2.258
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.090

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0010):    24.40   0.004    11.33     0.54
      + ID2= 2 (  0101):    18.90   0.005    11.25     0.71
        ==================================================
        ID = 3 (  0012):    43.30   0.008    11.25     0.61

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0012)|
```

```
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0012):    43.30   0.008    11.25     0.61
      + ID2= 2 (  0011):     6.80   0.012    10.08     2.26
        ====================================================
        ID = 1 (  0012):    50.10   0.014    10.17     0.84

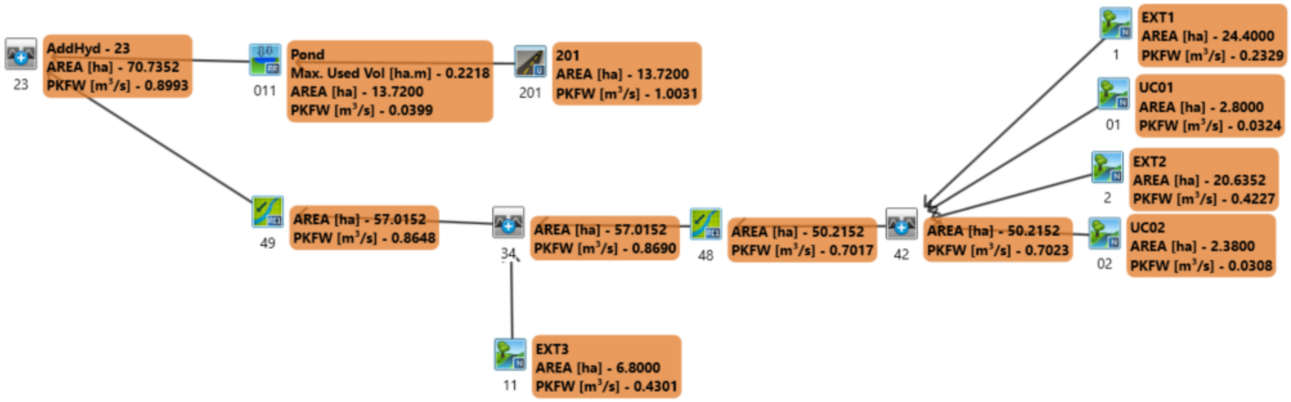
     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0012):    50.10   0.014    10.17     0.84
      + ID2= 2 (  0020):    20.64   0.009    10.83     1.18
        ====================================================
        ID = 3 (  0012):    70.74   0.022    10.83     0.94

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

 FINISH
===========================================================================================================
```

Proposed Conditions - VO Model Schematic



```
============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\3beef064-0a
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\3beef064-0a


DATE: 08-08-2025                          TIME: 09:23:20

USER:



COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 1 - 2yr 3hr 10min Chicago     **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 475.610
| Ptotal= 30.88 mm |                          B=   0.000
--------------------                          C=   0.738
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    3.17 |  0.83   86.95 |  1.67    5.04 |  2.50    3.05
                 0.17    3.77 |  1.00   15.73 |  1.83    4.42 |  2.67    2.85
                 0.33    4.72 |  1.17    9.66 |  2.00    3.95 |  2.83    2.67
                 0.50    6.58 |  1.33    7.25 |  2.17    3.59 |
                 0.67   12.69 |  1.50    5.91 |  2.33    3.30 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.030 (i)
```

```
     TIME TO PEAK    (hrs)=   2.083
     RUNOFF VOLUME    (mm)=   1.001
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.032

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.061 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=   2.091
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.068

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.004 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=   0.885
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.029

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
```

```
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
               0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
               0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
               0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
               0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
               0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
               0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
               0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
               0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.003 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=   0.885
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.029

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     2.80   0.004     1.67     0.88
      + ID2= 2 (  0002):     2.38   0.003     1.58     0.88
        ====================================================
        ID = 3 (  0042):     5.18   0.007     1.67     0.88

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):     5.18   0.007     1.67     0.88
      + ID2= 2 (  0001):    24.40   0.030     2.08     1.00
        ====================================================
        ID = 1 (  0042):    29.58   0.036     2.00     0.98

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):    29.58   0.036     2.00     0.98
      + ID2= 2 (  0002):    20.64   0.061     1.83     2.09
        ====================================================
        ID = 3 (  0042):    50.22   0.096     1.92     1.44

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60         0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60         0.0350

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY    TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)       (min)
       0.04   341.79    .203E+02       0.0          0.35       13.28
       0.09   341.84    .438E+02       0.1          0.54        8.60
       0.13   341.88    .706E+02       0.2          0.69        6.73
       0.18   341.93    .101E+03       0.3          0.81        5.68
       0.22   341.97    .134E+03       0.4          0.93        4.99
       0.27   342.02    .171E+03       0.6          1.03        4.50
       0.31   342.06    .210E+03       0.8          1.12        4.13
       0.36   342.11    .254E+03       1.1          1.21        3.83
       0.40   342.15    .300E+03       1.4          1.29        3.59
       0.45   342.20    .350E+03       1.7          1.36        3.39
       0.49   342.24    .403E+03       2.1          1.44        3.22
```

```
       0.54   342.29    .459E+03       2.5          1.51        3.07
       0.58   342.33    .518E+03       2.9          1.57        2.94
       0.63   342.38    .581E+03       3.4          1.64        2.82
       0.67   342.42    .647E+03       4.0          1.70        2.72
       0.72   342.47    .716E+03       4.5          1.76        2.63
       0.76   342.51    .789E+03       5.2          1.82        2.54
       0.81   342.55    .865E+03       5.8          1.88        2.46
       0.85   342.60    .944E+03       6.6          1.93        2.39

                                   <---- hydrograph ---->   <-pipe / channel->
                             AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                             (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0042)  50.22     0.10    1.92   1.44      0.09      0.55
   OUTFLOW: ID= 1 (  0048)  50.22     0.09    2.00   1.44      0.09      0.55


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
               0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
               0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
               0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
               0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
               0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
               0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
               0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
               0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.068 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   3.790
     TOTAL RAINFALL   (mm)=  30.883
     RUNOFF COEFFICIENT   =   0.123

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):     6.80   0.068     1.17     3.79
      + ID2= 2 (  0048):    50.22   0.095     2.00     1.44
        ====================================================
        ID = 3 (  0034):    57.02   0.123     1.75     1.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60         0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60         0.0350

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY    TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)       (min)
       0.04   341.79    .323E+02       0.0          0.35       21.13
       0.09   341.84    .697E+02       0.1          0.54       13.69
       0.13   341.88    .112E+03       0.2          0.69       10.71
       0.18   341.93    .160E+03       0.3          0.81        9.04
       0.22   341.97    .213E+03       0.4          0.93        7.95
       0.27   342.02    .272E+03       0.6          1.03        7.17
       0.31   342.06    .335E+03       0.8          1.12        6.57
```

```
       0.36   342.11    .404E+03       1.1          1.21       6.10
       0.40   342.15    .477E+03       1.4          1.29       5.72
       0.45   342.20    .557E+03       1.7          1.36       5.40
       0.49   342.24    .641E+03       2.1          1.44       5.13
       0.54   342.29    .730E+03       2.5          1.51       4.89
       0.58   342.33    .825E+03       2.9          1.57       4.68
       0.63   342.38    .925E+03       3.4          1.64       4.50
       0.67   342.42    .103E+04       4.0          1.70       4.33
       0.72   342.47    .114E+04       4.5          1.76       4.18
       0.76   342.51    .126E+04       5.2          1.82       4.05
       0.81   342.55    .138E+04       5.8          1.88       3.92
       0.85   342.60    .150E+04       6.6          1.93       3.81

                                    <---- hydrograph ---->   <-pipe / channel->
                              AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                              (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0034)   57.02     0.12    1.75   1.72      0.11      0.59
   OUTFLOW: ID= 1 (  0049)   57.02     0.12    2.00   1.72      0.11      0.59



-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44        10.28
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       0.50         2.00
     Length            (m)=     104.00        81.00
     Mannings n          =       0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.17 | 0.833   12.69 | 1.583    5.91 |  2.33    3.59
                0.167    3.17 | 0.917   86.95 | 1.667    5.91 |  2.42    3.30
                0.250    3.77 | 1.000   86.95 | 1.750    5.04 |  2.50    3.30
                0.333    3.77 | 1.083   15.73 | 1.833    5.04 |  2.58    3.05
                0.417    4.72 | 1.167   15.73 | 1.917    4.42 |  2.67    3.05
                0.500    4.72 | 1.250    9.66 | 2.000    4.42 |  2.75    2.85
                0.583    6.58 | 1.333    9.66 | 2.083    3.95 |  2.83    2.85
                0.667    6.58 | 1.417    7.25 | 2.167    3.95 |  2.92    2.67
                0.750   12.69 | 1.500    7.25 | 2.250    3.59 |  3.00    2.67

     Max.Eff.Inten.(mm/hr)=      86.95         1.75
                over (min)        5.00        60.00
     Storage Coeff.  (min)=       3.41 (ii)   57.82 (ii)
     Unit Hyd. Tpeak (min)=       5.00        60.00
     Unit Hyd. peak  (cms)=       0.26         0.02
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.43         0.03           0.435 (iii)
     TIME TO PEAK    (hrs)=       1.00         2.08            1.00
     RUNOFF VOLUME    (mm)=      28.88         1.97            5.66
     TOTAL RAINFALL   (mm)=      30.88        30.88           30.88
     RUNOFF COEFFICIENT   =       0.94         0.06            0.18

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  40.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0011)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0340      0.1452
                          0.0070     0.0032   |   0.0360      0.1704
                          0.0140     0.0140   |   0.0380      0.1964
                          0.0190     0.0318   |   0.0400      0.2233
                          0.0230     0.0529   |   0.0420      0.2509
                          0.0260     0.0747   |   0.0440      0.2794
```

```
                          0.0290     0.0974   |   0.0450      0.3087
                          0.0310     0.1209   |   0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     13.720      0.435      1.00       5.66
   OUTFLOW: ID= 1 (  0011)     13.720      0.023      3.08       5.65

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.23
                   TIME SHIFT OF PEAK FLOW         (min)=125.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0515

-------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):    13.72   0.023     3.08     5.65
      + ID2= 2 (  0049):    57.02   0.119     2.00     1.72
        ===================================================
        ID = 3 (  0023):    70.74   0.141     2.00     2.48

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
===========================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO     TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\8605cbaa-f6
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\8605cbaa-f6


DATE: 08-08-2025                           TIME: 09:23:20

USER:



COMMENTS: ____________________________________________________________


-----------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 2 - 5yr 3hr 10min Chicago     **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 632.750
| Ptotal= 40.45 mm |                          B=   0.000
--------------------                          C=   0.741
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    4.11 |  0.83  114.88 |  1.67    6.54 |  2.50    3.95
                 0.17    4.88 |  1.00   20.52 |  1.83    5.73 |  2.67    3.69
                 0.33    6.13 |  1.17   12.57 |  2.00    5.13 |  2.83    3.46
                 0.50    8.55 |  1.33    9.43 |  2.17    4.65 |
                 0.67   16.54 |  1.50    7.68 |  2.33    4.27 |


-------------------------------------------------------------------------------
```

```
--------------------
| CALIB             |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.063 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   2.034
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.050

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.123 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=   4.060
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.100

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
```

```
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.008 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=   1.846
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.046

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.008 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   1.846
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.046

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     2.80   0.008     1.67     1.85
      + ID2= 2 (  0002):     2.38   0.008     1.50     1.85
        ===================================================
        ID = 3 (  0042):     5.18   0.016     1.58     1.85

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):     5.18   0.016     1.58     1.85
      + ID2= 2 (  0001):    24.40   0.063     2.00     2.03
        ===================================================
        ID = 1 (  0042):    29.58   0.076     1.92     2.00

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):    29.58   0.076     1.92     2.00
      + ID2= 2 (  0002):    20.64   0.123     1.75     4.06
        ===================================================
        ID = 3 (  0042):    50.22   0.197     1.83     2.85

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
```

```
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

      <-------------------- TRAVEL TIME TABLE --------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .203E+02       0.0         0.35      13.28
       0.09   341.84    .438E+02       0.1         0.54       8.60
       0.13   341.88    .706E+02       0.2         0.69       6.73
       0.18   341.93    .101E+03       0.3         0.81       5.68
       0.22   341.97    .134E+03       0.4         0.93       4.99
       0.27   342.02    .171E+03       0.6         1.03       4.50
       0.31   342.06    .210E+03       0.8         1.12       4.13
       0.36   342.11    .254E+03       1.1         1.21       3.83
       0.40   342.15    .300E+03       1.4         1.29       3.59
       0.45   342.20    .350E+03       1.7         1.36       3.39
       0.49   342.24    .403E+03       2.1         1.44       3.22
       0.54   342.29    .459E+03       2.5         1.51       3.07
       0.58   342.33    .518E+03       2.9         1.57       2.94
       0.63   342.38    .581E+03       3.4         1.64       2.82
       0.67   342.42    .647E+03       4.0         1.70       2.72
       0.72   342.47    .716E+03       4.5         1.76       2.63
       0.76   342.51    .789E+03       5.2         1.82       2.54
       0.81   342.55    .865E+03       5.8         1.88       2.46
       0.85   342.60    .944E+03       6.6         1.93       2.39

                                        <---- hydrograph ---->   <-pipe / channel->
                               AREA    QPEAK    TPEAK    R.V.    MAX DEPTH  MAX VEL
                               (ha)    (cms)    (hrs)    (mm)       (m)      (m/s)
   INFLOW : ID= 2 (  0042)    50.22     0.20     1.83    2.85       0.14      0.71
   OUTFLOW: ID= 1 (  0048)    50.22     0.20     1.92    2.85       0.14      0.71


--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD    (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                   0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                   0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                   0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                   0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                   0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                   0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                   0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                   0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                   0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.136 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   6.941
     TOTAL RAINFALL   (mm)=  40.451
     RUNOFF COEFFICIENT   =   0.172

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):     6.80   0.136     1.17     6.94
      + ID2= 2 (  0048):    50.22   0.196     1.92     2.85
        ====================================================
```

```
        ID = 3 (  0034):    57.02   0.249     1.67     3.34

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

      <-------------------- TRAVEL TIME TABLE --------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .323E+02       0.0         0.35      21.13
       0.09   341.84    .697E+02       0.1         0.54      13.69
       0.13   341.88    .112E+03       0.2         0.69      10.71
       0.18   341.93    .160E+03       0.3         0.81       9.04
       0.22   341.97    .213E+03       0.4         0.93       7.95
       0.27   342.02    .272E+03       0.6         1.03       7.17
       0.31   342.06    .335E+03       0.8         1.12       6.57
       0.36   342.11    .404E+03       1.1         1.21       6.10
       0.40   342.15    .477E+03       1.4         1.29       5.72
       0.45   342.20    .557E+03       1.7         1.36       5.40
       0.49   342.24    .641E+03       2.1         1.44       5.13
       0.54   342.29    .730E+03       2.5         1.51       4.89
       0.58   342.33    .825E+03       2.9         1.57       4.68
       0.63   342.38    .925E+03       3.4         1.64       4.50
       0.67   342.42    .103E+04       4.0         1.70       4.33
       0.72   342.47    .114E+04       4.5         1.76       4.18
       0.76   342.51    .126E+04       5.2         1.82       4.05
       0.81   342.55    .138E+04       5.8         1.88       3.92
       0.85   342.60    .150E+04       6.6         1.93       3.81

                                        <---- hydrograph ---->   <-pipe / channel->
                               AREA    QPEAK    TPEAK    R.V.    MAX DEPTH  MAX VEL
                               (ha)    (cms)    (hrs)    (mm)       (m)      (m/s)
   INFLOW : ID= 2 (  0034)    57.02     0.25     1.67    3.34       0.16      0.76
   OUTFLOW: ID= 1 (  0049)    57.02     0.25     1.83    3.34       0.16      0.75


--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44        10.28
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       0.50         2.00
     Length            (m)=     104.00        81.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                    TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                     hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                   0.083    4.11 | 0.833   16.54 | 1.583    7.68 |  2.33    4.65
                   0.167    4.11 | 0.917  114.88 | 1.667    7.68 |  2.42    4.27
                   0.250    4.88 | 1.000  114.88 | 1.750    6.54 |  2.50    4.27
                   0.333    4.88 | 1.083   20.52 | 1.833    6.54 |  2.58    3.95
                   0.417    6.13 | 1.167   20.52 | 1.917    5.73 |  2.67    3.95
                   0.500    6.13 | 1.250   12.57 | 2.000    5.73 |  2.75    3.69
                   0.583    8.55 | 1.333   12.57 | 2.083    5.13 |  2.83    3.69
                   0.667    8.55 | 1.417    9.43 | 2.167    5.13 |  2.92    3.46
                   0.750   16.54 | 1.500    9.43 | 2.250    4.65 |  3.00    3.46

     Max.Eff.Inten.(mm/hr)=     114.88         3.90
               over (min)       5.00        45.00
     Storage Coeff.  (min)=       3.05 (ii)   42.48 (ii)
     Unit Hyd. Tpeak (min)=       5.00        45.00
     Unit Hyd. peak  (cms)=       0.27         0.03
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.58         0.06         0.586 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.67          1.00
     RUNOFF VOLUME    (mm)=      38.45         3.56          8.33
```

```
     TOTAL RAINFALL   (mm)=      40.45        40.45          40.45
     RUNOFF COEFFICIENT   =       0.95         0.09           0.21

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  40.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0011)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |  0.0340      0.1452
                          0.0070     0.0032   |  0.0360      0.1704
                          0.0140     0.0140   |  0.0380      0.1964
                          0.0190     0.0318   |  0.0400      0.2233
                          0.0230     0.0529   |  0.0420      0.2509
                          0.0260     0.0747   |  0.0440      0.2794
                          0.0290     0.0974   |  0.0450      0.3087
                          0.0310     0.1209   |  0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     13.720      0.586      1.00       8.33
   OUTFLOW: ID= 1 (  0011)     13.720      0.027      3.33       8.33

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.64
                   TIME SHIFT OF PEAK FLOW         (min)=140.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0838

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):    13.72   0.027     3.33     8.33
      + ID2= 2 (  0049):    57.02   0.245     1.83     3.34
        ===================================================
        ID = 3 (  0023):    70.74   0.270     1.83     4.30

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
===========================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\b9f1746c-d8
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\b9f1746c-d8


DATE: 08-08-2025                         TIME: 09:23:21

USER:


COMMENTS: ____________________________________________________________
```

```
-----------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 3 - 10yr 3hr 10min Chicago    **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 721.920
| Ptotal= 47.37 mm |                          B=   0.000
--------------------                          C=   0.736
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    4.90 |  0.83  132.58 |  1.67    7.77 |  2.50    4.72
                 0.17    5.82 |  1.00   24.19 |  1.83    6.82 |  2.67    4.40
                 0.33    7.29 |  1.17   14.88 |  2.00    6.10 |  2.83    4.13
                 0.50   10.14 |  1.33   11.18 |  2.17    5.54 |
                 0.67   19.52 |  1.50    9.12 |  2.33    5.09 |


-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW      (cms)=   0.093 (i)
     TIME TO PEAK   (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   2.988
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.063

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW      (cms)=   0.178 (i)
     TIME TO PEAK   (hrs)=   1.750
```

```
     RUNOFF VOLUME    (mm)=   5.826
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.123

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.013 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=   2.742
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.058

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
                0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
                0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
                0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
                0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
                0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.012 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   2.742
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.058

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     2.80   0.013     1.58     2.74
      + ID2= 2 (  0002):     2.38   0.012     1.50     2.74
        ================================================
        ID = 3 (  0042):     5.18   0.024     1.50     2.74

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

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--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):     5.18   0.024     1.50     2.74
      + ID2= 2 (  0001):    24.40   0.093     2.00     2.99
        ================================================
        ID = 1 (  0042):    29.58   0.113     1.92     2.94

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):    29.58   0.113     1.92     2.94
      + ID2= 2 (  0002):    20.64   0.178     1.75     5.83
        ================================================
        ID = 3 (  0042):    50.22   0.289     1.83     4.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

         <--------------------- TRAVEL TIME TABLE ---------------------->
          DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
           (m)     (m)      (cu.m.)      (cms)        (m/s)      (min)
          0.04   341.79    .203E+02       0.0          0.35      13.28
          0.09   341.84    .438E+02       0.1          0.54       8.60
          0.13   341.88    .706E+02       0.2          0.69       6.73
          0.18   341.93    .101E+03       0.3          0.81       5.68
          0.22   341.97    .134E+03       0.4          0.93       4.99
          0.27   342.02    .171E+03       0.6          1.03       4.50
          0.31   342.06    .210E+03       0.8          1.12       4.13
          0.36   342.11    .254E+03       1.1          1.21       3.83
          0.40   342.15    .300E+03       1.4          1.29       3.59
          0.45   342.20    .350E+03       1.7          1.36       3.39
          0.49   342.24    .403E+03       2.1          1.44       3.22
          0.54   342.29    .459E+03       2.5          1.51       3.07
          0.58   342.33    .518E+03       2.9          1.57       2.94
          0.63   342.38    .581E+03       3.4          1.64       2.82
          0.67   342.42    .647E+03       4.0          1.70       2.72
          0.72   342.47    .716E+03       4.5          1.76       2.63
          0.76   342.51    .789E+03       5.2          1.82       2.54
          0.81   342.55    .865E+03       5.8          1.88       2.46
          0.85   342.60    .944E+03       6.6          1.93       2.39

                                    <---- hydrograph ---->   <-pipe / channel->
                             AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                             (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0042)   50.22     0.29    1.83   4.13      0.18      0.81
   OUTFLOW: ID= 1 (  0048)   50.22     0.29    1.83   4.13      0.18      0.81


--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
                0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
                0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
                0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
```

```
              0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
              0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
              0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
              0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
              0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.194 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   9.662
     TOTAL RAINFALL   (mm)=  47.366
     RUNOFF COEFFICIENT   =   0.204

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):      6.80   0.194     1.17      9.66
      + ID2= 2 (  0048):     50.22   0.288     1.83      4.13
        ===============================================
        ID = 3 (  0034):     57.02   0.362     1.67      4.79

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60         0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60         0.0350

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .323E+02       0.0          0.35      21.13
       0.09   341.84    .697E+02       0.1          0.54      13.69
       0.13   341.88    .112E+03       0.2          0.69      10.71
       0.18   341.93    .160E+03       0.3          0.81       9.04
       0.22   341.97    .213E+03       0.4          0.93       7.95
       0.27   342.02    .272E+03       0.6          1.03       7.17
       0.31   342.06    .335E+03       0.8          1.12       6.57
       0.36   342.11    .404E+03       1.1          1.21       6.10
       0.40   342.15    .477E+03       1.4          1.29       5.72
       0.45   342.20    .557E+03       1.7          1.36       5.40
       0.49   342.24    .641E+03       2.1          1.44       5.13
       0.54   342.29    .730E+03       2.5          1.51       4.89
       0.58   342.33    .825E+03       2.9          1.57       4.68
       0.63   342.38    .925E+03       3.4          1.64       4.50
       0.67   342.42    .103E+04       4.0          1.70       4.33
       0.72   342.47    .114E+04       4.5          1.76       4.18
       0.76   342.51    .126E+04       5.2          1.82       4.05
       0.81   342.55    .138E+04       5.8          1.88       3.92
       0.85   342.60    .150E+04       6.6          1.93       3.81

                                    <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.    MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)       (m)      (m/s)
   INFLOW : ID= 2 (  0034)  57.02    0.36    1.67   4.79      0.20       0.86
   OUTFLOW: ID= 1 (  0049)  57.02    0.36    1.83   4.79      0.20       0.86


------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44        10.28
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       0.50         2.00
     Length            (m)=     104.00        81.00
     Mannings n          =      0.013        0.250
```

```
         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                             ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    4.90 | 0.833   19.52 | 1.583    9.12 |  2.33    5.54
               0.167    4.90 | 0.917  132.58 | 1.667    9.12 |  2.42    5.09
               0.250    5.82 | 1.000  132.58 | 1.750    7.77 |  2.50    5.09
               0.333    5.82 | 1.083   24.19 | 1.833    7.77 |  2.58    4.72
               0.417    7.29 | 1.167   24.19 | 1.917    6.82 |  2.67    4.72
               0.500    7.29 | 1.250   14.88 | 2.000    6.82 |  2.75    4.40
               0.583   10.14 | 1.333   14.88 | 2.083    6.10 |  2.83    4.40
               0.667   10.14 | 1.417   11.18 | 2.167    6.10 |  2.92    4.13
               0.750   19.52 | 1.500   11.18 | 2.250    5.54 |  3.00    4.13

     Max.Eff.Inten.(mm/hr)=     132.58         5.89
                over (min)        5.00        40.00
     Storage Coeff.  (min)=       2.88 (ii)   36.34 (ii)
     Unit Hyd. Tpeak (min)=       5.00        40.00
     Unit Hyd. peak  (cms)=       0.28         0.03
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.67         0.09          0.685 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.58           1.00
     RUNOFF VOLUME    (mm)=      45.37         4.95          10.49
     TOTAL RAINFALL   (mm)=      47.37        47.37          47.37
     RUNOFF COEFFICIENT   =       0.96         0.10           0.22

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  40.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0011)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0340     0.1452
                          0.0070     0.0032   |   0.0360     0.1704
                          0.0140     0.0140   |   0.0380     0.1964
                          0.0190     0.0318   |   0.0400     0.2233
                          0.0230     0.0529   |   0.0420     0.2509
                          0.0260     0.0747   |   0.0440     0.2794
                          0.0290     0.0974   |   0.0450     0.3087
                          0.0310     0.1209   |   0.0000     0.0000

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     13.720     0.685      1.00      10.49
   OUTFLOW: ID= 1 (  0011)     13.720     0.030      3.50      10.48

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.40
                   TIME SHIFT OF PEAK FLOW         (min)=150.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1106

------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):     13.72   0.030     3.50     10.48
      + ID2= 2 (  0049):     57.02   0.359     1.83      4.79
        ===============================================
        ID = 3 (  0023):     70.74   0.386     1.83      5.89

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
------------------------------------------------------------------------------
================================================================================================

       V    V   I   SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I   SS     U   U   A A   L
        V  V    I    SS    U   U  AAAAA  L
        V  V    I     SS   U   U  A   A  L
         VV     I   SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
```

```
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\87883151-ed
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\87883151-ed


DATE: 08-08-2025                             TIME: 09:23:21

USER:


COMMENTS: ____________________________________________________________


--------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 4 - 25yr 3hr 10min Chicago    **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 822.740
| Ptotal= 57.15 mm |                          B=   0.000
--------------------                          C=   0.725
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    6.14 |  0.83  154.98 |  1.67    9.68 |  2.50    5.92
                 0.17    7.28 |  1.00   29.61 |  1.83    8.51 |  2.67    5.53
                 0.33    9.09 |  1.17   18.34 |  2.00    7.63 |  2.83    5.19
                 0.50   12.58 |  1.33   13.85 |  2.17    6.94 |
                 0.67   23.97 |  1.50   11.32 |  2.33    6.38 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.144 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   4.620
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.081

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.268 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=   8.769
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.153

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.020 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=   4.285
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.075

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
```

```
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.019 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   4.284
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.075

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):      2.80   0.020     1.58     4.28
      + ID2= 2 (  0002):      2.38   0.019     1.50     4.28
        ===================================================
        ID = 3 (  0042):      5.18   0.038     1.50     4.28

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):      5.18   0.038     1.50     4.28
      + ID2= 2 (  0001):     24.40   0.144     2.00     4.62
        ===================================================
        ID = 1 (  0042):     29.58   0.175     1.92     4.56

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):     29.58   0.175     1.92     4.56
      + ID2= 2 (  0002):     20.64   0.268     1.75     8.77
        ===================================================
        ID = 3 (  0042):     50.22   0.440     1.83     6.29

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

      <-------------------- TRAVEL TIME TABLE --------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)     (cms)        (m/s)      (min)
       0.04   341.79    .203E+02       0.0         0.35      13.28
       0.09   341.84    .438E+02       0.1         0.54       8.60
       0.13   341.88    .706E+02       0.2         0.69       6.73
       0.18   341.93    .101E+03       0.3         0.81       5.68
       0.22   341.97    .134E+03       0.4         0.93       4.99
       0.27   342.02    .171E+03       0.6         1.03       4.50
       0.31   342.06    .210E+03       0.8         1.12       4.13
       0.36   342.11    .254E+03       1.1         1.21       3.83
       0.40   342.15    .300E+03       1.4         1.29       3.59
       0.45   342.20    .350E+03       1.7         1.36       3.39
       0.49   342.24    .403E+03       2.1         1.44       3.22
       0.54   342.29    .459E+03       2.5         1.51       3.07
       0.58   342.33    .518E+03       2.9         1.57       2.94
       0.63   342.38    .581E+03       3.4         1.64       2.82
       0.67   342.42    .647E+03       4.0         1.70       2.72
       0.72   342.47    .716E+03       4.5         1.76       2.63
       0.76   342.51    .789E+03       5.2         1.82       2.54
       0.81   342.55    .865E+03       5.8         1.88       2.46
       0.85   342.60    .944E+03       6.6         1.93       2.39
```

```
                                        <---- hydrograph ---->   <-pipe / channel->
                                   AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                                   (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0042)        50.22     0.44    1.83   6.29      0.22      0.92
   OUTFLOW: ID= 1 (  0048)        50.22     0.44    1.83   6.29      0.22      0.92


-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                   ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
                0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
                0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
                0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
                0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
                0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
                0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
                0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
                0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.284 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  14.060
     TOTAL RAINFALL   (mm)=  57.153
     RUNOFF COEFFICIENT   =   0.246

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):      6.80   0.284     1.17    14.06
      + ID2= 2 (  0048):     50.22   0.440     1.83     6.29
        ===================================================
        ID = 3 (  0034):     57.02   0.549     1.67     7.22

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

      <-------------------- TRAVEL TIME TABLE --------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)     (cms)        (m/s)      (min)
       0.04   341.79    .323E+02       0.0         0.35      21.13
       0.09   341.84    .697E+02       0.1         0.54      13.69
       0.13   341.88    .112E+03       0.2         0.69      10.71
       0.18   341.93    .160E+03       0.3         0.81       9.04
       0.22   341.97    .213E+03       0.4         0.93       7.95
       0.27   342.02    .272E+03       0.6         1.03       7.17
       0.31   342.06    .335E+03       0.8         1.12       6.57
       0.36   342.11    .404E+03       1.1         1.21       6.10
       0.40   342.15    .477E+03       1.4         1.29       5.72
       0.45   342.20    .557E+03       1.7         1.36       5.40
       0.49   342.24    .641E+03       2.1         1.44       5.13
       0.54   342.29    .730E+03       2.5         1.51       4.89
       0.58   342.33    .825E+03       2.9         1.57       4.68
       0.63   342.38    .925E+03       3.4         1.64       4.50
       0.67   342.42    .103E+04       4.0         1.70       4.33
       0.72   342.47    .114E+04       4.5         1.76       4.18
```

```
      0.76   342.51    .126E+04       5.2          1.82       4.05
      0.81   342.55    .138E+04       5.8          1.88       3.92
      0.85   342.60    .150E+04       6.6          1.93       3.81

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0034)  57.02     0.55    1.67   7.22      0.25      0.98
   OUTFLOW: ID= 1 (  0049)  57.02     0.55    1.75   7.22      0.25      0.98



--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44       10.28
     Dep. Storage     (mm)=       2.00        5.00
     Average Slope     (%)=       0.50        2.00
     Length            (m)=     104.00       81.00
     Mannings n           =      0.013       0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                             ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    6.14 | 0.833   23.97 | 1.583   11.32 |  2.33    6.94
               0.167    6.14 | 0.917  154.98 | 1.667   11.32 |  2.42    6.38
               0.250    7.28 | 1.000  154.98 | 1.750    9.68 |  2.50    6.38
               0.333    7.28 | 1.083   29.61 | 1.833    9.68 |  2.58    5.92
               0.417    9.09 | 1.167   29.61 | 1.917    8.51 |  2.67    5.92
               0.500    9.09 | 1.250   18.34 | 2.000    8.51 |  2.75    5.53
               0.583   12.58 | 1.333   18.34 | 2.083    7.63 |  2.83    5.53
               0.667   12.58 | 1.417   13.85 | 2.167    7.63 |  2.92    5.19
               0.750   23.97 | 1.500   13.85 | 2.250    6.94 |  3.00    5.19

     Max.Eff.Inten.(mm/hr)=     154.98         9.42
               over (min)        5.00        35.00
     Storage Coeff.  (min)=       2.70 (ii)   30.43 (ii)
     Unit Hyd. Tpeak (min)=       5.00        35.00
     Unit Hyd. peak  (cms)=       0.29         0.04
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.79         0.15         0.815 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.50          1.00
     RUNOFF VOLUME    (mm)=      55.15         7.27         13.83
     TOTAL RAINFALL   (mm)=      57.15        57.15         57.15
     RUNOFF COEFFICIENT   =       0.97         0.13          0.24

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  40.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0011)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0340      0.1452
                          0.0070     0.0032   |   0.0360      0.1704
                          0.0140     0.0140   |   0.0380      0.1964
                          0.0190     0.0318   |   0.0400      0.2233
                          0.0230     0.0529   |   0.0420      0.2509
                          0.0260     0.0747   |   0.0440      0.2794
                          0.0290     0.0974   |   0.0450      0.3087
                          0.0310     0.1209   |   0.0000      0.0000

                                AREA     QPEAK      TPEAK       R.V.
                                (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     13.720      0.815      1.00       13.83
   OUTFLOW: ID= 1 (  0011)     13.720      0.035      3.50       13.82

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.25
```

```
                    TIME SHIFT OF PEAK FLOW        (min)=150.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.1529

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):    13.72    0.035     3.50    13.82
      + ID2= 2 (  0049):    57.02    0.545     1.75     7.22
        ====================================================
        ID = 3 (  0023):    70.74    0.575     1.75     8.50

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
=================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\5b8caeb5-5c
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\5b8caeb5-5c


DATE: 08-08-2025                           TIME: 09:23:21

USER:



COMMENTS: ____________________________________________________________


-------------------------------------------------------------------------------------------------
  **************************************************
  ** SIMULATION : 5 - 50yr 3hr 10min Chicago    **
  **************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 893.800
| Ptotal= 64.05 mm |                          B=   0.000
--------------------                          C=   0.719
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    7.02 |  0.83  170.70 |  1.67   11.03 |  2.50    6.77
                 0.17    8.31 |  1.00   33.42 |  1.83    9.71 |  2.67    6.33
                 0.33   10.36 |  1.17   20.79 |  2.00    8.71 |  2.83    5.95
                 0.50   14.30 |  1.33   15.73 |  2.17    7.93 |
                 0.67   27.09 |  1.50   12.89 |  2.33    7.29 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

```
                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.185 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   5.960
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.093

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW       (cms)=   0.341 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=  11.130
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.174

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.026 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=   5.557
```

```
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.087

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.024 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   5.556
     TOTAL RAINFALL   (mm)=  64.054
     RUNOFF COEFFICIENT   =   0.087

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     2.80   0.026     1.58     5.56
      + ID2= 2 (  0002):     2.38   0.024     1.50     5.56
        ===============================================
        ID = 3 (  0042):     5.18   0.050     1.50     5.56

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):     5.18   0.050     1.50     5.56
      + ID2= 2 (  0001):    24.40   0.185     2.00     5.96
        ===============================================
        ID = 1 (  0042):    29.58   0.226     1.92     5.89

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):    29.58   0.226     1.92     5.89
      + ID2= 2 (  0002):    20.64   0.341     1.75    11.13
        ===============================================
        ID = 3 (  0042):    50.22   0.564     1.75     8.04

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00         342.60       0.0350
                   2.55         341.75    0.0350 /0.0350  Main Channel
                   4.05         341.75    0.0350 /0.0350  Main Channel
```

```
                6.50        342.60        0.0350

      <--------------------- TRAVEL TIME TABLE --------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .203E+02       0.0          0.35      13.28
       0.09   341.84    .438E+02       0.1          0.54       8.60
       0.13   341.88    .706E+02       0.2          0.69       6.73
       0.18   341.93    .101E+03       0.3          0.81       5.68
       0.22   341.97    .134E+03       0.4          0.93       4.99
       0.27   342.02    .171E+03       0.6          1.03       4.50
       0.31   342.06    .210E+03       0.8          1.12       4.13
       0.36   342.11    .254E+03       1.1          1.21       3.83
       0.40   342.15    .300E+03       1.4          1.29       3.59
       0.45   342.20    .350E+03       1.7          1.36       3.39
       0.49   342.24    .403E+03       2.1          1.44       3.22
       0.54   342.29    .459E+03       2.5          1.51       3.07
       0.58   342.33    .518E+03       2.9          1.57       2.94
       0.63   342.38    .581E+03       3.4          1.64       2.82
       0.67   342.42    .647E+03       4.0          1.70       2.72
       0.72   342.47    .716E+03       4.5          1.76       2.63
       0.76   342.51    .789E+03       5.2          1.82       2.54
       0.81   342.55    .865E+03       5.8          1.88       2.46
       0.85   342.60    .944E+03       6.6          1.93       2.39

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0042)  50.22    0.56    1.75   8.04      0.25      0.99
   OUTFLOW: ID= 1 (  0048)  50.22    0.56    1.83   8.04      0.25      0.99


-------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                   TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                    hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                  0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                  0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                  0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                  0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                  0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                  0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                  0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                  0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                  0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

    Unit Hyd Qpeak  (cms)=   1.181

    PEAK FLOW       (cms)=   0.354 (i)
    TIME TO PEAK    (hrs)=   1.167
    RUNOFF VOLUME    (mm)=  17.497
    TOTAL RAINFALL   (mm)=  64.054
    RUNOFF COEFFICIENT   =   0.273

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |        AREA    QPEAK    TPEAK     R.V.
--------------------        (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (  0011):     6.80   0.354     1.17    17.50
        + ID2= 2 (  0048):    50.22   0.563     1.83     8.04
          =================================================
          ID = 3 (  0034):    57.02   0.700     1.67     9.17

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
              <------ DATA FOR SECTION (   1.1) ------>
```

```
             Distance      Elevation       Manning
                 0.00       342.60        0.0350
                 2.55       341.75    0.0350 /0.0350  Main Channel
                 4.05       341.75    0.0350 /0.0350  Main Channel
                 6.50       342.60        0.0350

      <--------------------- TRAVEL TIME TABLE --------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .323E+02       0.0          0.35      21.13
       0.09   341.84    .697E+02       0.1          0.54      13.69
       0.13   341.88    .112E+03       0.2          0.69      10.71
       0.18   341.93    .160E+03       0.3          0.81       9.04
       0.22   341.97    .213E+03       0.4          0.93       7.95
       0.27   342.02    .272E+03       0.6          1.03       7.17
       0.31   342.06    .335E+03       0.8          1.12       6.57
       0.36   342.11    .404E+03       1.1          1.21       6.10
       0.40   342.15    .477E+03       1.4          1.29       5.72
       0.45   342.20    .557E+03       1.7          1.36       5.40
       0.49   342.24    .641E+03       2.1          1.44       5.13
       0.54   342.29    .730E+03       2.5          1.51       4.89
       0.58   342.33    .825E+03       2.9          1.57       4.68
       0.63   342.38    .925E+03       3.4          1.64       4.50
       0.67   342.42    .103E+04       4.0          1.70       4.33
       0.72   342.47    .114E+04       4.5          1.76       4.18
       0.76   342.51    .126E+04       5.2          1.82       4.05
       0.81   342.55    .138E+04       5.8          1.88       3.92
       0.85   342.60    .150E+04       6.6          1.93       3.81

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0034)  57.02    0.70    1.67   9.17      0.28      1.06
   OUTFLOW: ID= 1 (  0049)  57.02    0.70    1.75   9.17      0.28      1.05


-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44        10.28
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       0.50         2.00
     Length            (m)=     104.00        81.00
     Mannings n           =      0.013        0.250

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                   TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                    hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                  0.083    7.02 | 0.833   27.09 | 1.583   12.89 |  2.33    7.93
                  0.167    7.02 | 0.917  170.70 | 1.667   12.89 |  2.42    7.29
                  0.250    8.31 | 1.000  170.70 | 1.750   11.03 |  2.50    7.29
                  0.333    8.31 | 1.083   33.42 | 1.833   11.03 |  2.58    6.77
                  0.417   10.36 | 1.167   33.42 | 1.917    9.71 |  2.67    6.77
                  0.500   10.36 | 1.250   20.79 | 2.000    9.71 |  2.75    6.33
                  0.583   14.30 | 1.333   20.79 | 2.083    8.71 |  2.83    6.33
                  0.667   14.30 | 1.417   15.73 | 2.167    8.71 |  2.92    5.95
                  0.750   27.09 | 1.500   15.73 | 2.250    7.93 |  3.00    5.95

     Max.Eff.Inten.(mm/hr)=     170.70        13.06
                over (min)        5.00        30.00
     Storage Coeff.  (min)=       2.60 (ii)   26.93 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=       0.29         0.04
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.88         0.20        0.913 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.42         1.00
     RUNOFF VOLUME    (mm)=      62.05         9.13        16.38
     TOTAL RAINFALL   (mm)=      64.05        64.05        64.05
     RUNOFF COEFFICIENT   =       0.97         0.14         0.26

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  40.0    Ia = Dep. Storage  (Above)
```

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      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0011)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |  0.0340      0.1452
                          0.0070     0.0032   |  0.0360      0.1704
                          0.0140     0.0140   |  0.0380      0.1964
                          0.0190     0.0318   |  0.0400      0.2233
                          0.0230     0.0529   |  0.0420      0.2509
                          0.0260     0.0747   |  0.0440      0.2794
                          0.0290     0.0974   |  0.0450      0.3087
                          0.0310     0.1209   |  0.0000      0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     13.720      0.913      1.00      16.38
   OUTFLOW: ID= 1 (  0011)     13.720      0.037      3.50      16.37

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.07
                   TIME SHIFT OF PEAK FLOW         (min)=150.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1860

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0011):    13.72   0.037     3.50    16.37
      + ID2= 2 (  0049):    57.02   0.695     1.75     9.17
        ===================================================
        ID = 3 (  0023):    70.74   0.727     1.75    10.57

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
================================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\6d2b18c8-cc
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\6d2b18c8-cc


DATE: 08-08-2025                             TIME: 09:23:21

USER:


COMMENTS: ____________________________________________________________


----------------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 6 - 100yr 3hr 10min Chicago   **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 953.290
| Ptotal= 71.21 mm |                          B=   0.000
--------------------                          C=   0.711
```

```
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    8.02 |  0.83  185.45 |  1.67   12.53 |  2.50    7.73
                 0.17    9.47 |  1.00   37.49 |  1.83   11.04 |  2.67    7.23
                 0.33   11.77 |  1.17   23.45 |  2.00    9.92 |  2.83    6.80
                 0.50   16.19 |  1.33   17.80 |  2.17    9.04 |
                 0.67   30.45 |  1.50   14.61 |  2.33    8.32 |

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW      (cms)=   0.233 (i)
     TIME TO PEAK   (hrs)=   2.000
     RUNOFF VOLUME   (mm)=   7.509
     TOTAL RAINFALL  (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.105

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   1.336

     PEAK FLOW      (cms)=   0.423 (i)
     TIME TO PEAK   (hrs)=   1.750
     RUNOFF VOLUME   (mm)=  13.810
     TOTAL RAINFALL  (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.194

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
```

```
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                 0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                 0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                 0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                 0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                 0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                 0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                 0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                 0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.032 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=   7.030
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.099

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                 0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                 0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                 0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                 0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                 0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                 0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                 0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                 0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.031 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   7.030
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.099

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD   (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     2.80   0.032     1.58     7.03
      + ID2= 2 (  0002):     2.38   0.031     1.50     7.03
        ==================================================
        ID = 3 (  0042):     5.18   0.063     1.50     7.03

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD   (  0042)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):     5.18   0.063     1.50     7.03
      + ID2= 2 (  0001):    24.40   0.233     2.00     7.51
        ==================================================
```

```
        ID = 1 (  0042):    29.58   0.284     1.92     7.42

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD   (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):    29.58   0.284     1.92     7.42
      + ID2= 2 (  0002):    20.64   0.423     1.75    13.81
        ==================================================
        ID = 3 (  0042):    50.22   0.702     1.75    10.05

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY    TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)       (min)
       0.04   341.79    .203E+02       0.0          0.35       13.28
       0.09   341.84    .438E+02       0.1          0.54        8.60
       0.13   341.88    .706E+02       0.2          0.69        6.73
       0.18   341.93    .101E+03       0.3          0.81        5.68
       0.22   341.97    .134E+03       0.4          0.93        4.99
       0.27   342.02    .171E+03       0.6          1.03        4.50
       0.31   342.06    .210E+03       0.8          1.12        4.13
       0.36   342.11    .254E+03       1.1          1.21        3.83
       0.40   342.15    .300E+03       1.4          1.29        3.59
       0.45   342.20    .350E+03       1.7          1.36        3.39
       0.49   342.24    .403E+03       2.1          1.44        3.22
       0.54   342.29    .459E+03       2.5          1.51        3.07
       0.58   342.33    .518E+03       2.9          1.57        2.94
       0.63   342.38    .581E+03       3.4          1.64        2.82
       0.67   342.42    .647E+03       4.0          1.70        2.72
       0.72   342.47    .716E+03       4.5          1.76        2.63
       0.76   342.51    .789E+03       5.2          1.82        2.54
       0.81   342.55    .865E+03       5.8          1.88        2.46
       0.85   342.60    .944E+03       6.6          1.93        2.39

                                 <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0042)  50.22    0.70    1.75  10.05      0.28      1.06
   OUTFLOW: ID= 1 (  0048)  50.22    0.70    1.83  10.05      0.28      1.06


-------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
                 0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
                 0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
                 0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
                 0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
                 0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
                 0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
                 0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
                 0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW       (cms)=   0.430 (i)
```

```
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  21.320
     TOTAL RAINFALL   (mm)=  71.214
     RUNOFF COEFFICIENT   =   0.299

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0011):      6.80   0.430     1.17    21.32
     + ID2= 2 (  0048):     50.22   0.702     1.83    10.05
       ==================================================
       ID = 3 (  0034):     57.02   0.869     1.67    11.39

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60        0.0350
                   2.55        341.75    0.0350 /0.0350  Main Channel
                   4.05        341.75    0.0350 /0.0350  Main Channel
                   6.50        342.60        0.0350

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .323E+02       0.0          0.35      21.13
       0.09   341.84    .697E+02       0.1          0.54      13.69
       0.13   341.88    .112E+03       0.2          0.69      10.71
       0.18   341.93    .160E+03       0.3          0.81       9.04
       0.22   341.97    .213E+03       0.4          0.93       7.95
       0.27   342.02    .272E+03       0.6          1.03       7.17
       0.31   342.06    .335E+03       0.8          1.12       6.57
       0.36   342.11    .404E+03       1.1          1.21       6.10
       0.40   342.15    .477E+03       1.4          1.29       5.72
       0.45   342.20    .557E+03       1.7          1.36       5.40
       0.49   342.24    .641E+03       2.1          1.44       5.13
       0.54   342.29    .730E+03       2.5          1.51       4.89
       0.58   342.33    .825E+03       2.9          1.57       4.68
       0.63   342.38    .925E+03       3.4          1.64       4.50
       0.67   342.42    .103E+04       4.0          1.70       4.33
       0.72   342.47    .114E+04       4.5          1.76       4.18
       0.76   342.51    .126E+04       5.2          1.82       4.05
       0.81   342.55    .138E+04       5.8          1.88       3.92
       0.85   342.60    .150E+04       6.6          1.93       3.81

                                     <---- hydrograph ---->   <-pipe / channel->
                               AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                               (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0034)    57.02     0.87    1.67  11.39      0.32      1.13
   OUTFLOW: ID= 1 (  0049)    57.02     0.86    1.75  11.39      0.32      1.12



-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44        10.28
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       0.50         2.00
     Length            (m)=     104.00        81.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    8.02 | 0.833   30.45 | 1.583   14.61 |  2.33    9.04
               0.167    8.02 | 0.917  185.45 | 1.667   14.61 |  2.42    8.32
               0.250    9.47 | 1.000  185.45 | 1.750   12.53 |  2.50    8.32
```

```
               0.333    9.47 | 1.083   37.49 | 1.833   12.53 |  2.58    7.73
               0.417   11.77 | 1.167   37.49 | 1.917   11.04 |  2.67    7.73
               0.500   11.77 | 1.250   23.45 | 2.000   11.04 |  2.75    7.23
               0.583   16.19 | 1.333   23.45 | 2.083    9.92 |  2.83    7.23
               0.667   16.19 | 1.417   17.80 | 2.167    9.92 |  2.92    6.80
               0.750   30.45 | 1.500   17.80 | 2.250    9.04 |  3.00    6.80

     Max.Eff.Inten.(mm/hr)=     185.45        15.88
                over (min)        5.00        30.00
     Storage Coeff.  (min)=       2.52 (ii)   25.01 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=       0.29         0.04
                                                          *TOTALS*
     PEAK FLOW      (cms)=        0.95         0.26          1.003 (iii)
     TIME TO PEAK   (hrs)=        1.00         1.42           1.00
     RUNOFF VOLUME    (mm)=      69.21        11.25          19.19
     TOTAL RAINFALL   (mm)=      71.21        71.21          71.21
     RUNOFF COEFFICIENT   =       0.97         0.16           0.27

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
               YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  40.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0011)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0340     0.1452
                          0.0070     0.0032   |   0.0360     0.1704
                          0.0140     0.0140   |   0.0380     0.1964
                          0.0190     0.0318   |   0.0400     0.2233
                          0.0230     0.0529   |   0.0420     0.2509
                          0.0260     0.0747   |   0.0440     0.2794
                          0.0290     0.0974   |   0.0450     0.3087
                          0.0310     0.1209   |   0.0000     0.0000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)     13.720     1.003      1.00      19.19
   OUTFLOW: ID= 1 (  0011)     13.720     0.040      3.58      19.18

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.98
                   TIME SHIFT OF PEAK FLOW         (min)=155.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2218

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0011):     13.72   0.040     3.58    19.18
     + ID2= 2 (  0049):     57.02   0.865     1.75    11.39
       ==================================================
       ID = 3 (  0023):     70.74   0.899     1.75    12.90

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****
```

```
  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\7f07d98d-dd
  Summary filename: C:\Users\cmartin\AppData\Local\Civica\VH5\ad5ffb59-cdbf-44b8-b93e-1def18aa052d\7f07d98d-dd


DATE: 08-08-2025                         TIME: 09:23:21

USER:


COMMENTS: ____________________________________________________________

-------------------------------------------------------------------------------------------------------------
  **************************************************
  ** SIMULATION : 7 - 25mm                        **
  **************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\cmartin\AppD
|                  |              ata\Local\Temp\
|                  |              ea099e01-8d98-4e29-ac3c-4ddfc555edae\1e3bc16b
| Ptotal= 24.99 mm |    Comments: 25MM_S~1
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    0.44 |  6.00    0.77 | 12.00    1.20 | 18.00    0.60
                 0.17    0.44 |  6.17    0.77 | 12.17    1.20 | 18.17    0.60
                 0.33    0.44 |  6.33    0.77 | 12.33    1.20 | 18.33    0.60
                 0.50    0.44 |  6.50    0.77 | 12.50    1.05 | 18.50    0.60
                 0.67    0.44 |  6.67    0.78 | 12.67    1.05 | 18.67    0.60
                 0.83    0.44 |  6.83    0.77 | 12.83    1.05 | 18.83    0.60
                 1.00    0.44 |  7.00    0.95 | 13.00    1.05 | 19.00    0.60
                 1.17    0.44 |  7.17    0.95 | 13.17    1.05 | 19.17    0.60
                 1.33    0.44 |  7.33    0.95 | 13.33    1.05 | 19.33    0.60
                 1.50    0.44 |  7.50    0.95 | 13.50    0.95 | 19.50    0.60
                 1.67    0.44 |  7.67    0.95 | 13.67    0.95 | 19.67    0.60
                 1.83    0.44 |  7.83    0.95 | 13.83    0.95 | 19.83    0.60
                 2.00    0.51 |  8.00    1.25 | 14.00    0.79 | 20.00    0.46
                 2.17    0.51 |  8.17    1.25 | 14.17    0.79 | 20.17    0.46
                 2.33    0.51 |  8.33    1.25 | 14.33    0.79 | 20.33    0.46
                 2.50    0.51 |  8.50    1.75 | 14.50    0.79 | 20.50    0.46
                 2.67    0.51 |  8.67    1.75 | 14.67    0.79 | 20.67    0.46
                 2.83    0.51 |  8.83    1.75 | 14.83    0.79 | 20.83    0.46
                 3.00    0.51 |  9.00    2.45 | 15.00    0.79 | 21.00    0.46
                 3.17    0.51 |  9.17    2.45 | 15.17    0.79 | 21.17    0.46
                 3.33    0.51 |  9.33    2.45 | 15.33    0.79 | 21.33    0.46
                 3.50    0.51 |  9.50    5.90 | 15.50    0.79 | 21.50    0.46
                 3.67    0.51 |  9.67   10.60 | 15.67    0.79 | 21.67    0.46
                 3.83    0.51 |  9.83   15.30 | 15.83    0.79 | 21.83    0.46
                 4.00    0.61 | 10.00    3.40 | 16.00    0.60 | 22.00    0.46
                 4.17    0.61 | 10.17    3.40 | 16.17    0.60 | 22.17    0.46
                 4.33    0.61 | 10.33    3.40 | 16.33    0.60 | 22.33    0.46
                 4.50    0.61 | 10.50    2.05 | 16.50    0.60 | 22.50    0.46
                 4.67    0.61 | 10.67    2.05 | 16.67    0.60 | 22.67    0.46
                 4.83    0.61 | 10.83    2.05 | 16.83    0.60 | 22.83    0.46
                 5.00    0.61 | 11.00    1.50 | 17.00    0.60 | 23.00    0.46
                 5.17    0.61 | 11.17    1.50 | 17.17    0.60 | 23.17    0.46
                 5.33    0.61 | 11.33    1.50 | 17.33    0.60 | 23.33    0.46
                 5.50    0.61 | 11.50    1.50 | 17.50    0.60 | 23.50    0.46
                 5.67    0.61 | 11.67    1.40 | 17.67    0.60 | 23.67    0.46
                 5.83    0.61 | 11.83    1.30 | 17.83    0.60 | 23.83    0.46

-------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  24.40   Curve Number   (CN)= 36.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   9.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.73

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
                0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
                0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
```

```
                0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
                0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
                0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
                0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
                0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
                0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
                0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
                0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
                1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
                1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
                1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
                1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
                1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
                1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
                1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
                1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
                1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
                1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
                1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
                1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
                2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
                2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
                2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
                2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
                2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
                2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
                2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
                2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
                2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
                2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
                2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
                2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
                3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
                3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
                3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
                3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
                3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
                3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
                3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
                3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
                3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
                3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
                3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
                3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
                4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
                4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
                4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
                4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
                4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
                4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
                4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
                4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
                4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
                4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
                4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
                4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
                5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
                5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
                5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
                5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
                5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
                5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
                5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
                5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
                5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
                5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
                5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
                5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
                6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   1.277

     PEAK FLOW       (cms)=   0.004 (i)
     TIME TO PEAK    (hrs)=  11.333
     RUNOFF VOLUME    (mm)=   0.539
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.022

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  20.64   Curve Number   (CN)= 53.0
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|ID= 1 DT= 5.0 min |   Ia      (mm)=   8.11   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.59

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
               0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
               0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
               0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
               0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
               0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
               0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
               0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
               0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
               0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
               0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
               1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
               1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
               1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
               1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
               1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
               1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
               1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
               1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
               1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
               1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
               1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
               1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
               2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
               2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
               2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
               2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
               2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
               2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
               2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
               2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
               2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
               2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
               2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
               2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
               3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
               3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
               3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
               3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
               3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
               3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
               3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
               3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
               3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
               3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
               3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
               3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
               4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
               4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
               4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
               4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
               4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
               4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
               4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
               4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
               4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
               4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
               4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
               4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
               5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
               5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
               5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
               5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
               5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
               5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
               5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
               5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
               5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
               5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
               5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
               5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
               6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   1.336
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     PEAK FLOW       (cms)=   0.009 (i)
     TIME TO PEAK    (hrs)=  10.833
     RUNOFF VOLUME    (mm)=   1.176
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.047

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB              |
| NASHYD   (  0001)|   Area    (ha)=   2.80   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.47

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
               0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
               0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
               0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
               0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
               0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
               0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
               0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
               0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
               0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
               0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
               1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
               1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
               1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
               1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
               1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
               1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
               1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
               1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
               1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
               1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
               1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
               1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
               2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
               2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
               2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
               2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
               2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
               2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
               2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
               2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
               2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
               2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
               2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
               2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
               3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
               3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
               3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
               3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
               3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
               3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
               3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
               3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
               3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
               3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
               3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
               3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
               4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
               4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
               4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
               4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
               4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
               4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
               4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
               4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
               4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
               4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
               4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
               4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
               5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
               5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
               5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
               5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
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                5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
                5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
                5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
                5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
                5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
                5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
                5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
                5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
                6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   0.228

     PEAK FLOW       (cms)=   0.000 (i)
     TIME TO PEAK    (hrs)=  11.000
     RUNOFF VOLUME    (mm)=   0.461
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.018

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB              |
| NASHYD   (  0002)|   Area    (ha)=   2.38   Curve Number   (CN)= 35.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=  10.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.39

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
                0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
                0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
                0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
                0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
                0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
                0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
                0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
                0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
                0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
                0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
                1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
                1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
                1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
                1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
                1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
                1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
                1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
                1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
                1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
                1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
                1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
                1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
                2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
                2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
                2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
                2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
                2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
                2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
                2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
                2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
                2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
                2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
                2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
                2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
                3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
                3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
                3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
                3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
                3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
                3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
                3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
                3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
                3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
                3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
                3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
                3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
                4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
                4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
                4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
                4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
```

```
                4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
                4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
                4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
                4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
                4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
                4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
                4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
                4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
                5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
                5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
                5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
                5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
                5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
                5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
                5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
                5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
                5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
                5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
                5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
                5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
                6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   0.233

     PEAK FLOW       (cms)=   0.000 (i)
     TIME TO PEAK    (hrs)=  10.750
     RUNOFF VOLUME    (mm)=   0.461
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.018

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     2.80   0.000    11.00     0.46
      + ID2= 2 (  0002):     2.38   0.000    10.75     0.46
        ==================================================
        ID = 3 (  0042):     5.18   0.001    10.83     0.46

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0042)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0042):     5.18   0.001    10.83     0.46
      + ID2= 2 (  0001):    24.40   0.004    11.33     0.54
        ==================================================
        ID = 1 (  0042):    29.58   0.004    11.25     0.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0042)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0042):    29.58   0.004    11.25     0.53
      + ID2= 2 (  0002):    20.64   0.009    10.83     1.18
        ==================================================
        ID = 3 (  0042):    50.22   0.013    11.00     0.79

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0048)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                   0.00        342.60         0.0350
                   2.55        341.75     0.0350 /0.0350  Main Channel
                   4.05        341.75     0.0350 /0.0350  Main Channel
                   6.50        342.60         0.0350

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       0.04   341.79    .203E+02       0.0          0.35      13.28
```

```
       0.09   341.84    .438E+02       0.1          0.54       8.60
       0.13   341.88    .706E+02       0.2          0.69       6.73
       0.18   341.93    .101E+03       0.3          0.81       5.68
       0.22   341.97    .134E+03       0.4          0.93       4.99
       0.27   342.02    .171E+03       0.6          1.03       4.50
       0.31   342.06    .210E+03       0.8          1.12       4.13
       0.36   342.11    .254E+03       1.1          1.21       3.83
       0.40   342.15    .300E+03       1.4          1.29       3.59
       0.45   342.20    .350E+03       1.7          1.36       3.39
       0.49   342.24    .403E+03       2.1          1.44       3.22
       0.54   342.29    .459E+03       2.5          1.51       3.07
       0.58   342.33    .518E+03       2.9          1.57       2.94
       0.63   342.38    .581E+03       3.4          1.64       2.82
       0.67   342.42    .647E+03       4.0          1.70       2.72
       0.72   342.47    .716E+03       4.5          1.76       2.63
       0.76   342.51    .789E+03       5.2          1.82       2.54
       0.81   342.55    .865E+03       5.8          1.88       2.46
       0.85   342.60    .944E+03       6.6          1.93       2.39

                                    <---- hydrograph ---->   <-pipe / channel->
                              AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                              (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0042)   50.22     0.01   11.00   0.79      0.02      0.35
   OUTFLOW: ID= 1 (  0048)   50.22     0.01   11.25   0.79      0.02      0.35



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--------------------
| CALIB             |
| NASHYD   (  0011)|   Area    (ha)=   6.80   Curve Number   (CN)= 66.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.62   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.22

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                            ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME     RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs    mm/hr
                0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
                0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
                0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
                0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
                0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
                0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
                0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
                0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
                0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
                0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
                0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
                1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
                1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
                1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
                1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
                1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
                1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
                1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
                1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
                1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
                1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
                1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
                1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
                2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
                2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
                2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
                2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
                2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
                2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
                2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
                2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
                2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
                2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
                2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
                2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
                3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
                3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
                3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
                3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
                3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
                3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
                3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
                3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
                3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
```

```
                3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
                3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
                3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
                4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
                4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
                4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
                4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
                4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
                4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
                4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
                4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
                4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
                4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
                4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
                4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
                5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
                5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
                5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
                5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
                5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
                5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
                5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
                5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
                5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
                5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
                5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
                5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
                6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Unit Hyd Qpeak  (cms)=   1.181

     PEAK FLOW      (cms)=   0.012 (i)
     TIME TO PEAK   (hrs)=  10.083
     RUNOFF VOLUME    (mm)=   2.258
     TOTAL RAINFALL   (mm)=  24.987
     RUNOFF COEFFICIENT   =   0.090

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0034)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0011):      6.80    0.012    10.08     2.26
     + ID2= 2 (  0048):     50.22    0.013    11.25     0.79
       ==================================================
       ID = 3 (  0034):     57.02    0.017    11.08     0.97

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| ROUTE CHN(  0049)|
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
              <------ DATA FOR SECTION (   1.1) ------>
              Distance      Elevation       Manning
                  0.00        342.60         0.0350
                  2.55        341.75     0.0350 /0.0350  Main Channel
                  4.05        341.75     0.0350 /0.0350  Main Channel
                  6.50        342.60         0.0350

       <--------------------- TRAVEL TIME TABLE ---------------------->
        DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
         (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        0.04   341.79    .323E+02       0.0          0.35      21.13
        0.09   341.84    .697E+02       0.1          0.54      13.69
        0.13   341.88    .112E+03       0.2          0.69      10.71
        0.18   341.93    .160E+03       0.3          0.81       9.04
        0.22   341.97    .213E+03       0.4          0.93       7.95
        0.27   342.02    .272E+03       0.6          1.03       7.17
        0.31   342.06    .335E+03       0.8          1.12       6.57
        0.36   342.11    .404E+03       1.1          1.21       6.10
        0.40   342.15    .477E+03       1.4          1.29       5.72
        0.45   342.20    .557E+03       1.7          1.36       5.40
        0.49   342.24    .641E+03       2.1          1.44       5.13
        0.54   342.29    .730E+03       2.5          1.51       4.89
        0.58   342.33    .825E+03       2.9          1.57       4.68
        0.63   342.38    .925E+03       3.4          1.64       4.50
        0.67   342.42    .103E+04       4.0          1.70       4.33
        0.72   342.47    .114E+04       4.5          1.76       4.18
        0.76   342.51    .126E+04       5.2          1.82       4.05
        0.81   342.55    .138E+04       5.8          1.88       3.92
```

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       0.85   342.60    .150E+04       6.6          1.93       3.81

                                       <---- hydrograph ---->   <-pipe / channel->
                               AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                               (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 2 (  0034)    57.02     0.02   11.08   0.97      0.03      0.35
   OUTFLOW: ID= 1 (  0049)    57.02     0.02   11.42   0.97      0.03      0.35



-------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0201)|   Area    (ha)=  13.72
|ID= 1 DT= 5.0 min |   Total Imp(%)=  25.10   Dir. Conn.(%)=  13.70
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.44        10.28
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       0.50         2.00
     Length            (m)=     104.00        81.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.44 | 6.083    0.77 |12.083    1.20 | 18.08    0.60
                0.167    0.44 | 6.167    0.77 |12.167    1.20 | 18.17    0.60
                0.250    0.44 | 6.250    0.77 |12.250    1.20 | 18.25    0.60
                0.333    0.44 | 6.333    0.77 |12.333    1.20 | 18.33    0.60
                0.417    0.44 | 6.417    0.77 |12.417    1.20 | 18.42    0.60
                0.500    0.44 | 6.500    0.77 |12.500    1.20 | 18.50    0.60
                0.583    0.44 | 6.583    0.77 |12.583    1.05 | 18.58    0.60
                0.667    0.44 | 6.667    0.77 |12.667    1.05 | 18.67    0.60
                0.750    0.44 | 6.750    0.78 |12.750    1.05 | 18.75    0.60
                0.833    0.44 | 6.833    0.78 |12.833    1.05 | 18.83    0.60
                0.917    0.44 | 6.917    0.77 |12.917    1.05 | 18.92    0.60
                1.000    0.44 | 7.000    0.77 |13.000    1.05 | 19.00    0.60
                1.083    0.44 | 7.083    0.95 |13.083    1.05 | 19.08    0.60
                1.167    0.44 | 7.167    0.95 |13.167    1.05 | 19.17    0.60
                1.250    0.44 | 7.250    0.95 |13.250    1.05 | 19.25    0.60
                1.333    0.44 | 7.333    0.95 |13.333    1.05 | 19.33    0.60
                1.417    0.44 | 7.417    0.95 |13.417    1.05 | 19.42    0.60
                1.500    0.44 | 7.500    0.95 |13.500    1.05 | 19.50    0.60
                1.583    0.44 | 7.583    0.95 |13.583    0.95 | 19.58    0.60
                1.667    0.44 | 7.667    0.95 |13.667    0.95 | 19.67    0.60
                1.750    0.44 | 7.750    0.95 |13.750    0.95 | 19.75    0.60
                1.833    0.44 | 7.833    0.95 |13.833    0.95 | 19.83    0.60
                1.917    0.44 | 7.917    0.95 |13.917    0.95 | 19.92    0.60
                2.000    0.44 | 8.000    0.95 |14.000    0.95 | 20.00    0.60
                2.083    0.51 | 8.083    1.25 |14.083    0.79 | 20.08    0.46
                2.167    0.51 | 8.167    1.25 |14.167    0.79 | 20.17    0.46
                2.250    0.51 | 8.250    1.25 |14.250    0.79 | 20.25    0.46
                2.333    0.51 | 8.333    1.25 |14.333    0.79 | 20.33    0.46
                2.417    0.51 | 8.417    1.25 |14.417    0.79 | 20.42    0.46
                2.500    0.51 | 8.500    1.25 |14.500    0.79 | 20.50    0.46
                2.583    0.51 | 8.583    1.75 |14.583    0.79 | 20.58    0.46
                2.667    0.51 | 8.667    1.75 |14.667    0.79 | 20.67    0.46
                2.750    0.51 | 8.750    1.75 |14.750    0.79 | 20.75    0.46
                2.833    0.51 | 8.833    1.75 |14.833    0.79 | 20.83    0.46
                2.917    0.51 | 8.917    1.75 |14.917    0.79 | 20.92    0.46
                3.000    0.51 | 9.000    1.75 |15.000    0.79 | 21.00    0.46
                3.083    0.51 | 9.083    2.45 |15.083    0.79 | 21.08    0.46
                3.167    0.51 | 9.167    2.45 |15.167    0.79 | 21.17    0.46
                3.250    0.51 | 9.250    2.45 |15.250    0.79 | 21.25    0.46
                3.333    0.51 | 9.333    2.45 |15.333    0.79 | 21.33    0.46
                3.417    0.51 | 9.417    2.45 |15.417    0.79 | 21.42    0.46
                3.500    0.51 | 9.500    2.45 |15.500    0.79 | 21.50    0.46
                3.583    0.51 | 9.583    5.90 |15.583    0.79 | 21.58    0.46
                3.667    0.51 | 9.667    5.90 |15.667    0.79 | 21.67    0.46
                3.750    0.51 | 9.750   10.60 |15.750    0.79 | 21.75    0.46
                3.833    0.51 | 9.833   10.60 |15.833    0.79 | 21.83    0.46
                3.917    0.51 | 9.917   15.30 |15.917    0.79 | 21.92    0.46
                4.000    0.51 |10.000   15.30 |16.000    0.79 | 22.00    0.46
                4.083    0.61 |10.083    3.40 |16.083    0.60 | 22.08    0.46
                4.167    0.61 |10.167    3.40 |16.167    0.60 | 22.17    0.46
                4.250    0.61 |10.250    3.40 |16.250    0.60 | 22.25    0.46
                4.333    0.61 |10.333    3.40 |16.333    0.60 | 22.33    0.46
                4.417    0.61 |10.417    3.40 |16.417    0.60 | 22.42    0.46
                4.500    0.61 |10.500    3.40 |16.500    0.60 | 22.50    0.46
                4.583    0.61 |10.583    2.05 |16.583    0.60 | 22.58    0.46
```

```
                4.667    0.61 |10.667    2.05 |16.667    0.60 | 22.67    0.46
                4.750    0.61 |10.750    2.05 |16.750    0.60 | 22.75    0.46
                4.833    0.61 |10.833    2.05 |16.833    0.60 | 22.83    0.46
                4.917    0.61 |10.917    2.05 |16.917    0.60 | 22.92    0.46
                5.000    0.61 |11.000    2.05 |17.000    0.60 | 23.00    0.46
                5.083    0.61 |11.083    1.50 |17.083    0.60 | 23.08    0.46
                5.167    0.61 |11.167    1.50 |17.167    0.60 | 23.17    0.46
                5.250    0.61 |11.250    1.50 |17.250    0.60 | 23.25    0.46
                5.333    0.61 |11.333    1.50 |17.333    0.60 | 23.33    0.46
                5.417    0.61 |11.417    1.50 |17.417    0.60 | 23.42    0.46
                5.500    0.61 |11.500    1.50 |17.500    0.60 | 23.50    0.46
                5.583    0.61 |11.583    1.50 |17.583    0.60 | 23.58    0.46
                5.667    0.61 |11.667    1.50 |17.667    0.60 | 23.67    0.46
                5.750    0.61 |11.750    1.40 |17.750    0.60 | 23.75    0.46
                5.833    0.61 |11.833    1.40 |17.833    0.60 | 23.83    0.46
                5.917    0.61 |11.917    1.30 |17.917    0.60 | 23.92    0.46
                6.000    0.61 |12.000    1.30 |18.000    0.60 | 24.00    0.46

     Max.Eff.Inten.(mm/hr)=      15.30        0.32
                over (min)        5.00      115.00
     Storage Coeff.  (min)=       6.82 (ii)  114.41 (ii)
     Unit Hyd. Tpeak (min)=       5.00      115.00
     Unit Hyd. peak  (cms)=       0.18        0.01
                                                          *TOTALS*
     PEAK FLOW      (cms)=        0.07        0.00          0.073 (iii)
     TIME TO PEAK    (hrs)=      10.00       12.25         10.00
     RUNOFF VOLUME    (mm)=      22.99        1.21          4.19
     TOTAL RAINFALL   (mm)=      24.99       24.99         24.99
     RUNOFF COEFFICIENT   =       0.92        0.05          0.17

***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
              YOU SHOULD CONSIDER SPLITTING THE AREA.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  40.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0011)|      OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------        (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000      0.0000   |   0.0340      0.1452
                           0.0070      0.0032   |   0.0360      0.1704
                           0.0140      0.0140   |   0.0380      0.1964
                           0.0190      0.0318   |   0.0400      0.2233
                           0.0230      0.0529   |   0.0420      0.2509
                           0.0260      0.0747   |   0.0440      0.2794
                           0.0290      0.0974   |   0.0450      0.3087
                           0.0310      0.1209   |   0.0000      0.0000

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0201)      13.720     0.073     10.00       4.19
   OUTFLOW: ID= 1 (  0011)      13.720     0.013     10.75       4.18

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 18.43
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0132

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0023)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (  0011):    13.72   0.013    10.75     4.18
       + ID2= 2 (  0049):    57.02   0.016    11.42     0.97
         ==================================================
         ID = 3 (  0023):    70.74   0.029    11.42     1.59

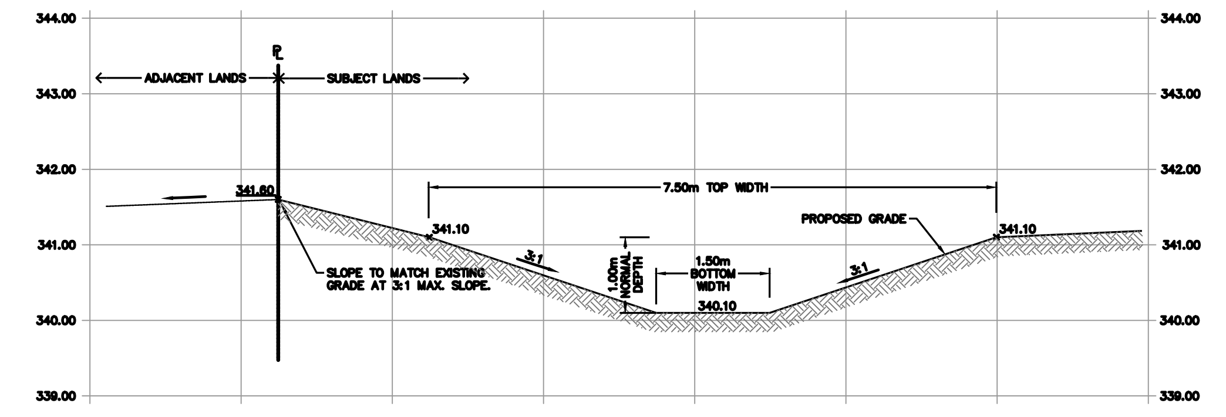
     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

 FINISH
=============================================================================================================
```

DRAWINGS & FIGURES

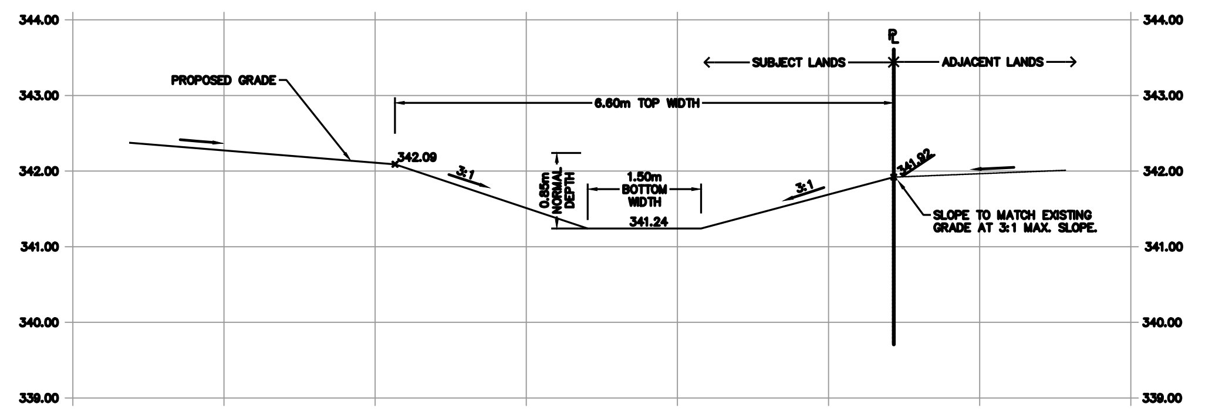
CROSS SECTION A – A'
PROFILE VIEW

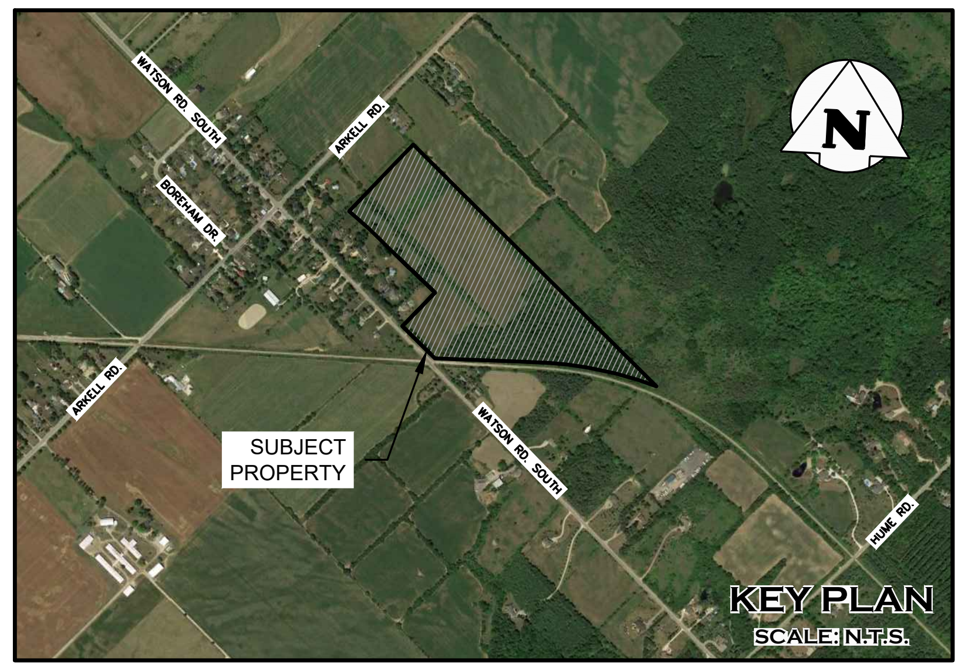
SCALE: H=1:100
V=1:100

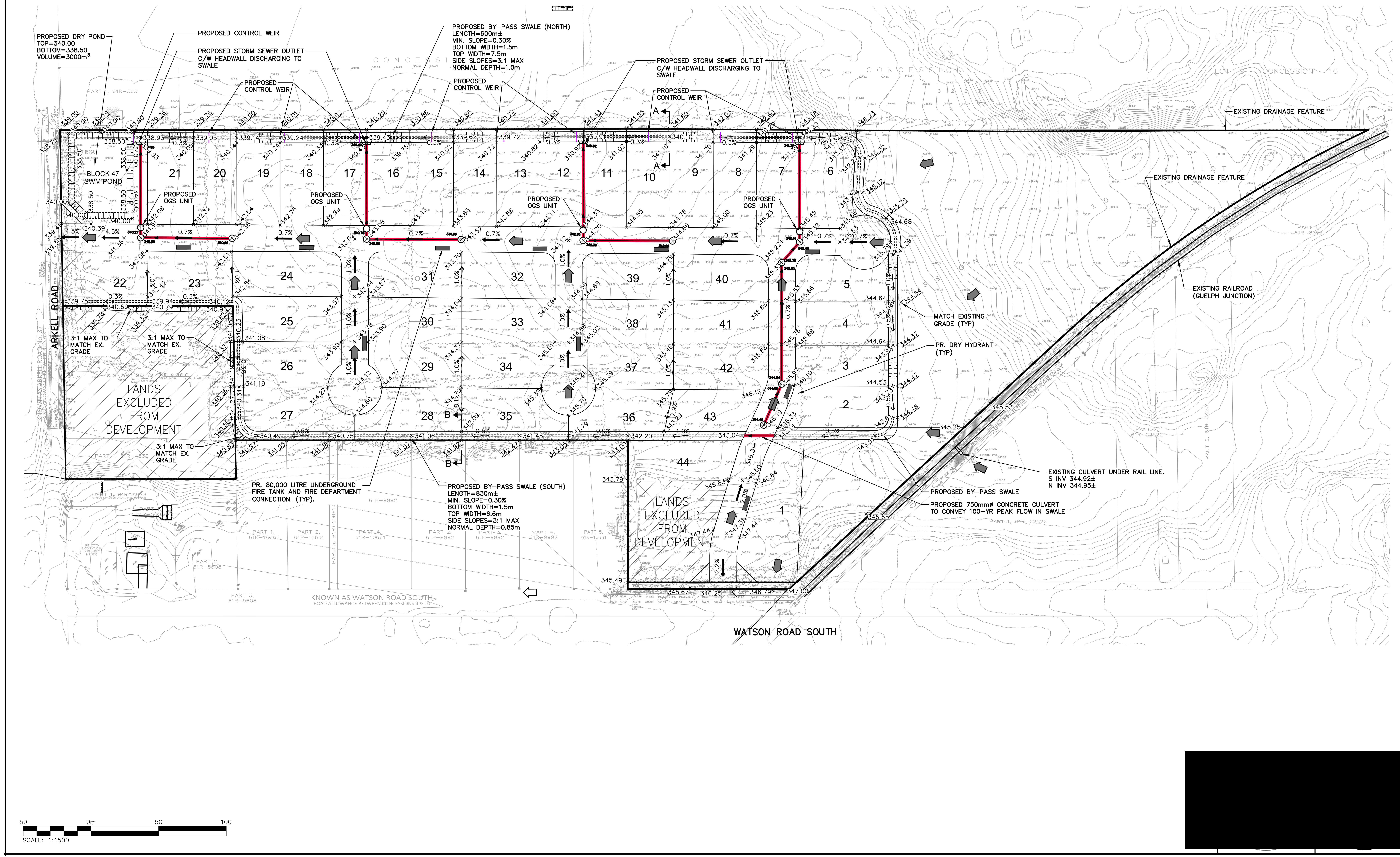


CROSS SECTION B – B'
PROFILE VIEW

SCALE: H=1:100
V=1:100







LEGEND

▬	PROPERTY LINE
	EXISTING CONTOUR (0.5m)
	EXISTING CONTOUR (1.0m)
×215.00	EXISTING GRADE
×215.00	PROPOSED GRADE
×215.00	PROPOSED GRADE (TO MATCH EXISTING)
2.0% →	PROPOSED MINOR FLOW DIRECTION
	PROPOSED SLOPE (3:1 MAX.)
|	PROPOSED CONTROL WEIR
⇨	EXISTING OVERLAND FLOW DIRECTION
➡	PROPOSED OVERLAND FLOW DIRECTION
2.0% →	PROPOSED SWALE FLOW DIRECTION
	PROPOSED LOT–LINE
▬	PROPOSED 80,000 LITRE UNDERGROUND FIRE TANK WITH FIRE DEPARTMENT CONNECTION
▥	PROPOSED CATCHBASIN
◎	PROPOSED CATCHBASIN MANHOLE
○	PROPOSED STORM MANHOLE
○	PROPOSED STORM SEWER & MANHOLE
▥ / ▥▥	PROPOSED SINGLE / DOUBLE CATCHBASIN

REFER TO TOWNSHIP OF PUSLINCH STANDARD DRAWING STD–102 "TYPICAL URBAN CROSS–SECTION" FOR DIMENSIONS AND DETAILS OF PROPOSED ROAD CROSS–SECTION.

1	ISSUED FOR 2nd DRAFT PLAN SUBMISSION	2025/AUG/01
0	ISSUED FOR PRE–CONSULTATION	2023/AUG/31
No.	ISSUE / REVISION	YYYY/MMM/DD

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON DRAFT SITE PLAN BY STOVEL AND ASSOCIATES INC.
PROJECT No. XXX
DRAWING No. XXX
DATE RECEIVED 2025/JUL/29

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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

WATSON ROAD SOUTH
TOWN OF PUSLINCH

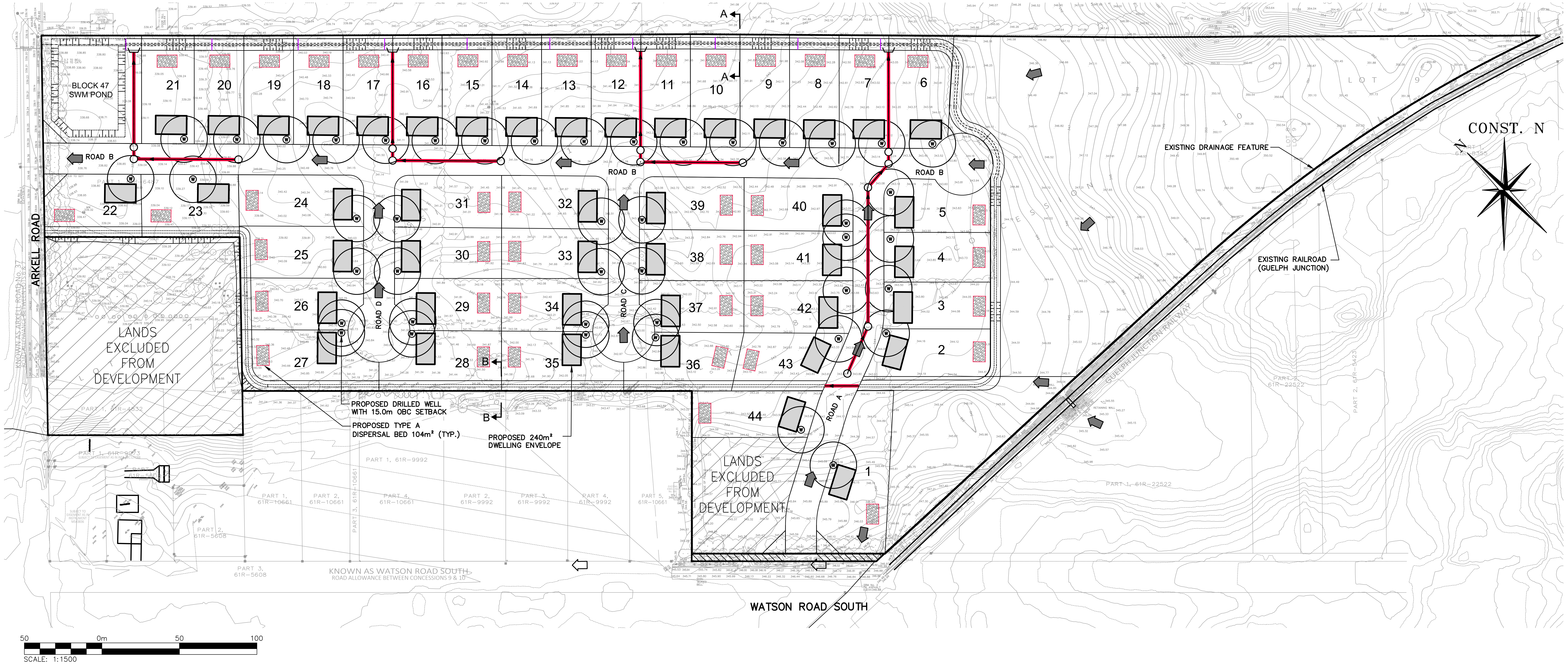
Drawing

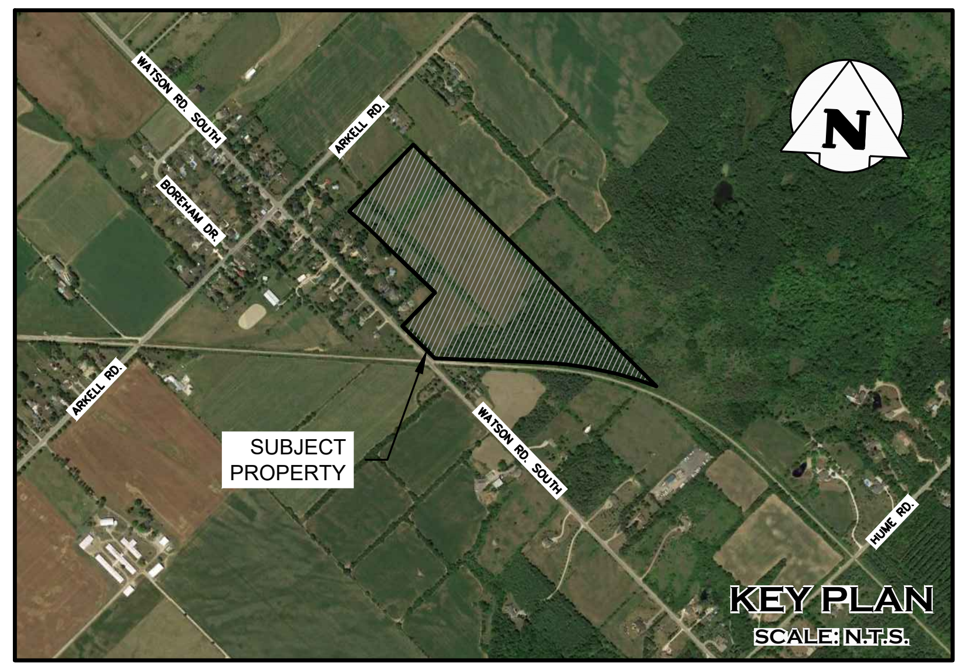
PRELIMINARY GRADING AND
SERVICING PLAN

[redacted]

CROZIER
CONSULTING ENGINEERS

A.O.	Design	A.O.	Project No.	2433–6646	
J.B.	Check	J.B.	Scale 1:1500	Dwg.	C101



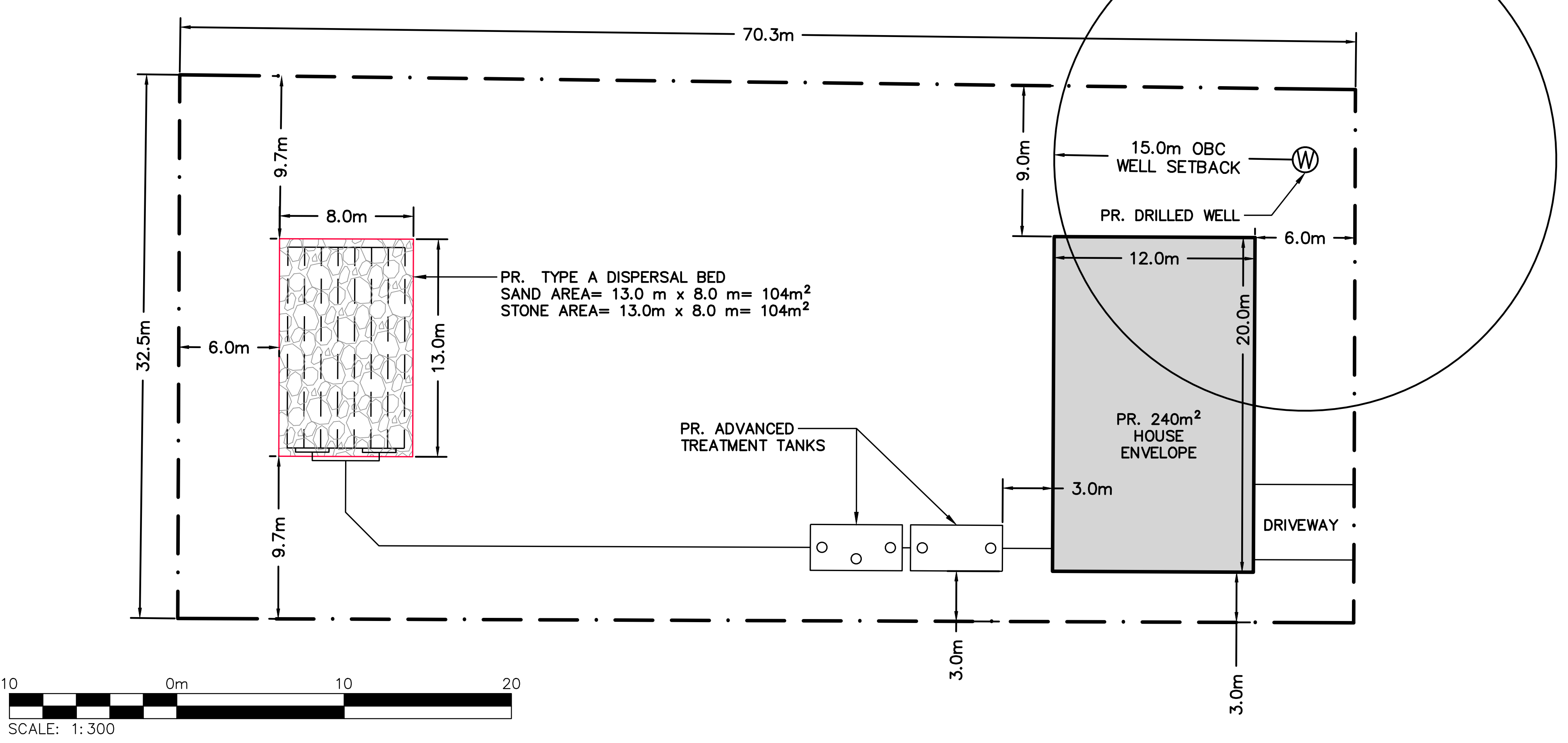


LEGEND

▬▬▬	PROPERTY LINE
┈┈┈	EXISTING CONTOUR (0.5m)
───	EXISTING CONTOUR (1.0m)
	LOT NUMBER
×215.00	EXISTING GRADE
×215.00	PROPOSED GRADE
×215.00	PROPOSED GRADE (TO MATCH EXISTING)
┬┬┬	PROPOSED SLOPE (3:1 MAX.)
— — · —	PROPOSED LOT–LINE
▭	CONCEPTUAL 240 m² BUILDING ENVELOPE
▨	PROPOSED TYPE A DISPERSAL BED 104 m²
Ⓦ	CONCEPTUAL PROPOSED DRILLED WELL LOCATION C/W 15.0m OBC SETBACK

TYPICAL LOT SCHEMATIC (LOT 42)

SCALE: 1:300



ONSITE SEWAGE SYSTEM DESIGN TYPICAL LOT NOTES

PROPOSED 6 BEDROOM, 240 m² HOME WITH SIXTY–TWO (62) FIXTURE UNITS	BASE FLOW (6 BEDROOMS)= 2,500 L/DAY ADDITIONAL FLOOR AREA (40 m2)= 400 L/DAY ADDITIONAL FIXTURE UNITS (42)= 2,075 L/DAY Q TOTAL (2,500+2,075)= 4,575 L/DAY
SOIL PERCOLATION RATE	T = 15 min/cm (ESTIMATED BY C.F. CROZIER)
PROPOSED TREATMENT UNIT	WATERLOO BIOFILTER AD–BA50
TYPE A DISPERSAL BED STONE AREA	MINIMUM SIZE=Q/50=4,575/50 = 91.5m² PROVIDED 13m x 8m = 104m²
TYPE A DISPERSAL BED SAND AREA	MINIMUM SIZE=QT/850= 4,575*15/850 = 80.7m² PROVIDED 13m x 8m = 104m²

1	ISSUED FOR 2nd DRAFT PLAN SUBMISSION	2025/AUG/01
0	ISSUED FOR PRE–CONSULTATION	2023/AUG/31
No.	ISSUE / REVISION	YYYY/MMM/DD

SITE PLAN NOTES:

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PROJECT No. XXX
DRAWING No. XXX
DATE RECEIVED 2025/JUL/29

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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

WATSON ROAD SOUTH
TOWN OF PUSLINCH

Drawing

ONSITE SEWAGE SERVICING SCHEMATIC

[redacted]

CROZIER
CONSULTING ENGINEERS

n A.O.	Design A.O.	Project No.	2433–6646
k K.B.	Check K.B.	Scale 1:1500	Dwg. C102

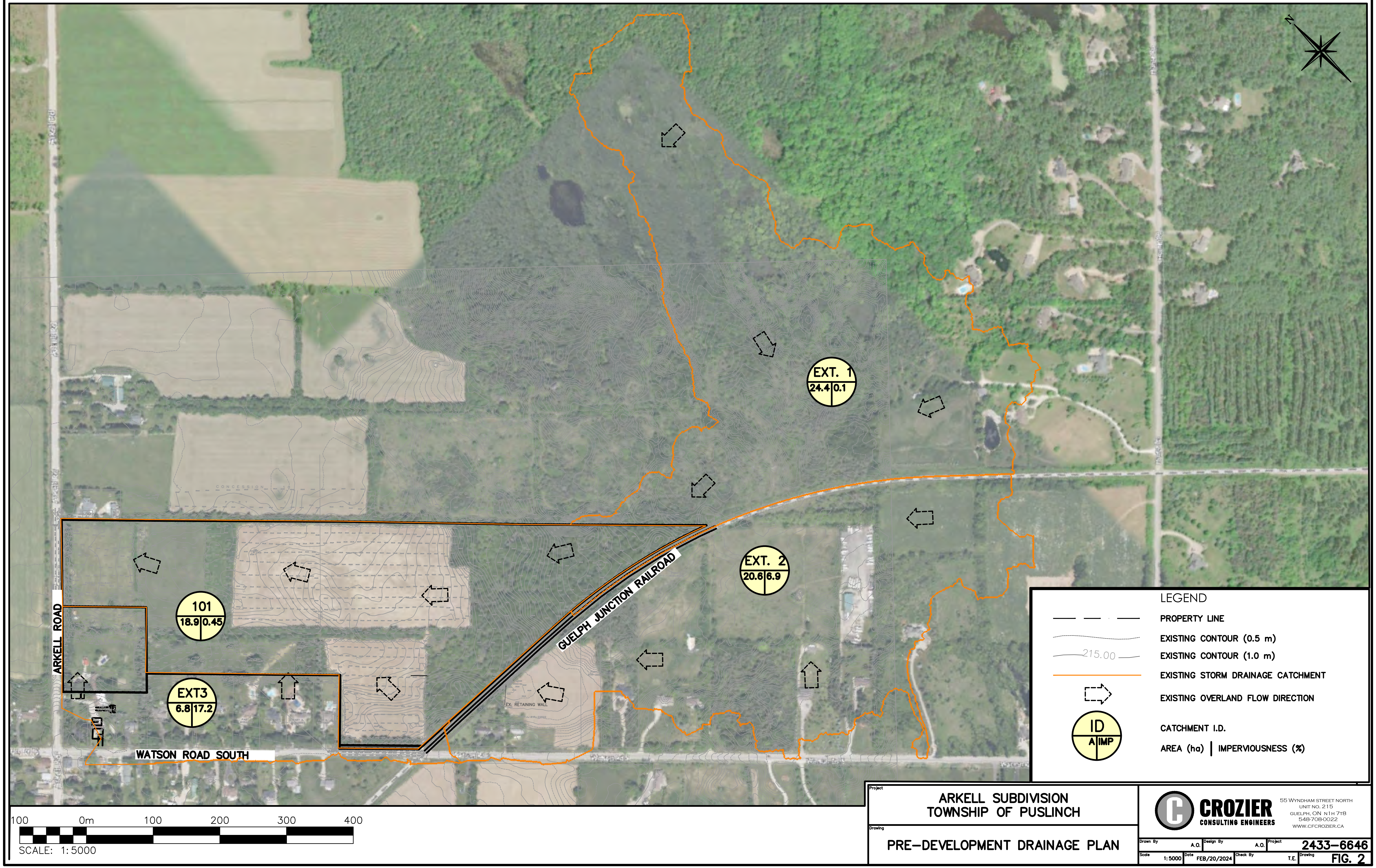
CROZIER
CONSULTING ENGINEERS

ARKELL SUBDIVISION

STUDY AREA

FIGURE 1

SCALE: 1:1000



Project

ARKELL SUBDIVISION
TOWNSHIP OF PUSLINCH

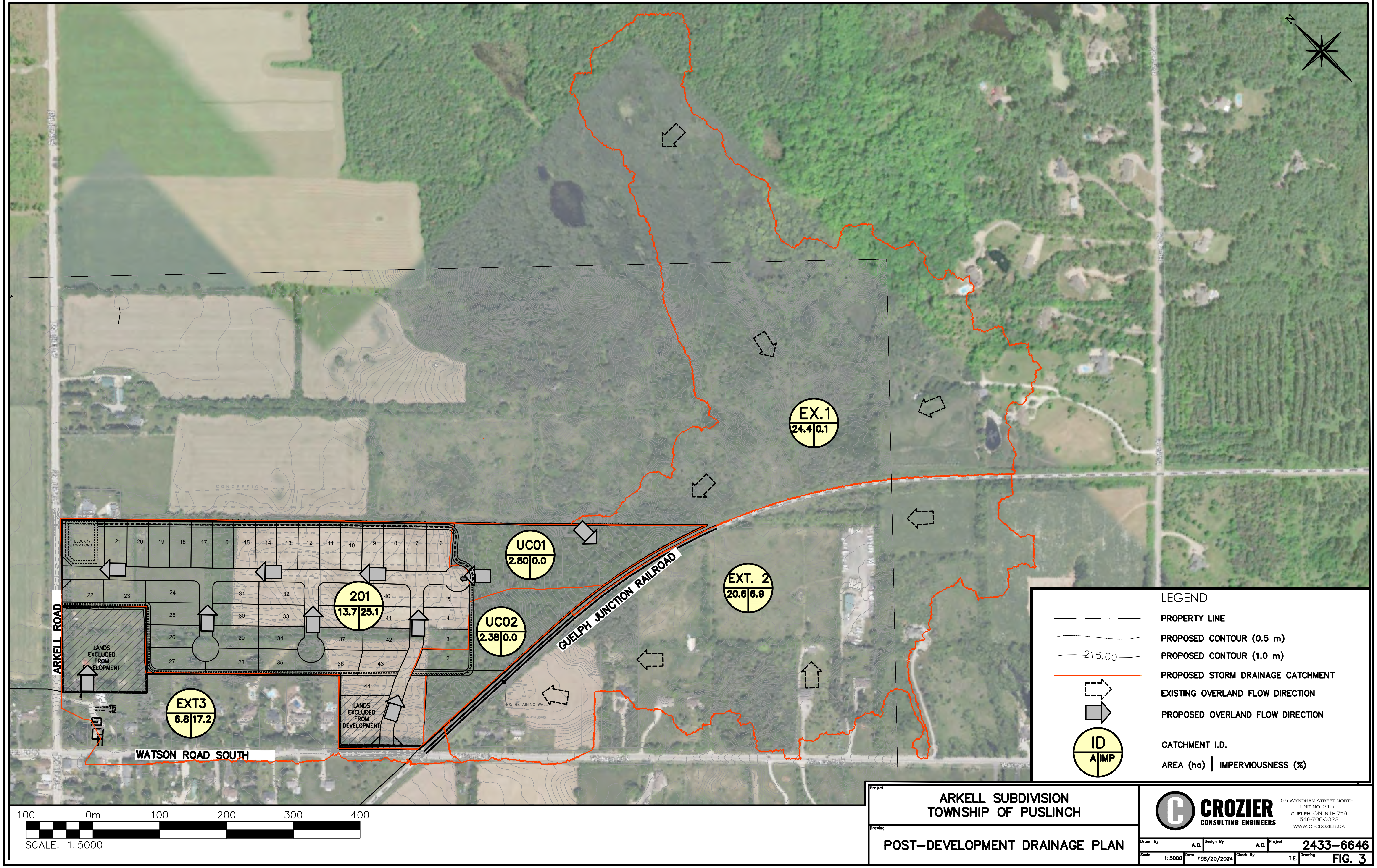
Drawing

PRE–DEVELOPMENT DRAINAGE PLAN

CROZIER
CONSULTING ENGINEERS

55 WYNDHAM STREET NORTH
UNIT NO. 215
GUELPH, ON N1H 7T8
548-708-0022
WWW.CFCROZIER.CA

Drawn By A.O.	Design By A.O.	Project	2433–6646
Scale 1:5000	Date FEB/20/2024	Check By T.E.	Drawing FIG. 2



Project

ARKELL SUBDIVISION
TOWNSHIP OF PUSLINCH

Drawing

POST–DEVELOPMENT DRAINAGE PLAN

CROZIER
CONSULTING ENGINEERS

55 WYNDHAM STREET NORTH
UNIT NO. 215
GUELPH, ON N1H 7T8
548-708-0022
WWW.CFCROZIER.CA

Drawn By A.O.		Design By A.O.		Project 2433–6646	
Scale 1: 5000	Date FEB/20/2024	Check By T.E.		Drawing FIG. 3	

AUGUST 14, 2025

PROJECT NO: 2433-6646

SENT VIA: EMAIL
SHAWN@TIMBERWORX.CA

Timberworx Custom Homes
Shawn Marsh
275 Hanlon Creek Boulevard, Unit 5
Guelph, ON N1C 0A1

Attention: Shawn Marsh

RE: WATER BALANCE ASSESSMENT
ARKELL DEVELOPMENTS
PART OF LOTS 7 & 8, CONCESSION 10
TOWNSHIP OF PUSLINCH, WELLINGTON COUNTY

Dear Shawn,

C.F. Crozier & Associates has been retained by Timberworx Custom Homes to prepare a preliminary water balance assessment for the site located on parts of lots 7 and 8, concession 10 in the Township of Puslinch. The water balance assessment has been prepared to define the pre-development infiltration and runoff conditions and determine the impact on infiltration and runoff in the post-development scenario. Please note that this assessment should be read in conjunction with the Functional Servicing and Stormwater Management Report (Crozier, August 2025).

Introduction

The Site encompasses an area of 20.45 ha with a developable area of approximately 17.45 ha. The Site currently consists of a single detached dwelling, garage, existing woodlot, and agricultural fields. The Site is bounded by agricultural fields to the north, Arkell Road to the West, Guelph Junction Railway (GJR) to the East, Watson Road, and existing detached homes to the South.

According to the Conceptual Plan prepared by Stovel and Associates Inc. (July 29, 2025), it is understood that the Site will consist of the following elements:

- Forty-Four (44) residential lots with associated onsite sewage systems and private wells.
- One (1) stormwater management facility for flood control.
- One (1) bioswale to act as a bypass for drainage external to the Site and one (1) bioswale
  to infiltrate and convey Site stormwater during minor and major storm events.
- A half (0.5) hectare of land to remain undeveloped.
- An access road connecting to Watson Road in the southwest and a secondary access road connecting to Arkell Road in the northwest.

Methodology

A water balance assessment is conducted to determine the pre to post change in groundwater recharge across a property where overall imperviousness is to increase post-development. Runoff increases where permanent structures, asphalt, concrete, and impermeable surfaces are added and therefore infiltration is reduced. A Thornthwaite and Mather water balance has been conducted to assess the proposed development's impact on groundwater recharge. The water balance has been conducted in accordance with accepted site condition values from 6.3 of the Urban Storm Drainage Criteria Manual: Volume 1 (Urban Drainage and Flood Control District, 2016) and Table 3.1 of the MECP Stormwater Management Planning and Design Manual (MECP, 2003). The appropriate reference tables are provided in enclosed Appendix A.

The water balance on a site can be estimated from the following equation described in Thornthwaite and Mather 1957:

$$P = S + R + I + ET$$

Where: P = precipitation

S = change in groundwater storage

R = surface water runoff

I = infiltration

ET = evapotranspiration/evaporation

The components of the water balance equation can be estimated using field observations of drainage conditions, land cover, soil types, groundwater conditions and local climate records.

The nearest climate data available for the Puslinch area is the data captured by the Kitchener/Waterloo composite station. Climate normals from 1991-2020 for the Kitchener/Waterloo Station was used to prepare the water balance assessment. Table 1 below summarizes the temperature and precipitation data referenced.

Table 1: Climate Normals for Kitchener/Waterloo Composite Station 1991-2020 (WMO: 71368)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOT
Temp. (C◦)	-6.3	-5.9	-0.8	5.9	12.6	17.8	20.2	19.1	15.2	8.8	2.6	-2.8	7.2
Precipitation (mm)	66.3	46.1	57.0	81.2	80.2	80.5	96.2	67.2	75.2	71.0	74.9	54.9	850

The total average temperature is approximately 7.2◦C and the average annual precipitation is 850.6 mm/year for the area.

The rate of evapotranspiration on a property is a function of the water holding capacity of the soil, soil and vegetation type and land cover. Through the Thornthwaite and Mather method or a soil moisture balance approach and local climate data, the Potential Evapotranspiration (PET) and the Actual Evapotranspiration (AET) can be calculated (see Appendix A) using the following equations:

$$PET{=}16 \times \left(\frac{10Ta}{H_i}\right)^{a}$$

Where: T_a = average daily temperature, 0 degrees for negative temperature months

Hi = heat index value, assuming 12 hours per day, 30 days a month of daylight

The average heat index value is estimated using the following equation:

$$Hi{=}\sum_{i=1}^{12}\left(\frac{10Ta}{5}\right)^{1.514}$$

The evapotranspiration factor (α) is determined using the following equation:

$$\alpha = 0.49 + (0.0179 \times H_i) - (0.0000771 \times H_i^2) + (0.000000675 \times H_i^3)$$

PET is adjusted to account for the average number of hours of daylight per month for a given location. The adjustment factor is dependent on the subject property's latitude and is presented in Appendix A (Thornthwaite and Mather, 1957). The PET is multiplied by the adjustment factor per month to determine the Adjusted Potential Evapotranspiration (PET_{adj}).

The Actual Evapotranspiration (AET) is determined using the following equation:

$$AET = PET_{adj} - \Delta S$$

The Change in Soil Storage (ΔS) is depended on the types of soil on the property and the Accumulated Potential Water Loss (APWL) per month. The Change in Soil Storage and Accumulated Potential Water Loss can be calculated using the following equations:

$$\Delta S = S_{mc}\ \text{x}$$

Where: S_{mc} = soil moisture capacity

APWL = accumulated potential water loss

$$\text{For } \Delta P < 0\text{: } APWL = -\Sigma_{i=0}^{12} PET_i$$

$$\text{For } \Delta P < 0\text{: } APWL = \frac{ln\left(\frac{|AET-PET|}{S_{mc}}\right)}{S_{mc}}$$

Existing land use is primarily agricultural with some woodlot and existing rural residential. According to local studies, existing soils are sandy and are estimated to be conducive to infiltration. Using the Ministry Environment, Conservation and Parks (MECP) Stormwater Management and Design Manual Table 3.1. (2003), the soil moisture capacity was estimated to be 250 mm for woodlots with sandy soil and 50 mm for shallow rooted crops and residential lawn with sandy soil. Therefore, based on local climate conditions the Actual Evapotranspiration (AET) is calculated to be approximately 591 mm/year.

The difference between mean annual P and mean annual ET outputs the amount of water surplus for the Site. The water surplus either infiltrates (I) into the soil or travels across the site as runoff (R).

The distribution of water that infiltrates into the soil is a function of an infiltration factor as described in Table 3.1 of the MECP Stormwater Management Planning and Design Manual (MECP, 2003). The infiltration factor for each land use was determined using the MECP methodology. The water balance components were used to estimate the pre-development and post-development water balance scenarios. Detailed water balance calculations for the subject property can be seen in Appendix A.

Results

Based on the assumptions above, pre-development infiltration is estimated to be 251 mm/yr and post-development infiltration is estimated to be 152 mm/yr. An infiltration deficit of 99 mm/yr is expected due to the development. Low-impact development (LID) structures can be implemented to improve post-development infiltration. Design of low impact development structures is beyond the scope of this report and is recommended to be completed at detailed design.

Although the onsite soils are coarse-grained, it is recommended that local infiltration testing be conducted in the area of any low impact development structures to confirm potential enhanced infiltration.

Conclusions and Recommendations

Based on the above water balance assessment, a deficit of 99 mm/yr is expected due to the development. In order to maintain pre-development infiltration and preserve groundwater recharge on the site, it is recommended that LIDs are employed such that pre-development infiltration volumes are maintained to the greatest extent possible. Clean runoff should be directed towards infiltration features to prevent groundwater contamination from runoff (e.g. salt from roads). Infiltration testing should be conducted at detailed design to confirm where LIDs are feasible.

Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Sincerely,

C.F. CROZIER & ASSOCIATES INC.

[redacted]

Caitlyn MacPhee, EIT, GIT
Hydrogeology
cm/tc

C.F. CROZIER & ASSOCIATES INC.

[redacted]

Chris Gerrits, M.Sc., P.Eng.
Director, Land Development

c.c.

Enclosure
Appendix A – Water Balance Assessment Calculations

J:\2400\2433 - Timberworx Custom Homes\6646 - Arkell Developments\Letters\6646_Arkell Water Balance Assessment.docx

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Project Information

Thornthwaite & Mather Method

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By:
Date: 05-Aug-25

Pre-Development Conditions

Landuse	**Woods**	**Agricultural**	**Lawn**						
Area (m^2)	64690	69926	54384						
Pervious Area (m^2)	64690	69926	53538						
Impervious Area (m^2)	0	0	846						
Percent Imperviousness (%)	0%	0%	2%						
Infiltration Factors									
Topography - Description	Rolling	Flat	Flat						
Topography - Infiltration Factor	0.20	0.30	0.30						
Soil - Description	Fine Sand	Fine Sand	Fine Sand						
Soil - Infiltration Factor	0.40	0.40	0.40						
Cover - Description	Mature Forests	Shallow Rooted Crops	Urban Lawns						
Cover - Infiltration Factor	0.20	0.10	0.10						
Total Infiltration Factor	0.80	0.80	0.80						
Soil Moisture Capacity (mm)	250	50	50						

Post-Development Conditions

Landuse	**Woods**	**Roads**	**Single-Family Dwellings**	**Exclusion Lands**	**SWM**	**Drainage Swale**			
Area (m^2)	49758	48294.04	70400	5311	3702.26	11534.7			
Pervious Area (m^2)	49758	4829.404	42240	5311	1851.13	11534.7			
Impervious Area (m^2)	0	43464.636	28160	0	1851.13	0			
Percent Imperviousness (%)	0%	90%	40%	0%	50%	0%			
Infiltration Factors									
Topography - Description	Rolling	Flat	Flat	Flat	Flat	Flat			
Topography - Infiltration Factor	0.20	0.30	0.30	0.30	0.30	0.30			
Soil - Description	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand	Fine Sand			
Soil - Infiltration Factor	0.40	0.40	0.40	0.40	0.40	0.40			
Cover - Description	Mature Forests	Urban Lawns	Urban Lawns	Urban Lawns	Urban Lawns	Urban Lawns			
Cover - Infiltration Factor	0.20	0.10	0.10	0.10	0.10	0.10			
Total Infiltration Factor	0.80	0.80	0.80	0.80	0.80	0.80			
Soil Moisture Capacity (mm)	250	50	50	50	50	50			

Canadian Climate Normals 1991-2020 Data

Composite Station Metadata

All stations used in the composite for all Normals and Extremes elements are listed. Station metadata includes station name, station identifiers, coordinates, and elevation.
Composite Station Name: KITCHENER/WATERLOO

Station Name	Climate ID	WMO ID	TC ID	Latitude	Longitude	Elevation (m)
WATERLOO WELLINGTON A	6149387			43°27'00.000" N	80°23'00.000" W	317
REGION OF WATERLOO INT'L AIRPORT	6149388			43°27'32.000" N	80°22'39.000" W	321.3
KITCHENER/WATERLOO	6144239	71368	YKZ	43°27'39.000" N	80°22'43.000" W	321.6

Code 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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Temperature														
Daily Average (°C)	-6.3	-5.9	-0.8	5.9	12.6	17.8	20.2	19.1	15.2	8.8	2.6	-2.8	7.2	A
Precipitation														
Precipitation (mm)	66.3	46.1	57	81.2	80.2	80.5	96.2	67.2	75.2	71	74.9	54.9	850.6	D
Days with Rainfall														
Days with Rainfall >= 0.2 mm	17.7	12.9	13.2	13.5	13.4	12.7	13.2	11.2	12	14.7	14.8	15	164	D
Days with Rainfall >= 5 mm	4.3	2.8	3.5	5	4.9	5.8	4.9	4.2	4.8	4.4	4.4	3.7	52.6	D
Days with Rainfall >= 10 mm	1.6	1.4	1.5	2.6	2.8	3.1	3.1	2.4	2.6	2.6	2	1.6	27.1	D
Days with Rainfall >= 25 mm	0.13	0.14	0.19	0.32	0.43	0.28	0.89	0.37	0.57	0.26	0.57	0.09	4.2	D
Days with Rainfall >= 50 mm	0	0	0	0.05	0.04	0	0.16	0	0.05	0	0.1	0	0.4	D
Days with Rainfall >= 100 mm	0	0	0	0	0	0	0.05	0	0	0	0	0	0.05	D

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Climate Parameters
Thornthwaite & Mather Method

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By:
Date: 05-Aug-25

PROJECT LOCATION Arkell
PROJECT LATITUDE ° **43**

Month	**Mean Temperature** (C°)[1]	**Heat Index** $[i = (t/5)^{1.514}]$	**α**	**Potential Evapotranspiration (PET)** (mm)	**Correction Factor**[2]	**Adjusted Potential Evapotranspiration (APET)** (mm)	**Precipitation (P)** (mm)[1]
January	-6.3	0.00		0.0	1.37	0.0	66.3
February	-5.9	0.00		0.0	0.82	0.0	46.1
March	-0.8	0.00		0.0	1.02	0.0	57.0
April	5.9	1.28		27.0	1.12	30.3	81.2
May	12.6	4.05		60.9	1.26	76.8	80.2
June	17.8	6.84		88.3	1.28	113.0	80.5
July	20.2	8.28		101.1	1.29	130.4	96.2
August	19.1	7.61		95.2	1.2	114.2	67.2
September	15.2	5.38		74.5	1.04	77.5	75.2
October	8.8	2.35		41.5	0.95	39.4	71.0
November	2.6	0.37		11.2	0.81	9.1	74.9
December	-2.8	0.00		0.0	0.77	0.0	54.9
TOTAL	7.2	**36.2**	**1.1**	**499.7**		**590.7**	**850.7**

NOTES: 1. Precipitation and temperature data referenced from the City of Guelph's Stormwater Management Master Plan, Appendix F.
2. Latitude adjustment/correction factors determined based on site location assuming 12 hours of sunlight per day for 30 days

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By:CG
Date: 05-Aug-25

Pre-Development Water Balance

Thornthwaite & Mather Method

Landuse	**Woods**					
Parameters	**Pervious Area**	6.47 ha	**Impervious Area**	0.00 ha	**Total Area**	6.47 ha
	Soil Moisture Holding Capacity	250 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	111	124	100	77	39	9	0	**567**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	5	55	**283**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	4	44	**227**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	1	11	**57**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	1958	4968	7177	8038	6471	4959	2550	589	0	**36710**
Impervious ET (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Infiltration (m^3)	3431	2386	2950	2636	176	0	0	0	0	0	238	2841	**14658**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	858	596	737	659	44	0	0	0	0	0	59	710	**3664**
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Pre-Development Water Balance Summary: Woods				
Pre-Development Evapotranspiration	36710	m^3/yr	567	mm/yr
Pre-Development Infiltration	14658	m^3/yr	227	mm/yr
Pre-Development Runoff	3664	m^3/yr	57	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.

2. Assumptions:
   - Evapotranspiration does not occur when average temperature is below zero.
   - Infiltration does not occur when average temperature is below zero.
   - Approximately 15% of the precipitation on impervious surfaces will evaporate.

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Pre-Development Water Balance

Thornthwaite & Mather Method

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Landuse	**Agricultural**					
Parameters	**Pervious Area**	6.99 ha	**Impervious Area**	0.00 ha	**Total Area**	6.99 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	2117	5370	7299	7631	5261	5275	2756	636	0	**36345**
Impervious ET (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Infiltration (m^3)	3709	2579	3189	2849	191	0	0	0	0	0	2926	3071	**18513**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	927	645	797	712	48	0	0	0	0	0	732	768	**4628**
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Pre-Development Water Balance Summary: Agricultural				
Pre-Development Evapotranspiration	36344.8	m^3/yr	519.8	mm/yr
Pre-Development Infiltration	18513.0	m^3/yr	264.8	mm/yr
Pre-Development Runoff	4628.3	m^3/yr	66.2	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

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Pre-Development Water Balance

Thornthwaite & Mather Method

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Landuse	**Lawn**					
Parameters	**Pervious Area**	5.35 ha	**Impervious Area**	0.08 ha	**Total Area**	5.44 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	1621	4111	5588	5843	4028	4038	2110	487	0	**27827**
Impervious ET (m^3)	8	6	7	10	10	10	12	9	10	9	10	7	**108**
Pervious Infiltration (m^3)	2840	1974	2441	2181	146	0	0	0	0	0	2240	2351	**14174**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	710	494	610	545	36	0	0	0	0	0	560	588	**3544**
Impervious Runoff (m^3)	48	33	41	58	58	58	69	48	54	51	54	39	**612**

Pre-Development Water Balance Summary: Lawn				
Pre-Development Evapotranspiration	27934.9	m^3/yr	513.7	mm/yr
Pre-Development Infiltration	14174.3	m^3/yr	260.6	mm/yr
Pre-Development Runoff	4155.3	m^3/yr	76.4	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

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Post-Development Water Balance

Thornthwaite & Mather Method

Project Name: **Arkell Subdivision**
Location: **Arkell, Guelph, Ontario**

Landuse	**Woods**					
Parameters	**Pervious Area**	4.98 ha	**Impervious Area**	0.00 ha	**Total Area**	4.98 ha
	Soil Moisture Holding Capacity	250 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	111	124	100	77	39	9	0	**567**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	5	55	**283**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	4	44	**227**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	1	11	**57**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	1506	3821	5521	6183	4977	3814	1961	453	0	**28236**
Impervious ET (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Infiltration (m^3)	2639	1835	2269	2027	136	0	0	0	0	0	183	2185	**11274**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	660	459	567	507	34	0	0	0	0	0	46	546	**2819**
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Post-Development Water Balance Summary: Woods				
Post-Development Evapotranspiration	28236.2	m^3/yr	567.5	mm/yr
Post-Development Infiltration	11274.3	m^3/yr	226.6	mm/yr
Post-Development Runoff	2818.6	m^3/yr	56.6	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

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Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Post-Development Water Balance

Thornthwaite & Mather Method

Project Name: **Arkell Subdivision**
Location: **Arkell, Guelph, Ontario**

Landuse	**Roads**					
Parameters	**Pervious Area**	0.48 ha	**Impervious Area**	4.35 ha	**Total Area**	4.83 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	146	371	504	527	363	364	190	44	0	**2510**
Impervious ET (m^3)	432	301	372	529	523	525	627	438	490	463	488	358	**5546**
Pervious Infiltration (m^3)	256	178	220	197	13	0	0	0	0	0	202	212	**1279**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	64	45	55	49	3	0	0	0	0	0	51	53	**320**
Impervious Runoff (m^3)	2449	1703	2106	3000	2963	2974	3554	2483	2778	2623	2767	2028	**31429**

Post-Development Water Balance Summary: Roads				
Post-Development Evapotranspiration	8056.4	m^3/yr	166.8	mm/yr
Post-Development Infiltration	1278.6	m^3/yr	26.5	mm/yr
Post-Development Runoff	31748.7	m^3/yr	657.4	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

CROZIER

Post-Development Water Balance

Thornthwaite & Mather Method

Project Name: **Arkell Subdivision**
Location: **Arkell, Guelph, Ontario**

Landuse	**Single-Family Dwellings**					
Parameters	**Pervious Area**	4.22 ha	**Impervious Area**	2.82 ha	**Total Area**	7.04 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	1279	3244	4409	4610	3178	3186	1665	384	0	**21955**
Impervious ET (m^3)	280	195	241	343	339	340	406	284	318	300	316	232	**3593**
Pervious Infiltration (m^3)	2240	1558	1926	1721	115	0	0	0	0	0	1768	1855	**11183**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	560	389	482	430	29	0	0	0	0	0	442	464	**2796**
Impervious Runoff (m^3)	1587	1103	1364	1944	1920	1927	2303	1608	1800	1699	1793	1314	**20362**

Post-Development Water Balance Summary: Single-Family Dwellings				
Post-Development Evapotranspiration	25548.1	m^3/yr	362.9	mm/yr
Post-Development Infiltration	11183.1	m^3/yr	158.9	mm/yr
Post-Development Runoff	23158.1	m^3/yr	329.0	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

CROZIER

Post-Development Water Balance

Thornthwaite & Mather Method

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Project Name: **Arkell Subdivision**
Location: **Arkell, Guelph, Ontario**

Landuse	**Exclusion Lands**					
Parameters	**Pervious Area**	0.53 ha	**Impervious Area**	0.00 ha	**Total Area**	0.53 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	161	408	554	580	400	401	209	48	0	**2760**
Impervious ET (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Infiltration (m^3)	282	196	242	216	14	0	0	0	0	0	222	233	**1406**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	70	49	61	54	4	0	0	0	0	0	56	58	**352**
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Post-Development Water Balance Summary: Exclusion Lands				
Post-Development evapotranspiration	2760.4	m^3/yr	519.8	mm/yr
Post-Development Infiltration	1406.1	m^3/yr	264.8	mm/yr
Post-Development Runoff	351.5	m^3/yr	66.2	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

CROZIER

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Post-Development Water Balance

Thornthwaite & Mather Method

Project Name: **Arkell Subdivision**
Location: **Arkell, Guelph, Ontario**

Landuse	**SWM**				
Parameters	**Pervious Area**	0.19 ha	**Impervious Area**	0.19 ha	**Total Area**	0.37 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	56	142	193	202	139	140	73	17	0	**962**
Impervious ET (m^3)	18	13	16	23	22	22	27	19	21	20	21	15	**236**
Pervious Infiltration (m^3)	98	68	84	75	5	0	0	0	0	0	77	81	**490**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	25	17	21	19	1	0	0	0	0	0	19	20	**123**
Impervious Runoff (m^3)	104	73	90	128	126	127	151	106	118	112	118	86	**1339**

Post-Development Water Balance Summary: SWM				
Post-Development evapotranspiration	1198.4	m^3/yr	323.7	mm/yr
Post-Development Infiltration	490.1	m^3/yr	132.4	mm/yr
Post-Development Runoff	1461.1	m^3/yr	394.6	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.
2. Assumptions:
- Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
- Evapotranspiration does not occur when average temperature is below zero.
- Approximately 15% of the precipitation on impervious surfaces will evaporate.

CROZIER

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Post-Development Water Balance

Thornthwaite & Mather Method

Project Name: **Arkell Subdivision**
Location: **Arkell, Guelph, Ontario**

Landuse	**Drainage Swale**					
Parameters	**Pervious Area**	1.15 ha	**Impervious Area**	0.00 ha	**Total Area**	1.15 ha
	Soil Moisture Holding Capacity	50 mm	**Infiltration Factor**	0.80	**% Impervious Evaporation**	15%

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	66	46	57	81	80	81	96	67	75	71	75	55	**851**
Pervious Area Water Balance													
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	**520**
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	**331**
Infiltration (mm)	53	37	46	41	3	0	0	0	0	0	42	44	**265**
Surface Water Runoff (mm)	13	9	11	10	1	0	0	0	0	0	10	11	**66**
Impervious Area Water Balance													
Evaporation (mm)	10	7	9	12	12	12	14	10	11	11	11	8	**128**
Surface Water Runoff (mm)	56	39	48	69	68	68	82	57	64	60	64	47	**723**
Combined Water Balance													
Pervious ET (m^3)	0	0	0	349	886	1204	1259	868	870	455	105	0	**5995**
Impervious ET (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Infiltration (m^3)	612	425	526	470	31	0	0	0	0	0	483	507	**3054**
Impervious Infiltration (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Pervious Runoff (m^3)	153	106	131	117	8	0	0	0	0	0	121	127	**763**
Impervious Runoff (m^3)	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Post-Development Water Balance Summary: Drainage Swale				
Post-Development evapotranspiration	5995.3	m^3/yr	519.8	mm/yr
Post-Development Infiltration	3053.8	m^3/yr	264.8	mm/yr
Post-Development Runoff	763.5	m^3/yr	66.2	mm/yr

NOTES: 1.The infiltration factor is determined using the MECP methodology outlined in the Stormwater Management Planning and Design Manual 2003.

2. Assumptions:
   - Surplus water is unavailable for runoff and recharge in months where water losses from APET exceed precipitation inputs.
   - Evapotranspiration does not occur when average temperature is below zero.
   - Approximately 15% of the precipitation on impervious surfaces will evaporate.

CROZIER

Project: Arkell Subdivsion
Project No.: 2433-6646
Created By: CM
Checked By: CG
Date: 05-Aug-25

Site Water Balance Summary

Thornthwaite & Mather Method

Pre-Development Water Balance							
Catchment ID	Area	Evapotranspiration		Infiltration		Runoff	
	(ha)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)
Woods	6.469	36710	567	14658	227	3664	57
Agricultural	6.9926	36345	520	18513	265	4628	66
Lawn	5.4384	27935	514	14174	261	4155	76
Total	**18.9**	**100989**	**534**	**47345**	**251**	**12448**	**66**

Post-Development Water Balance							
Catchment ID	Area	Evapotranspiration		Infiltration		Runoff	
	(ha)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)
Woods	4.9758	28236	567	11274	227	2819	57
Roads	4.829404	8056	167	1279	26	31749	657
Single-Family Dwellings	7.04	25548	363	11183	159	23158	329
Exclusion Lands	0.5311	2760	520	1406	265	352	66
SWM	0.370226	1198	324	490	132	1461	395
Drainage Swale	1.15347	5995	520	3054	265	763	66
Total	**18.9**	**71795**	**380**	**28686**	**152**	**60301**	**319**

Site Water Balance Summary							
Scenario	Area	Evapotranspiration		Infiltration		Runoff	
	(ha)	(m^3)	(mm)	(m^3)	(mm)	(m^3)	(mm)
Pre-Dev.	18.9	100989	534	47345	251	12448	66
Post-Dev.	18.9	71795	380	28686	152	60301	319
Difference	0	-29195	-154	-18659	-99	47853	253
% Difference	0%	-29%	-29%	-39%	-39%	384%	384%

Annual Infiltration Deficit **18659** **m^3**

Soil Moisture Capacity	50 mm												
Evapotranspiration Analysis													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	50	50	50	50	50	26	13	5	5	37	50	50	
Change in Storage (mm)	0	0	0	0	0	-24	-13	-8	0	32	13	0	
Evapotranspiration (mm)	0	0	0	30	77	104	109	75	75	39	9	0	520
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	52	55	331

Soil Moisture Capacity	75 mm												
Evapotranspiration Analysis													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	75	75	75	75	75	49	31	16	16	48	75	75	
Change in Storage (mm)	0	0	0	0	0	-26	-18	-14	0	32	27	0	
Evapotranspiration (mm)	0	0	0	30	77	107	114	82	76	39	9	0	534
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	38	55	317

Soil Moisture Capacity	100 mm												
Evapotranspiration Analysis													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	100	100	100	100	100	72	51	32	31	63	100	100	
Change in Storage (mm)	0	0	0	0	0	-28	-21	-19	-1	32	37	0	
Evapotranspiration (mm)	0	0	0	30	77	108	117	86	76	39	9	0	543
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	29	55	307

Soil Moisture Capacity	125 mm												
Evapotranspiration Analysis													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	125	125	125	125	125	96	73	50	49	81	125	125	
Change in Storage (mm)	0	0	0	0	0	-29	-23	-23	-1	32	44	0	
Evapotranspiration (mm)	0	0	0	30	77	109	119	90	76	39	9	0	550
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	22	55	300

Soil Moisture Capacity	150 mm												
Evapotranspiration Analysis													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	150	150	150	150	150	121	96	70	69	101	150	150	
Change in Storage (mm)	0	0	0	0	0	-29	-25	-26	-1	32	49	0	
Evapotranspiration (mm)	0	0	0	30	77	110	121	93	76	39	9	0	555
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	17	55	295

Soil Moisture Capacity	200 mm												
Evapotranspiration Analysis													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	200	200	200	200	200	170	143	113	112	144	200	200	
Change in Storage (mm)	0	0	0	0	0	-30	-27	-30	-1	32	56	0	
Evapotranspiration (mm)	0	0	0	30	77	110	123	97	76	39	9	0	563
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	9	55	288

Soil Moisture Capacity	250 mm												
						Evapotranspiration Analysis							
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	250	250	250	250	250	220	191	159	157	189	250	250	
Change in Storage (mm)	0	0	0	0	0	-30	-28	-33	-1	32	61	0	
Evapotranspiration (mm)	0	0	0	30	77	111	124	100	77	39	9	0	567
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	5	55	283

Soil Moisture Capacity	300 mm												
						Evapotranspiration Analysis							
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	300	300	300	300	300	269	240	205	204	235	300	300	
Change in Storage (mm)	0	0	0	0	0	-31	-29	-35	-2	32	65	0	
Evapotranspiration (mm)	0	0	0	30	77	111	125	102	77	39	9	0	571
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	1	55	280

Soil Moisture Capacity	350 mm												
						Evapotranspiration Analysis							
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	350	350	350	350	350	319	289	253	251	283	349	350	
Change in Storage (mm)	0	0	0	0	0	-31	-30	-36	-2	32	66	1	
Evapotranspiration (mm)	0	0	0	30	77	112	126	104	77	39	9	0	573
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	0	54	277

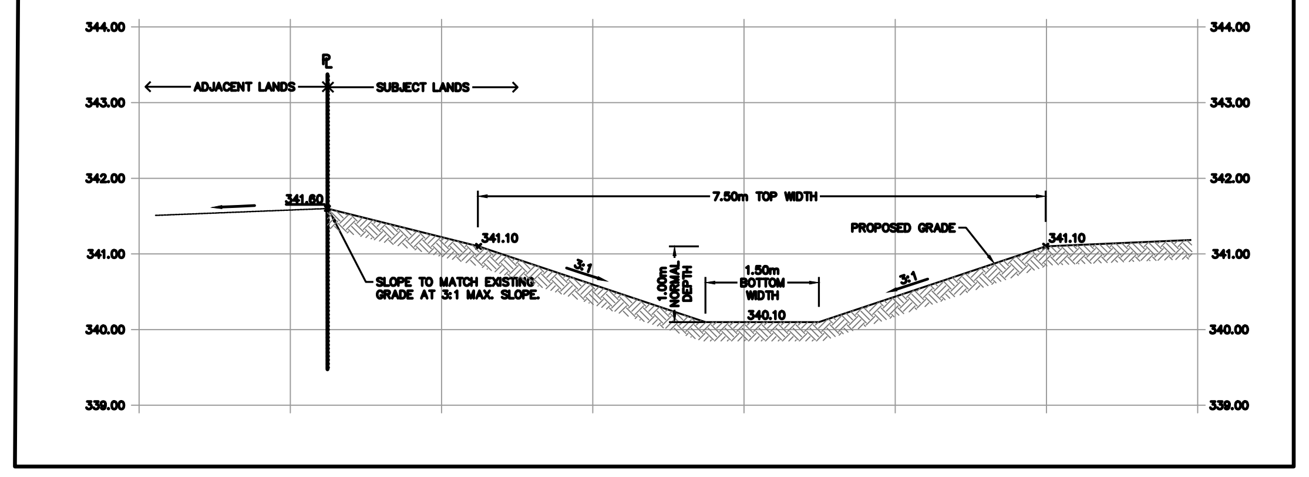
Soil Moisture Capacity	400 mm												
						Evapotranspiration Analysis							
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (P)	66	46	57	81	80	81	96	67	75	71	75	55	851
Adjusted Potential Evapotranspiration (APET)	0	0	0	30	77	113	130	114	78	39	9	0	591
P-APET	66	46	57	51	3	-32	-34	-47	-2	32	66	55	260
Cummulative moisture deficit	0	0	0	0	0	-32	-67	-114	-116	0	0	0	
Storage (S) (mm)	400	400	400	400	400	369	339	301	299	331	397	400	
Change in Storage (mm)	0	0	0	0	0	-31	-30	-38	-2	32	66	3	
Evapotranspiration (mm)	0	0	0	30	77	112	126	105	77	39	9	0	575
Water Surplus (mm)	66	46	57	51	3	0	0	0	0	0	0	52	275

Adjustment Factors Based on Site Latitude Based on 12 hours of Sunlight per day for 30 days

Latitude °	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50	0.74	0.78	1.02	1.15	1.33	1.36	1.37	1.25	1.06	0.92	0.76	0.70
49	0.75	0.79	1.02	1.14	1.32	1.34	1.35	1.24	1.05	0.93	0.76	0.71
48	0.76	0.80	1.02	1.14	1.31	1.33	1.34	1.23	1.05	0.93	0.77	0.72
47	0.77	0.80	1.02	1.14	1.30	1.32	1.33	1.22	1.04	0.93	0.78	0.73
46	0.79	0.81	1.02	1.13	1.29	1.31	1.32	1.22	1.04	0.94	0.79	0.74
45	0.80	0.81	1.02	1.13	1.28	1.29	1.31	1.21	1.04	0.94	0.79	0.75
44	0.81	0.82	1.02	1.13	1.27	1.29	1.30	1.20	1.04	0.95	0.80	0.76
43	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.20	1.04	0.95	0.81	0.77
42	0.82	0.83	1.03	1.12	1.26	1.27	1.28	1.19	1.04	0.95	0.82	0.79
41	0.83	0.83	1.03	1.11	1.25	1.26	1.27	1.19	1.04	0.96	0.82	0.80
40	0.84	0.83	1.03	1.11	1.24	1.25	1.27	1.18	1.04	0.96	0.83	0.81
39	0.85	0.84	1.03	1.11	1.23	1.24	1.26	1.18	1.04	0.96	0.84	0.82
38	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83
37	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83
36	0.87	0.85	1.03	1.10	1.21	1.22	1.24	1.16	1.03	0.97	0.86	0.84
35	0.87	0.85	1.03	1.09	1.21	1.21	1.23	1.16	1.03	0.97	0.86	0.85
34	0.88	0.85	1.03	1.09	1.20	1.20	1.22	1.16	1.03	0.97	0.87	0.86
33	0.88	0.86	1.03	1.09	1.19	1.20	1.22	1.15	1.03	0.97	0.88	0.86
32	0.89	0.86	1.03	1.08	1.19	1.19	1.21	1.15	1.03	0.98	0.88	0.87
31	0.90	0.87	1.03	1.08	1.18	1.18	1.20	1.14	1.03	0.98	0.89	0.88
30	0.90	0.87	1.03	1.08	1.18	1.17	1.20	1.14	1.03	0.98	0.89	0.88
29	0.91	0.87	1.03	1.07	1.17	1.16	1.19	1.13	1.03	0.98	0.90	0.89
28	0.91	0.88	1.03	1.07	1.16	1.16	1.18	1.13	1.02	0.98	0.90	0.90
27	0.92	0.88	1.03	1.07	1.16	1.15	1.18	1.13	1.02	0.99	0.90	0.90
26	0.92	0.88	1.03	1.06	1.15	1.15	1.17	1.12	1.02	0.99	0.91	0.91
25	0.93	0.89	1.03	1.06	1.15	1.14	1.17	1.12	1.02	0.99	0.91	0.91
20	0.95	0.90	1.03	1.05	1.13	1.11	1.14	1.11	1.02	1.00	0.93	0.94
15	0.97	0.91	1.03	1.04	1.11	1.08	1.12	1.08	1.02	1.01	0.95	0.97
10	1.00	0.91	1.03	1.03	1.08	1.06	1.08	1.07	1.02	1.02	0.98	0.99
5	1.02	0.93	1.03	1.02	1.06	1.03	1.06	1.05	1.01	1.03	0.99	1.02
0	1.04	0.94	1.04	1.01	1.04	1.01	1.04	1.04	1.01	1.04	1.01	1.04
-5	1.06	0.91	1.04	1.00	1.02	0.99	1.02	1.03	1.00	1.05	1.03	1.06
-10	1.08	0.97	1.05	0.99	1.01	0.96	1.00	1.01	1.00	1.06	1.05	1.10
-15	1.12	0.98	1.05	0.98	0.98	0.94	0.97	1.00	1.00	1.07	1.07	1.12
-20	1.14	1.00	1.05	0.97	0.96	0.91	0.95	0.99	1.00	1.08	1.09	1.15
-25	1.17	1.01	1.05	0.96	0.94	0.88	0.93	0.98	1.00	1.10	1.11	1.18
-30	1.20	1.03	1.06	0.95	0.92	0.85	0.90	0.96	1.00	1.12	1.14	1.21
-35	1.23	1.04	1.06	0.94	0.89	0.82	0.87	0.94	1.00	1.13	1.17	1.25
-45	1.27	1.06	1.07	0.93	0.86	0.78	0.84	0.92	1.00	1.15	1.20	1.29
-42	1.28	1.07	1.07	0.92	0.85	0.76	0.82	0.92	1.00	1.16	1.22	1.31
-44	1.30	1.08	1.07	0.92	0.83	0.74	0.81	0.91	0.99	1.17	1.23	1.33
-46	1.32	1.10	1.07	0.91	0.82	0.72	0.79	0.90	0.99	1.17	1.25	1.35
-48	1.34	1.11	1.08	0.90	0.80	0.70	0.76	0.89	0.99	1.18	1.27	1.37
-50	1.37	1.12	1.08	0.89	0.77	0.67	0.74	0.88	0.99	1.19	1.29	1.41

Source: Dunne, T. and Leopold, L.B., 1978. Water in environmental planning, Freeman Publishers.

CROSS SECTION A – A'
PROFILE VIEW
SCALE: H=1:100
V=1:100



CROSS SECTION B – B'
PROFILE VIEW
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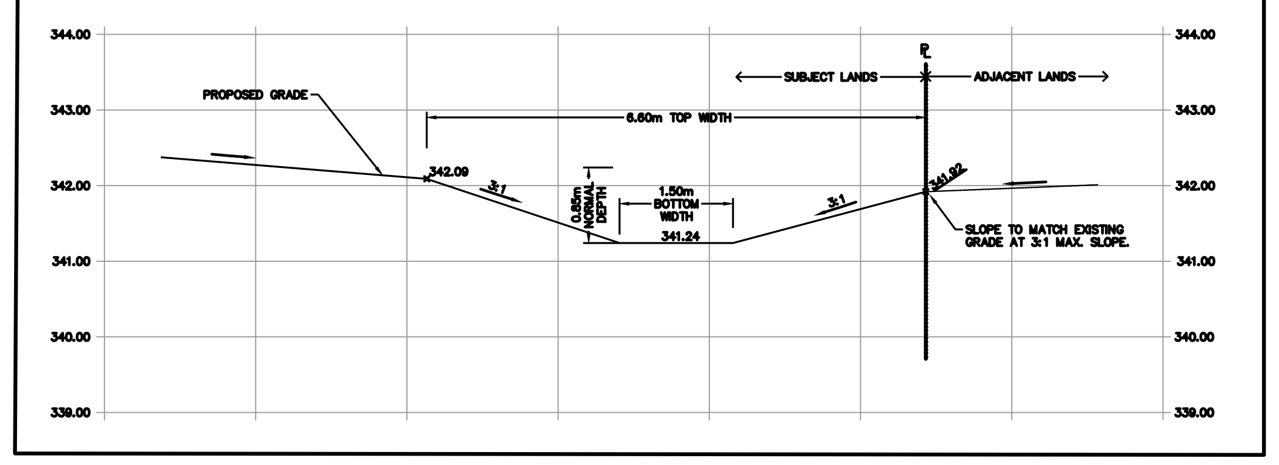
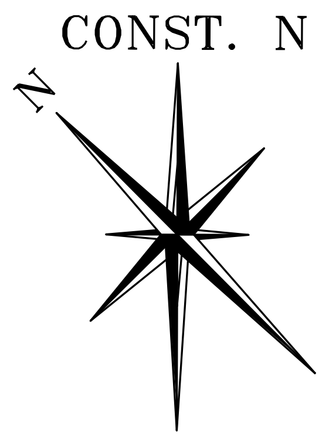
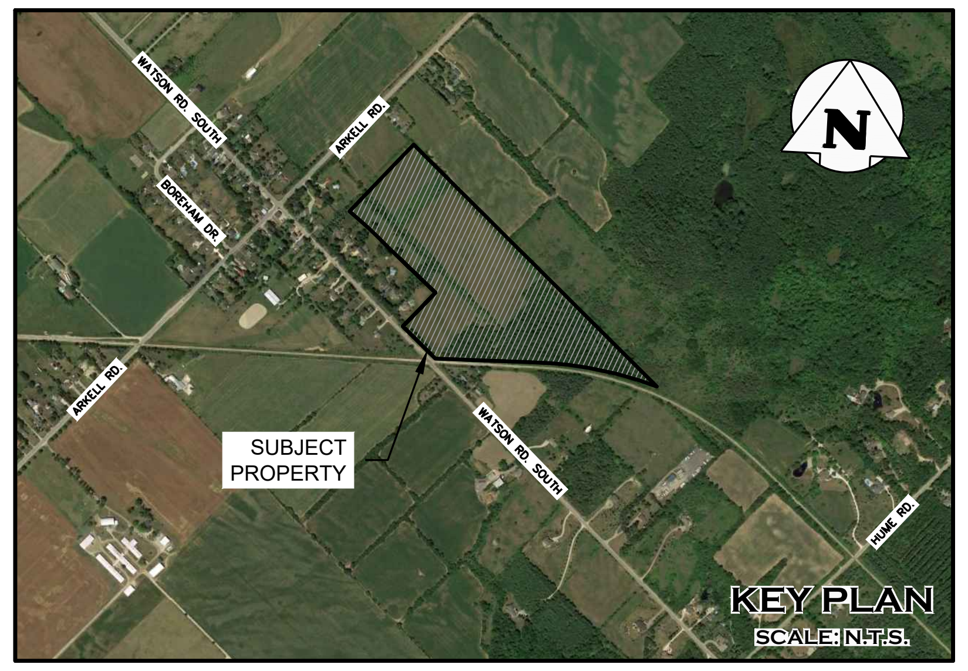
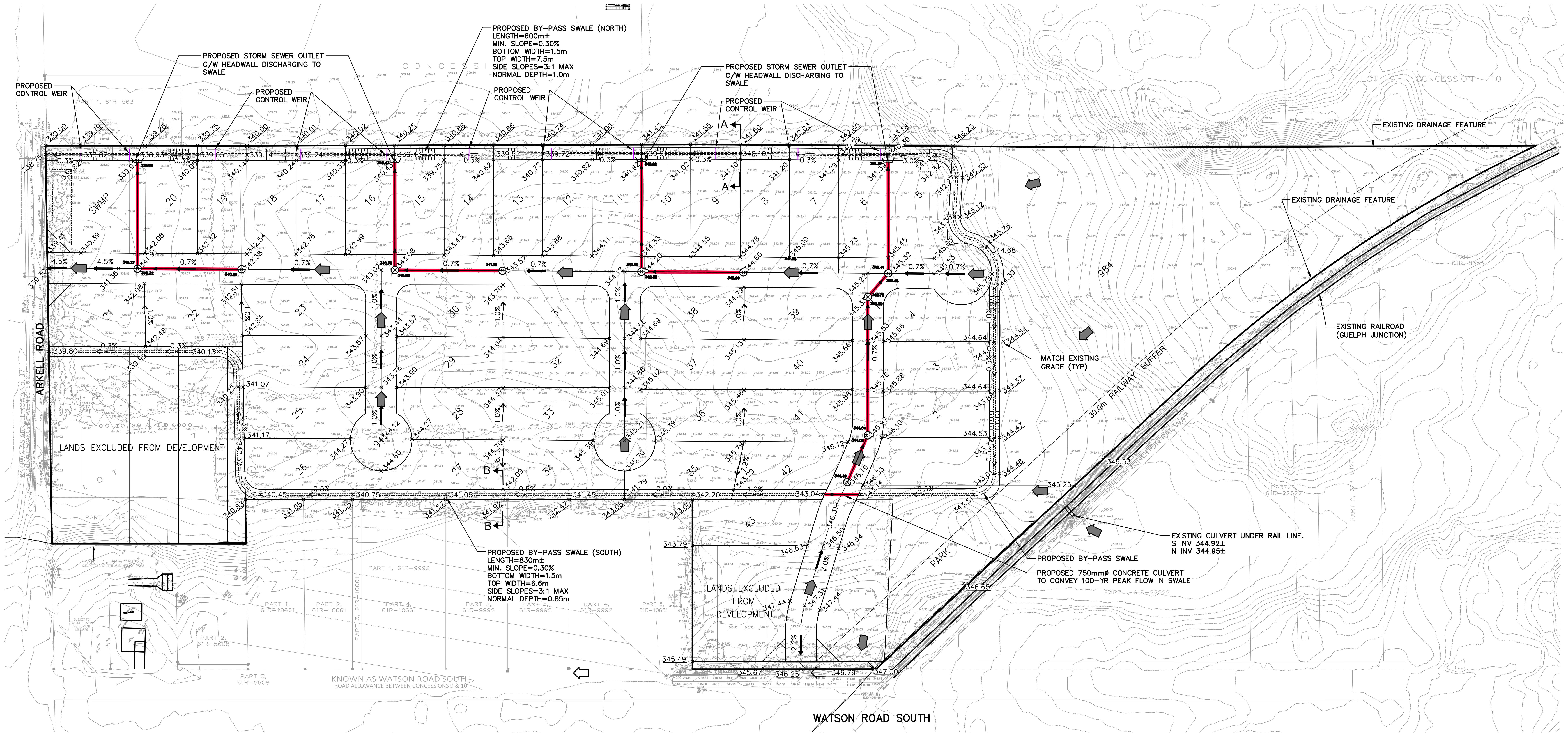
V=1:100









LEGEND

━━━	PROPERTY LINE
───	EXISTING CONTOUR (0.5m)
───	EXISTING CONTOUR (1.0m)
×215.00	EXISTING GRADE
×215.00	PROPOSED GRADE
×215.00	PROPOSED GRADE (TO MATCH EXISTING)
2.0% ➡	PROPOSED MINOR FLOW DIRECTION
┬┬┬┬	PROPOSED SLOPE (3:1 MAX.)
|	PROPOSED CONTROL WEIR
⇨	EXISTING OVERLAND FLOW DIRECTION
➡	PROPOSED OVERLAND FLOW DIRECTION
2.0% →	PROPOSED SWALE FLOW DIRECTION
— —	PROPOSED LOT–LINE
☁	MISSING SURVEY
▥	PROPOSED CATCHBASIN
◎	PROPOSED CATCHBASIN MANHOLE
○	PROPOSED STORM MANHOLE
━○━	PROPOSED STORM SEWER & MANHOLE
▥ / ▥▥	PROPOSED SINGLE / DOUBLE CATCHBASIN

REFER TO TOWNSHIP OF PUSLINCH STANDARD DRAWING STD–102 "TYPICAL URBAN CROSS–SECTION" FOR DIMENSIONS AND DETAILS OF PROPOSED ROAD CROSS–SECTION.

No.	ISSUE / REVISION	YYYY/MMM/DD
1	ISSUED FOR INTERNAL COORDINATION	2024/FEB/28
0	ISSUED FOR PRE–CONSULTATION	2023/AUG/31

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON SITE PLAN BY STOVEL AND ASSOCIATES INC.
PROJECT No. XXX
DRAWING No. XXX
DATE RECEIVED 2023/AUG/23

DRAWING NOTES:

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THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.

THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT. DO NOT SCALE THIS DRAWING.

ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project
WATSON ROAD SOUTH
TOWN OF PUSLINCH

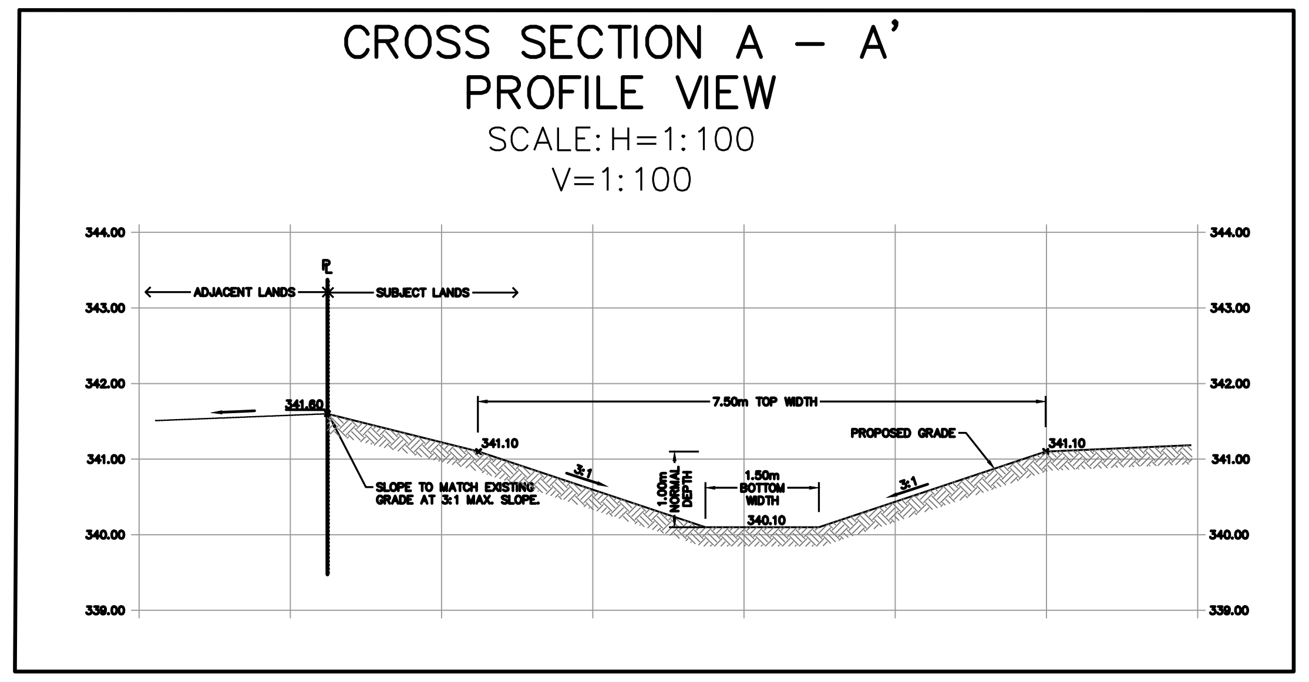
Drawing
PRELIMINARY GRADING AND
SERVICING PLAN

Stamp
Stamp
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

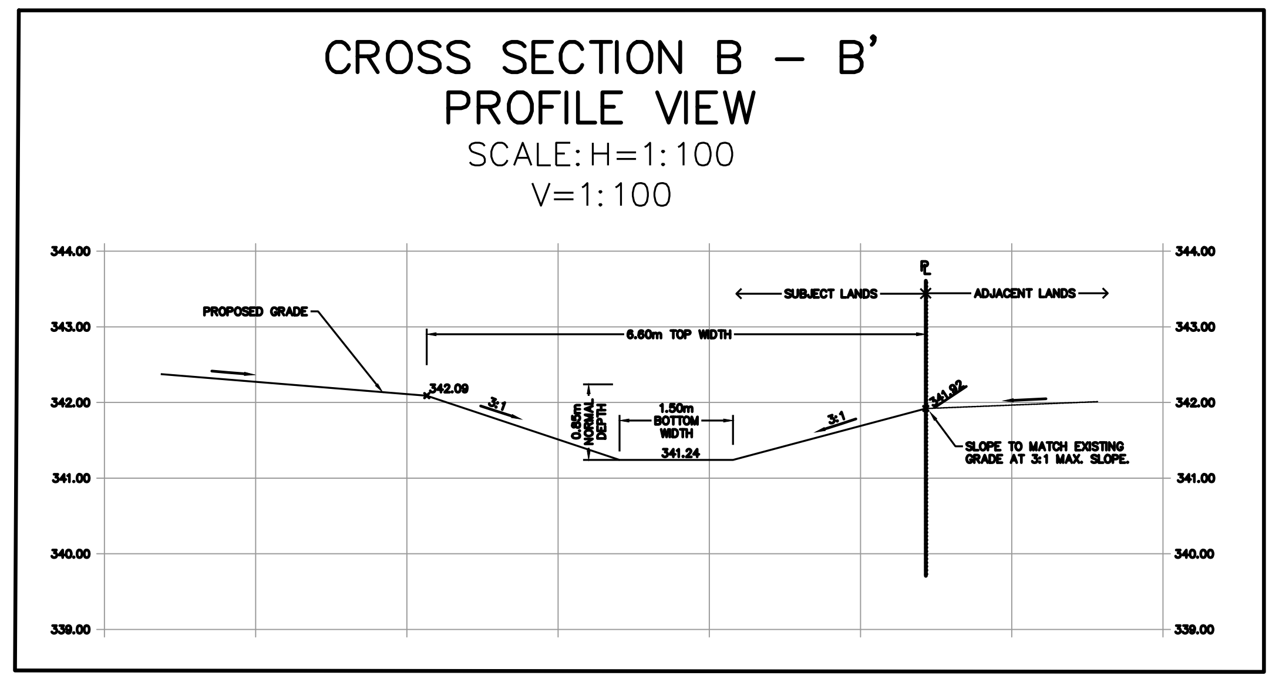
CROZIER
CONSULTING ENGINEERS

Drawn A.O.	Design A.O.	Project No. 2433–6646	
Check J.B.	Check T.E.	Scale 1:1500	Dwg. C101

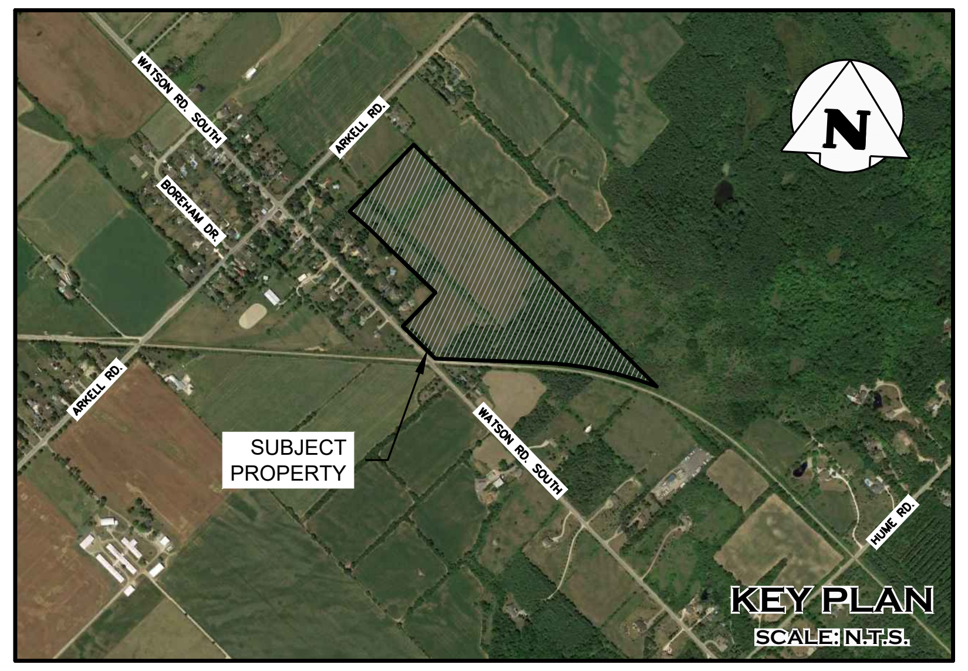
CROSS SECTION A – A'
PROFILE VIEW
SCALE: H=1:100
V=1:100

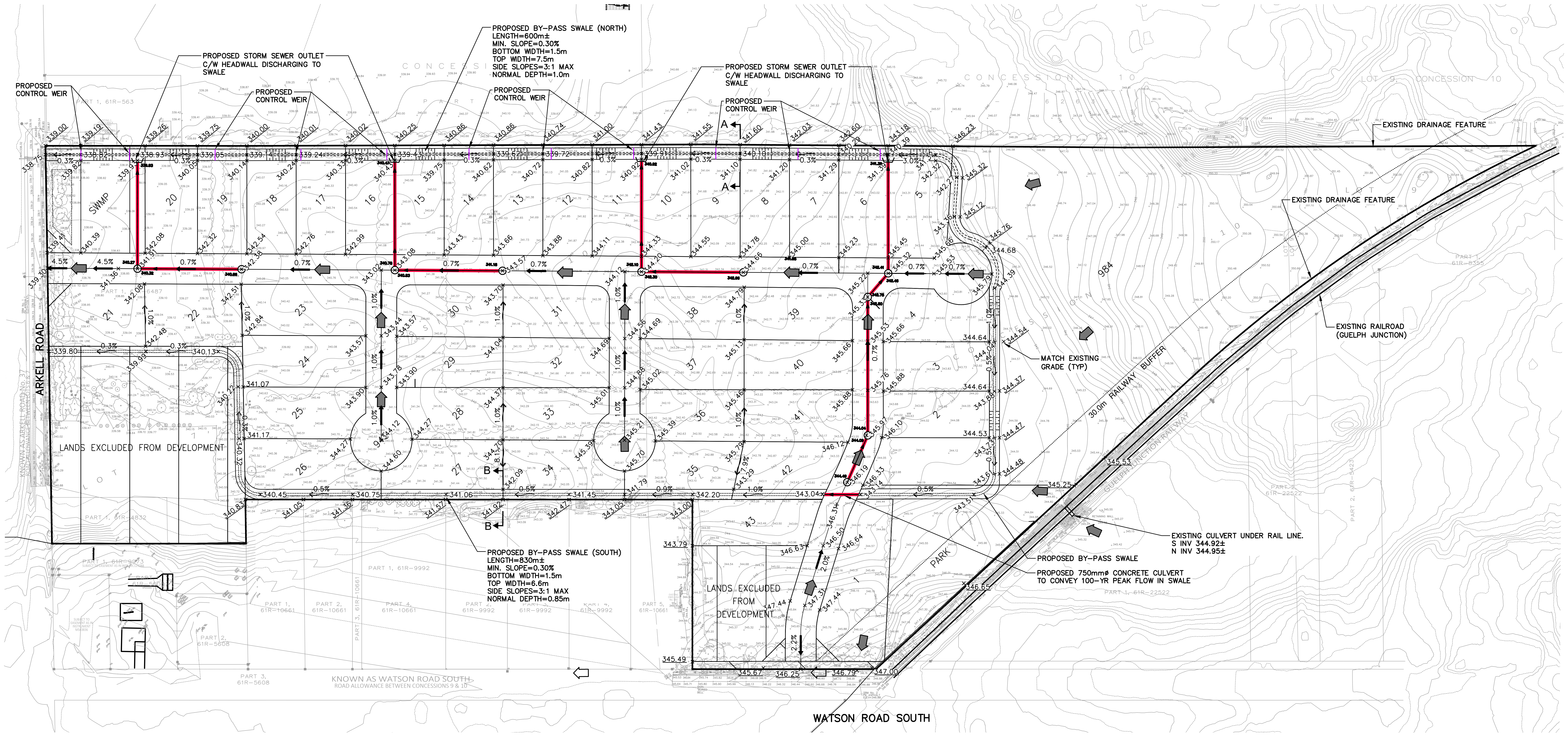


CROSS SECTION B – B'
PROFILE VIEW
SCALE: H=1:100
V=1:100



CONST. N





SCALE: 1:1500

	LEGEND
▬	PROPERTY LINE
	EXISTING CONTOUR (0.5m)
	EXISTING CONTOUR (1.0m)
×215.00	EXISTING GRADE
×215.00	PROPOSED GRADE
×215.00	PROPOSED GRADE (TO MATCH EXISTING)
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	PROPOSED SLOPE (3:1 MAX.)
|	PROPOSED CONTROL WEIR
⇨	EXISTING OVERLAND FLOW DIRECTION
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2.0% →	PROPOSED SWALE FLOW DIRECTION
	PROPOSED LOT-LINE
	MISSING SURVEY
□	PROPOSED CATCHBASIN
⊡	PROPOSED CATCHBASIN MANHOLE
○	PROPOSED STORM MANHOLE
○	PROPOSED STORM SEWER & MANHOLE
□ / □□	PROPOSED SINGLE / DOUBLE CATCHBASIN

REFER TO TOWNSHIP OF PUSLINCH STANDARD DRAWING STD-102 "TYPICAL URBAN CROSS-SECTION" FOR DIMENSIONS AND DETAILS OF PROPOSED ROAD CROSS-SECTION.

No.	ISSUE / REVISION	YYYY/MMM/DD
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PROJECT No. XXX
DRAWING No. XXX
DATE RECEIVED 2023/AUG/23

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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

WATSON ROAD SOUTH
TOWN OF PUSLINCH

Drawing

PRELIMINARY GRADING AND
SERVICING PLAN

Stamp

Stamp

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

CROZIER
CONSULTING ENGINEERS

Drawn	A.O.	Design	A.O.	Project No.	2433-6646		
Check	J.B.	Check	T.E.	Scale	1:1500	Dwg.	C101

COLVILLE
CONSULTING INC.

September 19, 2023

Mr. Rob Stovel
Stovel and Associates Inc.
Delivered Via Email

RE: **Results of Breeding Bird Surveys – 890 Watson Road, Arkell**

Thank you for contacting Colville Consulting Inc. regarding the completion of breeding bird surveys on the 890 Watson Road property, Arkell (Township of Puslinch). This letter report is intended to present the results of surveys completed on this property.

Study Area

The Subject Property for these surveys is located south of Arkell Road and east of Watson Road, in Arkell (see Figure 1). This property measures approximately 17.4ha (43.1 acres) in size and has been assigned the address of 890 Watson Road. A majority of the property is currently in agricultural production, with a woodland and thicket community on the southern portion of the property.

Results

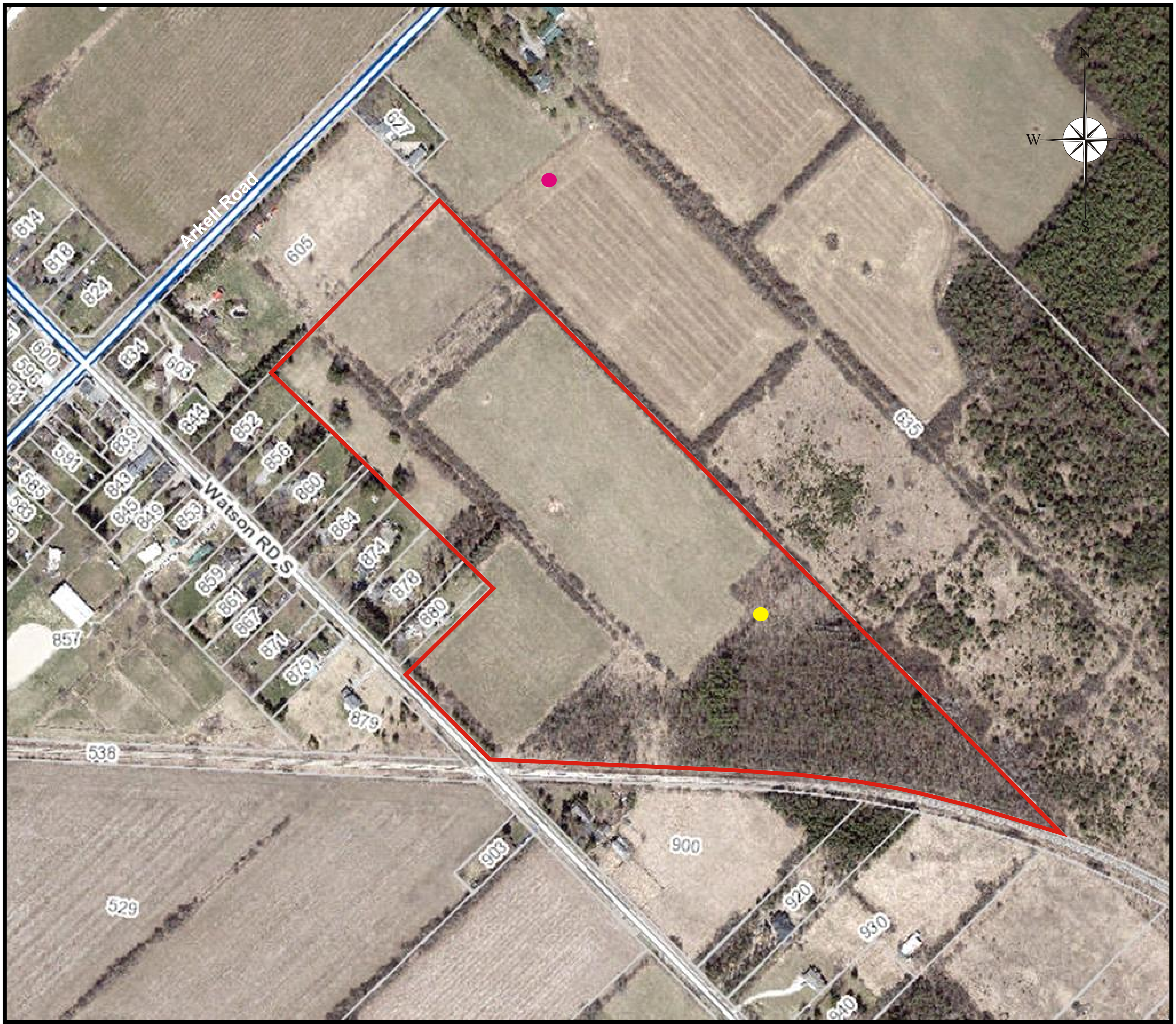
Breeding bird surveys were conducted on May 23, June 10 and June 25, 2023. Surveys were completed at least a week apart, under suitable weather conditions with little to no wind or precipitation. A thorough search of the Subject Property was completed during all surveys between dawn and no later than 10:00 am. All birds seen or heard calling were recorded and the highest breeding evidence per species was determined in accordance with the criteria of the Atlas of the Breeding Birds of Ontario (Cadman et al. 2007).

A total of 44 species of birds were observed or heard on or above the Subject Property and two additional species were observed on adjacent lands (see Table 1). According to Ontario conservation status ranks (S-rank) designations, with the exception of two non-native species, all recorded species are considered to be “secure” (S5 - common, widespread and abundant) or “apparently secure” (S4 - uncommon but not rare) in the province of Ontario.

Several Barn Swallows were observed flying, foraging and calling over the agricultural portions of the property on the first and second site visits. This species is listed as Special Concern in Ontario, and also designated as Special Concern federally. No buildings or structures suitable for nesting are present on the property, and therefore this property is considered to be providing incidental foraging opportunities.

An Eastern Wood-pewee was heard calling in the woodland at the south end of the property during all three site visits. An individual was also observed frequenting a nest site on the second site visit. The approximate location of observations is illustrated in Figure 1. This species is designated as Special Concern in Ontario and Canada.

Although not detected on the property, an Eastern Meadowlark was heard calling from lands east of the property during the second and third site visits. This species is designated as Threatened in Ontario and is also considered to be Threatened in Canada. The estimated location



Legend

— Subject Property

● Approximate Location of Eastern Wood-pewee

● Approximate Location of Eastern Meadowlark

Figure 1
Extent of Subject Property

Breeding Bird Surveys
890 Watson Road, Arkell

Prepared for: **Stovel and Associates Inc.**

Prepared by: COLVILLE CONSULTING INC.

September 2023

FILE: C23055

Table 1. List of bird species documented within and adjacent to the Study Area.

Species	S Rank	Agricultural Lands	Hedgerow	Woodland	Adjacent Lands	Highest Breeding Evidence*	Breeding Code**
American Crow	S5B		X	X		PO	H
American Goldfinch	S5B		X	X		PO	H
American Robin	S5B		X	X		PO	S
Baltimore Oriole	S4B		X	X		PO	S
Barn Swallow	S4B	X				OBS	
Black-billed Cuckoo	S4S5B			X		PO	S
Black-capped	S5		X	X		PO	S
Blue Jay	S5			X		PO	H
Blue-winged Warbler	S4B			X		CO	CF
Brown-headed	S4B		X	X		PO	
Canada Goose	S5	X				OBS	X
Cedar Waxwing	S5B		X	X		PO	H
Chipping Sparrow	S5B		X	X		PO	S
Common Grackle	S5B		X	X		PO	H
Common Raven	S5				X	PO	H
Common Yellowthroat	S5B		X	X		PO	S
Downy Woodpecker	S5			X		CO	NY
Eastern Bluebird	S5B,S4N			X	X	PO	S
Eastern Kingbird	S4B			X		PO	S
Eastern Meadowlark	S4B,S3N				X	PO	S
Eastern Towhee	S4B		X	X		PO	S
Eastern Wood-pewee	S4B			X		CO	AE
European Starling	SNA			X		PO	H
Field Sparrow	S4B,S3N		X	X	X	PO	S
Gray Catbird	S4B		X	X		PO	S
Great Blue Heron	S4	X				OBS	X
Great Crested	S4B			X		PO	S
Horned Lark	S4	X	X			PO	S
House Finch	SNA			X	X	PO	S
House Wren	S5B		X	X		CO	FY
Indigo Bunting	S5B		X	X		PR	A
Killdeer	S5B	X			X	PO	H
Mallard	S5	X				OBS	X
Mourning Dove	S5		X	X		PO	S
Mourning Warbler	S5B			X		PR	T
Northern Cardinal	S5		X	X		PO	S
Northern Flicker	S4B		X	X		PO	S
Red-eyed Vireo	S5B			X		PR	A
Red-winged Blackbird	S4			X		PO	S
Ring-billed Gull	S5	X				OBS	X
Rose-breasted	S4B			X		PO	S
Ruby-throated	S5B			X		PO	H
Savannah Sparrow	S5B,S3N	X	X		X	PO	S
Sharp-shinned Hawk	S5		X			PO	H
Song Sparrow	S5B		X	X		PO	S
Wild Turkey	S5			X	X	PO	S

Table 1 Legend
* OBS – observed, no evidence of breeding; PO – possible breeding; PR – probable breeding; CO - confirmed breeding
** X – observed in its breeding season, no evidence of breeding
H – species observed in its breeding season in suitable nesting habitat
S – singing male present in its breeding season in suitable nesting habitat
P – pair observed in their breeding season in suitable nesting habitat A – agitated behavior or anxiety calls of an adult
N – nest building or excavation of nest hole FY – recently fledged young
CF – adult carrying food for young NY – nest with young

of this individual is illustrated in Figure 1, however it should be noted that access to this property was not available and no nests were confirmed on the adjacent lands.

Summary and Recommendations

As indicated in Table 1, a majority of the bird species documented on this property were observed in and adjacent to the woodland and hedgerow. All bird species documented using these habitats are considered to be common and secure in the province of Ontario, with one of these species (Eastern Wood-pewee) considered to be a Species of Special Concern. Eastern Wood-pewee were documented in the woodland during each of the breeding bird surveys and this species is considered to be breeding in this woodland.

One meadow species (Savannah Sparrow) was documented using the agricultural portions of the property and Eastern Meadowlark was documented east of this parcel. No use of the property by Eastern Meadowlark was documented during our surveys and no active nests were verified on the adjacent lands. It is therefore our observation that the Subject Property is not providing significant habitat for this species.

Several Barn Swallows were observed flying, foraging and calling over the agricultural portions of the property on the first and second site visits. As no buildings or structures suitable for nesting are present on the property, use of this property by Barn Swallows is considered to be opportunistic.

Please do not hesitate to contact the undersigned should you have any questions regarding the results in this report.

Respectively submitted by:

[redacted]

Ian Barrett, M.Sc.
Colville Consulting Inc.

Test Pit Location Map

Part of Lots 7,8 & 9 Concession 10
Township of Puslinch, Wellington County
Arkell, Ontario

Notes

1. This is not a Plan of Survey.
2. Distances shown on this plan are adjusted ground distances and can be converted to grid distances by multiplying by an averaged combined scale factor of 0.999573.
3. Coordinates on this plan are UTM, ZONE 17, NAD83 (CSRS-2010) Adjustment and are based on gps observations from a network of permanent gps reference stations.
4. Aerial Imagery Provided By Microsoft Corporation @ 2023 Maxar CNES (2024) Distribution Airbus DS.

Legend

Subject Property ━━━━━━
Existing Property Line — — · —
Test Pit Location ●

Stovel and Associates Inc.
651 Orangeville Road,
Fergus ON
N1M 1T9
P: 519-766-8042
E: stovel.associates@outlook.com

DRAFT

January 8, 2024

0 100 200
Meters

Scale 1:3500

ARL Groundwater Resources Ltd.
13 Douglas Drive
Ayr, ON N0B 1E0

June 25, 2024

Timberworx Custom Homes Inc.
c/o Stovel and Associates Inc.
651 Orangeville Road,
Fergus, ON N1M 1T9

Attention: Rob Stovel Sr.

Proposed Arkell Residential Development
Part Lots 7, 8 and 9, Concession 10
Township of Puslinch, County of Wellington

I have reviewed the comments provided by Harden Environmental Services Ltd. (Harden) regarding the proposed Arkell residential development noted above, in letters submitted to the Township of Puslinch, dated May 18, 2023, and April 2, 2024. The following provides a response to those comments that are related to (a) the proposed water supply for the development, (b) items in the Wellington County Official Plan (Paris Galt Moraine Policy Area), and (c) Source Water Protection. Other specialists assisting with the servicing and design of the development will be addressing the other comments provided by Harden.

Water Supply

In the May 2023 correspondence, Harden recommends that one or more water supply wells for lots adjacent to existing homes be constructed early in the development time line and used to monitor the aquifer between the proposed development and existing homes. This recommendation was made again in the April 2024 comments from Harden.

Response:

I concur with this recommendation and note that it could be considered as a condition of the subdivision agreement.

In the April 2024 comments, Harden requests that the proponent comment on whether there could be an overall impact on groundwater and surface water levels due to groundwater removal from the aquifer and infiltration at surface, taking into account long term effects at both the local and regional scale.

Response:

As noted in the groundwater supply assessment (ARL 2023), the maximum water demand for 50 residential lots at the site was estimated at 90,000 L/day (approximately 1 L/s). For context, this is a low flow rate in comparison with the typical permitted flow rates for municipal wells in the City of Guelph and elsewhere in Wellington County, which typically exceed 7.6 L/s and go as high as 50 L/s. Overall, the effects of water use at the proposed development on bedrock groundwater levels at the local scale (within 10 - 200 m of the development) could be a modest decline in the range of approximately 0 - 2 m. It is my opinion that the effects on surface water and groundwater levels at the regional scale will be negligible (no measurable effect).

In the April 2024 comments, Harden requests a "fulsome analysis of the aquifer water quality by analyzing all parameters in Tables 1 and 2 of Ontario Regulation 169/03".

Response:

Ontario Regulation 169/03 is titled "Ontario Drinking Water Quality Standards" and was made under the Safe Drinking Water Act, which applies to municipal and non-municipal drinking water systems in Ontario. Ontario Regulation 169/03 includes three schedules. The only reference to any tables is in Schedule 3 (Radionuclides), where there are 2 tables (Schedule 3 - Table 1 provides Standards for 14 natural radionuclides; Schedule 3 - Table 2 provides Standards for 24 artificial radionuclides). We spoke with Stan Denhoed at Harden Environmental and confirmed that Harden's intent with this comment was to have a more fulsome analysis of general drinking water quality, as opposed to radionuclide water quality. With this in mind, it is my opinion that additional drinking water quality testing can be performed when the first of the supply wells for the development are installed.

Supply Well Construction

We are in general agreement with the Harden comments related to supply well construction at the development property. However, we note that Ont. Regulation 903 does not explicitly prohibit wells connecting two potable water sources (aquifers) and many of the existing wells in the Arkell are constructed across both the Guelph Fm. and the Gasport Fm.

Wellington County Official Plan

Harden notes that only the southeast corner of the site is located within the Paris and Galt Moraine Policy Area and acknowledges that the portion within the Policy Area is mostly not proposed for development. We did not observe any surface water features or wetlands on or in the immediate vicinity of the property during our site visits. The area of the property proposed for residential development was observed to be relatively flat with no obvious evidence of the hummocky terrain that characterizes the Paris and Galt Moraines.

Land Use planning maps indicate that the nearest greenlands are about 200 - 400 m to the northeast of the site. The nearest surface/groundwater features are the springs at the Arkell Springs property, approximately 500 - 1000 m o to the north of the site. The nearest continuous surface water feature is the Eramosa River beyond the Arkell Springs property. In my opinion, there is little to no opportunity for the development to have a measurable effect on any of these features given the separation distances involved.

Source Water Protection

Mapping available on the County of Wellington website indicates that the site is part of a WHPA-B protection zone associated with the municipal wells serving the City of Guelph. Vulnerability is scored 8 across the site and the immediate surrounding areas. This means that waste disposal, conventional sewage disposal systems and DNAPLs are all considered significant threats. The proposed development does not include waste disposal facilities or DNAPL storage. On site sewage disposal systems with tertiary treatment is proposed to for wastewater disposal. It is understood that the tertiary treatment systems are not considered significant threats, provided that they receive regular inspections and maintenance. As a result, the need for application of source protection policies should be limited.

Well Decommissioning

We agree that unused wells on the property should be abandoned in accordance with Ont. Regulation 903.

We trust that the above comments are sufficient at this time. Please advise if there are any questions.

ARL Groundwater Resources Ltd.

[redacted]

A.R. (Tony) Lotimer, M.Sc., P.Geo., FGC
Principal Hydrogeologist

BURNSIDE

Hydrogeological Review and Predictive Nitrate Assessment
Proposed Residential Subdivision
Part Lots 7, 8 & 9, Concession 10
Township of Puslinch
Kukovica Development - Arkell

Prepared by

R.J. Burnside & Associates Limited
292 Speedvale Avenue West Unit 7 Guelph ON N1H 1C4 Canada

July 2006

File No: PTA 10312

Table of Contents

Figures

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Appendices

1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by Kukovica Development to complete a hydrogeological assessment and predicative nitrate impact study as part of the approval process for a residential development near Guelph, Ontario. Burnside understands that the proposed development includes a Draft Plan of Subdivision to create 38 single-family residential lots on 21.68 ha of land. The lots will be individually serviced with septic systems and private water supply wells. A copy of the Draft Plan of Subdivision is provided in Appendix A.

1.1 Site Description

The site is currently a vacant parcel of land located on the eastern edge of Guelph, Ontario. The property is approximately 21.68 ha (53.57 acres) and is located on the southeast corner of the intersection of Arkell Road and Watson Road South. The site is generally flat with a gentle slope to the north. The Town of Arkell is located to the west of the property. A railway line (Guelph Junction) is present along the southern property boundary.

Current land use in the vicinity of the site is primarily rural residential and agricultural. A small, treed area is present along the southern boundary of the property. Surface water features with a kilometre of the site include two large marsh areas to the east and southeast and the Eramosa River to the north.

The legal description of the property, as provided by Van Harten Surveying, is Part Lots 7, 8 & 9, Concession 10, Township of Puslinch. Figure 1 provides a site location map.

2.0 Scope of Work

The scope of work for the project is based upon the Ministry of the Environment's *Hydrogeological Technical Information Requirements for Land Development Applications*.

Burnside worked in cooperation with V.A.Wood (Guelph) Incorporated (V.A.Wood) on this assignment. V.A.Wood arranged utility locates, conducted all drilling and soil testing activities and surveyed the locations of installed monitoring wells and boreholes. Burnside used the information generated by V.A.Wood, such as borehole logs and grainsize analysis to complete the hydrogeological assessment.

The scope of work for the groundwater impact assessment included:

- Review of available geological information including mapping, water well records and regional hydrogeological reports;
- Observation of drilling activities and inspection during the construction of two monitoring wells;
- Collection of water samples for analysis of general chemistry including nitrogen and phosphorus;
- Hydraulic testing of the monitoring wells to assess groundwater velocity;
- Collection and analysis of groundwater elevations to assess groundwater conditions; and
- Preparation of a technical report complete with figures, tables and cross-sections along with the necessary analysis and interpretation.

3.0 Geological Setting

Background information for the site was obtained from MOE water well records, geologic reports and mapping for the area.

The site is located in the physiographic region known as the Horseshoe Moraines, which occupies approximately 8.73 km^2 (2158 square miles) including the southeast portion of Wellington County. In the area of the site the Horseshoe Moraines physiographic region is represented by the Paris Moraine. The soils are generally a coarse textured, open, stony till composed largely of dolostone with traces of red shale, which are highly calcareous. The overburden is typically greyish brown or pale to dark brown in colour (Chapman & Putnam, 1984).

3.1 Overburden Geology

Based upon a review of the Ministry of Northern Mines and Development Map 2556 the overburden in the area of the site varies. Glaciofluvial outwash sand and gravel deposits are prevalent throughout the area. The Port Stanley Till, which is a strongly calcareous, silt to sandy silt till is also present in the vicinity of the site. Figure 2 illustrates the quaternary geology of the area.

3.2 Bedrock Geology

The Middle and Lower Silurian group of formations is found over the major portion of Wellington County. In the Guelph area this group includes the Guelph Formation and the Amabel Formation, which are made up of dolostone. Figure 3 shows the bedrock geology of the area.

Based on review of the Ontario Department of Mines Map P. 2224 there appears to be a bedrock ridge in the area of the site. The bedrock surface, located at an elevation of approximately 328 mASL (1078 feetASL), slopes to the north, west and south. In general the bedrock slopes to the southwest at a rate of two to three metres per kilometre. Based upon a comparison of the bedrock and surface topography, the overburden thickness in the area of the site ranges from approximately 12 to 17 metres (40 to 55 feet).

3.3 Hydrogeology

Groundwater is an abundant and reliable resource in Wellington County. Overburden aquifers are not as commonly exploited as the bedrock aquifers. Groundwater recharge is enhanced in areas of coarse-textured soils with either limited slope or hummocky topography. Approximately 25 percent of the precipitation in Puslinch Township infiltrates as groundwater recharge (Golder, 2005). The site is located within the Zone 1 (0-2 year time of travel) capture zone of the Arkell Springs municipal wells located to the north.

Based upon a review of Figure 3.12 "*Groundwater Elevations in the Overburden*" from the County of Wellington's "*Groundwater Protection Study*" the groundwater in the overburden is present at an elevation of approximately 331 to 340 mASL (1086 to 1115 feetASL). In comparison with the surface topography, groundwater in the overburden is present at a depth of approximately 10 metres. This corresponds to the groundwater elevations of approximately 334 mASL encountered in the monitoring wells installed on-site. Groundwater flow in the overburden is generally towards the Eramosa River to the north; however there may be to be local variations due to topography and groundwater discharge features.

Based upon a review of Figure 3.13 "*Groundwater Elevations in the Bedrock*" from the County of Wellington's "*Groundwater Protection Study*" the groundwater in the bedrock is present at an elevation of approximately 330 to 350 mASL (1099 to 1150 feetASL). Groundwater flow in the bedrock is generally towards the Eramosa River to the north.

The specific capacity of the wells constructed in the bedrock range between 0.1 and 2,908 L/min/m having a geometric mean of 7.8 L/min/m. The transmissivity, calculated from the specific capacity, ranges between 0.1 and 7,548 m^2/day with a geometric mean of 15.5 m^2/day. The relatively high geometric means indicate that the Guelph-Amabel-Lockport hydrogeologic unit has good water-yield capabilities (Singer et al, 1994).

3.3.1 Water Well Records

Burnside completed a review of the water wells records for the Township of Puslinch. There were a total of 17 registered water wells on Lots 7, 8 and 9 of Concession 10. All the wells were constructed in the bedrock at depths ranging from 27 metres to 104 metres and produced fresh water. There were no concerns noted of sulphurous or saline water. The depth to the bedrock ranged from approximately 17 metres to 50 metres below grade (~ 323 mASL to 290 mASL). Pumping rates ranged from 18 L/min to 136 L/min (4 to 30 Igpm). Accordingly it appears that the bedrock aquifer is capable of producing sufficient quantities of water for this residential development.

The overburden descriptions in the water well records indicate that the soils in the vicinity of the site are predominantly a clayey till although there are some indications of sand or gravelly sand deposits. Copies of the water well records are included in Appendix B. Figure 4 illustrates the location of the water wells in the vicinity of the site. A geological cross section is provided as Figure 5.

3.4 Water Quality

Groundwater quality at each municipal pumping well servicing the City of Guelph was documented in a report titled "City of Guelph – Water System Study Resource Evaluation Summary" dated 1999. The study indicated that groundwater from bedrock wells in the Arkell Springs well field was hard and enriched in calcium and magnesium, which is to be expected, given the origin of the water is a carbonate bedrock aquifer. Chloride concentrations are low (ranging from 22mg/L to 43mg/L) whereas nitrate concentrations are slightly elevated (ranging from 0.8mg/L to 3mg/L).

As part of the testing program samples were also submitted for micro particulate analysis. Micro particulate concentrations were generally below laboratory method detection limits however low concentrations of algae suggest a small portion of the groundwater pumped from the Arkell Springs wells originated as surface water. The Arkell Springs well field also contains an overburden municipal pumping well. Groundwater collected from this well contained lower concentrations of calcium and magnesium as well as lower chloride and nitrate concentrations versus the bedrock wells. Micro particulate analysis showed a slightly higher concentration of algae in the overburden groundwater versus the bedrock groundwater suggesting surface water infiltration. No surface water organisms such as Giardia or Cryptosporidium were detected in either the overburden or bedrock groundwater samples. No organic compounds have been detected in samples collected from these wells.

3.5 Groundwater Pollution Susceptibility

Figure 3.21 "*Groundwater ISI Map – Shallow Overburden*" from the County of Wellington's "*Groundwater Protection Study*" indicates that the shallow overburden groundwater resources in the vicinity the site have a high susceptibility to surface sources of pollution.

Figure 3.23 "*Groundwater ISI Map – Bedrock*" from the County of Wellington's "*Groundwater Protection Study*" indicates that bedrock groundwater resources in the vicinity the site have a medium susceptibility to surface sources of pollution. However there is a small area in the vicinity of the property that has a high susceptibility index.

The area of high susceptibility near the site is likely due to the thinner overburden and presence of sand and gravel deposits as noted in the water wells records.

The Intrinsic Susceptibility Index (ISI) is determined based upon a review of soil types, conductivity of the soil and overall depth to water. The above-mentioned figures have been included in Appendix C.

4.0 Field and Laboratory Program

4.1 Borehole Drilling

A borehole drilling program was completed on January 12, 13 and 16, 2006. Aardvark Drilling Inc. completed the drilling program and a V.A.Wood representative logged the soil stratigraphy and collected representative soil samples. Burnside representatives were present during the installation of the two monitoring wells.

A total of ten boreholes were advanced using a CME 75 hollow stem auger and monitoring wells (MW1 and MW2) were installed in BH1 and BH10 to allow the collection of water level measurements and water quality samples. Originally three monitoring wells were proposed however many of the holes were terminated on either boulders or bedrock and as a result a suitable location for a third well was not identified.

The depths explored ranged between 3.3 and 12.6 metres below ground surface (~11 to 41 feet).

The stratigraphy at the site included a layer of topsoil typically 0.2 to 0.4 metres thick, with two locations (BH7 and BH10) having considerably more topsoil cover (0.8 metres and 1.5 metres respectively). A brown, compact to very dense sandy gravel or sand and gravel underlies the topsoil. A layer of brown very dense silt was noted in BH1 followed by grey dolostone fragments. A layer of brown, very dense gravely, silty sand till was identified in BH10 containing layers of very dense sand and silt. The till is interpreted to be Port Stanley Till.

Figure 6 shows the locations of the boreholes and monitoring wells. Borehole logs are included in Appendix D.

4.2 Water Level Data

Burnside collected water levels on Jan 26, 2006. The following table provides the results.

Table 1: Water Level Data

Location	Ground Elevation	Stickup	January 26, 2006	
MW1	340.45 mASL	0.88 m	8.31 mbtp	333.02 mASL
MW2	344.90 mASL	0.41 m	10.78 mbtp	334.53 mASL

mASL: metres above mean sea level.

mbtp: metres below top of pipe.

The data indicates that the groundwater table is located at depths ranging between 8.31 and 10.78 metres below top of pipe, corresponding to an approximate elevation of 333.02 to 334.53 mASL.

4.3 Groundwater Sampling

Groundwater samples were collected from MW1 and MW2 on January 26, 2006 and submitted to AGAT Laboratories for water quality analysis. The sample was collected using industry standard practices. The certificate of analysis is included in Appendix D.

The analytical results indicate that nitrates are present in the shallow groundwater at an elevated concentration of 3.76 mg/L. Although this concentrations is below the Ministry of the Environment Ontario Drinking Water Standard of 10 mg/L, the concentration is considered elevated above a typical background concentration of 1.0 mg/L. The elevated concentrations are likely due to the influence of fertilizer application, especially on local crop fields. Septic systems present in the Town of Arkell may also be providing a source of nitrates. Analytical results also indicated a concentration of sodium in MW1 of 38.9 mg/L exceeds the MOE OWDS of 20 mg/L. This may be due to winter de-icing activities on the nearby roadways. However, additional sampling would be required to further investigate these results. Additional sampling would also be required to evaluate seasonal variations in nitrate loads.

4.4 Grainsize Analysis

V.A.Wood collected representative soil samples at various boreholes across the site. The samples were collected from BH1, BH5, BH6, BH8, BH9, and BH10 from depths ranging from 1.5 metres to 12.2 metres below ground surface and submitted for grainsize analysis.

- The soil sample collected from 7.6 to 8.1 metres below ground surface Borehole 1 is described as silt with some clay, some sand and trace gravel. The proportions are approximately 8 percent clay, 76 percent silt, 13 percent sand and 3 percent gravel.
- The soil sample collected from 3 to 3.5 metres below ground surface in Borehole 5 is described as sandy gravel with trace silt. The proportions are approximately 8 percent silt, 34 percent sand and 58 percent gravel.
- The soil sample collected from 1.5 to 2 metres below ground surface in Borehole 6 is described as gravel and sand with some silt. The proportions are approximately 14 percent silt, 42 percent sand and 44 percent gravel.
- The soil sample collected from 1.5 to 2 metres below ground surface in Borehole 8 is described as sandy gravel with trace silt. The proportions are approximately 10 percent silt, 23 percent sand and 67 percent gravel.
- The soil sample collected from 2.3 to 2.7 metres below ground surface in Borehole 9 is described as gravel and sand with some silt. The proportions are approximately 14 percent silt, 35 percent sand and 51 percent gravel.
- The soil from Borehole 10 is described as gravely, silty clay till at 9.1 metres below ground surface, sand and silt with trace clay and trace gravel at 10.7 metres below ground surface and sand with some silt and trace gravel at 12.2 metres below ground surface. The proportions approximately range from 0 to 4% clay, 13 to 42 percent silt, 47 to 87 percent sand and 1 percent to 26 percent gravel.

The laboratory reports from V.A.Wood are provided in Appendix F.

5.0 Development Impact Assessment

Burnside understands that the development will be serviced with on-site sewage disposal and individual water wells. To assess the effects of the proposed septic systems, Burnside completed a nitrate loading assessment. The assessment was based upon the MOE's *Hydrotechnical Information Requirements for Land Development Application* dated April 1995 (HTIR).

The following equation was used to determine the potential concentrations of nitrate on the groundwater due to the effects of the proposed septic systems:

$$Q_t*C_t = Q_e*C_e + Q_i*C_i$$

Where:

- Q_t is the total volume of water entering the system;
- C_t is the total concentration of nitrates;
- Q_e is the volume of effluent disposed in the subsurface;
- C_e is the concentration of nitrates in the effluent;
- Q_i is the volume of infiltration from precipitation; and
- C_i is the concentration of nitrates in the infiltration.

The equation takes into account dilution from infiltrating precipitation, which is assumed to be 225 mm/year and a septic system effluent loading rate of 1,000 L/day per unit. The infiltration assumption of 225 mm/year is based on Figure 3.25 "*Schematic Illustration of Approximate Water Balance*" from the County of Wellington's "*Groundwater Protection Study*", which is included in Appendix C. The nitrate concentration of the wastewater from a Class IV septic system is assumed to be 40 mg/L. The assumed nitrate concentration in the precipitation is estimated to be 0.1 mg/L. Table 2 illustrates the anticipated effects on the groundwater. Worksheets illustrating the calculations are attached in Appendix E.

Table 2: Summary of Nitrate Evaluation

System Type	Effluent Concentration	Nitrate Loading Concentrations
38 Class IV System	40 mg/L	8.93 mg/L
38 Tertiary Systems	20 mg/L	4.51 mg/L

The results indicate that 38 Class IV septic systems operating on the property will result in an additional 8.93 mg/L of nitrate being introduced to the shallow groundwater. However Burnside understands that tertiary treatment systems will be installed to improve the quality of the septic effluent. Burnside calculates that the use of tertiary systems will result in an additional 4.51 mg/L of nitrate being introduced to the shallow groundwater. These concentrations are below the MOE Ontario Drinking Water Standard (ODWS) of 10 mg/L.

It should be noted that the proposed residential development would result in the construction of hard surfaces that will affect the infiltration and effluent dilution volume. Based upon information provided by Van Harten Surveying the area of the roadways is estimated to be 2.23 ha. Burnside has assumed an average lot impervious area (roofs and driveways) of 0.035 ha/lot for a total of 3.56 ha of impervious surfaces. Accounting for this loss of infiltration the predicted nitrate loading is 10.23 mg/L. This is slightly above the MOE ODWS of 10 mg/L. To mitigate the effects of hard capped surfaces, at-source infiltration techniques will need to be employed to balance pre and post development infiltration volumes. A worksheet illustrating the calculation is attached in Appendix G.

5.1 Arkell Water Management Protection Area

The subject property is located within the Arkell Water Management Protection Area and as a result Policy 4.9.5 of the County of Wellington Official Plan requires that:

a) Landuses that may create groundwater contamination problem will not be located with the protection area; and
b) Storm water management options to promote clean water recharge to the aquifer will be promoted.

The development of the property for residential use will not result in an increase in groundwater contamination given that tertiary treatment systems are being proposed. As indicated in the policy, the design of the storm water management system should promote clean water recharge to the aquifer.

6.0 Conclusions

The following can be concluded from the study discussed above:

6.1 Water Supply

- The wells for the development should be constructed in the bedrock aquifer at depths ranging between 17 to 50 metres (~56 to 164 feet) below ground surface. Based upon the information reviewed pumping rates will likely range between 18 L/min to 136 L/min (4 to 30 Igpm). The bedrock aquifer is capable of producing sufficient quantities of water for typical domestic purposes.
- Bedrock wells were observed to have generally higher calcium and magnesium concentrations. As a result homes will likely have to be equipped with standard ion exchange equipment such as water softeners.

6.2 Nitrate Loading

- The result of groundwater sampling indicates that the average background nitrate concentrations are 3.76 mg/L.

- The results indicate that 38 Class IV septic systems operating on the property will result in an additional 8.93 mg/L of nitrate being introduced to the shallow groundwater. However Burnside understands that tertiary treatment systems will be installed to improve the quality of the septic effluent. Burnside calculates that the use of tertiary systems will result in 4.51 mg/L of nitrate being introduced to the shallow groundwater. These concentrations are below the MOE Ontario Drinking Water Standard (ODWS) of 10 mg/L.

6.3 Septic System Design

- Grainsize analysis indicates that the soil on the site is generally comprised of gravel and sand with some silt. Septic system design and construction should be completed under the supervision of a qualified engineer.
- Burnside understands that the development will serviced using tertiary treatment systems.

6.4 Groundwater Resource Protection

- Overburden groundwater resources in the vicinity of the site have a high susceptibility to surface sources of pollution. This is likely due to the presence of sand and gravel deposits as noted in the water wells records.
- Bedrock groundwater resources in the vicinity of the site have a medium susceptibility to surface sources of pollution.
- Given the use of tertiary treatment systems an increase in groundwater pollution due to the residential development is not anticipated.

7.0 Discussion

Based upon the work completed during this study, Burnside offers the following recommendations.

The information suggests that the bedrock aquifer is capable of producing sufficient quantities of water to service the residential development. Groundwater samples collected at the site in the shallow overburden suggests that nitrates are present in the shallow water table aquifer at slightly elevated concentrations. *Burnside recommends that water wells be constructed in the bedrock aquifer according to Ontario Regulation 903. Water quality sampling should be completed on water supply wells to assess the quality of the water in the bedrock aquifer at the site. The analytical program should include nitrates, nitrites, TKN, ammonia, hardness, iron, and sulphates.*

Typical rural residential developments result in land surface being covered in hard surfaces. *Burnside recommends that, if possible, at-source infiltration techniques such as soak away pits, grass swales and infiltration galleries be employed to minimize the effects infiltration losses from the construction of impermeable surfaces.* This condition should be reviewed with a development engineer to determine feasibility.

8.0 Summary of Recommendations

- *Water wells should be constructed in the bedrock aquifer according to Ontario Regulation 903.*
- *Water quality sampling should be collected from newly constructed water supply wells to confirm the potability of the supply. Testing should include nitrates, nitrites, TKN, ammonia, hardness, iron, sodium, chlorides and sulphates.*
- *At-source infiltration techniques such as soak away pits, grass swales and infiltration galleries should be employed to minimize the effects infiltration losses from the construction of impermeable surfaces.*
- *Storm water management facilities should be designed to meet the requirements of the County of Wellington's OP Policy 4.9.5.*

9.0 Limitations

Services provided by R.J. Burnside & Associates Limited were conducted in a manner consistent with the level of care and skill ordinarily exercised by member of the Environmental Engineering and Geoscience Consulting Profession. No other representations, expressed or implied as to the accuracy of the information, conclusions or recommendations is included, or intended in this report.

It should be recognized that the passage of time might affect the views, conclusions and recommendations provided in this report because environmental conditions of a property can change. Should additional or new information become available, Burnside recommends that it be brought to our attention in order that we may re-assess the contents of this report.

We trust that this report is suitable, if you have any questions please do not hesitate to contact the undersigned.

Respectfully Submitted,

R.J. Burnside & Associates Limited

[redacted]

David R. Marks, P.Geo.
Senior Geoscientist
M:\2006\P\PTA\10312\Proposal\0215.doc

David Wilson, B. Math
Environmental Technologist

[redacted]

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Figures

Map Reference:
Map Art Publishing
Ontario Road Atlas

KEY MAP OF ONTARIO

FIGURE 1 - SITE LOCATION MAP

KUKOVICA SUBDIVISION
ARKELL, ONTARIO
HYDROGEOLOGICAL ASSESSMENT

February 2006
Project Number: PTA 10312

Prepared by: C. Reynolds

Verified by: D. Marks

BURNSIDE

XREF: N:\MAPS\GUELPH\GUELPH AREA.JPG

PTA10312 SL.DWG

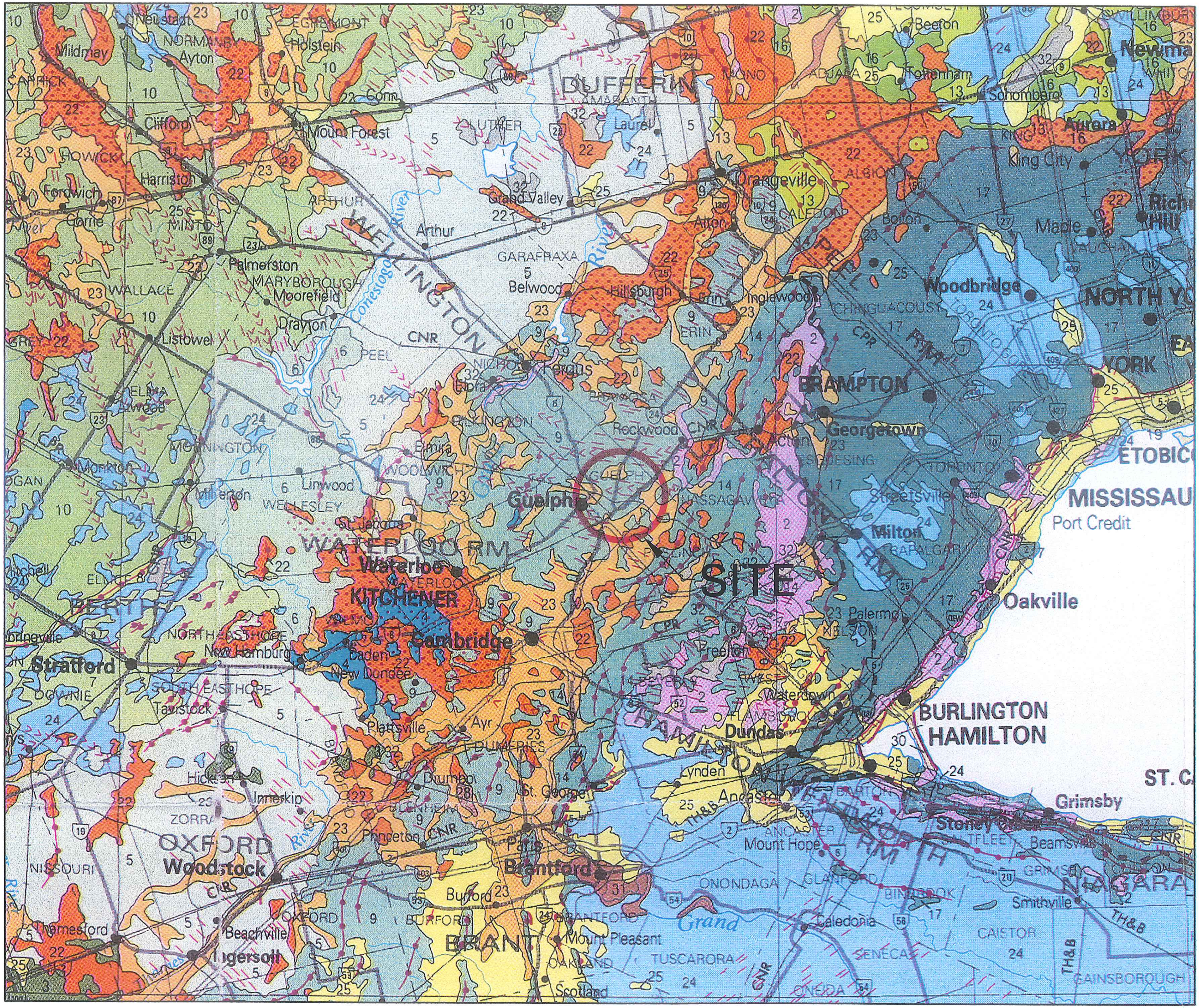
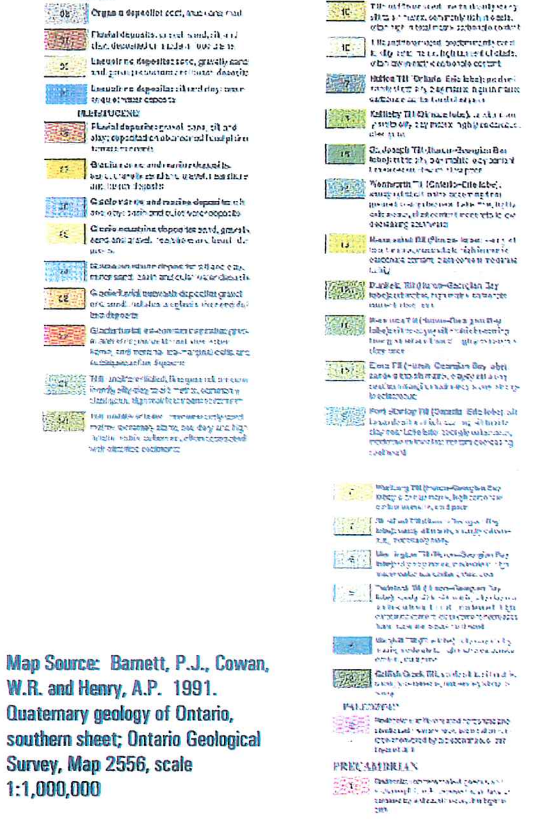


FIGURE 2

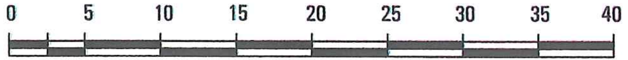
KUKOVICA SUBDIVISION

HYDROGEOLOGICAL ASSESSMENT

QUATERNARY GEOLOGY



Map Source: Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991. Quaternary geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556, scale 1:1,000,000



1:5,000,000
February 2006
Project Number: PTA 10312

Prepared by: C. Reynolds

Verified by: D. Marks

BURNSIDE

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PTA10312 QUAT GEOLOGY.DWG

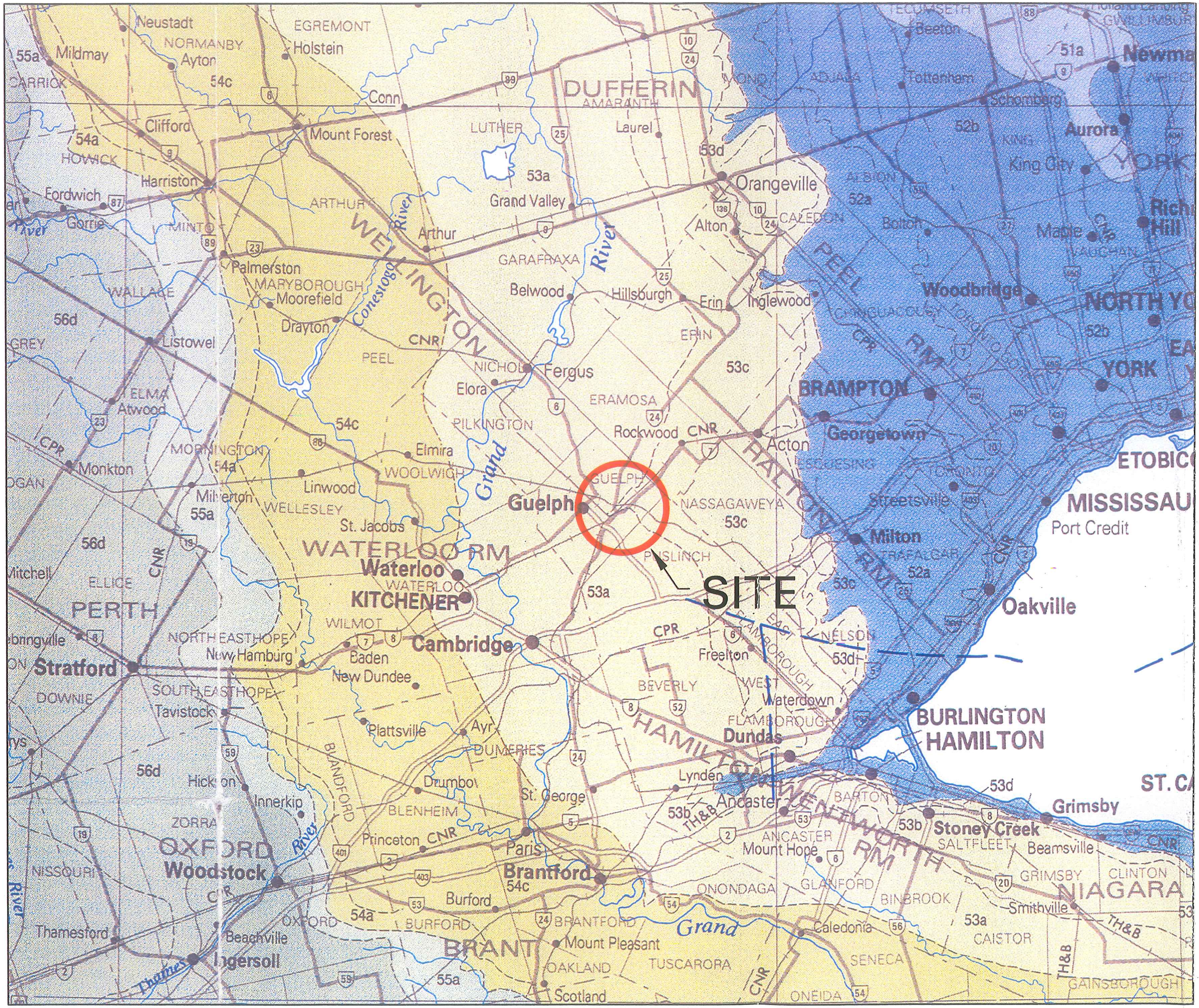
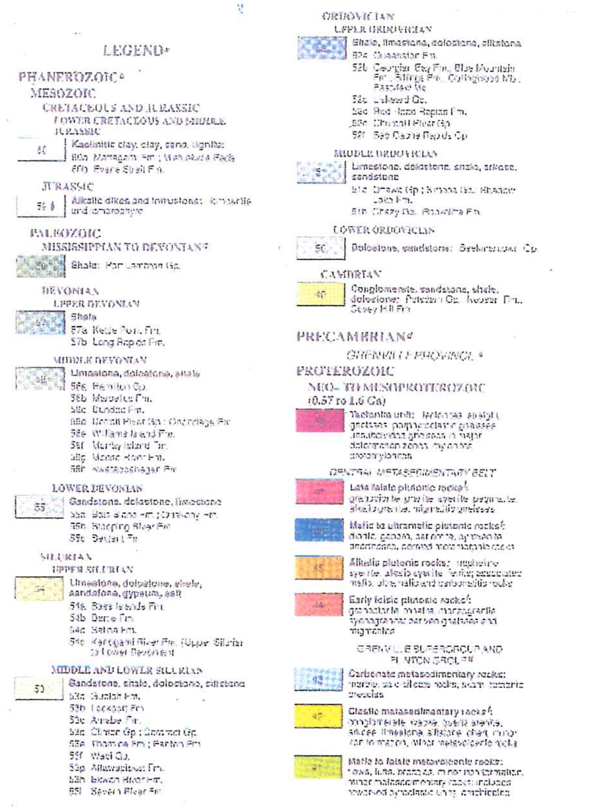


FIGURE 3

KUKOVICA SUBDIVISION

HYDROGEOLOGICAL ASSESSMENT

BEDROCK GEOLOGY



Map Source: Ontario Geological Survey 1991. Bedrock Geology of Ontario, southern sheet; Ontario Geological Survey, Map2544, scale 1:1 000 000.

1:5,000,000

February 2006

Project Number: PTA 10312

Prepared by: C. Reynolds

Verified by: D. Marks

BURNSIDE

XREF: PTA10312 BEDROCK GEOLOGY.JPG

PTA10312 BEDROCK GEOLOGY.DWG

FIGURE 5

KUKOVIC SUBDIVISION
HYDROGEOLOGICAL ASSESSMENT

CROSS-SECTION A-A'

LEGEND

5693	WELL LOCATION & NUMBER
	INDICATES A FLOWING WELL
	EXISTING GROUND PROFILE
grey limestone	GEOLOGICAL STRATIGRAPHY
▼	STATIC WATER LEVEL
▨	WELL SCREEN
🟨	PRIMARILY SAND AND GRAVEL
🟧	PRIMARILY CLAY AND SILT

Vertical Scale 1:500
Horizontal Scale 1:5,000
Vertical Exaggeration 10x

February 2006
Project Number: PTA 10312

Prepared by: C. Reynolds
Verified by: D. Marks

BURNSIDE

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PTA10312 XSA.DWG

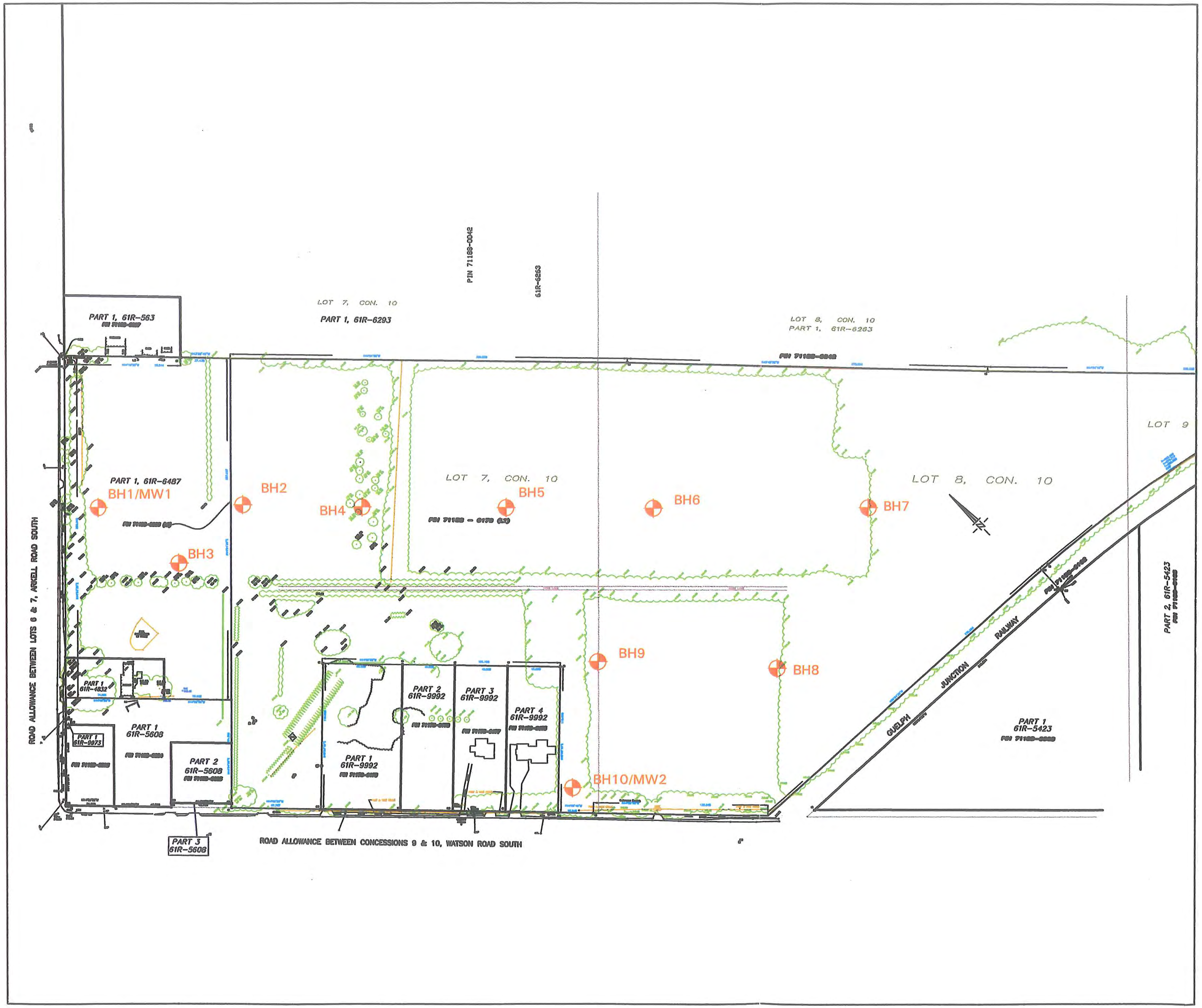


FIGURE 6

KUKOVICA SUBDIVISION
HYDROGEOLOGICAL ASSESSMENT

BOREHOLE / MONITORING WELL LOCATION PLAN

Legend

⊕	MONITORING WELL LOCATION

Base Plan Provided by: Van Harten Surveying Inc., Land Surveyors and Engineers, February 2006

0 20 40 60 80 100 120 140 160 180 200 220 240

Meters

1:3,000
February 2006
Project Number: PTA 10312

Prepared by: C. Reynolds

Verified by: D. Marks

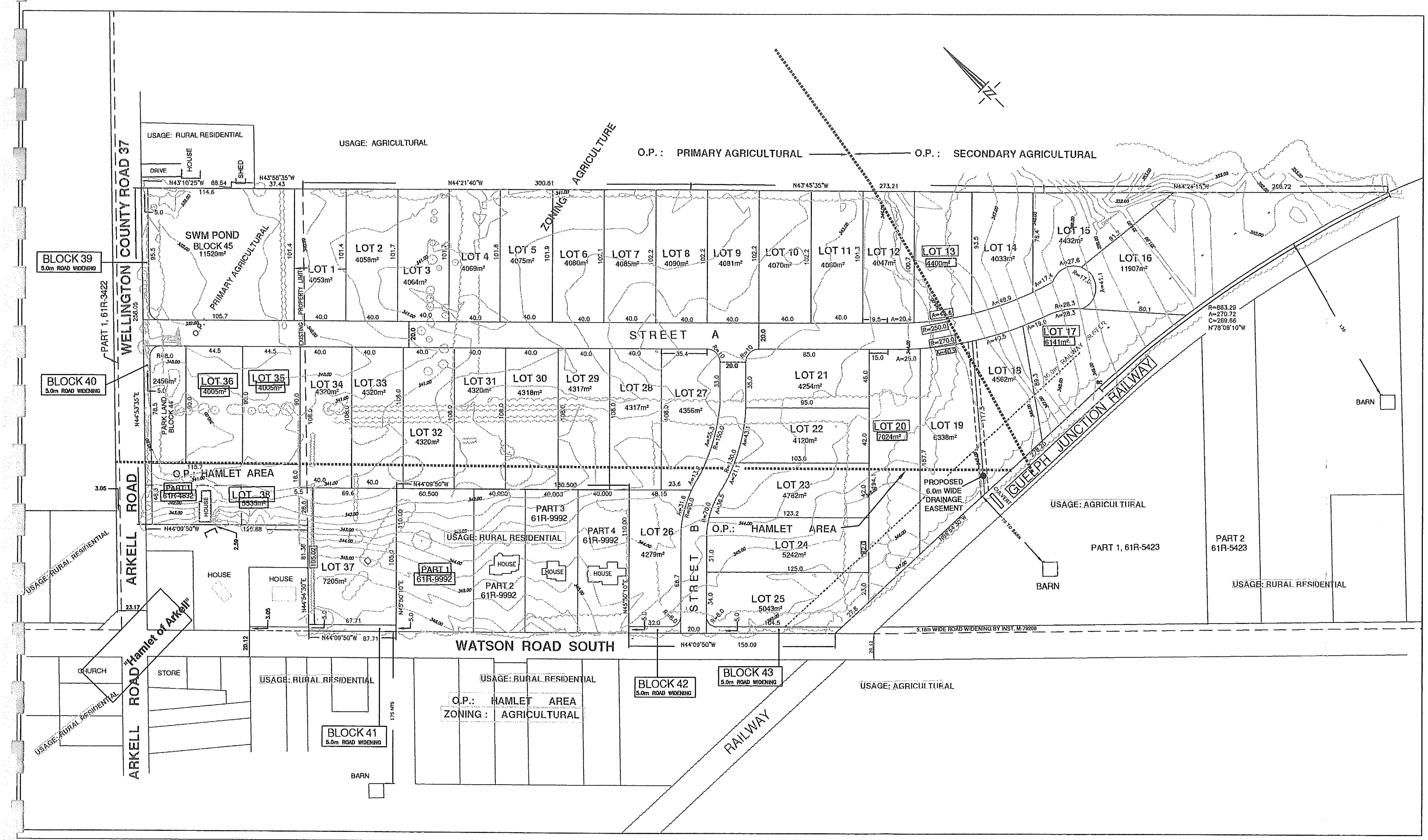
BURNSIDE

XREF: PTA10312 SP BASE.DWG

PTA10312 SP.DWG

BURNSIDE

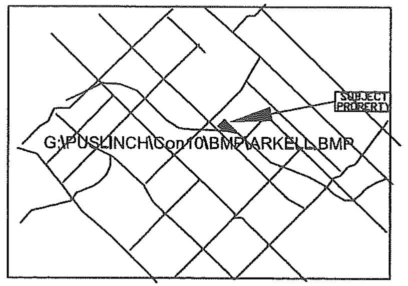
Appendix A
Draft Plan of Subdivision



DRAFT PLAN
OF SUBDIVISION
KUKOVICA

SCALE: 1 – 1500

0 25 50 75 metres



LEGAL DESCRIPTION

PART OF LOTS 7, 8 and 9, CONCESSION 10
TOWNSHIP OF PUSLINCH
COUNTY OF WELLINGTON

LAND USE SCHEDULE

DESCRIPTION	LOTS /BLOCKS	AREA (hectares)
SINGLE DETACHED RESIDENTIAL LOTS	1-38	18.07
STORMWATER MANAGEMENT AREA	BLOCK 45	1.15
ROAD WIDENING BLOCKS	BLOCK 39-43	0.23
ROADS		1.98
PARK LAND DESIGNATION	BLOCK 44	0.25
	TOTAL:	21.68

ADDITIONAL INFORMATION

(UNDER SECTION 51(17) OF THE PLANNING ACT)

a) the boundaries of the land proposed to be subdivided;(as shown)
b) the locations, widths and names of proposed highways within the proposed subdivision and of existing highways abutting proposed subdivision;(as shown)
c) key plan;(as shown)
d) purpose for which proposed lots are to be used;(as shown)
e) existing uses of all abutting lands;(as shown)
f) approximate dimensions and layout of proposed lots;(as shown)
g) natural and artificial features such as buildings, railways, watercourses, drainage ditches, wetlands and wooded areas within the land proposed to be subdivided;(as shown)
h) availability and nature of domestic water supplies; water to be supplied by wells
i) nature and porosity of soil; compact to dense sandy gravel or sand under topsoil; some dense silt and dense gravely silty sand known as Port StenleyTill
j) existing contours;(as shown)
k) municipal services available; none
l) nature and extent of any restrictions affecting land proposed to be subdivided; none

OWNER'S CERTIFICATE

I AUTHORIZE ____________ TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE TOWNSHIP OF PUSLINCH.

TOM KUKOVICA — DATE

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECTLY SHOWN.

JEFFREY E. BUISMAN, O.L.S.
Van Harten Surveying Inc.

DATE

DATE	REVISIONS
MAY 18, 2006	FIRST SUBMISSION

Van Harten
SURVEYING INC.
LAND SURVEYORS and ENGINEERS

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DRAWN BY: M.A.M. | CHECKED BY: J.E.B. | PROJECT No. 15919–04

BURNSIDE

Appendix B
Water Well Records

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CONTINUING... PUSLINCH TOWNSHIP																	
CON 08	053	67- 13525	999999~ 9999999		2000/10	2336	06	FR	0144	57	58	20	1 :	DO			VERDONE,A. BRWN CLAY STNS 0015 BRWN CLAY SAND GRVL 0055 BRWN GRVL SAND 0070 GREY CLAY SAND GRVL 0095 BRWN ROCK 0125 GREY ROCK 0144
CON 09	001	67- 08591	564936 4821799	1033	1986/06	1906	05	FR	0096	10	20	110	:	DO			CITY OF GUELPH SHLE 0003 BLCK ROCK SOFT 0030 BLUE ROCK 0032 GREY ROCK 0046 LMSN SOFT 0062 GREY LMSN SOFT 0086 BRWN LMSN 0094 GREY LMSN 0140
CON 09	001	67- 08651	564936 4821799	1036	1987/01	2336	12	FR	0104	7			:	MN			CITY OF GUELPH BRWN ROCK FCRD 0003 BRWN ROCK 0035 GREY ROCK 0080 BRWN ROCK 0088 GREY ROCK 0138 GREY ROCK 0150
CON 09	001	67- 04579	565540 4821970	1060	1973/04	1906	05	FR	0043	13	21	9	6 :0	DO			CLARKE P BLDR GRVL CLAY 0040 GRVL 0043
CON 09	001	67- 10988	565525 4822012	1049	1992/07	6624	05	FR	0185	27	85	15	1 :	DO AC			SPIRA, KEN STNS GRVL SAND 0022 BRWN FSND GRVL CLAY 0038 GREY HPAN CLAY 0050 BRWN ROCK 0058 BLCK ROCK 0070 BRWN ROCK 0118 GREY ROCK 0128 GREY ROCK 0188
CON 09	001	67- 07126	564800 4821550	980	1979/11	2336	05	SU	0086	26	48	12	1 :0	DO			GAMSBY D BRWN CLAY SAND GRVL 0022 BRWN STNS 0050 BLCK STNS 0087
CON 09	001	67- 08858	565228 4821448	1033	1987/06	4005	06	FR	0039	6	37	15	1 :	DO			CRASHLY, BOB BRWN BLDR SAND CLAY 0018 BRWN GRVL SAND LOOS 0021 GREY LMSN SAND LYRD 0023 GREY LMSN HARD 0042
CON 09	001	67- 08640	565745 4822009	1043	1986/12	4005	06	FR	0035	10	18	20	3 :0	DO			SLOOT, JOHN BRWN CLAY SNDY BLDR 0008 BRWN GRVL CLAY BLDR 0030 GREY SAND CGVL LOOS 0033 GREY FGVL SAND LOOS 0035
CON 09	001	67- 02686	565550 4822145	1120	1962/08	2521	04	FR	0036	5	30	10	2 :0	DO			ESTATE HOMES CLAY BLDR 0005 GRVL 0010 BLCK ROCK 0036
CON 09	001	67- 06265	565360 4822180	1050	1976/01	4208	06	FR	0035	4	40	12	1 :0	DO			BURFORD JAMES BRWN STNS GRVL 0010 BRWN CLAY SNDY 0014 GREY LMSN 0047
CON 09	001	67- 02688	564250 4820845	1125	1962/11	2406		FR	0055	32	35	10	1 :0	ST DO			LEHMAN H PRDG 0018 BRWN CLAY CSND 0032 BRWN ROCK 0055
CON 09	001	67- 02690	565720 4822000	1075	1965/12	2406	05	FR	0048	7	15	10	3 :0	DO			OSKAM T PRDG 0005 BRWN STNS 0015 BRWN ROCK 0048
CON 09	001	67- 02691	565550 4822160	1150	1965/10	1906	04	FR	0040	7	20	10	2 :0	DO			LIVINGSTONE L CLAY STNS 0012 BRWN ROCK 0040
CON 09	001	67- 02692	564940 4821535	1075	1964/06	2406	05	FR	0035	5	20	15	4 :0	DO			SCHENK C GRVL BLDR 0014 BRWN LMSN 0026 BLCK ROCK 0039
CON 09	001	67- 02693	565490 4822050	1075	1967/10	1906	04	FR	0048	12	15	8	5 :0	DO			ZIEGLER C BLDR CLAY GRVL 0023 GRVL 0048
CON 09	001	67- 03304	565480 4822050	1075	1969/02	1906	04	FR	0050	5	20	10	3 :0	DO			BUCHANAN SMITH CLAY STNS GRVL 0019 BLCK LMSN 0050
CON 09	001	67- 02689	564255 4820840	1125	1963/08	2406		FR	0080	45	50	10	3 :0	ST DO			ELLIOTT F PRDR 0055 BLCK ROCK 0080
CON 09	001	67- 11471	564818 4821195	1066	1994/06	2336	06	FR	0125	45	87	10	1 :	DO			DYNES, R. BRWN CLAY STNS 0006 BRWN ROCK 0030 BRWN ROCK 0070 GREY ROCK 0090 GREY ROCK 0125
CON 09	002	67- 10406	565287 4821214	1076	1990/07	2336	06	FR	0082	28	50	10	1 :	DO			OOSTERVELD, RON BRWN CLAY GRVL 0015 GREY CLAY SAND GRVL 0035 BRWN ROCK 0084
CON 09	002	67- 07436	565200 4821200	1070	1980/10	1906	05	FR	0092	31	60	20	2 :0	DO			FRIDD G GRVL 0030 BLCK STNS 0067 GREY STNS 0092

CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 09	002	67-08693	565812 4821899	1043	1987/02	2336	05	SU	0085	8	75	3	1 :0	DO			DUNMILL CONST. LTD. BRWN LOAM FILL 0005 BRWN ROCK 0063 GREY ROCK 0071 GREY ROCK 0085
CON 09	002	67-02696	565465 4821310	1075	1962/11	2801	10	UK	0010	1	8	700	24:0	MN			P U C LOAM 0002 MSND GRVL 0009 BRWN LMSN 0029 GREY LMSN 0068
CON 09	002	67-09444	564364 4820701	1095	1988/10	2336	06	FR	0080	31	50	25	1 :0	DO			7-M PROPERTIES BRWN CLAY STNS 0010 BRWN CLAY SAND GRVL 0035 BRWN ROCK 0060 BRWN ROCK 0084
CON 09	002	67-06373	565700 4821980	1048	1977/04	2336	05	FR	0051	9	17	10	1 :0	DO			SHERWOOD ROBT PRDG 0008 BRWN CLAY STNS 0032 BRWN CLAY GRVL 0040 HPAN GRVL 0050 GRVL 0052
CON 09	002	67-02695	565460 4821550	1040	1959/05	2521	04	FR	0040	2	10	10	1 :0	DO			KUS JOHN FILL 0003 GREY LMSN 0040
CON 09	002	67-02694	565850 4821860	1045	1957/10	2521	04	FR	0065	9	9	10	1 :0	DO			GUERNEY F GRVL 0002 BLCK ROCK 0065
CON 09	002	67-04360	565660 4821980	1048	1972/09	2521	05	FR	0035	8	8	10	2 :0	DO			OSKIN T GRVL STNS 0035
CON 09	002	67-05309	565800 4821850	1045	1974/10	1906	04	UK	0044	8	30	15	1 :0	DO			WOORTH SAND STNS 0003 BLCK ROCK 0044
CON 09	002	67-06372	565180 4821120	1068	1977/04	2336	05	FR	0065	26	32	10	2 :0	DO			OOSTERVELD H BRWN CLAY STNS 0030 BRWN CLAY GRVL 0037 GREY CLAY GRVL DKCL 0044 BRWN ROCK DKCL 0050 ROCK DKCL 0060 BRWN ROCK DKCL 0066 BRWN CLAY ROCK DKCL 0067
CON 09	002	67-04005	564350 4820550	1125	1971/09	1906	04	FR	0075	32	35	10	1 :0	DO			CARTER EARL CLAY MSND 0028 BRWN SHLE 0034 BRWN ROCK 0087 BLCK ROCK 0110
CON 09	002	67-04027	565500 4821560	1040	1971/09	1906	05	FR		2	3	8	1 :0	DO			SMITH PHILIP G CLAY STNS GRVL 0006 BRWN ROCK 0028
CON 09	002	67-12111	565959 4821750	1033	1996/10	2336	06	FR	0048		15	20	1 :0	DO			MORRISON, PAUL BRWN ROCK 0030 GREY ROCK 0048
CON 09	002	67-12008	565783 4821882	1043	1996/07	2336	06	FR	0062	3	39	15	1 :0	DO			ABBY HOMES BRWN ROCK 0015 BRWN ROCK 0062
CON 09	003	67-02700	564900 4820005	1075	1954/08	2521	04	SU	0120	21	25	10	2 :0	DO			LODGE H PRDG 0007 HPAN STNS 0069 BLCK ROCK 0121
CON 09	003	67-02698	565770 4821245	1050	1962/10	2801	10	UK	0065	26	67	48	0 :5	MN			P U C LOAM 0001 MSND GRVL 0005 BRWN MSND 0016 MSND GRVL CLAY 0065 GREY LMSN 0094
CON 09	003	67-02697	565880 4821350	1060	1962/10	2801	10						:	NU			P U C LOAM 0002 MSND GRVL BLDR 0029 BRWN LMSN 0033 GREY LMSN 0073
CON 09	003	67-08860	564942 4820022	1099	1987/06	2336	06	FR	0178	32	60	20	1 :	DO			DECORSO, A. BRWN CLAY STNS GRVL 0068 BRWN ROCK 0120 GREY ROCK 0178
CON 09	003	67-05015	565452 4821016	1065	1974/02	2521	04	FR	0115	15	20	15	2 :0	DO			CURON JOHN GRVL STNS 0038 BRWN ROCK 0115
CON 09	003	67-05652	565760 4821220	1072	1975/06	1906	06	SU	0128	FLW	118	110	:	PS			CITY OF GUELPH PEAT 0004 GRVL 0007 BRWN ROCK SHLE 0014 BRWN ROCK SHLE HARD 0030 BLCK ROCK SHLE 0052 GREY ROCK 0132 GREY ROCK SOFT 0136 GREY ROCK 0158
CON 09	003	67-09383	565171 4820240	1085	1988/07	1906	06	FR	0245	12	19	60	8 :	IR			DECORSO BRWN CLAY STNS 0037 BRWN SHLE LOOS 0049 BRWN ROCK HARD 0070 BLCK ROCK HARD 0095 GREY ROCK 0200 BLUE SHLE 0220 RED SHLE 0245
CON 09	003	67-05337	564915 4820015	1100	1974/07	1906	05	FR	0108	24	88	9	3 :0	DO			PIZZIOLA G CLAY STNS 0040 GRVL 0051 SAND 0067 BRWN ROCK 0087 BLCK ROCK 0108

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MUNICIPALITY              UTM                                       CSG KIND  WATER STAT PUMP TEST TEST          SCREEN                OWNER
CONCESSION           WELL EASTING ELEV                              DIA  OF   FOUND LVL  LVL  RATE TIME  WATER DEPTH LENGTH DEPTHS IN FEET TO WHICH
   ETC         LOT    NO  NORTHING FEET DATE    DRILLER             INS WATER FEET  FEET FEET GPM  HR:MN USE   FEET  FEET       FORMATIONS EXTEND

CONTINUING... PUSLINCH TOWNSHIP

CON     09  003  67-   565827  1046 1996/07 2336  02  UK   0005   2                 :  IN
                 12009 4821386                                                                    MCKENZIE BROS.GUELPH
CON     09  003  67-   566278  1046 1996/07 2336  02  FR   0013   4                 :  IN         BRWN STNS SAND GRVL 0009 BRWN ROCK 0017
                 12012 4821457                                                                    MCKENZIE BROS.GUELPH
                                                                                                  BRWN SAND GRVL 0010 BRWN ROCK 0028 BRWN ROCK
CON     09  003  67-   566169  1072 1996/07 2336  02  FR   0010   9                 :  IN         0041
                 12010 4821340                                                                    MCKENZIE BROS.GUELPH
CON     09  003  67-   565494~      1998/06 2336  06  FR   0080   6   35    20   1 :0  DO         BRWN SAND GRVL 0025 BRWN ROCK 0033
                 12592 4820858                                                                    ANTHONY, PAUL
                                                                                                  BRWN CLAY STNS 0010 GREY CLAY STNS 0050 GREY
CON     09  003  67-   565494~      1999/05 2336  06  FR   0140  32   87    10   1 :0  DO JR      CLAY GRVL 0061 BRWN ROCK 0080
                 12962 4820858                                                                    RALSTON,ART
                                                                                                  BRWN SAND GRVL 0022 GREY CLAY STNS 0043 BRWN
CON     09  003  67-   566252  1053 1996/07 2336  02  FR   0010   9                 :  IN         ROCK 0100 GREY ROCK 0140
                 12011 4821423                                                                    MCKENZIE BROS.GUELPH
CON     09  004  67-   565850  1110 1969/08 2406  04  UK   0143  45   50    15   1 :0  DO         BRWN SAND GRVL 0022 BRWN ROCK 0030
                 03432 4820540                                                                    PATERSON D L
                                                                                                  LOAM 0006 BRWN CLAY STNS 0030 BRWN CLAY GRVL
CON     09  004  67-   566140  1090 1962/11 2801  10  FR   0021   5   13  1200  60:0  MN         0055 BRWN LMSN 0143
                 02699 4821145                                                                    P U C
                                                                                                  LOAM 0002 MSND GRVL 0006 CLAY GRVL 0021 BRWN
CON     09  004  67-   565768  1108 1991/07 2336  06  FR   0079  51   65    10   1 :0  DO         LMSN 0029 GREY LMSN 0065
                 10738 4820617                                                                           ,THOMAS
                                                                                                  BRWN CLAY STNS 0025 GREY CLAY STNS 0036 BRWN
CON     09  004  67-   565780  1108 1978/05 2904  06  UK   0210  37  210    22   2 :30 DO         ROCK 0068 BRWN ROCK 0081
                 06690 4820540                                                                    JEFFERSON L A
                                                                                                  BRWN CLAY STNS LOOS 0028 GREY CLAY FGVL PCKD
                                                                                                  0046 BRWN LMSN HARD 0072 BRWN LMSN HARD DKCL
                                                                                                  0086 BRWN LMSN LTCL SOFT 0089 BRWN LMSN HARD
                                                                                                  DKCL 0110 GREY LMSN SOFT 0117 BRWN LMSN HARD
                                                                                                  0135 WHIT LMSN HARD 0162 GREY LMSN HARD 0202
CON     09  004  67-   565020  1095 1966/11 2521  04  FR   0140  25   90     5   2 :0  DO         WHIT LMSN HARD 0213
                 02701 4819895                                                                    KACZMARCZYK B
CON     09  004  67-   565780  1102 1969/11 2521  04  FR   0077  50   65    10   2 :0  DO         CLAY 0074 BRWN ROCK 0140
                 03560 4820630                                                                    PORTER L
CON     09  004  67-   566500  1080 1958/05 4208  06  FR   0093  27   50    17   1 :0  ST DO      CLAY 0030 BRWN LMSN 0077
                 02743 4821165                                                                    COMPHELL T
CON     09  004  67-   565000  1055 1975/08 1906  04  UK   0107  30   80    12   3 :0  DO         CLAY GRVL 0084 LMSN 0095
                 05702 4819900                                                                    BASA ERNESTO
CON     09  004  67-   566551  1099 1996/07 2336  02  FR   0010   8                 :  IN         BRWN CLAY 0047 SAND GRVL 0072 BRWN ROCK 0108
                 12013 4821098                                                                    MCKENZIE BROS.GRAVEL
CON     09  004  67-   565786~      2000/10 2663  06  FR   0210  45   48    30   1 :   DO         BRWN SAND GRVL 0018 BRWN ROCK 0033
                 13535 4820580                                                                    VICTORIA RD GOLE EAS
                                                                                                  BLCK LOAM 0002 GREY CLAY STNS 0054 BRWN LMSN
                                                                                                  0080 BRWN LMSN 0120 GREY LMSN 0140 GREY LMSN
CON     09  005  67-   566069~      1992/11 6624  05  FR   0070  14   20    20   2 :0  DO         0210
                 11027 4820290                                                                    CANPOL CONST.
                                                                                                  LOAM 0001 BRWN CLAY 0007 BRWN CLAY GRVL 0015
CON     09  005  67-   566796  1135 1986/05 1906  05  SU   0139  25  120     6   2 :   DO         GRVL SAND 0032 BRWN LMSN 0073
                 08458 4820366                                                                    MALDONADO, C.
                                                                                                  BLDR 0015 BRWN CLAY 0034 LMSN ROCK 0095 BLCK
CON     09  005  67-   565880  1110 1968/09 1906  04  FR   0150  55   65    10   2 :0  DO         ROCK 0140
                 03249 4820500                                                                    GALLOWAY RONALD E
                                                                                                  CLAY STNS 0010 CLAY MSND 0040 BRWN CLAY 0050
                                                                                                  LMSN 0070 BRWN LMSN 0110 BLCK LMSN 0128 BLUE
CON     09  005  67-   566100  1095 1968/08 2521  04  FR   0093  25   85     4   1 :0  DO         LMSN 0150
                 03195 4820300                                                                    CARTER DAVID
                                                                                                  GRVL 0035 GREY LMSN 0085 BRWN LMSN 0093
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CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 09	005	67- 02703	565960 4820460	1100	1964/05	1906	04	FR	0167	42	45	12	2 :0	DO			GALLOWAY E STNS CLAY 0015 CLAY 0049 BRWN LMSN 0100 GREY SHLE 0110 BLCK LMSN 0129 BLUE LMSN 0167
CON 09	005	67- 02702	566105 4820370	1100	1963/09	2521	04	FR	0075	30	60	12	2 :0	ST DO			CARTER H GRVL STNS 0033 BRWN LMSN 0075
CON 09	005	67- 05226	565486 4819509	1090	1974/07	1906	05			35	70	20	3 :0	PS DO			DECORSO ENDERPRISES CLAY STNS 0051 BRWN ROCK 0100 BLCK ROCK 0119 BRWN ROCK 0132
CON 09	005	67- 13313	566069~ 4820289		1999/12	4207		FR	0085	33	90	30	1 :	DO			JEFFERSON,TOM PRDR 0048 BLCK ROCK 0090
CON 09	005	67- 11902	565947 4820350	1095	1995/07	4207	06	FR	0045	28	48	20	1 :0	DO			JEFFERSON, TOM BRWN CLAY STNS GRVL 0027 GREY LMSN 0048
CON 09	005	67- 12611	566069~ 4820290		1998/07	2663	06	FR	0082	21	65	12	1 :0	DO			DUNNINK HOMES BRWN CLAY STNS 0015 GRVL 0025 BRWN CLAY SAND GRVL 0038 BRWN LMSN DKCL 0075 GREY LMSN 0082
CON 09	006	67- 07525	566100 4820400	1100	1981/07	4868	06	FR	0172	40	90	10	:	DO			WYGA O BRWN CLAY STNS SILT 0059 BRWN LMSN SNDS HARD 0076 BLCK STNS VERY HARD 0172 GREY LMSN HARD 0176 BLCK STNS VERY HARD 0180
CON 09	006	67- 02715	567275 4820440	1120	1961/02	2521	04	FR	0100	26	60	10	2 :0	DO			ELLIS J CLAY 0045 BRWN LMSN 0100
CON 09	006	67- 02716	565965 4819500	1095	1963/04	2406	04	FR	0060	25	38	10	1 :0	DO			GOLDING C LOAM 0002 GRVL STNS 0018 BRWN CLAY GRVL 0026 BRWN LMSN 0073
CON 09	006	67- 02714	567165 4820540	1125	1959/12	2521	04	FR	0102	22	40	10	2 :0	DO			HUME R CLAY 0010 GRVL 0030 CLAY 0046 BRWN LMSN 0102
CON 09	006	67- 03454	566250 4819980	1095	1969/08	2406	04	FR	0116	25	37	10	1 :0	DO			RICHARDSON R R LOAM 0001 BRWN CLAY STNS 0035 BRWN LMSN 0105 GREY LMSN 0112 BRWN LMSN 0116
CON 09	006	67- 08576	565904 4819756	1099	1986/10	2336	05	FR	0102	32	60	10	1 :	DO			WYGA CONSTRUCTION BRWN CLAY SAND STNS 0027 BRWN ROCK 0040 GREY ROCK 0078 BRWN ROCK 0102
CON 09	006	67- 02717	567005 4820750	1125	1964/04	2521	04	FR	0145	25	80	4	2 :0	DO			BOREHAM N CLAY MSND 0015 CLAY GRVL 0050 GREY LMSN 0105 LMSN 0145
CON 09	006	67- 02718	565960 4819505	1095	1964/06	2406		FR	0120	30	60	8	1 :0	DO			GOLDING C PRDR 0073 BLCK LMSN 0120 GREY LMSN 0130
CON 09	006	67- 08887	565891 4819776	1099	1987/07	2336	05	FR	0116	23	60	15	1 :	DO			WYGA CONSTRUCTION BRWN CLAY SAND GRVL 0031 BRWN ROCK 0085 BRWN ROCK 0116
CON 09	006	67- 02719	567145 4820495	1125	1961/06	2521	04	FR	0110	16	60	8	2 :0	PS			ARKELL UNITED CHURCH CLAY 0040 GRVL 0051 GREY LMSN 0110
CON 09	006	67- 08575	566408 4820263	1105	1986/10	2336	05	FR	0107	25	60	8	1 :	DO			ROFFEL, MR. HARRY BRWN CLAY GRVL 0031 BRWN ROCK 0055 BRWN ROCK 0070 BRWN ROCK 0107
CON 09	006	67- 02721	565960 4819500	1095	1965/11	2406	05	FR	0128	29	60	40	0 :30	DO			TRUSCOTT R LOAM 0001 STNS GRVL 0018 CSND 0024 GRVL CLAY 0031 BRWN LMSN 0075 BLCK LMSN 0098 GREY LMSN 0130
CON 09	006	67- 11690	567004 4820773	1138	1995/02	2336	06	FR	0120	20	89	5	5 :0	DO			NASA HOLDINGS INC. BRWN CLAY GRVL 0015 GREY CLAY GRVL 0044 BRWN ROCK 0080 BRWN ROCK 0105 BRWN ROCK 0120
CON 09	006	67- 02704	567005 4820465	1120	1948/12	2414		FR	0115	24	30	10	2 :0	ST DO			BOREHAM H PRDG 0028 HPAN 0047 BRWN LMSN 0120
CON 09	006	67- 02708	567005 4820735	1125	1955/08	2414	05	FR	0100	24	70	8	3 :0	DO			AYRES H LOAM 0001 CLAY STNS 0052 GREY LMSN 0112 BLCK LMSN 0153 BLUE LMSN 0156

CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 09	006	67-02709	567140 4820585	1125	1950/11	2521	04	FR	0100	26	50	10	0 :30	DO			RIDLER G GRVL STNS 0032 LMSN 0100
CON 09	006	67-02707	566390 4819980	1100	1955/04	2521	04	FR	0106	24	90	10	2 :0	DO			CASHIE J GRVL STNS 0033 GREY LMSN 0086 BLCK LMSN 0106
CON 09	006	67-02706	566665 4820350	1125	1953/05	2414	05	FR	0118	38	50	6	4 :0	ST DO			LASBY G LOAM 0006 GRVL STNS 0011 MSND 0014 CLAY 0022 GRVL MSND 0025 CLAY STNS 0046 MSND GRVL 0049 CLAY STNS 0053 BRWN LMSN 0078 WHIT LMSN 0118 BLCK LMSN 0141 BRWN LMSN 0147
CON 09	006	67-07527	566000 4819700	1105	1981/11	1906	05	FR	0120	25	60	15	2 :0	DO			FERGUSON W CLAY STNS 0056 LMSN STNS 0120
CON 09	006	67-03307	566030 4819500	1095	1969/01	2406	05	FR	0122	23	40	10	0 :30	DO			BOREHAM GEORGE BRWN CLAY STNS 0018 BRWN CLAY GRVL 0037 BRWN LMSN 0116 GREY LMSN 0125
CON 09	006	67-02710	566450 4819955	1100	1957/07	2521	04	FR	0098	18	18	15	1 :0	DO			STERKEY J GRVL STNS 0021 GREY LMSN 0081 BLCK LMSN 0098
CON 09	006	67-02705	566520 4819920	1125	1951/05	2414	06	FR	0050	12	18	12	6 :0	DO			CUNNINGHAM K GRVL 0012 MSND 0018 CLAY BLDR 0031 WHIT LMSN 0046 BRWN LMSN 0091
CON 09	006	67-10768	567008 4820436	1125	1991/10	2336	06	FR	0118	42	70	10	1 :	DO			SMITH, DOUG BRWN CLAY STNS 0015 GREY CLAY GRVL 0047 BRWN ROCK 0120
CON 09	006	67-11691	567133 4820540	1135	1995/02	2336	06	FR	0120	20	44	10	24:0	DO			NASA HOLDINGS INC. BRWN CLAY GRVL 0020 GREY CLAY GRVL 0041 BRWN ROCK 0098 BRWN ROCK 0110 BRWN ROCK 0120
CON 09	006	67-10121	566432 4819969	1102	1989/11	2663	06	FR	0126	70		12	1 :0	DO			J & S CONSTRUCTION GRVL 0029 WHIT LMSN 0040 BRWN LMSN 0086 BRWN LMSN 0120 GREY LMSN 0126
CON 09	006	67-04893	566239 4819614	1094	1973/11	2406	05	FR	0090	29	35	15	1 :0	DO			WALTON V LOAM 0001 BRWN CLAY STNS 0025 BRWN CLAY GRVL 0039 BRWN ROCK 0065 BRWN ROCK 0123
CON 09	006	67-04944	566314 4820077	1095	1973/09	2332	04	FR	0130	28	47	8	3 :0	DO			MORRIS H BLCK LOAM 0002 BRWN GRVL CLAY 0023 GREY SHLE STNS 0029 BRWN ROCK 0036 BRWN ROCK 0075 BLCK ROCK 0112 GREY ROCK LMSN 0127 GREY LMSN 0165
CON 09	006	67-02711	567135 4820595	1120	1958/09	2521	04	FR	0108	24	65	10	1 :0	DO			BUITENDYK H CLAY GRVL 0046 GREY LMSN 0108
CON 09	006	67-02712	565990 4819700	1100	1958/10	2521	04	FR	0081	28	28	10	1 :0	DO			FERGUSON W PRDG 0025 MSND 0031 GREY LMSN 0065 BRWN LMSN 0081
CON 09	006	67-02713	566005 4819720	1100	1958/11	2521	04	FR	0080	25	25	10	1 :0	DO			RAE G GRVL 0032 GREY LMSN 0080
CON 09	006	67-05874	566973 4820411	1128	1975/01	4208	06	FR	0126	24	120	15	1 :0	DO			A REID CONST LTD GREY CLAY STNS GRVL 0047 GREY LMSN 0130
CON 09	006	67-10920	566461 4820248	1108	1992/04	2336	06	FR	0118	62	90	8	1 :	DO			PAGNAN, PAUL BRWN CLAY STNS 0029 BRWN ROCK 0055 BRWN ROCK 0085 BRWN ROCK 0121
CON 09	006	67-03643	565950 4819650	1090	1970/03	2521	04	SU	0100	28	50	10	2 :0	DO			SHORTREED W GRVL 0026 GREY ROCK 0100
CON 09	006	67-04851	565729 4819561	1102	1973/11	2406	05	FR	0115	27	75	10	4 :0	DO			DECORSO C BRWN CLAY GRVL 0030 BRWN CLAY GRVL STNS 0050 BRWN GRVL STNS 0057 BRWN ROCK 0115
CON 09	006	67-03749	566540 4819995	1095	1970/07	2521	04	FR	0099	17	40	12	2 :0	DO			RIDDLER R GRVL 0026 GREY ROCK 0099
CON 09	006	67-10778	567117 4820634	1135	1991/11	2336	06	FR		28	85	6	1 :0	DO			HUTCHINSON, HERB BRWN CLAY STNS 0018 GREY CLAY GRVL 0043 BRWN ROCK 0075 BRWN ROCK 0105 BRWN ROCK 0120

CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 09	006	67- 04242	566500 4819900	1100	1972/06	2521	04	FR	0118	20	60	10	1 :30	DO			SANDERS H GRVL STNS 0024 GREY ROCK 0118
CON 09	006	67- 04784	566696 4820077	1107	1973/09	2521	04	FR	0080	25	30	10	1 :0	DO			FRETSCHENSHU H GRVL STNS 0023 GREY LMSN 0080
CON 09	006	67- 02720	565955 4819615	1095	1962/02	2521	04	FR	0077	32	40	10	2 :0	DO			BUSSHAFF A CLAY GRVL 0028 BRWN LMSN 0077
CON 09	006	67- 08372	566558 4820190	1105	1985/12	1906	05	FR	0065	26	50	10	1 :30	DO			MCPHERSON,ALEXANDER GRVL CLAY STNS 0012 CLAY STNS 0028 LMSN ROCK 0035 GREY ROCK 0040 BLUE ROCK 0045 BRWN ROCK 0066
CON 09	006	67- 11668	566095 4819972	1095	1994/12	4207	06	SU	0121	38	124	8	1 :0	ST			JEFFERSON FARMS LTD. BRWN GRVL 0015 BRWN SILT STNS 0041 GREY LMSN 0065 BLCK LMSN 0105 GREY LMSN 0124
CON 09	006	67- 13777	566364~ 4820000		2001/07	2336	06	FR	0238	31	119	7	1 :	DO			DETERCO BUILDERS INC BRWN CLAY STNS 0028 BRWN ROCK 0110 GREY ROCK 0240
CON 09	006	67- 12256	568548 4816570	340	1997/05	2663	06	FR	0090	36	70	25	1 :	DO			CAMPAGNOLO, ALDO GRVL SAND STNS 0090
CON 09	006	67- 13407	566364~ 4820000		2000/07	2336	06	FR	0100	18	40	10	1 :	DO			HULSHOFF-JANZEN,RUTH BRWN CLAY GRVL BLDR 0020 BRWN CLAY STNS 0030 GREY CLAY STNS 0032 BRWN ROCK 0100
CON 09	006	67- 13417	566364~ 4820000		1999/05	2663	06	UK	0125	18	29	5	1 :	DO			NASA HOLDINGS INC LOAM 0001 BRWN CLAY STNS 0020 BRWN CLAY GRVL SAND 0030 BRWN LMSN 0050 BRWN LMSN 0080 BRWN LMSN 0125
CON 09	006	67- 13745	566364~ 4820000		2001/03	2663	06	FR	0185	35	57	10	1 :	DO			MANNING,TERRY BRWN LMSN 0160 GREY LMSN 0185
CON 09	007	67- 02736	566770 4819805	1120	1957/12	2402	07	FR	0125	24	80	12	4 :0	ST DO			AGRICULTURAL COLLEGE LOAM 0001 HPAN BLDR 0035 CLAY 0048 HPAN 0052 GREY LMSN 0115 BRWN LMSN 0135 BLCK LMSN 0141
CON 09	007	67- 02726	567220 4820495	1125	1963/03	2521	04	FR	0144	36	90	2	1 :0	DO			PAGE L CLAY 0052 GREY LMSN 0120 BRWN LMSN 0130 BLCK LMSN 0144
CON 09	007	67- 02731	567140 4820500	1125	1961/02	2521	04	FR	0095	24	70	15	1 :0	DO			RONALD K CLAY 0040 GREY LMSN 0095
CON 09	007	67- 10891	567237 4820552	1138	1992/02	2336	06	FR	0118	33	80	4	1 :0	DO			DALTON FINANCIAL INC BRWN CLAY STNS 0015 GREY SAND GRVL 0025 GREY CLAY GRVL 0052 BRWN ROCK 0120
CON 09	007	67- 02737	566340 4819605	1100	1958/06	2521	04	FR	0100	30	50	10	1 :0	DO			TOLTON J CLAY 0038 GRVL 0043 GREY LMSN 0100
CON 09	007	67- 03745	567200 4820520	1130	1970/08	2521	04	FR	0129	40	70	7	2 :0	DO			FLETCHER R CLAY GRVL 0056 GREY LMSN 0129
CON 09	007	67- 07182	566100 4819350	1100	1979/05	2402	08	FR	0206	31	210	20	24:0	ST			ARKELL FARM LOAM 0001 CLAY STNS 0033 LMSN 0254
CON 09	007	67- 02734	567100 4820450	1125	1957/05	2414	04	FR	0092	23	43	5	2 :0	DC			HUME S LOAM 0001 CLAY STNS 0040 CLAY 0044 BRWN LMSN 0100
CON 09	007	67- 09504	567220 4820417	1138	1988/12	2336	06	FR	0120	32	65	10	1 :0	DC ST			GUTHRIE, MR.L. BRWN CLAY STNS 0015 BRWN SAND CLAY 0055 BRWN ROCK 0080 BRWN ROCK 0115 BRWN ROCK 0124
CON 09	007	67- 03193	567350 4820350	1135	1968/05	2406	04	FR	0215	40	85	6	0 :30	DO			CROSWELL C H LOAM 0001 BRWN CLAY STNS 0010 GREY CLAY STNS 0038 MSND GRVL 0054 BRWN LMSN 0065 GREY LMSN 0090 BRWN LMSN 0125 BLCK LMSN 0155 GREY LMSN 0215
CON 09	007	67- 02735	566940 4820255	1120	1957/11	2402	07	FR	0102	32	40	30	4 :0	ST DO			PUBLIC WORKS DEPT LOAM 0002 HPAN STNS 0034 BRWN LMSN 0090 GREY LMSN 0135

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MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 09	007	67- 02728	567100 4820505	1125	1961/02	2521	04	FR	0134	33	80	5	2 :0	DO			BARNETT R CLAY 0051 BRWN LMSN 0134
CON 09	007	67- 02729	566860 4820205	1125	1953/07	2414	04	FR	0050	9	29	5	3 :0	DO			METCALF L CLAY STNS 0033 BRWN LMSN 0096
CON 09	007	67- 02730	567315 4820395	1120	1953/09	2521	04	FR	0200	40	100	10	1 :0	DO			ROBERTS K LOAM CLAY 0010 HPAN 0025 GRVL 0055 LMSN 0125 GREY LMSN 0200
CON 09	007	67- 02727	567180 4820550	1125	1962/07	2521	04	FR	0132	35	85	5	1 :0	DO			WATSON H CLAY 0053 BRWN LMSN 0132
CON 09	007	67- 02725	567010 4820360	1125	1964/04	2521	04	FR	0090	12	20	10	2 :0	DO			TOLTON R GRVL 0032 BRWN LMSN 0090
CON 09	007	67- 02723	567280 4820445	1125	1964/01	2521	04	FR	0129	40	80	5	2 :0	CO ST			KNIGHT LUMBER CO CLAY GRVL 0053 GREY LMSN 0105 BRWN LMSN 0129
CON 09	007	67- 10001	567478 4820291	1138	1989/09	1906	05	UK	0080	49	49	25	4 :0	DO			PEPPARD, MICHAEL BRWN CLAY STNS 0030 GRVL 0039 LMSN 0080
CON 09	007	67- 02733	567065 4820410	1125	1956/04	2521	04	FR	0140	45	60	10	2 :0	DO			JAY A GRVL 0010 CLAY MSND 0054 GREY LMSN 0120 BRWN LMSN 0140
CON 09	007	67- 04037	567350 4820320	1140	1971/05	4208	06	FR	0060	41	65	12	1 :0	DO			VANESCH JOHN GREY CLAY GRVL 0054 GREY LMSN 0075
CON 09	007	67- 02722	566100 4819350	1075	1951/08	2414	06	FR	0060	16	40	60	8 :0	IR			AGRICULTURAL COLLEGE GRVL 0012 CLAY 0024 MSND GRVL 0030 WHIT LMSN 0040 MSND LMSN 0042 WHIT LMSN 0073 BRWN LMSN 0079 WHIT LMSN 0092 BLCK LMSN 0112 GREY LMSN 0136
CON 09	007	67- 02741	567185 4820545	1125	1961/01	2521	04	FR	0120	30	70	4	1 :0	DO			COULSON L CLAY 0011 GRVL 0051 BRWN LMSN 0120
CON 09	007	67- 02724	567100 4820440	1125	1965/01	1906	04	FR	0080	26	60	15	10:0	DO			FEIKEMA J PRDG 0020 GRVL CLAY 0050 BRWN LMSN 0080
CON 09	007	67- 10504	567399 4820388	1138	1990/10	1906	05	UK	0230	94	137	8	3 :0	DO			DAMAREN, RENO CLAY STNS 0055 BRWN LMSN 0060 GREY ROCK 0100 BRWN ROCK 0125 BLCK ROCK 0147 GREY ROCK 0230
CON 09	007	67- 08794	565753 4822255	1049	1987/05	2336	05	FR	0040	6	20	10	1 :	DO			RON INGLIS HOMES LTD BRWN CLAY SAND STNS 0019 BRWN ROCK 0040
CON 09	007	67- 02739	567260 4820460	1125	1959/08	2521	04	FR	0105	25	40	10	1 :0	DO			ORME D GRVL CLAY 0046 BRWN LMSN 0105
CON 09	007	67- 02738	567150 4820490	1125	1959/07	2521	04	FR	0112	35	40	10	2 :0	DO			LUMBER CO CLAY 0040 MSND 0043 GREY LMSN 0112
CON 09	007	67- 02742	567225 4820495	1125	1961/02	2521	04	FR	0128	35	85	4	1 :0	DO			HAM M CLAY 0045 GRVL 0053 GREY LMSN 0128
CON 09	007	67- 11568	567372 4820382	1135	1994/10	2663	06	FR	0163	36	80	12	1 :0	DO			GRANDMARK HOMES LOAM 0001 BRWN CLAY GRVL 0055 BRWN LMSN 0163
CON 09	007	67- 02732	567045 4820380	1120	1954/02	2414	05	FR	0098	18	160	37	4 :0	DO			RYCHMAN V CLAY STNS 0019 GRVL 0021 CLAY STNS 0039 FSND 0041 BRWN LMSN 0079 WHIT LMSN 0104
CON 09	007	67- 02740	567290 4820440	1125	1959/12	2521	04	FR	0100	20	70	10	1 :0	DO			HUME R CLAY 0030 GRVL 0043 BRWN LMSN 0100
CON 09	007	67- 13413	566662~ 4819708		1999/05	2663	06	FR	0185	23	85	5	7 :	DO			NASA HOLDINGS INC LOAM 0001 BRWN CLAY STNS 0020 BRWN CLAY SAND GRVL 0031 BRWN LMSN 0055 BRWN LMSN 0080 BRWN LMSN 0135 GREY LMSN 0155 GREY LMSN 0185
CON 09	008	67- 04361	567620 4820150	1140	1972/09	2521	04	FR	0145	60	90	10	2 :0	DO			PALMER S GRVL STNS 0066 GREY LMSN 0120 BLCK ROCK 0145
CON 09	008	67- 13423	566954~ 4819418		1999/05	2663	06	FR	0180	19	116		1 :	DO			NASA HOLDING INC LOAM 0001 BRWN CLAY STNS 0020 BRWN CLAY SAND GRVL 0034 BRWN LMSN 0055 BRWN LMSN 0080 BRWN LMSN 0135 GREY LMSN 0155 GREY LMSN 0184

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MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 09	009	67- 07636	566220 4819320	1100	1981/07	2402	08	FR	0194	26	28	60	24:0	ST			ARKELL FARM LOAM 0001 SAND BLDR 0016 CLAY 0041 LMSN 0235
CON 09	009	67- 13422	567244~ 4819130		1999/05	2663	06	FR	0182	28	41	8	7 :	DO			NASA HOLDINGS INC LOAM 0001 BRWN CLAY STNS 0020 BRWN CLAY SAND GRVL 0038 BRWN LMSN 0055 BRWN LMSN 0075 BRWN LMSN 0140 GREY LMSN 0182
CON 09	009	67- 13347	567244~ 4819130		2000/05	2663	06	FR	0182	18	72	8	3 :	DO			NASA HOLDINGES INC GREY LMSN 0140 GREY LMSN 0182
CON 09	009	67- 12761	567243~ 4819129		1998/11	2336	06	FR	0175	81	120	20	1 :0	DO			KUKOVICA, PETER BRWN CLAY STNS 0040 BRWN SAND GRVL 0085 GREY CLAY GRVL 0104 BRWN ROCK 0179
CON 09	010	67- 04581	567725 4819920	1100	1973/03	1906	05	SU	0186	88	89	15	3 :0	DO			KUKOVICA I PRDG 0005 CLAY GRVL STNS 0055 STNS SAND 0080 GRVL CLAY 0123 HPAN STNS 0132 BRWN ROCK 0150 GREY ROCK 0176 BRWN ROCK 0187
CON 09	010	67- 10962	568193 4819755	1194	1992/07	2336	06	FR	0138	87		15	1 :	DO			FITTON, B. BRWN CLAY STNS 0015 BRWN SAND GRVL 0085 GREY CLAY GRVL 0114 BRWN ROCK 0140
CON 09	010	67- 13421	567544~ 4818844		1999/05	2663	06	FR	0182	20	43	8	3 :	DO			NASA HOLDINGS INC LOAM 0001 BRWN CLAY STNS 0020 BRWN SAND 0025 BRWN CLAY SAND GRVL 0038 BRWN LMSN 0055 BRWN LMSN 0075 BRWN LMSN 0135 GREY SNDS 0182
CON 09	010	67- 13348	567544~ 4818844		2000/05	2663	06	FR	0182	20	43	8	3 :	DO			NASA HOLDINGES INC GREY LMSN 0135 GREY LMSN 0182
CON 09	011	67- 06319	568500 4819140	1220	1976/01	2803	06	FR	0150	120	155	10	2 :0	ST			CONWAY C ABBOTT PRDR 0006 BRWN GRVL 0105 BRWN HPAN 0144 GREY LMSN 0170
CON 09	012	67- 09162	568702 4819328	1190	1988/02	2336	06	FR	0190	95	125	15	2 :	DO			MITTEN, JOHN BRWN CLAY STNS 0015 BRWN CLAY GRVL 0070 BRWN GRVL SAND 0100 BRWN CLAY SAND 0133 BRWN ROCK 0180 BRWN ROCK 0191
CON 09	012	67- 10195	568831 4819195	1167	1990/01	2336	06	FR	0140	84	100	15	1 :	DO			SPIKMAN, MR. RICK BRWN CLAY SAND STNS 0025 BRWN SAND GRVL 0045 BRWN GRVL 0065 BRWN CLAY GRVL 0115 BRWN ROCK 0141
CON 09	012	67- 13420	568124~ 4818261		1999/09	2663	06	FR	0182	20	39	5	3 :	DO			NASA HOLDINGS INC LOAM 0001 BRWN CLAY STNS 0020 BRWN CLAY GRVL 0040 BRWN LMSN FCRD ROCK 0045 BRWN LMSN 0055 BRWN LMSN 0080 BRWN LMSN 0150 GREY LMSN 0182
CON 09	012	67- 13349	568124~ 4818261		2000/05	2663	06	FR	0182	20		5	3 :	DO			NASA HOLDINGES BRWN LMSN 0150 GREY LMSN 0182
CON 09	013	67- 10050	568405~ 4817977		1989/11	4552	05	FR	0055	8	20	10	1 :0	DO			ROTH, ROBERT BRWN FILL 0005 GREY CLAY STNY HARD 0048 BRWN GRVL CMTD 0055
CON 09	013	67- 13414	568406~ 4817977		1999/04	2663	06	FR	0016	59	62	5	7 :	DO			NASA HOLDING INC LOAM 0001 BRWN CLAY STNS 0020 BRWN CLAY GRVL 0036 BRWN LMSN 0055 UNKN 0080 UNKN 0135 UNKN 0150 UNKN 0163
CON 09	014	67- 08741	569322 4818124	1148	1986/09	2332	05	FR	0106	50	50	10	3 :0	DO			HUIZINGA, J. BRWN CLAY STNS GRVL 0035 GREY CLAY STNS 0105 GREY STNS ROCK 0106
CON 09	014	67- 09948	569247 4818808	1131	1989/09	4005	06	FR	0108	68	92	25	1 :	DO			GATTO CONSTRUCTION BRWN SAND GRVL LOOS 0010 GREY GRVL SAND LOOS 0072 GREY CLAY SNDY LOOS 0103 GREY LMSN HARD 0110

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MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 10		67- 13297	999999~ 9999999		2000/02	2336	06	FR	0190	24	32	300	2 :	MN			CITY OF GUELPH BRWN LOAM 0001 BRWN CLAY SAND 0002 BRWN SAND GRVL CLAY 0027 BRWN ROCK 0122 GREY ROCK 0163 GREY ROCK FCRD 0190
CON 10		67- 13298	999999~ 9999999		2000/02	2336	06	FR	0055				:	MN			CITY OF GUELPH BRWN SAND GRVL BLDR 0035 BRWN ROCK 0055
CON 10		67- 13290	999999~ 9999999		2000/02	2336	02						:	MN	0042	10	CITY OF GUELPH BRWN CLAY STNS 0005 BRWN SAND GRVL BLDR 0047 BRWN ROCK 0052
CON 10		67- 13287	999999~ 9999999		2000/01	2336	06	SU	0100	2	14	50	2 :	MN			CITY OF GUELPH BRWN FILL 0004 BLCK LOAM 0007 BRWN ROCK 0078 GREY ROCK 0100
CON 10		67- 13293	999999~ 9999999		2000/03	2336	02			33			:	MN	0041	51	CITY OF GUELPH BRWN FILL 0002 BRWN CLAY SAND 0005 BRWN GRVL SAND 0051 BRWN ROCK 0052
CON 10	001	67- 02760	565621~ 4822160	1050	1957/10	2521	04	FR	0040	15	15	10	1 :0	DO			NICKOLS B CLAY BLDR 0011 BLCK LMSN 0040
CON 10	001	67- 08051	565980 4822660	1120	1983/10	2336	06	FR	0125	70	90	10	1 :0	ST DO			INGLIS B LOAM 0001 BRWN CLAY SAND STNS 0025 BRWN CLAY GRVL 0044 BRWN STNS LTCL 0070 BRWN STNS DKCL 0095 BLCK STNS 0127
CON 10	001	67- 02761	565621 4822160	1050	1959/05	2521	04	FR	0040	16	16	10	1 :0	DO			MILLARD D CLAY SHLE 0018 GREY LMSN 0040
CON 10	001	67- 02759	565595~ 4822235	1070	1955/06	4838	04	FR	0035	20	22	7	2 :0	DO			NEISH M PRDG 0015 BLCK LMSN 0042
CON 10	001	67- 12003	565839 4822225	1046	1996/06	4207	06	FR	0070	23	76	7	1 :0	DO			HALL, MURRAY BRWN CLAY STNS GRVL 0009 GREY LMSN SOFT FCRD 0028 GREY LMSN 0076
CON 10	002	67- 08695	565810 4821786	1040	1986/09	4207	06	SU	0057	3	58	30	1 :0	DO			OOSTERVELD, RANCE BRWN CLAY GRVL STNS 0005 BLCK LMSN 0058
CON 10	002	67- 05032	567210 4823366	1125	1974/04	2336	06	FR	0114	60	70	15	1 :0	DO			HULLAND T J BRWN LOAM 0002 BRWN CLAY STNS 0012 BRWN ROCK 0030 GREY ROCK 0075 BLCK ROCK 0095 GREY ROCK 0114
CON 10	002	67- 12772	566625~ 4822628		1998/10	2663	06	FR	0035	19	25	20	1 :0	DO			LODDER,TONY BRWN CLAY SAND STNS 0013 BRWN LMSN 0018 BRWN LMSN 0035
CON 10	002	67- 11971	565800 4822041	1046	1996/05	2336	06	FR	0040	13	21	10	1 :0	DO			MACDONALD, TOM BRWN CLAY STNS 0010 BRWN SAND GRVL 0015 BRWN ROCK 0040
CON 10	002	67- 11970	565798 4822044	1046	1986/05	2336	04						:	DO			MACDONALD, TOM PRDR 0042
CON 10	004	67- 04351	567300 4822500	1050	1968/02	0001	20	FR	0006	3			:	NU			CITY OF GUELPH CLAY BLDR 0006 GRVL 0011
CON 10	004	67- 02809	568056 4822756	1115	1963/06	2801	12	FR	0113	47	52	700	24:0	MN			GUELPH P U C LOAM 0001 GRVL MSND BLDR 0005 GRVL CLAY BLDR 0027 MSND GRVL CLAY 0032 MSND 0038 SHLE 0053 GREY LMSN 0113 LMSN 0115 GREY LMSN 0127 LMSN 0131 GREY LMSN 0138
CON 10	004	67- 02763	566680 4821515	1075	1962/12	2801	01	FR	0038	37			:	NU	0049	10	GUELPH P U C LOAM 0001 GRVL MSND BLDR 0037 MSND GRVL 0054 BRWN LMSN 0066 BLCK SHLE 0072 BRWN LMSN 0083 BLCK SHLE 0092 BRWN LMSN 0103 BLCK SHLE 0105
CON 10	004	67- 02764	567238 4822397	1140	1963/05	2801	01	FR	0048	46	68	200	24:0	NU	0034	20	GUELPH CITY LOAM 0001 BLDR GRVL 0040 GRVL 0048 GREY LMSN 0096

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WATER WELL DATA SYSTEM   Mar 18 2003        PAGE: 97    COUNTY:  WELLINGTON                                  GROUND WATER BULLETIN REPORT

MUNICIPALITY                   UTM                        CSG KIND  WATER STAT PUMP TEST TEST            SCREEN            OWNER
CONCESSION          WELL EASTING  ELEV                    DIA  OF   FOUND LVL  LVL  RATE TIME  WATER DEPTH LENGTH DEPTHS IN FEET TO WHICH
  ETC        LOT     NO  NORTHING FEET DATE    DRILLER INS WATER FEET  FEET FEET GPM  HR:MN USE   FEET   FEET       FORMATIONS EXTEND

CONTINUING... PUSLINCH TOWNSHIP

CON      10  005  67-   567792~  1075 1963/04 2801   12  FR    0020  2    10   358  4 :30  NU                  GUELPH P U C
              02762 4822260                                                                                  BLDR CLAY 0007 GRVL CLAY BLDR 0020 GRVL CLAY
                                                                                                             0022 GRVL BLDR 0025 GREY LMSN 0040
CON      10  005  67-   567767   1110 1966/05 2801   02  UK          10   24   300  54:0   NU    0027 03       GUELPH WATERWORKS
              02770 4822295                                                                                  GRVL CLAY BLDR 0017 GRVL BLDR MSND 0031 GRVL
                                                                                                             0038 GRVL MSND 0041 GREY CLAY GRVL 0056 LMSN
                                                                                                             0057
CON      10  005  67-   567792~  1075 1966/05 2801   08  FR    0013  14   29   500  26:0   MN    0032 15       GUELPH WATERWORKS
              02769 4822285                                                                                  LOAM BLDR 0001 GRVL CLAY BLDR 0006 GRVL BLDR
                                                                                                             0031 GRVL CLAY BLDR 0034 GRVL MSND BLDR 0035
                                                                                                             GRVL 0036 GRVL MSND BLDR 0044  RED CLAY GRVL
                                                                                                             0066 LMSN 0067
CON      10  005  67-   566663   1020 1963/01 2801   12                                :                     GUELPH CITY
              02768 4821349                                                                                  BLCK LOAM 0001 BRWN CLAY MSND 0007 MSND GRVL
                                                                                                             BLDR 0015 MSND CLAY 0017 GRVL MSND CLAY 0020
                                                                                                             BRWN LMSN 0047 LMSN 0052 BRWN LMSN 0083 BLCK
                                                                                                             LMSN 0085
CON      10  005  67-   567995   1075 1963/07 2801   02  UK    0028  11   17   150  3 :0   NU    0023 10       GUELPH CITY
              02767 4822295                                                                                  LOAM MSND 0001 BLDR 0003 GRVL BLDR 0006 CLAY
                                                                                                             GRVL BLDR 0028 MSND GRVL BLDR 0035 GRVL CLAY
                                                                                                             BLDR 0040 GRVL MSND CLAY 0056 CLAY MSND GRVL
                                                                                                             0064 SHLE 0066
CON      10  005  67-   567882   1025 1963/06 2801   16  FR    0129  39   59   1000 68:0   MN                  GUELPH CITY
              02766 4822302                                                                                  CLAY BLDR 0026 GRVL MSND 0055 GRVL CLAY 0061
                                                                                                             BLUE CLAY 0072 GRVL CLAY 0074 GREY LMSN 0142
CON      10  005  67-   567976   1075 1966/05 2801   12                                :                     GUELPH WATERWORKS
              02771 4822991                                                                                  FSND 0003 BLDR CLAY GRVL 0022 GRVL MSND 0025
                                                                                                             GRVL 0042  RED CLAY GRVL 0052 LMSN 0053
CON      10  005  67-   567463   1090 1963/03 2801   02  FR    0054  32                    :   NU    0044 13       GUELPH CITY
              02765 4821813                                                                                  BRWN CLAY MSND GRVL 0003 MSND GRVL BLDR 0046
                                                                                                             CLAY GRVL 0048 LMSN 0050 BRWN LMSN 0083 BLCK
                                                                                                             LMSN 0091 GREY LMSN 0093 BLCK LMSN 0095
CON      10  005  67-   567000   1095 1992/04 2336   06  FR    0138  46   100  5    1 :   DO                  FERRARO, D
              10921 4821346                                                                                  BRWN CLAY GRVL 0025 GREY CLAY GRVL 0068 BRWN
                                                                                                             ROCK 0090 BRWN ROCK 0135 BRWN ROCK 0160
CON      10  005  67-   566800   1125 1968/11 1906   04  FR    0141  30   60   5    1 :0   DO                  SHERWOOD ROBERT
              03252 4821050                                                                                  CLAY STNS 0050 CLAY GRVL 0055 BRWN LMSN 0109
                                                                                                             GREY LMSN 0130 BLUE LMSN 0135 BLCK LMSN 0141
CON      10  005  67-   566889   1082 1995/04 2336   06  FR    0160  48   110  5    1 :   DO                  FERRARO, D
              11714 4821353                                                                                  BRWN CLAY STNS 0030 BRWN SAND 0050 GREY CLAY
                                                                                                             STNS 0066 BRWN ROCK 0120 BRWN ROCK 0160
CON      10  005  67-   566954   346  1995/07 2336   06  FR    0158  95   120  10   1 :0   DO                  LAKING, BILL
              11758 4820924                                                                                  BRWN CLAY STNS 0035 GREY CLAY STNS 0056 BRWN
                                                                                                             ROCK 0150 GREY ROCK 0158
CON      10  006  67-   567100   1125 1979/07 2904   06  FR    0170  65   172  10   2 :30  DO                  DYER B
              07023 4820700                                                                                  BRWN CLAY STNS BLDR 0046 BRWN LMSN SOFT 0065
                                                                                                             BRWN LMSN HARD DKCL 0086 GREY LMSN HARD 0090
                                                                                                             BRWN LMSN DKCL 0132 GREY LMSN HARD 0172
CON      10  006  67-   568302   1125 1963/02 2801   02  FR    0028  24   29   250  6 :0   NU    0022 11       GUELPH CITY
              02772 4822098                                                                                  BRWN CLAY MSND 0005 MSND GRVL CLAY 0017 SILT
                                                                                                             CLAY MSND 0024 MSND GRVL CLAY 0028 BRWN LMSN
                                                                                                             0078 GREY LMSN 0087 BLCK LMSN 0101 GREY LMSN
                                                                                                             0122
CON      10  006  67-   567197   1115 1989/08 1906   05  FR    0245  51   150  6    8 :   DO                  LINDSAY, CAROL
              09937 4820910                                                                                  BRWN CLAY STNS 0047 LMSN 0065 GREY ROCK 0115
                                                                                                             BLCK ROCK 0180 GREY ROCK 0245
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CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 10	006	67- 13324	567788~ 4821477		2000/05	2336	06	FR	0160	25	110	10	1 :	DO			DETERCO BUILDERS INC BRWN CLAY STNS 0030 GREY CLAY STNS 0038 BRWN ROCK 0085 BLCK ROCK 0135 GREY ROCK 0160
CON 10	006	67- 13787	567788~ 4821477		2001/08	2663	06	FR	0205	89	148	10	1 :	DO			GRINYER, IVAN LOAM 0002 BRWN CLAY STNS 0041 LMSN SOFT FCRD 0043 LMSN 0090 BRWN LMSN 0125 LMSN 0205
CON 10	006	67- 13185	567788~ 4821477		1999/10	2336	06	FR	0175	53	123	8	1 :0	DO			GARSON, REID HOMES BRWN CLAY STNS 0020 GREY CLAY GRVL 0047 BRWN ROCK 0085 BLCK ROCK 0150 GREY ROCK 0175
CON 10	007	67- 10077	567338 4820897	1135	1989/10	1906	05	FR	0172	77	95	12	5 :0	DO			VANRYN, MARK BRWN CLAY STNS 0039 BRWN ROCK 0055 GREY ROCK 0070 BRWN ROCK 0115 GREY ROCK 0120 BLCK ROCK 0140 GREY ROCK 0173
CON 10	007	67- 05715	568258 4821566	1134	1975/09	2336	05	FR	0153	84	100	10	1 :0	DO			WATSON MURRAY LOAM 0001 BRWN CLAY STNS 0040 BRWN CLAY SAND GRVL 0093 BRWN ROCK 0118 BRWN ROCK DKCL 0140 BLCK ROCK 0153
CON 10	007	67- 06077	567425 4820726	1114	1976/06	2336	05	FR	0092	24	35	15	1 :0	DO			GEO REID CONST BRWN CLAY STNS 0015 BRWN CLAY GRVL 0033 BRWN ROCK 0070 BRWN ROCK DKCL 0095
CON 10	007	67- 08056	568480 4821600	1180	1983/10	2336	05	FR	0234	100	150	12	1 :0	DO			SLATER J PRDR 0153 BLCK STNS 0185 GREY STNS DKCL 0236
CON 10	007	67- 07923	568500 4821560	1140	1983/09	2336	06	FR	0223	129	150	30	1 :0	IR			SLATER J PRDG 0011 BRWN CLAY SAND STNS 0045 BRWN CLAY GRVL HARD 0055 BRWN CLAY SAND 0102 BRWN STNS 0145 BRWN STNS DKCL 0160 BLCK STNS 0185 GREY STNS DKCL 0226
CON 10	007	67- 02774	568318~ 4821747	1150	1958/08	1532	06	FR	0127	40	60	10	0 :30	DO			BASCH P BRWN CLAY 0003 GREY MSND 0125 LMSN 0127
CON 10	007	67- 02775	567393 4820558	1125	1965/03	2521	04	FR	0125	30	120	4	2 :0	DO			TOWNSEND G CLAY 0046 BRWN LMSN 0125
CON 10	007	67- 02773	567314 4820511	1130	1964/07	2521	05	FR	0140	40	130	4	2 :0	DO			TOWNSEND G CLAY 0045 GRVL 0053 GREY LMSN 0130 BLCK LMSN 0140
CON 10	007	67- 12591	568080~ 4821182		1998/07	2336	06	FR	0090	17	18	20	1 :0	DO			POPOFSKI, JOHN BRWN CLAY STNS 0040 GREY CLAY SAND GRVL 0077 BRWN ROCK 0090
CON 10	007	67- 12507	567347 4820610	344	1998/04	2663	06	FR	0201	34	90	10	1 :	DO			SATZEWICH, VICTOR LOAM 0001 BRWN CLAY SAND STNS 0030 BRWN CLAY GRVL 0039 BRWN LMSN 0165 GREY LMSN 0201
CON 10	007	67- 12521	567488 4820770	342	1998/04	2336	06	FR	0118	30	76	25	1 :0	DO			EUTENEIER, TOM BRWN CLAY STNS 0010 BRWN CLAY SAND GRVL 0029 BRWN ROCK 0120
CON 10	008	67- 03988	567650 4820150	1148	1971/07	2521	04	FR	0130	57	60	10	2 :0	DO			WALKER R GRVL STNS 0061 GREY LMSN 0130
CON 10	008	67- 13509	568372~ 4820895		2000/08	2336	06	FR	0340	151	185	25	1 :	IR			SLATER, JIM PRDR 0226 GREY ROCK 0320 BLUE ROCK SHLE 0335 RED SHLE 0340
CON 10	008	67- 13996	568372~ 4820895		2001/12	2663	06	UK	0192	98	127	8	1 :0	DO			FAVAO, MARIO BRWN CLAY STNS 0055 GRVL CLAY 0098 BRWN CLAY STNS 0122 BRWN LMSN FCRD 0124 BRWN LMSN 0142 BRWN LMSN 0160 BRWN LMSN 0222
CON 10	008	67- 13303	568372~ 4820895		2000/04	2663	06	FR	0162	88	145	20	1 :	DO			PINDER, KEN BRWN CLAY STNS 0065 BRWN CLAY STNS LOAM 0085 BRWN LMSN 0125 BRWN LMSN 0145 BRWN LMSN 0162
CON 10	009	67- 03650	567880 4819950	1165	1970/03	2414	04	FR	0151	77	87	10	1 :0	DO			WALKER A LOAM 0001 BRWN CLAY STNS 0015 BRWN CLAY GRVL 0087 BRWN ROCK 0151

CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 10	009	67- 04688	568070 4819895	1180	1973/05	4208	06	FR	0150	80	130	8	1 :0	DO			FELAUER N BRWN GRVL CLAY 0065 GREY CLAY GRVL HPAN 0097 GREY LMSN 0160 BLCK LMSN 0225 GREY LMSN 0232
CON 10	010	67- 03975	568720 4820200	1200	1971/06	3316	04	FR	0163	78	84	9	3 :0	DC			JAMIESON D M GRVL STNS CLAY 0130 BRWN LMSN 0167
CON 10	010	67- 02783	569338 4820719	1173	1966/06	2521	04	FR	0097	23	45	12	2 :0	DO			ROGERS R CLAY STNS GRVL 0058 BRWN LMSN 0097
CON 10	010	67- 02782	569166 4820465	1170	1965/05	2406	04	FR	0105	52	90	6	2 :0	DO			SPURRELL R LOAM 0001 BRWN CLAY MSND STNS 0035 BRWN CLAY GRVL 0070 GREY CLAY 0088 BRWN LMSN 0115 BLCK LMSN 0182
CON 10	010	67- 03422	568650 4819900	1175	1969/06	2406	04	FR	0180	80	85	10	:	DO			SHIAN NORMAN E F BRWN CLAY STNS 0045 BRWN CLAY GRVL MSND 0060 BRWN CLAY STNS 0085 BRWN GRVL MSND 0107 BRWN LMSN 0180
CON 10	010	67- 02781	569476 4820862	1125	1965/05	2406	05	FR	0099	20	40	30	1 :0	DO			GORDON R LOAM 0001 BRWN CLAY MSND GRVL 0035 GRVL STNS 0044 BRWN CLAY STNS 0068 BRWN LMSN 0080 BLCK LMSN 0100
CON 10	010	67- 02780	569188 4820677	1080	1964/09	2406	05	FR	0080	8	25	25	7 :0	DO			RILEY E BRWN CLAY STNS 0032 BRWN MSND 0043 GREY CLAY GRVL 0068 BRWN LMSN 0090
CON 10	010	67- 07911	568740 4820400	1180	1984/06	2336	05	FR	0165	80	95	10	1 :0	DO			DAWKINS F BRWN CLAY STNS 0025 BRWN CLAY SAND GRVL 0070 BRWN SAND GRVL CLAY 0090 BRWN CLAY SAND 0095 BRWN CLAY GRVL HARD 0114 BRWN STNS 0135 BRWN STNS 0155 BRWN STNS 0170
CON 10	010	67- 05098	569245 4820476	1170	1974/04	4208	06	FR	0115	41	120	15	1 :0	DO			JEFFERY W BRWN CLAY SAND 0025 GREY CLAY GRVL STNS 0103 GREY LMSN 0120
CON 10	010	67- 02776	568231 4819612	1195	1961/11	4208	06	FR	0112	75	80	12	1 :0	ST DO			DOUGLAS W CLAY STNS 0020 GRVL CLAY 0055 GRVL STNS 0070 GRVL CLAY HPAN 0108 LMSN 0116
CON 10	010	67- 02777	569447 4820776	1150	1966/11	2521	04	FR	0130	60	85	7	2 :0	DO			BIFFIS R CLAY STNS 0092 BRWN LMSN 0130
CON 10	010	67- 02778	569605~ 4820949	1125	1963/03	2406	05	FR	0083	20	20	15	1 :0	DO			LEFNESKI R BLDR CLAY 0022 GRVL STNS 0037 BRWN CLAY 0064 HPAN STNS 0082 BLCK SLTE 0083
CON 10	010	67- 05163	569070 4820277	1180	1974/04	3316	04	FR	0175	78	85	10	2 :0	DO			BALMER DAVID BRWN CLAY STNS 0020 GREY CLAY STNS GRVL 0075 GREY CLAY STNS 0125 GREY LMSN 0132 BRWN ROCK 0176
CON 10	010	67- 02779	569003 4820277	1180	1964/10	1906	04	FR	0125	80	85	10	5 :0	DO			YOUNG K CLAY STNS 0025 GRVL CLAY 0085 FSND 0091 BRWN LMSN 0125
CON 10	010	67- 09267	568739 4820090	1194	1988/05	2336	06	FR	0180	80	98	20	1 :0	DO			PROKIPLAK, MR.J. BRWN CLAY SAND GRVL 0045 BRWN CLAY GRVL HARD 0085 BRWN CLAY GRVL FSND 0110 BRWN SAND 0118 BRWN GRVL SAND HARD 0123 BRWN ROCK 0150 BRWN ROCK 0170 BRWN ROCK 0180
CON 10	010	67- 14103	568954~ 4820314		2002/06	2663	06	FR	0122	65	65	20	1 :0	DO			BUNYOUSKY,STEVE BRWN CLAY BLDR 0090 BRWN LMSN SOFT FCRD 0101 BRWN LMSN 0122
CON 10	010	67- 12202	568466 4819584	365	1997/03	2336	06	FR	0120	82	100	15	1 :0	DC			PILKEY, DOUG BRWN CLAY STNS 0018 GREY CLAY GRVL 0050 BRWN GRVL 0095 GREY CLAY GRVL 0112 BRWN ROCK 0120

CONTINUING... PUSLINCH TOWNSHIP

MUNICIPALITY CONCESSION ETC	LOT	WELL NO	UTM EASTING NORTHING	ELEV FEET	DATE	DRILLER	CSG DIA INS	KIND OF WATER	WATER FOUND FEET	STAT LVL FEET	PUMP LVL FEET	TEST RATE GPM	TEST TIME HR:MN	WATER USE	SCREEN DEPTH FEET	SCREEN LENGTH FEET	OWNER DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
CON 10	011	67- 10767	569084 4820091	1171	1991/08	2336	06	FR	0120	56	70	25	1 :0	DO			MANNING, G.F. BRWN CLAY STNS 0025 GREY CLAY SAND GRVL 0055 BRWN SAND GRVL 0105 BRWN ROCK 0121
CON 10	011	67- 02787	568640 4819453	1180	1967/07	4208	06	FR	0105	68	75	25	2 :0	DO			MACTAGGART W LOAM CLAY MSND 0015 CLAY GRVL 0050 CLAY STNS 0080 CLAY GRVL 0095 MSND 0103 GRVL 0105
CON 10	011	67- 03392	568450 4819430	1195	1969/05	2521	04	FR	0157	90	110	10	2 :0	DO			PETTERSEN J GRVL STNS 0114 BRWN LMSN 0157
CON 10	011	67- 03325	569550 4820550	1140	1969/04	2406	04	FR	0104	20	35	15	:	DO			CROSS BRIAN BRWN CLAY STNS 0015 BRWN MSND 0025 BRWN CLAY GRVL 0066 BRWN LMSN 0107
CON 10	011	67- 02786	568515 4819466	1200	1967/04	2406	04	FR	0120	80	85	8	1 :0	DO			HYDE E LOAM 0002 BRWN CLAY STNS 0015 BRWN CLAY GRVL 0070 STNS 0075 BRWN CLAY GRVL 0107 BRWN LMSN 0180
CON 10	011	67- 05000	569287 4820268	1155	1974/02	4005	06	FR	0073	41	55	18	1 :30	DO			SCRIVENER W BRWN SAND GRVL BLDR 0042 BRWN SAND GRVL 0065 GREY SAND GRVL 0072 GREY LMSN 0075
CON 10	011	67- 02784	569479 4820686	1140	1966/04	2521	04	FR	0083	5	5	25	2 :0	DO			MELZER J GRVL STNS 0063 BRWN LMSN 0083
CON 10	011	67- 05331	569639 4820559	1125	1974/10	2336	04	FR	0110	27	60	10	1 :0	DO			TYSZKA GEORGE BRWN CLAY GRVL SAND 0070 GREY CLAY GRVL SAND 0085 BRWN ROCK 0110
CON 10	011	67- 02785	569650 4820669	1125	1965/04	2406	05	FR	0076	4	18	15	1 :30	DO			MCNINCH C LOAM 0001 BRWN CLAY STNS 0035 GREY CLAY GRVL 0068 BRWN LMSN 0095
CON 10	011	67- 08371	568989 4820170	1181	1985/07	3317	05	FR	0125	49	70	20	2 :	DO			LUE-KIM, H CLAY GRVL 0055 CLAY BLDR 0070 CLAY STNS SAND 0093 GREY LMSN 0105 BRWN ROCK 0156
CON 10	011	67- 05358	569316 4820209	1145	1974/11	2336	05	FR	0118	57	80	20	1 :0	DO			LUE-KIM H LOAM 0001 BRWN CLAY STNS GRVL 0076 GREY CLAY STNS GRVL 0093 GREY ROCK 0112 BRWN ROCK 0118
CON 10	011	67- 05376	568570 4819374	1190	1974/07	4208	06	FR	0120	81	120	20	1 :0	DO			VONFIELITZ JURGEN GREY CLAY STNS GRVL 0050 GREY GRVL 0090 GREY CLAY SAND GRVL 0115 GREY LMSN 0125
CON 10	011	67- 10493	570046 4820778	1122	1990/07	4207	06	FR	0088	21	80	75	1 :	DO			CARSON REED HOMES GREY GRVL CLAY 0084 BRWN LMSN 0089
CON 10	011	67- 02788	569173 4820345	1160	1967/07	1906	04	FR	0105	50	60	15	3 :0	DO			PALMER A LOAM 0001 STNS CLAY 0050 CLAY MSND 0065 STNS CLAY 0078 BRWN LMSN 0105
CON 10	011	67- 03925	569840 4820850	1125	1971/05	2406	05	FR	0095	25	30	20	1 :0	DO			CULLEN BARRY BRWN CLAY MSND STNS 0010 BRWN CLAY MSND GRVL 0043 GRVL 0080 BRWN CLAY MSND GRVL 0088 BRWN ROCK 0098 BLCK ROCK 0103
CON 10	011	67- 11982	569246 4820220	1164	1996/05	2663	06	FR	0101	40	65	20	1 :0	DO			FERGUSON, H. LOAM 0001 BRWN CLAY SAND GRVL 0040 GRVL SAND LOOS 0060 GRVL CLAY 0068 BRWN LMSN SOFT 0101
CON 10	011	67- 12733	569255~ 4820030		1998/10	2336	06	FR	0115	70	71	20	1 :0	DO			MOORE,DAVE-SANDY BRWN CLAY STNS 0020 BRWN GRVL SAND BLDR 0060 BRWN GRVL SAND 0090 GREY CLAY GRVL 0108 GREY ROCK 0120
CON 10	011	67- 13638	569255~ 4820029		2001/02	2663	06	FR	0082	38	48	20	1 :	DO			GANSON,IAN BRWN CLAY STNS SAND 0058 LMSN FCRD SOFT 0069 LMSN 0082
CON 10	011	67- 13784	569255~ 4820029		2001/08	2663	06	FR	0102	24	28	30	1 :	DO			DIXON,KICTH BRWN CLAY 0020 BRWN CLAY GRVL 0055 BRWN SAND 0091 BRWN LMSN FCRD 0092 BRWN LMSN 0102

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WATER WELL DATA SYSTEM   Mar 18 2003          PAGE: 101   COUNTY:  WELLINGTON                          GROUND WATER BULLETIN REPORT

MUNICIPALITY              UTM                        CSG KIND WATER STAT PUMP TEST TEST          SCREEN          OWNER
CONCESSION        WELL EASTING ELEV                  DIA  OF  FOUND LVL  LVL  RATE TIME  WATER DEPTH LENGTH DEPTHS IN FEET TO WHICH
   ETC        LOT  NO NORTHING FEET DATE    DRILLER INS WATER FEET  FEET FEET GPM  HR:MN USE   FEET   FEET      FORMATIONS EXTEND

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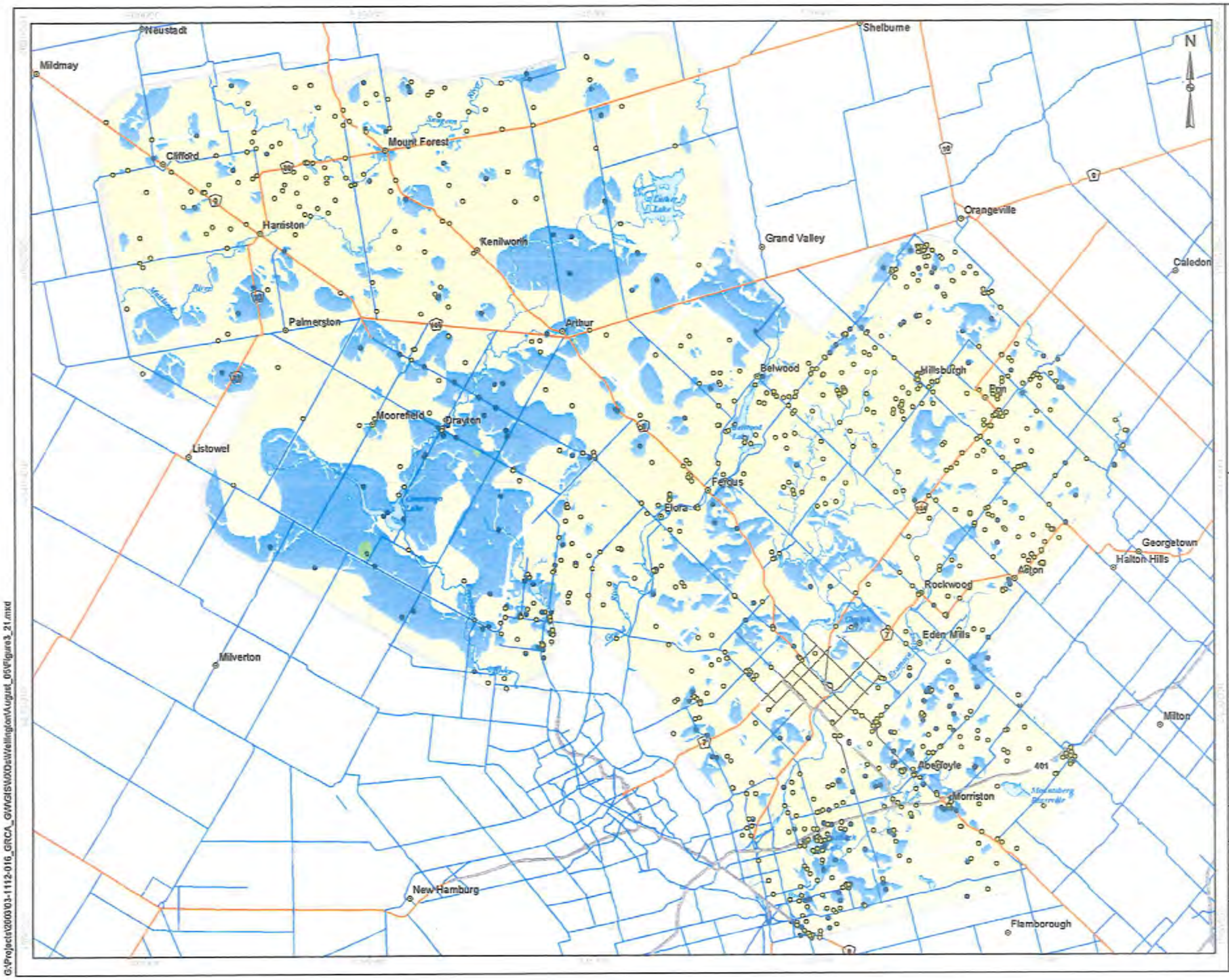
CON      10  011   67- 569255~       2002/01 2336  06  FR    0120  35   68   10   1 :0  DO                 VERDONE HOMES LTD
                  13998 4820029                                                                            BRWN CLAY STNS 0030 BRWN GRVL SAND 0058 GREY
                                                                                                           CLAY SAND GRVL 0063 BRWN ROCK 0120
CON      10  011   67- 569255~       2000/10 4005  06  FR    0135  96   130  15   1 :   DO                 GATTO CONSTRUCTION
                  13559 4820029                                                                            BRWN SAND GRVL BLDR 0025 BRWN GRVL SAND 0075
                                                                                                           BRWN CLAY SAND GRVL 0094 BRWN LMSN HARD 0144
CON      10  012   67- 569050    1100 1979/07 2904  08                               :                      GROENENDYK
                  07024 4818800                                                                            BRWN CLAY STNS SAND 0008 BRWN STNS BLDR GRVL
                                                                                                           0073 BLUE CLAY STNS SAND 0076 GREY SAND STNS
                                                                                                           CLAY 0087 GREY SAND CLAY BLDR 0094 GREY LMSN
                                                                                                           BLDR 0098 UNKN 0099
CON      10  012   67- 569050    1100 1979/11 1906  05  FR    0095  57   58   15   2 :0  DO                 GROENENDYK C
                  07199 4818800                                                                            BRWN CLAY STNS 0008 GRVL STNS 0087 GREY STNS
                                                                                                           0112
CON      10  012   67- 568762    1184 1989/11 2336  06  FR    0158  81   98   15   1 :   DO                 HUME, P.
                  10112 4819307                                                                            BRWN CLAY STNS 0015 BRWN CLAY SAND GRVL 0114
                                                                                                           BRWN ROCK 0160
CON      10  012   67- 570296    1125 1989/07 2336  06  FR    0059  17   35   25   1 :   DO                 RUHL, A
                  09880 4820561                                                                            BRWN CLAY SAND STNS 0015 BRWN CLAY SAND GRVL
                                                                                                           0045 BRWN GRVL CSND 0060
CON      10  012   67- 568947    1164 1994/07 3317  06  FR    0108  65   67   15   1 :30 DO                 FILIPPIN, SILVANO
                  11514 4819193                                                                            GRVL SAND BLDR 0090 GREY CLAY GRVL 0103 GREY
                                                                                                           LMSN 0110
CON      10  013   67- 569065~  1130 1958/12 2521  04  FR    0142  24   30   10   1 :0  ST DO              SMEENK J
                  02789 4818958                                                                            PRDG 0020 GRVL 0055 CLAY 0066 BRWN LMSN 0142
CON      10  013   67- 569825~       1981/07 2564  04  FR    0069  23   45   25   6 :0  DO ST              WILSON, WIM.
                  07624 4819454                                                                            BRWN CLAY SNDY 0025 GRVL 0040 SAND 0065 GREY
                                                                                                           ROCK 0069
CON      10  013   67- 569160    1110 1981/07 2564  04  FR    0069  23   45   25   6 :0  DO                 WILSON W
                  07666 4818880                                                                            BRWN CLAY SNDY 0025 GRVL 0040 SAND 0065 STNS
                                                                                                           0069
CON      10  013   67- 569113    1132 1975/01 4208  06  MN    0070  27   30   30   1 :0  DO                 WILSON W
                  05871 4818850                                                                            GREY CLAY GRVL 0067 GREY LMSN 0072
CON      10  013   67- 570567    1115 1987/07 2336  05  FR    0118  20   50   20   1 :   DO                 READER, MR.
                  08888 4820316                                                                            BRWN CLAY SAND STNS 0015 BRWN CLAY GRVL 0025
                                                                                                           BRWN FSND GRVL 0040 GREY CLAY SAND 0082 BRWN
                                                                                                           ROCK 0118
CON      10  013   67- 569825~       1991/06 4005  06  UK    0075  15   55   20   1 :0  DO                 APPLEHILL CONST.INC.
                  10663 4819454                                                                            BRWN SAND LOOS 0008 BRWN CLAY LOOS 0014 BRWN
                                                                                                           SAND GRVL LOOS 0038 GREY CLAY LOOS 0069 GREY
                                                                                                           GRVL SAND LOOS 0075
CON      10  013   67- 568761    1184 1994/07 1737  02                               :   NU    0120 05      G.R.C.A.
                  11656 4819279                                                                            BRWN GRVL BLDR SAND 0012 GREY GRVL SAND STNS
                                                                                                           0122 BRWN LMSN 0125
CON      10  014   67- 569239    1160 1974/02 4208  06  FR    0093  45   50   20   1 :0  DO                 CLARK C
                  05093 4818631                                                                            BRWN CLAY SAND GRVL 0030 GREY CLAY GRVL 0090
                                                                                                           GREY GRVL 0093
CON      10  014   67- 569550    1150 1969/08 2406  05  FR    0140  26   38   15   1 :0  ST DO              ANGERMANN P
                  03465 4818700                                                                            PRDG 0006 BRWN CLAY STNS 0025 BRWN MSND 0030
                                                                                                           BRWN CLAY 0045 BRWN CLAY GRVL 0087 BRWN LMSN
                                                                                                           0143
CON      10  015   67- 571044    1148 1992/09 2336  06  FR    0158  17   65   15   1 :   DO                 PARKER HOMES
                  10999 4819879                                                                            BRWN CLAY STNS 0010 BRWN CLAY GRVL 0035 GREY
                                                                                                           CLAY GRVL 0064 BRWN ROCK 0090 BRWN ROCK 0120
                                                                                                           GREY ROCK 0160
```

BURNSIDE

Appendix C

Portions of County of Wellington Groundwater Protection Study



County of Wellington Groundwater Protection Study

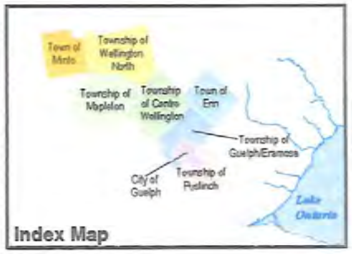
DRAFT

Legend

- Expressway
- Highway
- County Roads
- City Roads
- Major River
- Major Waterbody

Aquifer Vulnerability Indicator At Wells
- ○ Low
- ● Medium
- ○ High

Shallow Overburden Aquifer Vulnerability
- 🟩 Low
- 🟦 Medium
- ☐ High



Index Map

Digital Mapping Sources:
Base Mapping Features - CANMAP v5.0; County of Wellington;
Grand River Conservation Authority; MOE NRVIS data.
Map Projection: UTM 17, NAD 83

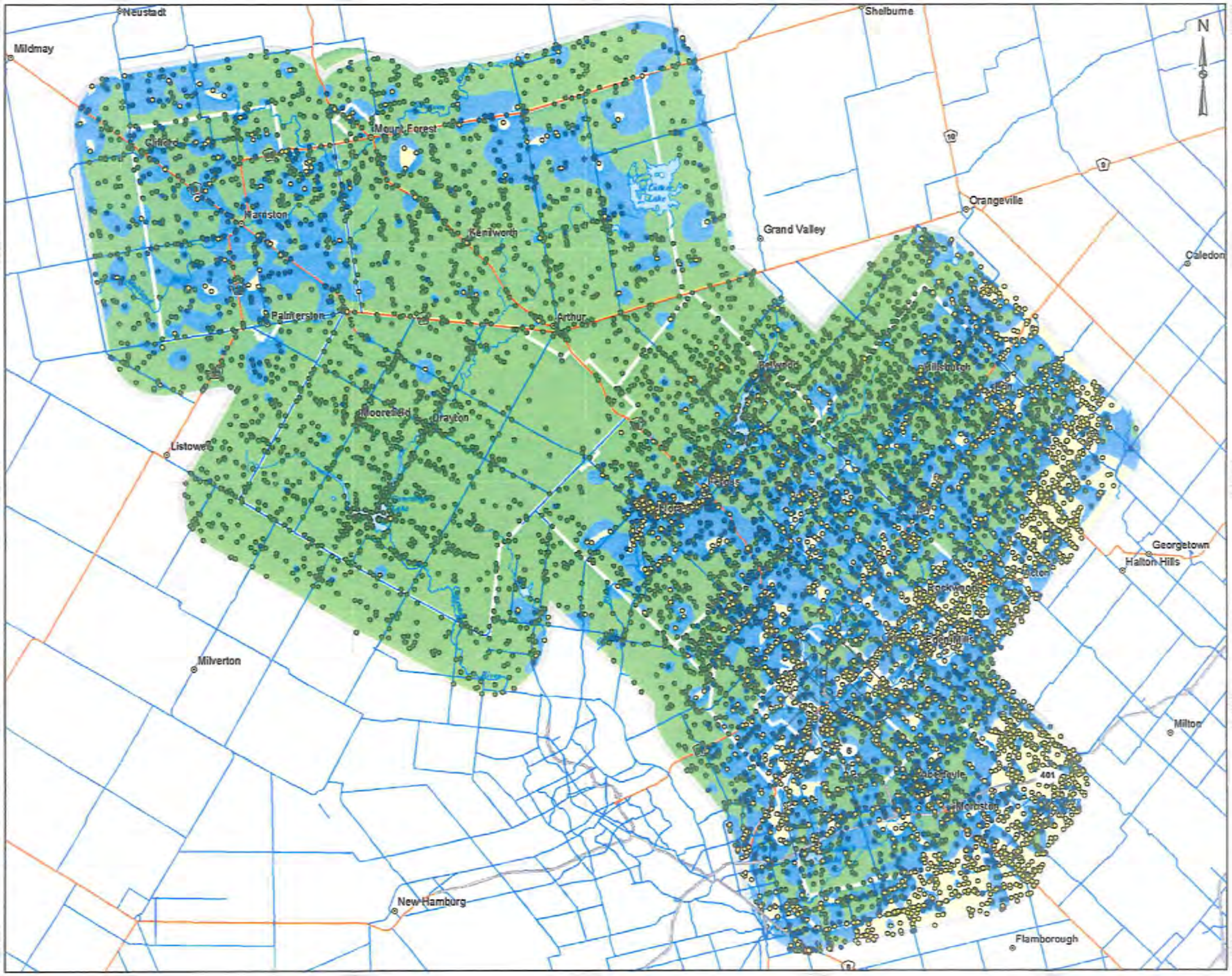
Disclaimer: The information conveyed by this map is regional in nature and is not suitable for use in site specific evaluations. This map should only be interpreted in conjunction with the accompanying written report.

Date: August 2005 Project No: 03-1112-015

1:325,000
5 0 5 10 Kilometres

Figure 3.21: Groundwater ISI Map - Shallow Overburden

G:\Projects\2003\03-1112-016_GRCA_GWGIS\MXDs\Wellington\August_05\Figure3_21.mxd



County of Wellington Groundwater Protection Study

DRAFT

Legend

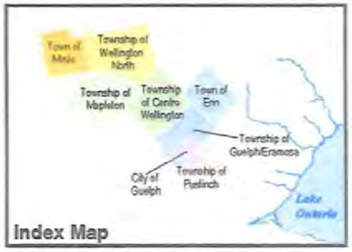
— Expressway
— Highway
— County Roads
— City Roads
— Major River
▭ Major Waterbody

Aquifer Vulnerability Indicator At Wells

- ○ Low
- ○ Medium
- ○ High

Bedrock Aquifer Vulnerability

- 🟩 Low
- 🟦 Medium
- ☐ High



Index Map

Digital Mapping Sources:
Base Mapping Features - CANMAP v5.0; County of Wellington;
Grand River Conservation Authority; MOE NRVIS data.
Map Projection: UTM 17, NAD 83

Disclaimer: The information conveyed by this map is regional in nature and is not suitable for use in site specific evaluations. This map should only be interpreted in conjunction with the accompanying written report.

Date: August 2005

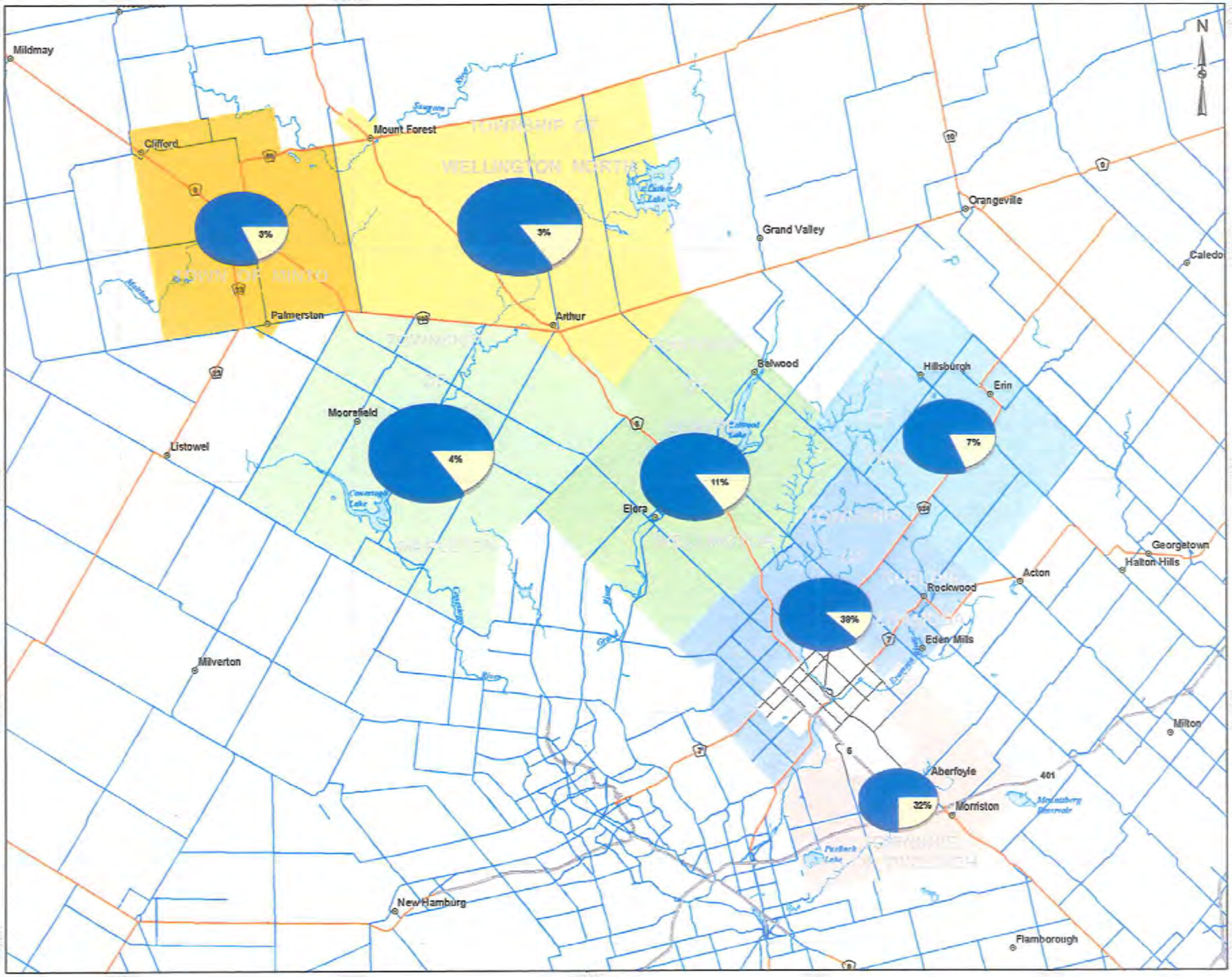
Project No: 03-1112-015

1:325,000

5 0 5 10 Kilometres

Figure 3.23: Groundwater ISI Map - Bedrock

G:\Projects\2003\03-1112-016_GRCA_GWGIS\WORKDa\Wellington\August_05\Figure3_23.mxd



County of Wellington Groundwater Protection Study

DRAFT

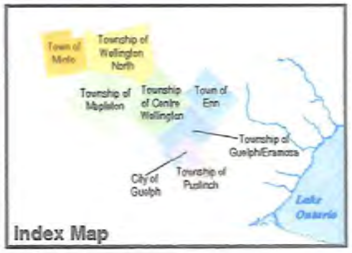
Legend

- Expressway
- Highway
- County Roads
- City Roads
- Major River
- Major Waterbody
- Study Area Boundary

Total Water Use

- ■ Evaporation and Surface Runoff
- □ Groundwater Recharge

Note: Percentages Shown are:
Groundwater Use as a Percentage
of Groundwater Recharge



Index Map

Digital Mapping Sources:
Base Mapping Features - CANMAP v5.0; County of Wellington;
Grand River Conservation Authority; MOE NRVIS data.
Map Projection: UTM 17, NAD 83

Disclaimer: The information conveyed by this map is regional in nature and is not suitable for use in site specific evaluations. This map should only be interpreted in conjunction with the accompanying written report.

Date: August 2005 Project No: 03-1112-015

1:325,000
5 0 5 10 Kilometres

MHBC
Golder Associates
SRG SOIL RESOURCE GROUP

Figure 3.25: Schematic Illustration of Approximate Water Balance

BURNSIDE

Appendix D
Borehole Logs

REFERENCE No: G2547-6-2

BOREHOLE No: 1

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

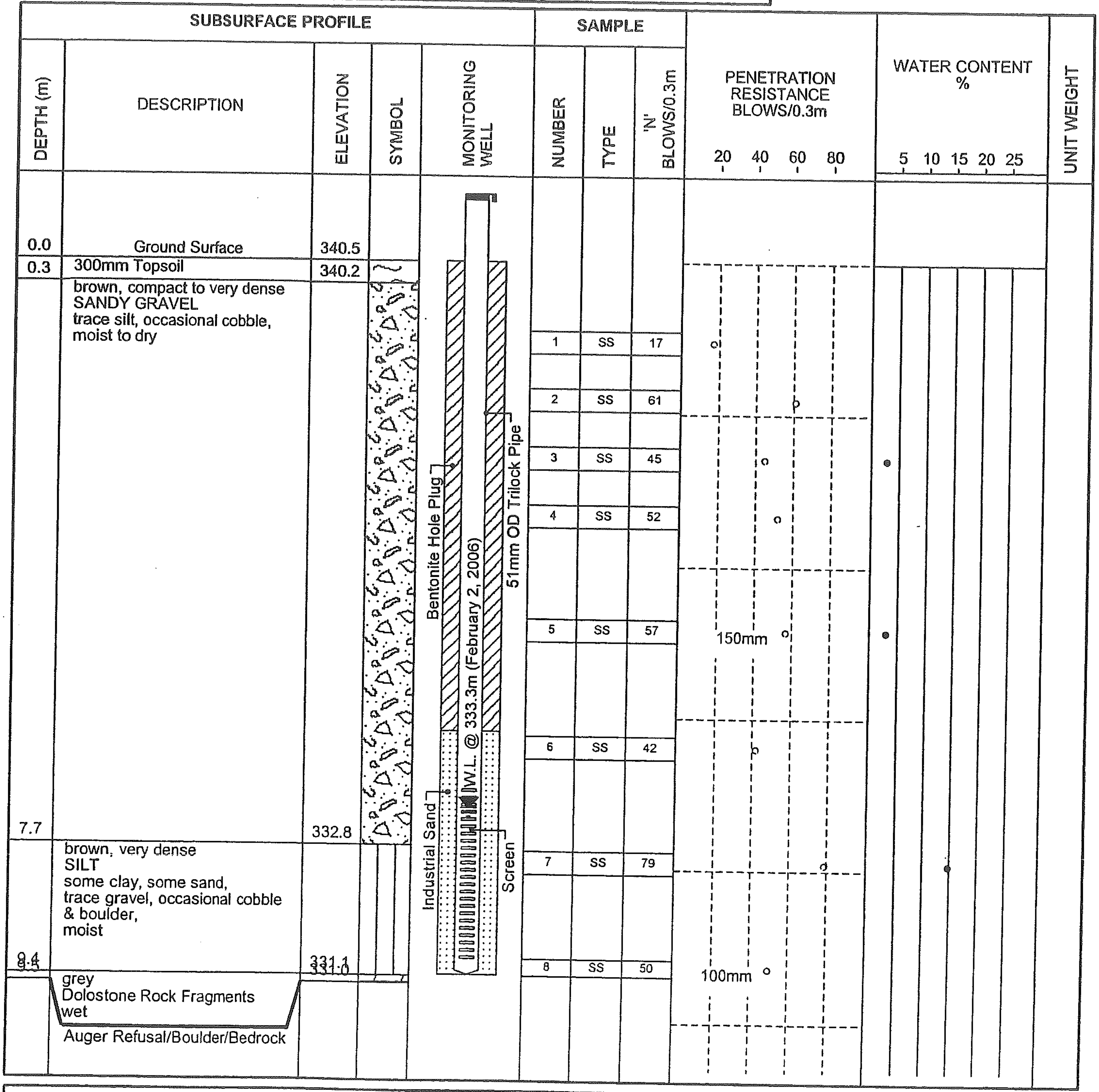
ENCLOSURE No: 2

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912



DEPTH (m)	DESCRIPTION	ELEVATION
0.0	Ground Surface	340.5
0.3	300mm Topsoil	340.2
	brown, compact to very dense SANDY GRAVEL trace silt, occasional cobble, moist to dry	
7.7		332.8
	brown, very dense SILT some clay, some sand, trace gravel, occasional cobble & boulder, moist	
9.4 9.5		331.1 331.0
	grey Dolostone Rock Fragments wet	
	Auger Refusal/Boulder/Bedrock	

NUMBER	TYPE	'N' BLOWS/0.3m
1	SS	17
2	SS	61
3	SS	45
4	SS	52
5	SS	57
6	SS	42
7	SS	79
8	SS	50

DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 12, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 2

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

CLIENT: 1648253 Ontario Inc.

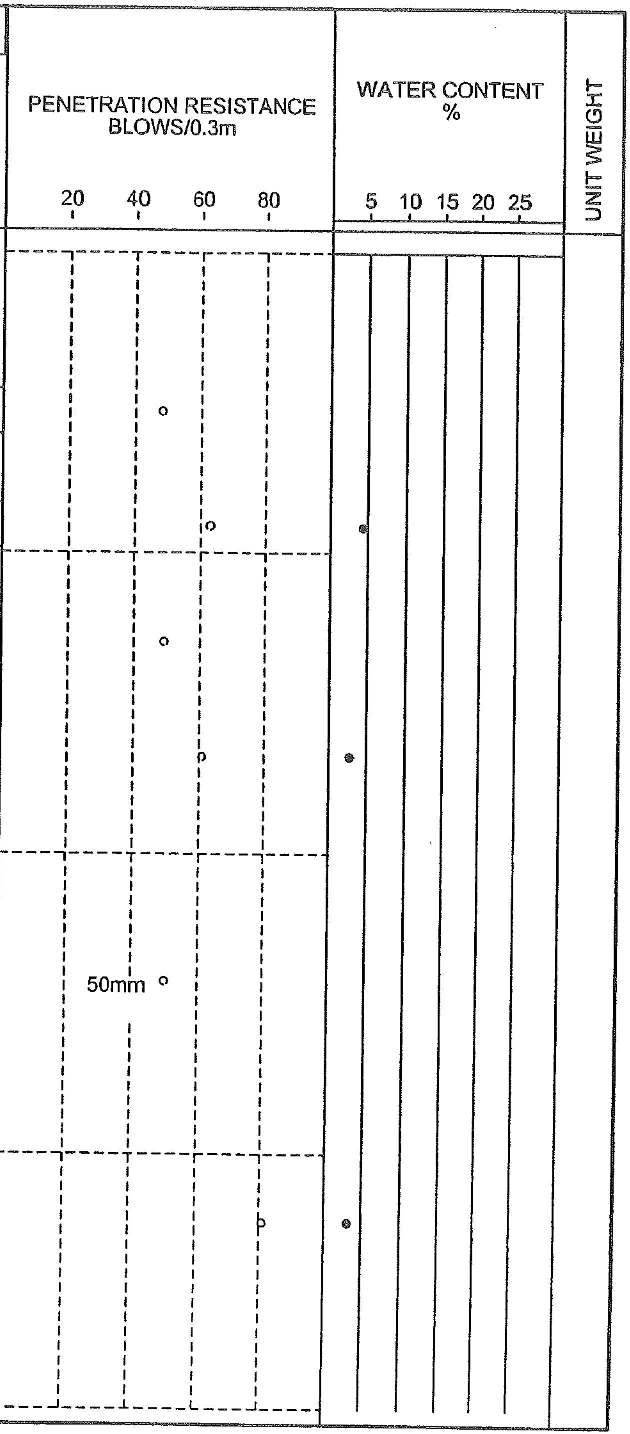
PROJECT: Proposed Residential Development

ENCLOSURE No: 3

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	340.1					
0.4	400mm Topsoil	339.7					
	brown, dense to very dense SANDY GRAVEL trace silt, occasional cobble, moist to dry			DRY CAVE-IN @ 335.4m (January 12, 2006)	1	SS	48
					2	SS	63
					3	SS	49
	occasional boulder @ 4.3m				4	SS	61
					5	SS	50
6.6		333.5			6	SS	81
	End of Borehole						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 12, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 3

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

ENCLOSURE No: 4

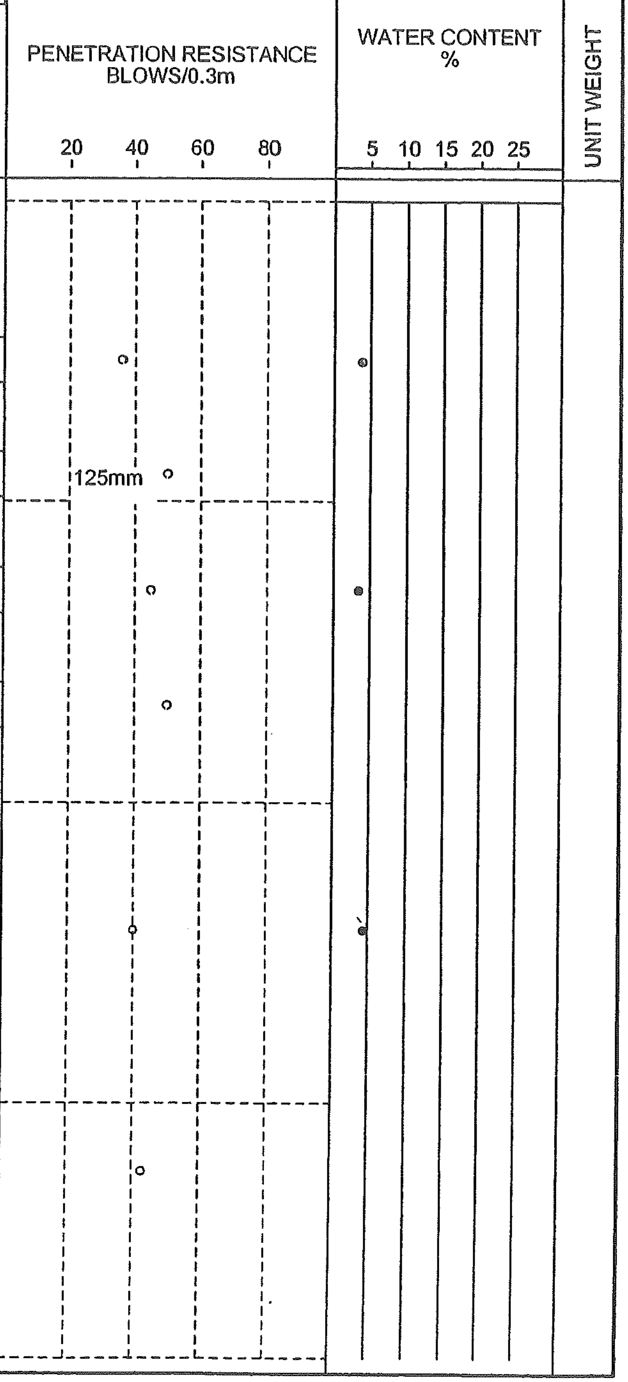
LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	339.9		DRY (January 12, 2006)			
0.2	200mm Topsoil	339.7	~				
	brown, very dense SANDY GRAVEL trace silt, occasional cobble, dry				1	SS	36
					2	SS	50
	occasional boulder @ 3.6m				3	SS	45
					4	SS	50
					5	SS	40
6.6		333.3			6	SS	43
	End of Borehole						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 12, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 4

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

ENCLOSURE No: 5

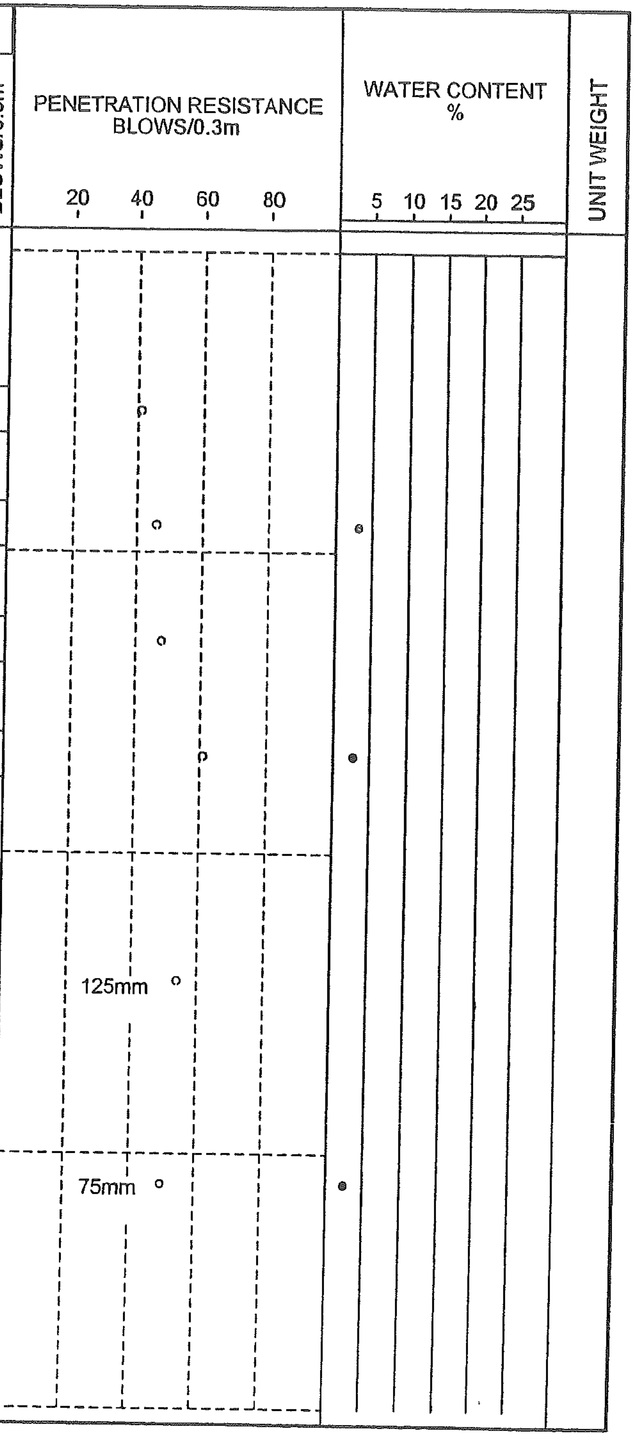
LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	340.9		DRY CAVE-IN @ 336.1m (January 13, 2006)			
0.2	200mm Topsoil	340.7					
	brown, dense to very dense SANDY GRAVEL some silt, occasional cobble, moist to dry				1	SS	41
					2	SS	46
					3	SS	48
					4	SS	61
					5	SS	54
6.3		334.6			6	SS	50
	End of Borehole						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 13, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 5

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

CLIENT: 1648253 Ontario Inc.

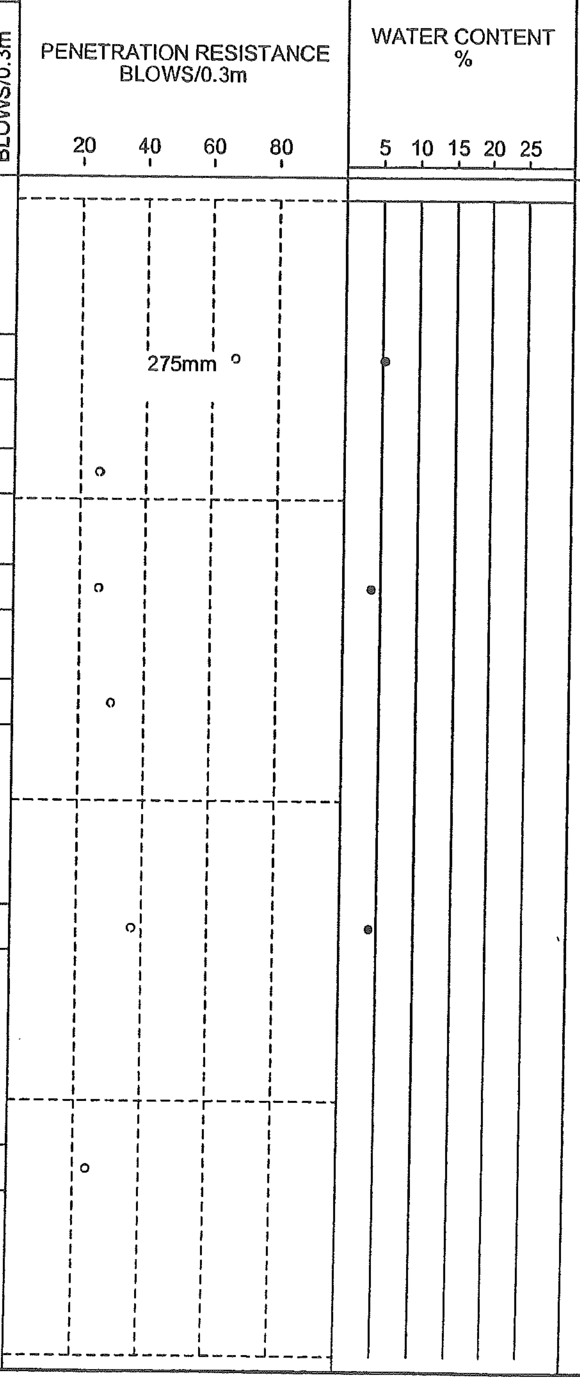
PROJECT: Proposed Residential Development

ENCLOSURE No: 6

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m	PENETRATION RESISTANCE BLOWS/0.3m	WATER CONTENT %	UNIT WEIGHT
0.0	Ground Surface	341.9								
0.2	200mm Topsoil	341.7								
	brown, very dense to compact SANDY GRAVEL trace silt, occasional cobble, moist to dry			⊻ DRY CAVE-IN @ 336.9m (January 13, 2006)	1	SS	67			
					2	SS	26			
					3	SS	26			
					4	SS	30			
					5	SS	37			
6.6		335.3			6	SS	24			
	End of Borehole									



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 13, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 6

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

ENCLOSURE No: 7

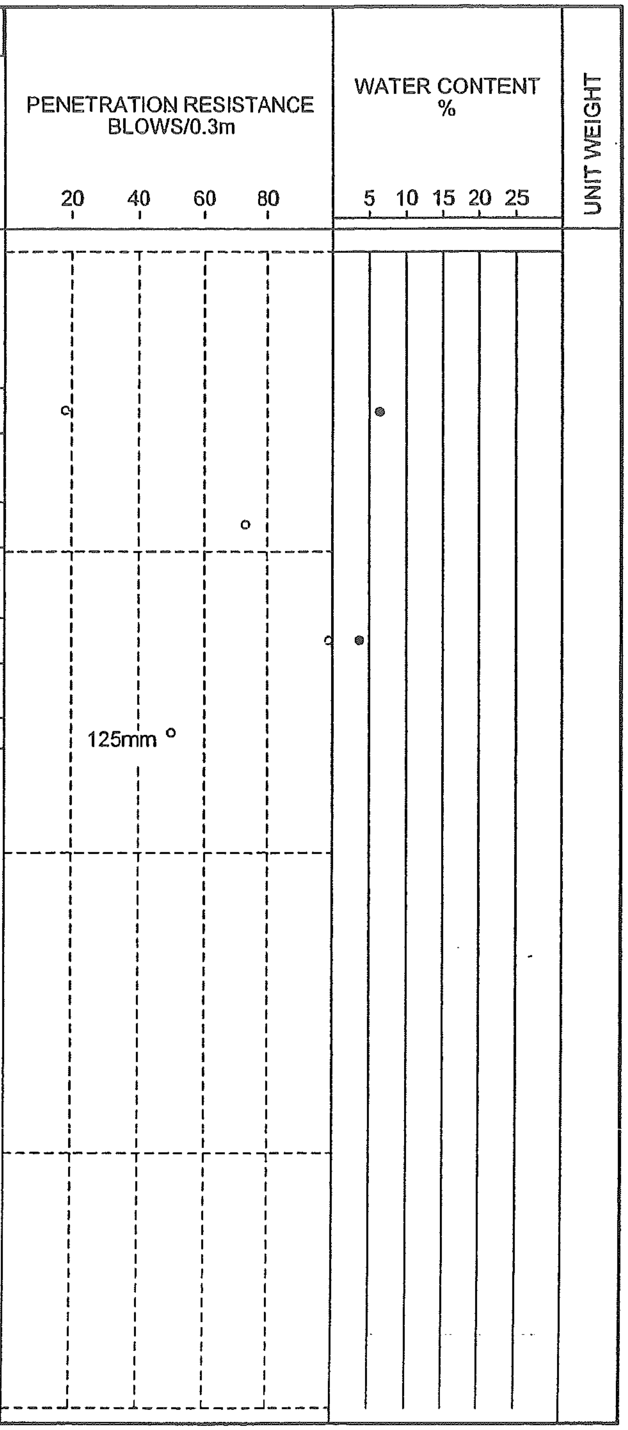
LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	342.9					
0.3	250mm Topsoil	342.6					
	brown, compact to very dense GRAVEL AND SAND some silt, occasional cobble & boulder, moist			DRY (January 13, 2006)			
					1	SS	18
					2	SS	73
					3	SS	99
3.3		339.6			4	SS	50
	Refusal on Probable Boulder/Bedrock						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 13, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 7

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

ENCLOSURE No: 8

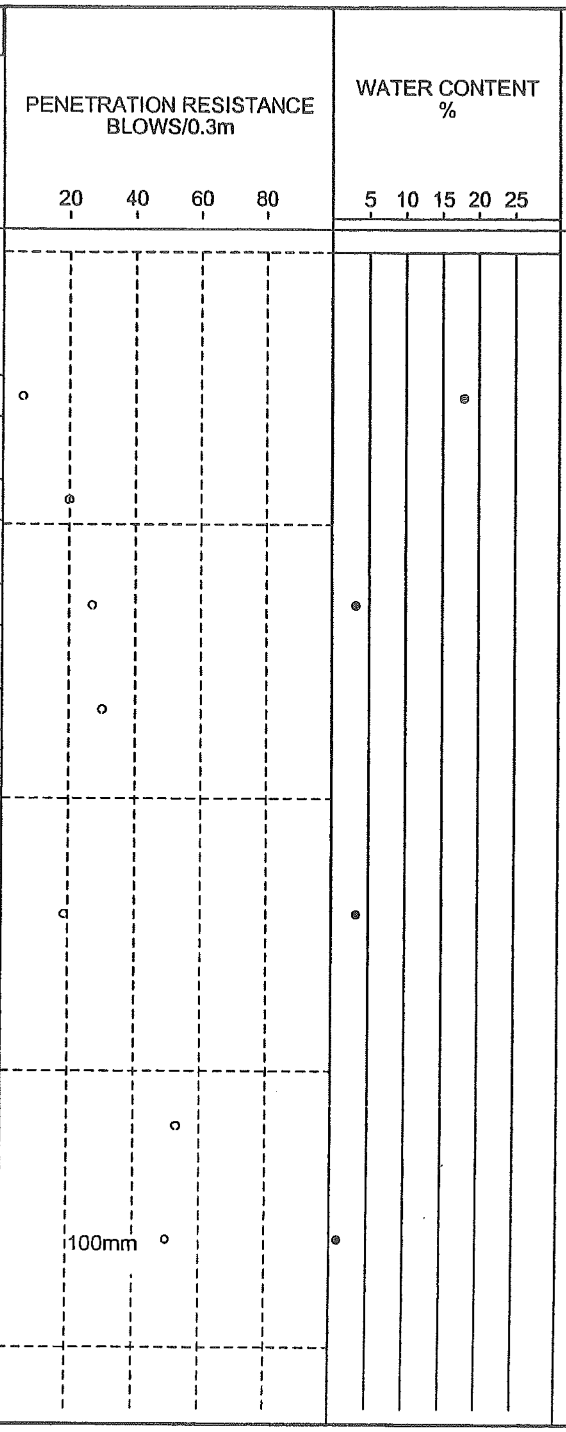
LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: MN

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	344.4		DRY (January 16, 2006)			
	1500mm Topsoil		≈				
					1	SS	6
1.5		342.9					
	brown, compact to very dense GRAVEL AND SAND some silt, occasional cobble, dry				2	SS	20
					3	SS	27
					4	SS	30
	occasional boulder @ 4.5m						
					5	SS	19
					6	SS	53
7.2		337.2					
7.3	grey Dolostone Rock Fragments	337.1			7	SS	50
	Refusal on Probable Boulder/Bedrock						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 16, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 8

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

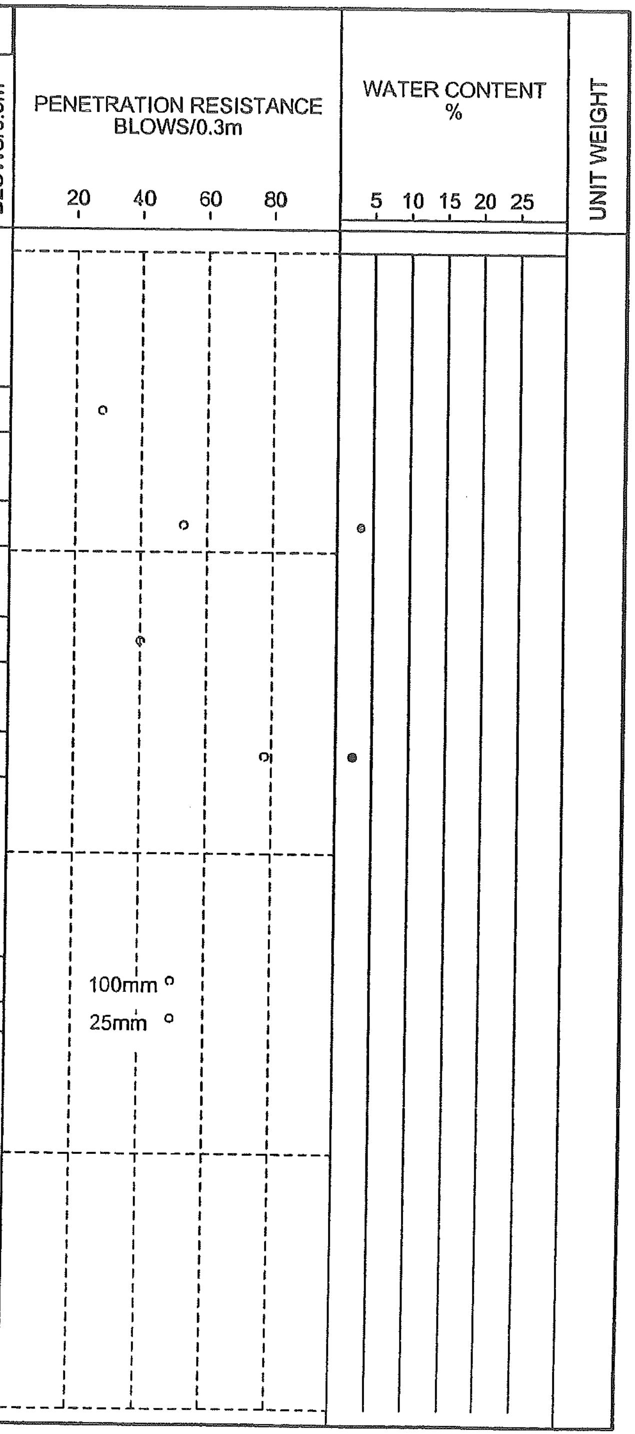
ENCLOSURE No: 9

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS
405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	344.3					
0.2	200mm Topsoil	344.1		DRY CAVE-IN @ 340.3m (January 13, 2006)			
	brown, compact to very dense SANDY GRAVEL some silt, occasional cobble, moist to dry						
					1	SS	28
					2	SS	53
					3	SS	40
					4	SS	78
					5	SS	50
5.2		339.1			6	SS	50
	Refusal on Probable Boulder/Bedrock						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 13, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 9

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

ENCLOSURE No: 10

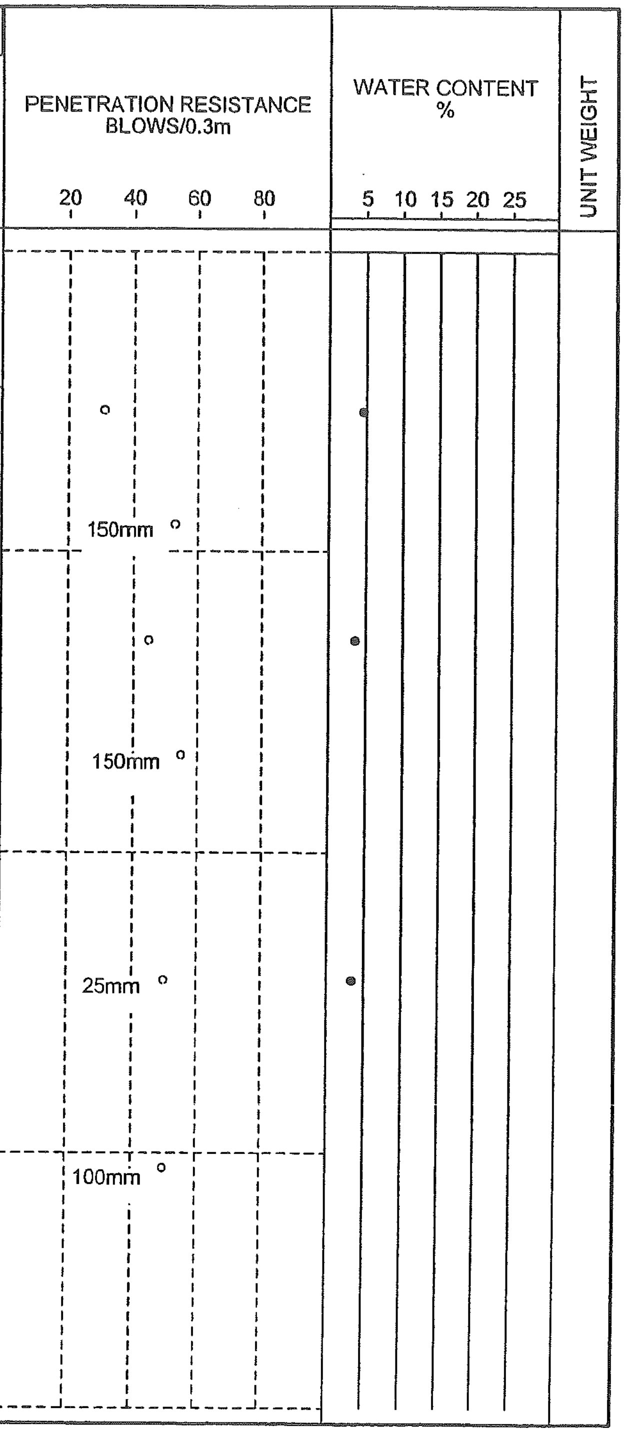
LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE		
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m
0.0	Ground Surface	343.3					
0.3	250mm Topsoil	343.1					
	brown, dense to very dense GRAVEL AND SAND some silt, occasional cobble, moist to dry			DRY CAVE-IN @ 338.7m (January 13, 2006)			
					1	SS	31
					2	SS	53
					3	SS	45
					4	SS	55
					5	SS	50
6.2		337.1			6	SS	50
	End of Borehole						



DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 13, 2006

SHEET: 1 of 1

REFERENCE No: G2547-6-2

BOREHOLE No: 10

CLIENT: 1648253 Ontario Inc.

PROJECT: Proposed Residential Development

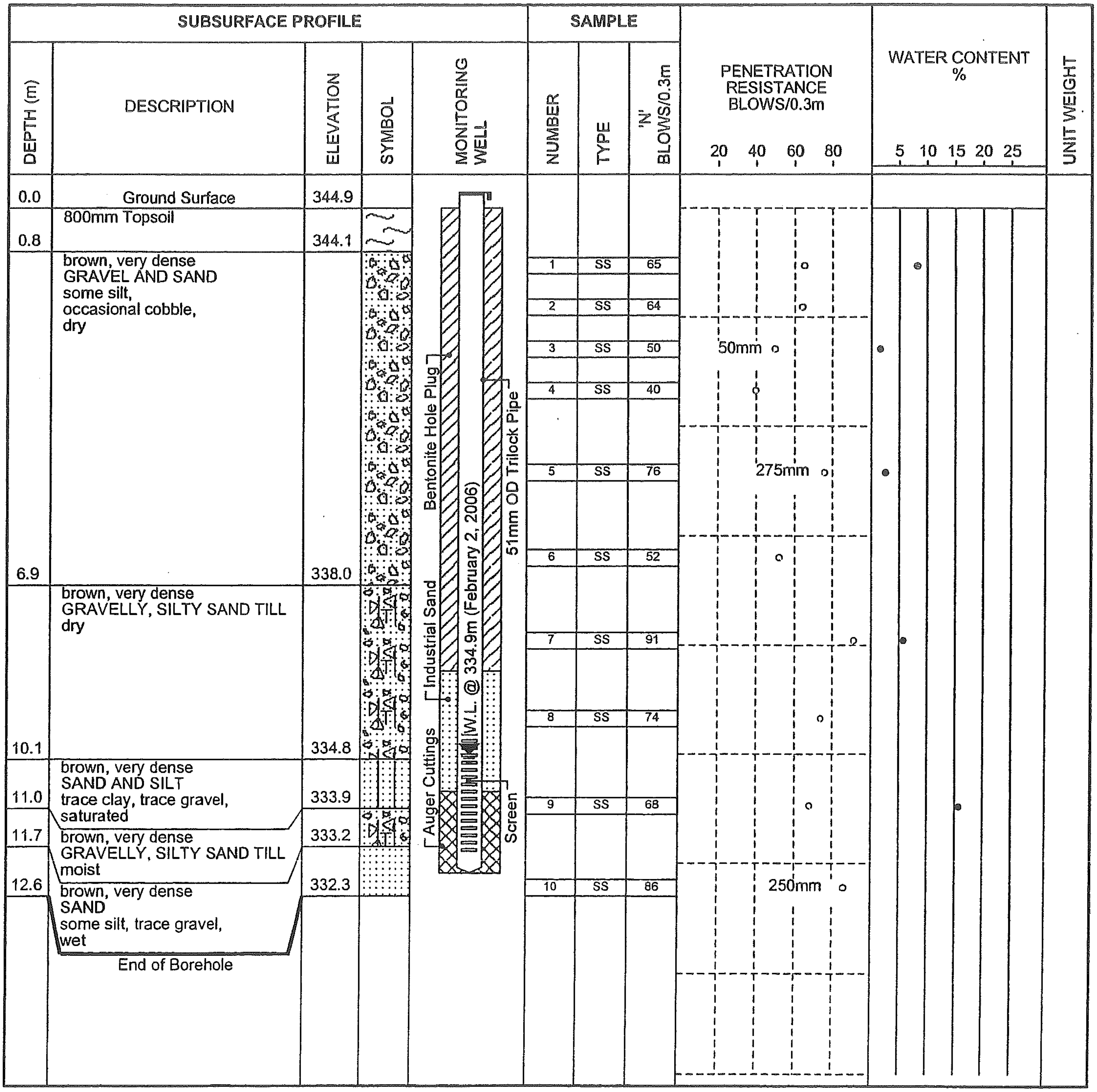
ENCLOSURE No: 11

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: MN

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912



DEPTH (m)	DESCRIPTION	ELEVATION
0.0	Ground Surface	344.9
0.8	800mm Topsoil	344.1
6.9	brown, very dense GRAVEL AND SAND some silt, occasional cobble, dry	338.0
10.1	brown, very dense GRAVELLY, SILTY SAND TILL dry	334.8
11.0	brown, very dense SAND AND SILT trace clay, trace gravel, saturated	333.9
11.7	brown, very dense GRAVELLY, SILTY SAND TILL moist	333.2
12.6	brown, very dense SAND some silt, trace gravel, wet	332.3
	End of Borehole	

NUMBER	TYPE	'N' BLOWS/0.3m
1	SS	65
2	SS	64
3	SS	50
4	SS	40
5	SS	76
6	SS	52
7	SS	91
8	SS	74
9	SS	68
10	SS	86

DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 16, 2006

SHEET: 1 of 1

BURNSIDE

Appendix E
Laboratory Certificates of Analysis

AGAT® Laboratories

Certificate of Analysis

AGAT WORK ORDER: 06T154459
PROJECT NO: 10312.0

CLIENT NAME: R.J. BURNSIDE & ASSOCIATES LTD
ATTENTION TO: David Wilson

Water Quality Assessment

DATE SAMPLED: January 26 2006 **DATE RECEIVED:** January 30 2006 **DATE REPORTED:** February 07 2006 **SAMPLE TYPE:** Water

	Unit	G / S	M.D.L.	MW1 494294	M.D.L	MW2 494295
Electrical Conductivity	uS/cm		2	808	2	792
pH	N/A			8.05		8.05
Saturation pH			N/A	6.93	N/A	6.84
Total Dissolved Solids	mg/L		20	414	20	450
Total Hardness (as CaCO3)	mg/L		10	291	10	348
Alkalinity (as CaCO3)	mg/L		10	294	10	299
Bicarbonate (as CaCO3)	mg/L		10	294	10	299
Carbonate (as CaCO3)	mg/L		10	<10	10	<10
Hydroxide	mg/L		10	<10	10	<10
Fluoride	mg/L	1.5	0.05	0.08	0.05	0.09
Chloride	mg/L		0.10	70.9	0.10	51.0
Bromide	mg/L		0.05	<0.05	0.05	0.18
Nitrate as N	mg/L	10.0	0.05	3.34	0.05	4.18
Nitrite as N	mg/L	1.0	0.05	<0.05	0.05	0.09
Sulphate	mg/L		0.10	15.3	0.10	27.0
Calcium	mg/L		0.05	71.5	0.05	79.6
Magnesium	mg/L		0.05	27.3	0.05	36.3
Sodium	mg/L	20	0.05	**38.9**	0.05	16.5
Potassium	mg/L		0.05	9.68	0.05	2.11
Ammonia (as N)	mg/L		0.05	0.76	0.05	1.01
Orthophosphate as P	mg/L		0.10	<0.10	0.10	<0.10
Total Organic Carbon *	mg/L		5	154	1	21
Reactive Silica *	mg/L		0.05	7.54	0.05	10.2
Colour	Colour Units		5	<5	5	<5
Turbidity	NTU		0.5	3.8	0.5	2.0
Aluminum	mg/L		0.004	0.020	0.004	0.015
Arsenic	mg/L	0.025	0.003	<0.003	0.003	<0.003
Barium	mg/L	1.0	0.002	0.032	0.002	0.021
Boron	mg/L	5.0	0.010	0.025	0.010	0.076
Cadmium	mg/L	0.005	0.002	<0.002	0.002	<0.002
Chromium	mg/L	0.05	0.003	<0.003	0.003	<0.003

Certified By: [redacted]

AGAT® Laboratories

Certificate of Analysis

AGAT WORK ORDER: 06T154459
PROJECT NO: 10312.0

CLIENT NAME: R.J. BURNSIDE & ASSOCIATES LTD **ATTENTION TO:** David Wilson

Water Quality Assessment

DATE SAMPLED: January 26 2006 **DATE RECEIVED:** January 30 2006 **DATE REPORTED:** February 07 2006 **SAMPLE TYPE:** Water

	Unit	G / S	M.D.L.	MW1 494294	M.D.L	MW2 494295
Copper	mg/L		0.003	0.004	0.003	0.004
Iron	mg/L		0.005	0.349	0.005	0.341
Lead	mg/L	0.01	0.002	<0.002	0.002	<0.002
Manganese	mg/L		0.002	0.018	0.002	0.140
Mercury	mg/L	0.001	0.0001	<0.0001	0.0001	<0.0001
Molybdenum	mg/L		0.002	<0.002	0.002	0.012
Nickel	mg/L		0.003	<0.003	0.003	<0.003
Total Phosphorus	mg/L		0.05	0.11	0.05	0.59
Selenium	mg/L	0.01	0.004	<0.004	0.004	<0.004
Silver	mg/L		0.002	<0.002	0.002	<0.002
Strontium	mg/L		0.005	0.093	0.005	0.137
Thallium	mg/L		0.006	<0.006	0.006	<0.006
Titanium	mg/L		0.001	<0.001	0.001	<0.001
Uranium	mg/L	0.02	0.001	<0.001	0.001	<0.001
Vanadium	mg/L		0.001	<0.001	0.001	<0.001
Zinc	mg/L		0.004	0.016	0.004	0.022
% Difference/Ion Balance	%			4.0		5.54
Langlier Index				1.12		1.21

Comments: M.D.L. - Method Detection Limit; G / S - Guideline / Standard: Refers to ODWS-Schedule 23
494294 * Analysis performed at AGAT Laboratories Calgary.
494295 * Analysis performed at AGAT Laboratories Calgary.

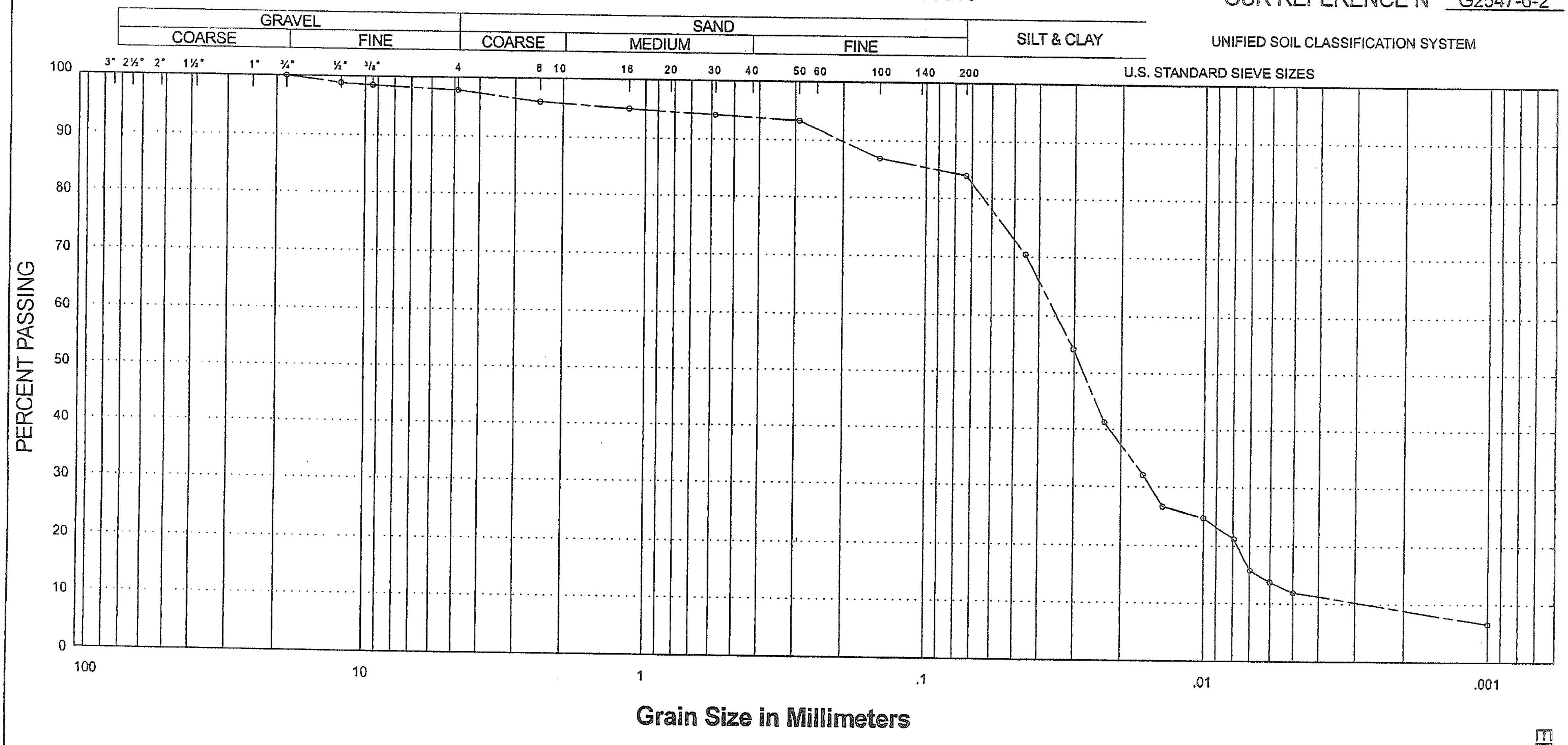
Certified By: [redacted]

BURNSIDE

Appendix F
Grainsize Analysis

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con. 10, Puslinch,ON
BOREHOLE N°: 1
SAMPLE N°: 7
DEPTH: 7.6 - 8.1m±
ELEVATION: 332.9 - 332.4m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SILT, some clay, some sand, trace gravel (ML)

PLASTIC PROPERTIES
LIQUID LIMIT % =
PLASTIC LIMIT % =
PLASTICITY INDEX % =
MOISTURE CONTENT % = 14.8

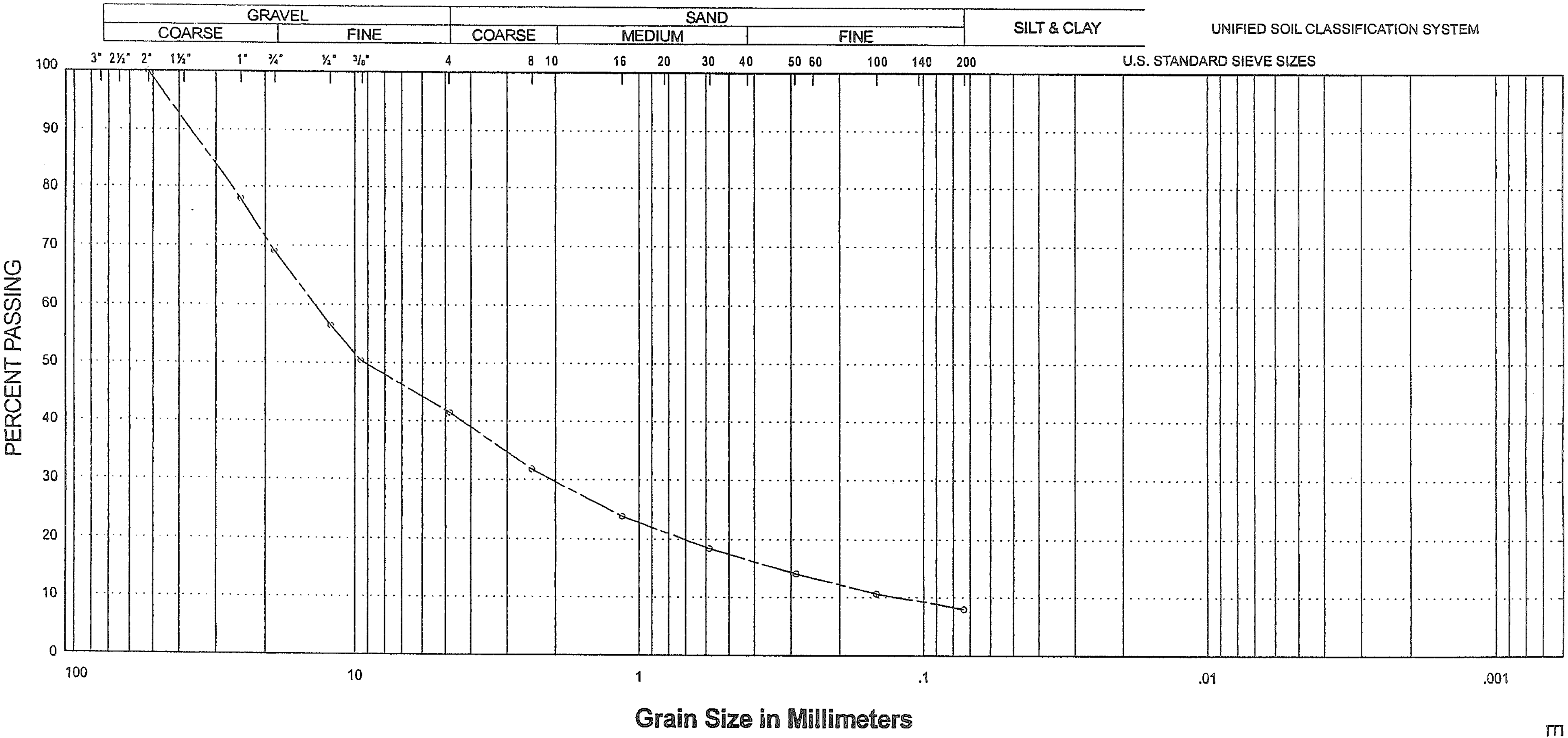
ENCLOSURE N° 16

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2

UNIFIED SOIL CLASSIFICATION SYSTEM



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch, ON
BOREHOLE N°: 5
SAMPLE N°: 4
DEPTH: 3.0 - 3.5m±
ELEVATION: 338.9.0 - 338.4m±

COEFFICIENT OF UNIFORMITY: 6.4
COEFFICIENT OF CURVATURE: 2.5

Classification of Sample and Group Symbol:

SANDY GRAVEL, trace silt (GW-GM)

PLASTIC PROPERTIES
LIQUID LIMIT % =
PLASTIC LIMIT % =
PLASTICITY INDEX % =
MOISTURE CONTENT % = 2.8

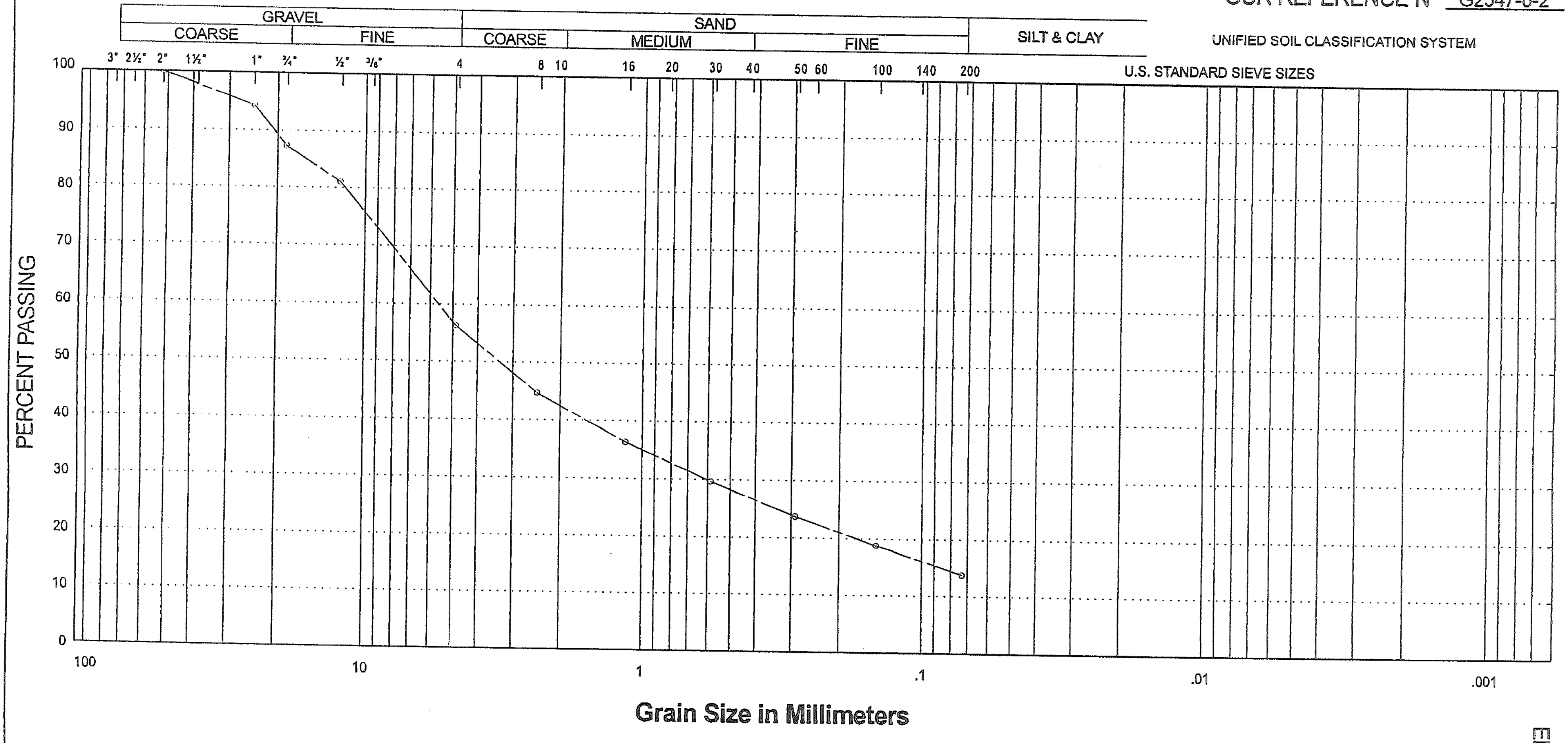
ENCLOSURE N° 12

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2

UNIFIED SOIL CLASSIFICATION SYSTEM



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch, ON
BOREHOLE N°: 6
SAMPLE N°: 2
DEPTH: 1.5 - 2.0m±
ELEVATION: 341.4.0 - 340.9m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

GRAVEL AND SAND, some silt (GM)

PLASTIC PROPERTIES

LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% = 3.7

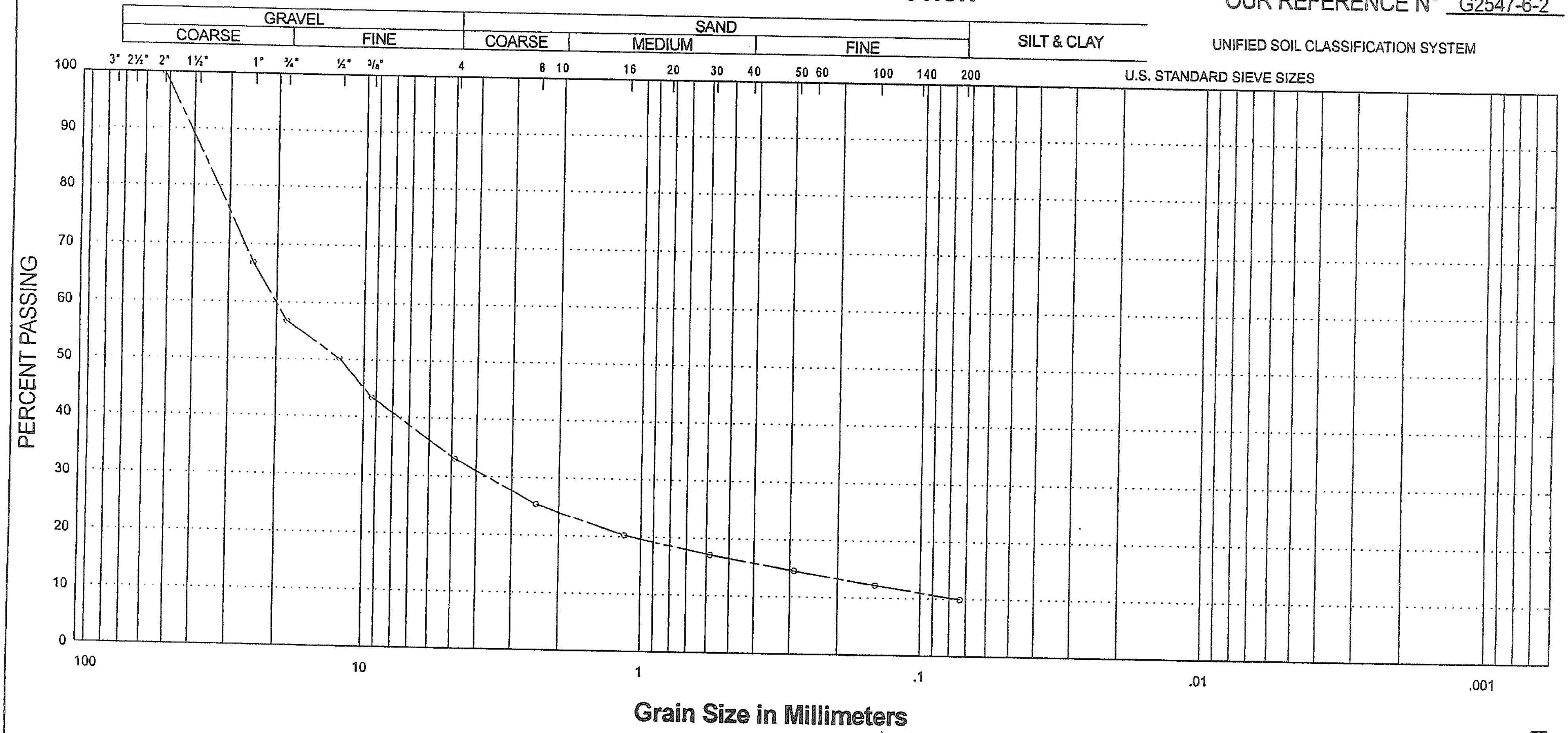
ENCLOSURE N° 14

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2

UNIFIED SOIL CLASSIFICATION SYSTEM



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch, ON
BOREHOLE N°: 8
SAMPLE N°: 2
DEPTH: 1.5 - 2.0m±
ELEVATION: 342.8.0 - 342.3m±

COEFFICIENT OF UNIFORMITY: 273.9
COEFFICIENT OF CURVATURE: 8.9

Classification of Sample and Group Symbol:

SANDY GRAVEL, trace silt (GP-GM)

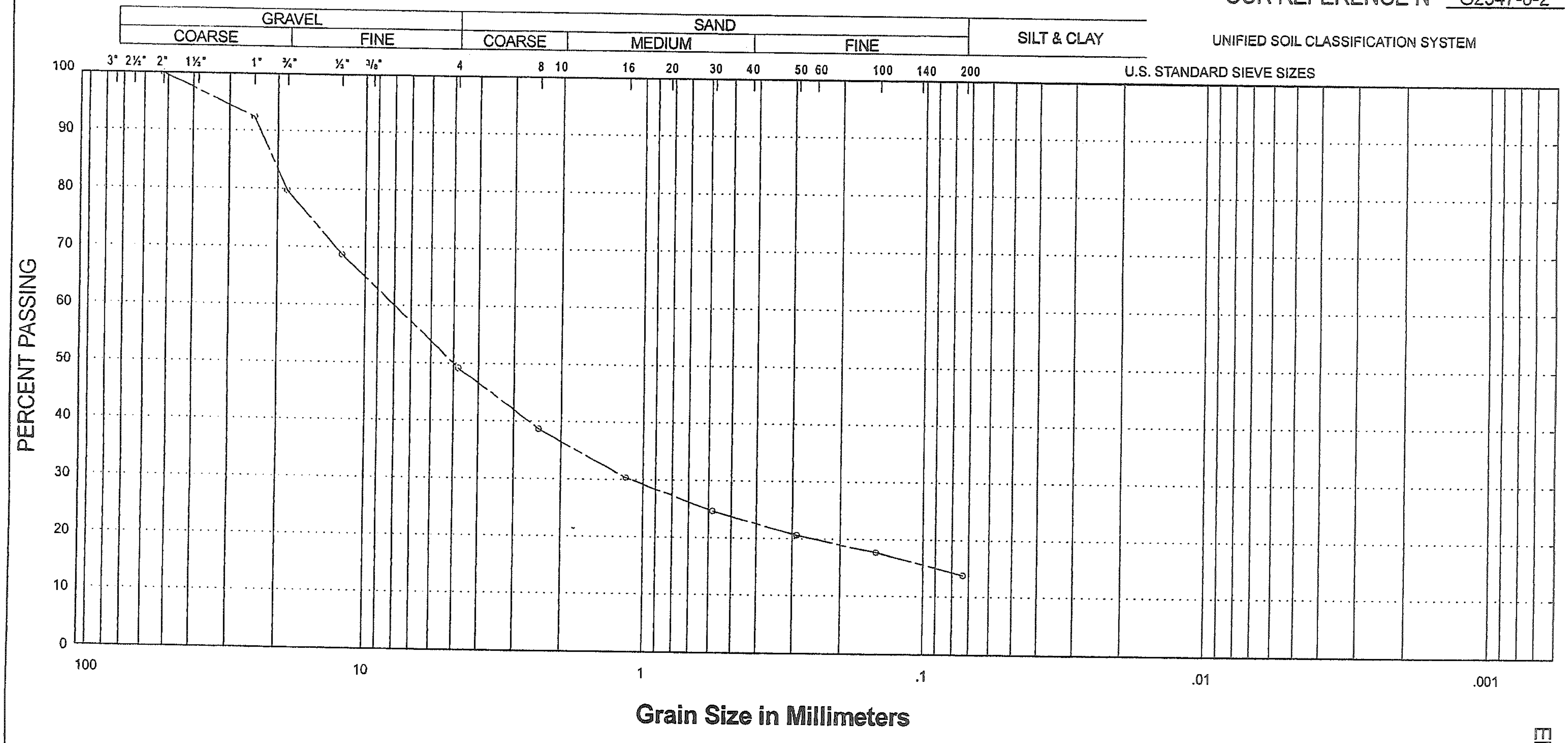
PLASTIC PROPERTIES
LIQUID LIMIT % =
PLASTIC LIMIT % =
PLASTICITY INDEX % =
MOISTURE CONTENT % = 2.6

ENCLOSURE N° 13

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch, ON
BOREHOLE N°: 9
SAMPLE N°: 3
DEPTH: 2.3 - 2.7m±
ELEVATION: 341.0 - 340.6m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

GRAVEL AND SAND, some silt (GM)

PLASTIC PROPERTIES

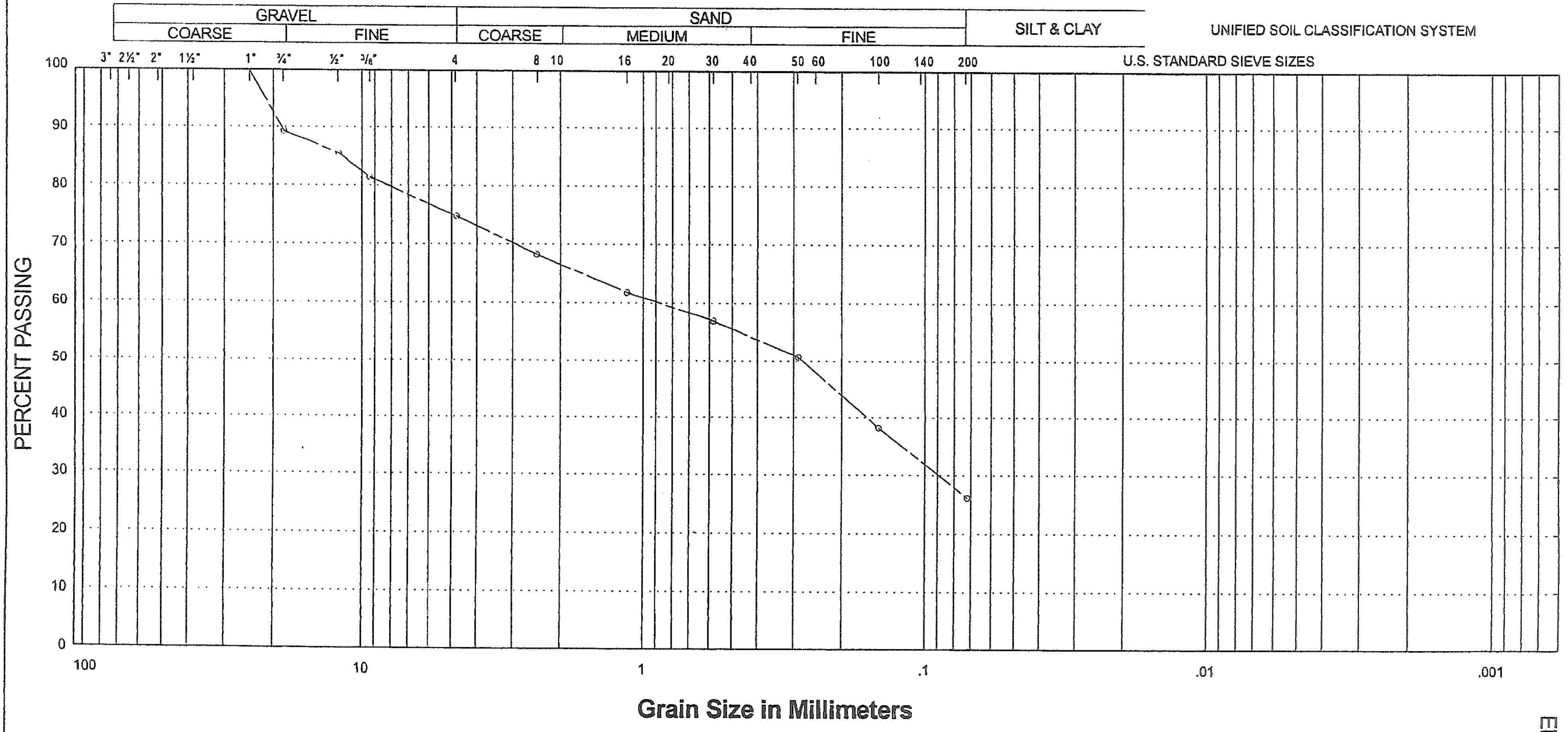
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% = 3.6

ENCLOSURE N° 15

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch, ON
BOREHOLE N°: 10
SAMPLE N°: 8
DEPTH: 9.1 - 9.6m±
ELEVATION: 331.4 - 330.9m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

GRAVELLY, SILTY SAND TILL (SM)

PLASTIC PROPERTIES

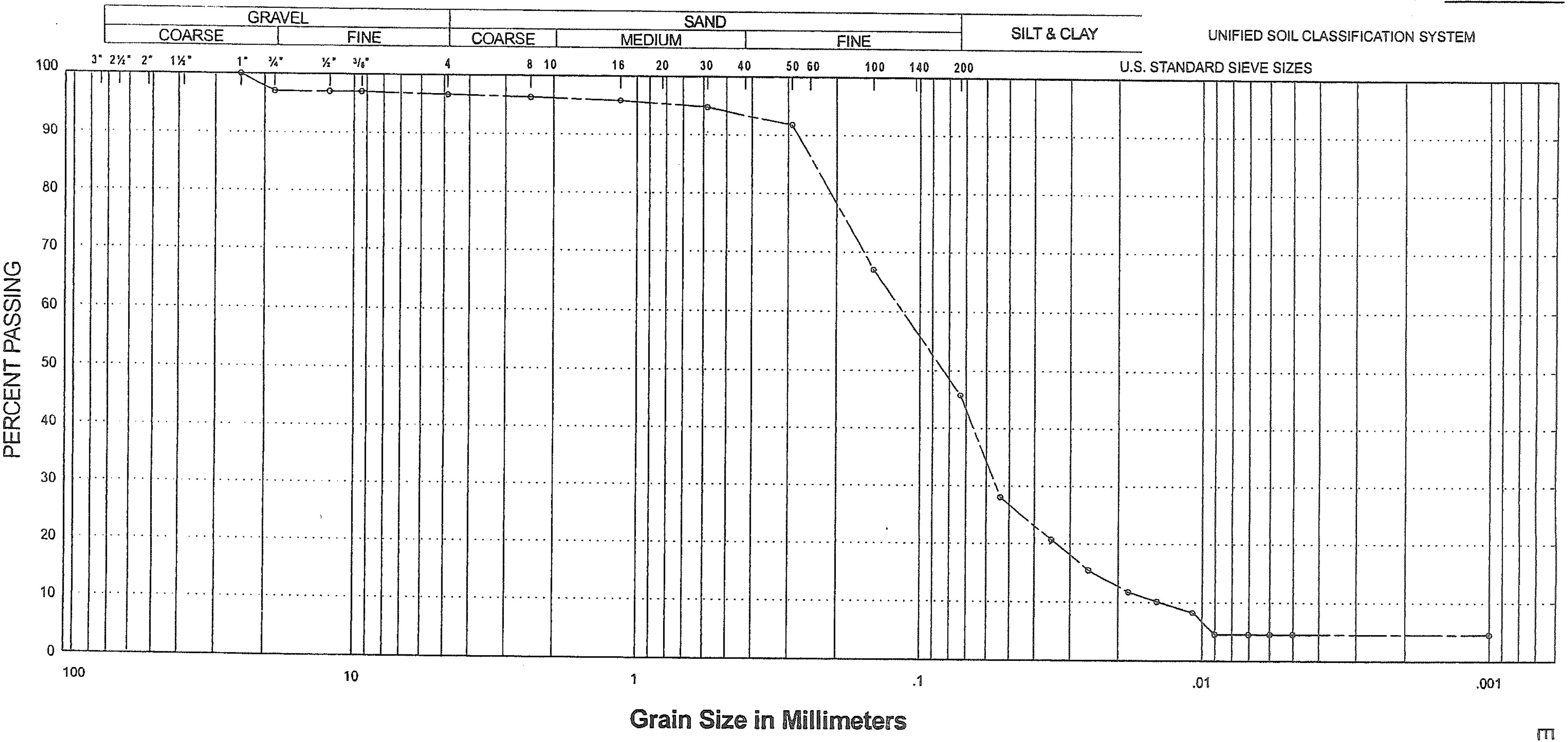
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =

ENCLOSURE N° 17

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2



PROJECT: Proposed Residential Subdivision
LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch,ON
BOREHOLE N°: 10
SAMPLE N°: 9
DEPTH: 10.7 - 11.1m±
ELEVATION: 334.2.0 - 333.8m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SAND AND SILT, trace clay, trace gravel (SM)

PLASTIC PROPERTIES

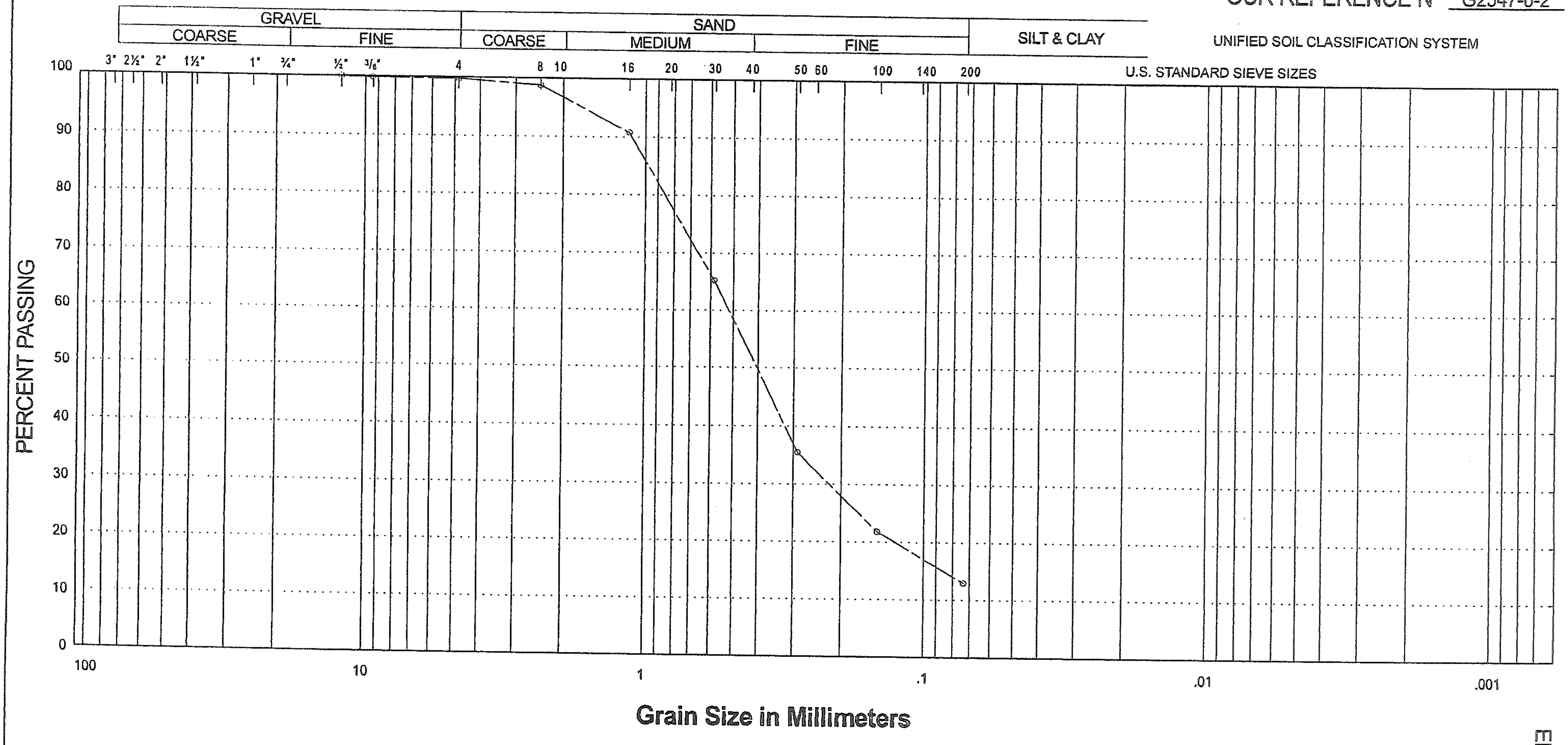
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% = 15.7

ENCLOSURE N° 18

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G2547-6-2



PROJECT: Proposed Residential Subdivision

LOCATION: Pt Lots 7, 8 & 9, Con 10, Puslinch, ON

BOREHOLE N°: 10

SAMPLE N°: 10

DEPTH: 12.2 - 12.6m±

ELEVATION: 332.7 - 332.3m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SAND, some silt, trace gravel (SM)

PLASTIC PROPERTIES

LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =

ENCLOSURE N° 19

V. A. WOOD (GUELPH) INCORPORATED

BURNSIDE

Appendix G
Nitrate Calculations

Kukovica Development - Arkell
MOE Mass Balance Equation
Nitrate Loading Calculations

$Q_t C_t = Q_e C_e + Q_i C_i$

Where:

Q_e	13870 **m^3/year**	Sewage Effluent Volume	(38 units @ 1000 litres/day)
Q_i	48780 **m^3/year**	Infiltration Volume = (recharge * study area)	(21.68 ha x .225 m)
Q_t	62650 **m^3/year**	Total Volume	
C_e	40000 **mg/m^3**	Concentration of sewage effluent	40 mg/L
C_i	100 **mg/m^3**	Concentration of precipitation	0.1 mg/L

$C_t = (Q_e C_e + Q_i C_i)/Q_t$

$Q_e C_e$	554800000 **mg/year**
$Q_i C_i$	4878000 **mg/year**
$C_t =$	8933 **mg/m^3**
	8.93 mg/L

Therefore the predicted concentration of nitrate being introduced to groundwater by the Class IV septic systems is 8.93 mg

Kukovica Development - Arkell
MOE Mass Balance Equation
Nitrate Loading Calculations

$Q_t C_t = Q_e C_e + Q_i C_i$

Where:

Q_e	13870 **m^3/year**	Sewage Effluent Volume	(38 units @ 1000 litres/day)
Q_i	48780 **m^3/year**	Infiltration Volume = (recharge * study area)	(21.68 ha x .225 m)
Q_t	62650 **m^3/year**	Total Volume	

C_e	20000 **mg/m^3**	Concentration of sewage effluent	20 mg/L
C_i	100 **mg/m^3**	Concentration of precipitation	0.1 mg/L

$C_t = (Q_e C_e + Q_i C_i)/Q_t$

$Q_e C_e$	277400000 **mg/year**
$Q_i C_i$	4878000 **mg/year**

$C_t =$ 4506 **mg/m^3**
4.51 mg/L

Therefore the predicted concentration of nitrate being introduced to groundwater by the Tertiary Treatment systems is 4.51 mg/L

Kukovica Development - Arkell
MOE Mass Balance Equation
Nitrate Loading Calculations - Hard Capped Surfaces

$Q_t C_t = Q_e C_e + Q_i C_i$

Where:

Q_e	13870 m^3/year	Sewage Effluent Volume	(38 units @ 1000 litres/day)
Q_i	40770 m^3/year	Infiltration Volume = (recharge * study area)	(18.12 ha x .225 m)
Q_t	54640 m^3/year	Total Volume	
C_e	40000 mg/m^3	Concentration of sewage effluent	40 mg/L
C_i	100 mg/m^3	Concentration of precipitation	0.1 mg/L

$C_t = (Q_e C_e + Q_i C_i)/Q_t$

$Q_e C_e$	5.5E+08 mg/year
$Q_i C_i$	4077000 mg/year

$C_t =$ 10228 mg/m^3
10.23 mg/L

Therefore the predicted concentration of nitrate being introduced to groundwater by the septic systems is 10.23 mg/L.

FIGURE 4

KUKOVICA SUBDIVISION HYDROGEOLOGICAL ASSESSEMENT

WELL LOCATION PLAN

Legend

- ✚ MOE Bedrock Well Location
- ✚ MOE Overburden Well Location
- ▭ Site Boundary
- ■ Building: To Scale
- ▪ Building: Not to Scale
- Contour
- Contour: Approximate
- Contour: Interpolated
- Contour: Depression
- ☐ Lot
- Miscellaneous Linear Feature: Unspecified
- ▨ Pit/Quarry: Unspecified
- Rail: Unspecified
- River/Stream: Seasonal
- River/Stream: Permanent
- Road: Primary
- Road: Secondary
- Road: Other
- • Spot Height
- Spot Height (Vertical Control)
- • Spot Height (Water)
- Trail
- Utility Line: Unspecified
- 🟩 Wooded Area
- ☐ Waterbody
- Wetland
- Cross Section Orientation

N

0 100 200 300 400 500 600 700 800

Meters

Scale: 1:10,000
Mapping Date: February, 2006

Projection: UTM Zone 17
Datum: NAD 83

Project: PTA 10312
Prepared By: C. Reynolds

Verified By: D. Wilson

BURNSIDE

W:\Projects\P\PTA10312\PTA10312 OBM MAP.mxd

GROUNDWATER SUPPLY ASSESSMENT

PROPOSED RESIDENTIAL DEVELOPMENT

ARKELL, ONTARIO
(TOWNSHIP OF PUSLINCH)

Prepared for:

Stovel and Associates Inc.
Timberworx Custom Homes Inc.

March 2023

Prepared by:

ARL Groundwater Resources Ltd.

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

ARL Groundwater Resources Ltd. was retained by Timberworx Inc. and Stovel & Associates Inc. to undertake to undertake a groundwater supply assessment for a proposed multi-lot residential development in and adjacent to the Hamlet of Arkell located in the Township of Puslinch. The development property is understood to be within Part Lots 7, 8 & 9, Concession 10, Township of Puslinch, County of Wellington (**FIGURE 1**).

The proposed residential development is to be serviced by individual private wells and wastewater disposal systems. In general, the groundwater supply assessment presented in this report addresses the requirements of the guideline D-5-5 (Private Wells: Water Supply Assessment), published by the Ontario Ministry of the Environment, Conservation and Parks (MECP). The most recent revision to Guideline D-5-5 is understood to have been made in August 1996, and the MECP has continued to publish the guideline in its current form up until at least December 2018.

2.0 BACKGROUND INFORMATION ON THE SITE HYDROGEOLOGY

The property was previously considered for development in about 2005-2006. At that time R.J. Burnside & Associates Limited (RJB 2006) completed a hydrogeological review and predictive nitrate assessment for a proposed 38 single family residential lot development at the site. The land size for the development was reported to be 21.68 ha.

Some of the information presented in the following discussion is based in part on the results of the RBJ (2006) report.

2.1 QUATERNARY (SURFICIAL) GEOLOGY

Quaternary geological mapping by P.F. Karrow in the 1960s (Map 2153, Geological Report 61, Ontario Department of Mines, 1968) indicates that the surficial sediments on the property are described as outwash gravel. Wentworth Till occurs to the east and north of the property where it occurs as a surface expression of the Paris Moraine. Karrow (1968) describes the Wentworth Till as predominantly a sand till (typically 49% sand, 33% silt, 18% clay). RBJ (2006) reports that the Port Stanley Till (sandy silt till) is present in the general area, but this is not evident from the mapping by Karrow. Kame and esker deposits (consisting of sand and gravel) are mapped directly beneath the centre of the Hamlet of Arkell and to the north of the Hamlet where Arkell Road rises in elevation towards an intersection with the Paris Moraine.

RBJ (2006; Figure 5, Cross-Section A-A') indicates that overburden sediment thickness beneath the proposed development property is approximately 15 - 20 m. Sediment types are shown to consist of sand, gravel and stones to silty sand, clay, and stones. In general, the overburden materials appear to be mostly coarse-grained materials.

2.2 BEDROCK GEOLOGY

Geological mapping of the Toronto to Windsor corridor by Sanford (Geological Survey of Canada, 1969) includes the study area. The mapping indicates that the Hamlet of Arkell and the proposed development property are underlain by the Eramosa Member of the Guelph Fm. The Eramosa Member is shown as occurring as a relatively narrow band in the area and is described as a dark brown to black bituminous dolomite and shale that intertongues with the basal Guelph Formation. The Eramosa Member is bordered to the west/southwest by the main Guelph Fm. unit, described by Sanford as a cream to brown, fine to medium crystalline dolomite containing numerous bioherm reefs. The Guelph Fm. sub-crop is shown to extend over a wide area to the west of Arkell, including the cities of Guelph, Cambridge, and a large part of Kitchener. The Eramosa Member is bordered on the east/northeast side by the Amabel Group, described as a grey and blue-grey medium crystalline dolomite containing numerous bioherm reefs. Stratigraphically, the Guelph Fm. overlies the Eramosa Member, which overlies the Amabel Group. The regional dip of the formations is to the southwest towards the Michigan Basin.

The bedrock nomenclature associated with the Guelph-Eramosa-Amabel stratigraphic sequence was revised by Brunton in about 2006. The corresponding revised stratigraphic sequence in descending order (Brunton 2006) is as follows: Guelph Fm., Eramosa Fm., Goat Island Fm., Gasport Fm., and Irondequoit Fm. In general, the former un-subdivided Amabel Fm. has now been subdivided into 3 separate formations (Goat Island, Gasport, Irondequoit).

2.3 BOREHOLE INFORMATION

R.J. Burnside and Associates Limited (RBJ 2006) provide the results of 10 boreholes drilled into the overburden sediments at the site using hollow stem auger drilling equipment. Two of the boreholes (BH1, BH10) were equipped as single monitoring wells for measuring groundwater levels in the overburden sediments. The borehole locations are shown in **FIGURE 2**. Based on the borehole logs as presented in the RBJ (2006) report, a summary of the borehole results is provided in **TABLE 1**.

TABLE 1
SUMMARY OF BOREHOLE LOG INFORMATION
(from RJB 2006)

Borehole Number	Total Depth	Sediment Description	Sediment Description	Bedrock Encountered
BH1 (MW1)	9.5 m (31.2 ft.)	Mostly sand & gravel to 7.7 m (25.2 ft.)	Silt, some clay, sand & gravel (7.7 - 9.5 m)	Yes
BH2	6.6 m (21.7 ft.)	Mostly sand & gravel to 6.6 m		No
BH3	6.6 m (21.7 ft.)	Mostly sand & gravel to 6.6 m		No
BH4	6.3 m (20.7 ft.)	Mostly sand & gravel to 6.3 m		No
BH5	6.6 m (21.7 ft.)	Mostly sand & gravel to 6.6 m		No
BH6	3.3 m (10.8 ft.)	Mostly sand & gravel to 3.3 m		No
BH7	7.3 m (24 ft.)	Mostly sand & gravel to 7.3 m		Uncertain
BH8	5.2 m (17.1 ft.)	Mostly sand & gravel to 5.2 m		No
BH9	6.2 m (20.3 ft.)	Mostly sand & gravel to 6.2 m		No
BH10 (MW2)	12.6 m (41.3 ft.)	Mostly sand & gravel to 6.9 m	Gravel-silt till to 10.1 m, interbedded sand, silt, till (10.1 - 12.6 m)	No

RBJ (2006) reported one round of water levels measurements recorded in the two monitoring wells approximately 2 weeks after the borehole drilling and well installation program (January 26, 2006). The water level measurements indicated that there was approximately 2 m of standing water in the two wells.

The borehole logs indicate that sand and gravel are the predominant sediment types present at the site to depths of at least 6 - 8 m (20 - 26 ft.).

2.4 WATER WELL RECORD INFORMATION

Existing water well record locations in the vicinity of Arkell were obtained from the MECP water well record database and are shown in **FIGURE 2**. The locations in **FIGURE 2** are based on a combination of the well coordinates provided in the MECP database and a site inspection to confirm apparent well locations. The water well records provide useful information with respect to the hydrogeological conditions at the site. Summary information from the water well records is provided in **TABLE 2**.

TABLE 2
Existing Water Well Record Information (Arkell)

Water Well Record	Date	Depth to Bedrock (ft.)	Brown Limestone or Rock Thickness (ft.)	Dark Brown Limestone or Rock Thickness (ft.)	Grey Limestone or Rock Thickness (ft.)	Brown Limestone or Rock Thickness (ft.)	Total Well Depth (ft.)
7046276	**Jun. 25, 2007**	**49**	**36**	**75**	**80**	**-**	**240**
6715979	**Oct. 3, 2006**	**50**	**40**	**70**	**60**	**20**	**240**
6715668	**Jan. 10, 2006**	**49**	**41**	**65**	**75**	**10**	**240**
6715483	**Aug. 31, 2005**	**50**	**50**	**-**	**-**	**-**	**100**
7100299	**Dec. 31, 2007**	**54**	**24**	**97**	**25**	**-**	**200**
7046277	**Jun. 21, 2007**	**51**	**24**	**95**	**50**	**-**	**220**
6712507	**May 1, 1998**	**39**	**66**	**60**	**36**	**-**	**201**
6706077	**Jun. 24, 1976**	**33**	**37**	**25**	**-**	**-**	**95**
6712521	**Apr. 14, 1998**	**29**	**81**	**10**	**-**	**-**	**120**
6702775	**Mar. 20, 1965**	**46**	**54**	**25**	**-**	**-**	**125**
6702773	**July 4, 1964**	**55**	**75**	**10**	**-**	**-**	**140**
6710001	**Sept. 11, 1989**	**39**	**41**	**-**	**-**	**-**	**80**

The water well record information indicates that the overburden thickness at the site ranges from approximately 9 - 17 m (30 - 55 ft.). The sediments are described as clay, sand and gravel, and boulders. Most of the existing water well records describe clay and stones in the upper part of the overburden sequence and clay and sand-gravel in the lower part of the overburden sequence. When interpreting the water well record information, it is important to note that most of the wells were targeting the bedrock aquifer system. Accurate sampling and descriptions of the overburden sediments was not a priority during drilling of the wells.

The existing water well record descriptions indicate that the following stratigraphic sequence appears to occur at the site; the upper 7 - 25 m (24 - 81 ft.) of bedrock (including the bedrock subcrop) is part of the Guelph Fm. (brown dolostone). The Eramosa Fm. occurs below the Guelph Fm., and is described by Brunton (OGS 2011) as a dark brown to black dolostone unit; the darker colour is due to a higher shale/organic content in the rock compared to the dolostone of the overlying Guelph Fm. The existing water well records indicate that thickness of the Eramosa Fm. is approximately 18 - 39 m (60 - 100 ft.) at the site.

At least 15 - 24 m (50 - 80 ft.) of grey rock occurs below the Eramosa Fm. The grey rock is interpreted as the Goat Island/Gasport Fm. (formerly referred to as unsubdivided Amabel Fm.). For the purposes of this report, the lower grey rock unit will be referred to as the Gasport Fm.

The Guelph Fm. is interpreted as the upper bedrock aquifer at the site. The Gasport Fm. are interpreted as a lower bedrock aquifer at the site. The Guelph Fm. is interpreted to be an unconfined to semi-confined aquifer as there is limited evidence of a confining layer in the overburden sediments at the site. Recharge to the Guelph Fm. is inferred as being relatively high due to the absence or limited occurrence of low hydraulic conductivity materials (such as silt and clay till) in the overlying overburden sediments. The Gasport

Fm. is interpreted as a semi-confined to confined aquifer; in this case the overlying Eramosa Fm. has a high shale content that imparts some aquitard characteristics to the unit and impedes leakage across the Eramosa Fm. from the overlying Guelph Fm.

The earlier bedrock geological mapping by Sanford (1969) showing the Eramosa Fm. as the bedrock subcrop in Arkell appears to be out-of-date. Based on the water well record information and the 2022 test well information (described in the following section), the Guelph Fm. is interpreted as forming the bedrock subcrop at the site.

3.0 TEST WELL INVESTIGATION

2.1 GENERAL

It is understood that the proposed development could eventually consist of up to about 50 individual single family residential lots on the 22-ha property. However, the initial stage of development may consist of something less than 50 lots on only a portion of the property. Based on this consideration, a program of 3 test wells was undertaken at the site in November 2022.The test well locations are shown in **FIGURE 3**.

2.2 TEST WELL PROGRAM

A test well program was designed so that the 3 test wells would be constructed in the lower aquifer (Gasport Fm.) at the site. The well design was selected to provide additional protection from surface sources of contamination.

The well design included drilling and installation of 150 mm (6 inch) nominal steel outer casing through the overburden sediments and into the top of the bedrock. The annular space surrounding the outer well casing was sealed with a bentonite slurry. Drilling of the bedrock commenced inside of the outer casing and continued to the base of the Eramosa Fm. A nominal 130 mm (5 inch) inner steel casing equipped with packers was installed to the base of Eramosa Fm. The packers are intended to serve as an annular seal around the inner casing. Drilling of a nominal 127 mm (5 inch) open hole continued inside of the inner steel casing, eventually terminating in the Gasport Fm. Final well depths are as follows.

TW1/2022: 72.5 m (238 ft.)
TW2/2022: 73.5 m (241 ft.)
TW3/2022: 79.6 m (261 ft.).

All work was performed by a licensed water well contractor. Water well records for the three test wells are included as **APPENDIX A**.

2.3 TEST WELL PUMPING TEST RESULTS

Constant rate pumping tests were performed by the water well contractor at each of the three test wells. Pumping rates were the same for all 3 tests (45.5 L/min; 10 Igal./min) and the pumping tests lasted for 6 hours. Flow rate for each test was recorded with a calibrated flow meter. The test pumping rates exceed the peak demand attributed to a four-person household (4 x 3.75 L/min = 15 L/min or 1,800 L/day) as specified in MECP guideline D-5-5.

Manual water level measurements were recorded during each pumping test. Manual water level recovery measurements were also recorded for 40 - 90 minutes following shutdown of the pump in each of the 3 test wells.

The dates of each pumping test were as follows:

TW1/2022 - November 21, 2022
TW2/2022 - November 23, 2022
TW3/2022 - November 25, 2022.

The results of the pumping test at TW1/2022 with elapsed time at an arithmetic scale are shown in **FIGURE 4**. The graph shows that water levels decline at a consistent rate of drawdown from about 1 minute until pump shutdown at an elapsed time of 6 hours (360 minutes). Water levels recover sharply for the first minute following pump shutdown, mirroring the initial drawdown observed during the first minute of the test. Water levels then recover at about the same rate in reverse as the drawdown trend.

The results of the pumping test at TW2/2022 with elapsed time at an arithmetic scale are shown in **FIGURE 5**. The graph shows that water levels decline at a relatively steep rate for the first 10 minutes of pumping before levelling off and approaching steady- state for about the next 215 minutes (3.5 hours into the pumping test). At that point water levels drop sharply by approximately 11 m, followed by a steady drawdown trend for the next 2 hours, at which time the pump is shut-off. After pump shutdown, water levels follow a steady recovery to within 4 m of the pre-test level after 40 minutes. The sudden decline in water level observed at 3.5 hours into the pumping test is interpreted as a probable boundary condition affecting one or more of the fractures/producing zones in the well.

The results of the pumping test at TW3/2022 with elapsed time at an arithmetic scale are shown in **FIGURE 6**. Water levels at TW3/2022 decline at a relatively steep rate for the first 15 minutes of pumping before levelling off for the next 60 minutes, and then following a recovery trend for the remainder of the pumping portion of the test. Recovery to the pre-test level essentially occurs within 75 minutes of pump shutdown. The apparent recovery in water levels measured during the pumping portion of the test may reflect ongoing development of some of the fractures/producing zones during the pumping test.

The results from the 3 pumping tests indicate that the test wells can easily meet the water quantity requirements of a single-family residence. Additional wells at the site can be expected to yield similar performance with respect to water quantity.

Additional graphs showing pumping water level and drawdown versus a log time scale for the three pumping tests are included in **APPENDIX B**.

2.4 WATER QUALITY TEST RESULTS

Water samples were collected from the three test wells during the pumping tests for water quality analysis. The water samples were collected at the following intervals during each test:

TW1 - samples collected after an elapsed time of approximately two hours.
TW2 - samples collected at approximately 1.5, 2.5, 4 hours.
TW3 - samples collected at approximately 3 and 6 hours.
TW3 - repeat set of samples collected at 3 hours during a second test.

The water samples were submitted to a commercial analytical laboratory (ALS Environmental - Waterloo, Ontario) for testing of parameters related to drinking water quality. The lab reports are included as an **APPENDIX C**.

Results from TW1

The water samples collected from TW1 were analyzed by the lab for a comprehensive list of parameters, including:

- Hardness, Total Dissolved Solids (TDS)
- Anions (including chloride, fluoride, nitrate, nitrite, sulphate, sulphide)
- Cyanide
- Bacteria (E. coli, total coliforms)
- Metals (including antimony, arsenic, barium, boron, cadmium, chromium, selenium, uranium)
- Volatile Organic Compounds (VOC)
- Benzo(a)pyrene (a polycyclic aromatic hydrocarbon)
- Semi-volatile organics (including Aldrin + Dieldrin and NDMA)
- Organochlorine Pesticides
- Herbicides and Pesticides.

The list included many of the parameters with an Ontario Microbiological or Chemical Drinking Water Standard (both Standards are human health-based). Review of the lab report indicates all parameters tested that have a Microbiological or Chemical Standard were measured at levels below the Standard.

Sulphide was reported at a concentration of 0.182 mg/L. This concentration exceeds the aesthetic-based Ontario Drinking Water Objective of 0.05 mg/L. The Ministry notes that aesthetic criteria do not affect the safety of a water supply but may cause objectionable effects or render water unsuitable for domestic use. In this case, the elevated sulphide may result in some unpleasant odour in the water but should not otherwise prevent the water from being used for domestic supply.

Hardness was reported at a concentration of 365 mg/L (as $CaCO_3$), which exceeds the Ontario Drinking Water Operational Guideline of 80 - 100 mg/L (as $CaCO_3$). The Ministry notes that operational guidelines are established for parameters that, if not controlled, may negatively affect efficient and effective treatment, disinfection, and distribution of the water. Elevated hardness is a common occurrence in both municipal and private well supplies in Ontario. For private well systems the solution is often a home-based water softener.

Results from TW2

The water samples collected from TW2 were analyzed by the lab for a reduced number of parameters compared with TW1. Two sets of samples collected from TW2 were tested for nitrate and nitrite, E. coli and total coliforms, and a list of approximately 40 parameters that are part of a total metals scan.

Nitrate and nitrite were below the laboratory detection limit in both samples. E. coli and total coliforms were not detected in either sample.

In the metals scan, lead was reported at a concentration of 0.0219 mg/L in the first sample and 0.00668 mg/L in the second sample. The Ontario Drinking Water Chemical Standard for lead is 0.01 mg/L. Iron was reported at a concentration of 1.11 mg/L in the first sample and 0.355 mg/L in the second sample. The aesthetic Ontario Drinking Water Objective for iron is 0.3 mg/L. Manganese was reported at concentrations of 0.0399 mg/L in the first sample and 0.0148 mg/L in the second sample. The aesthetic Ontario Drinking Water Objective for manganese is 0.05 mg/L. Iron and manganese concentrations above the aesthetic drinking water objectives are common occurrences in both municipal and private well supplies.

Results from TW3

The lab analyses performed on all three sets of samples collected at TW3 included nitrate, nitrite, E. coli, total coliforms, and a metals scan of approximately 40 parameters.

The two samples from the first day of testing had reported nitrate concentrations of 4.7 and 5.3 mg/L (N). The Ontario Drinking Water Chemical Standard for nitrate is 10 mg/L (N). E. coli and total coliforms were not detected. Arsenic was reported at concentrations of 0.0203 and 0.0502 mg/L. The Ontario Drinking Water Chemical Standard for arsenic is 0.01 mg/L. Lead was reported at concentrations of 0.123 mg/L and 0.332 mg/L. As noted previously, the Ontario Drinking Water Chemical Standard for lead is 0.01 mg/L. It was noted at the time of sampling that there was some turbidity in the pump discharge water.

The one set of samples collected on the second day of testing had a reported nitrate concentration of 5 mg/L (N). E. coli and total coliforms were not detected. Lead was reported at 0.0052 mg/L, now below the Ontario Drinking Water Standard of 0.01 mg/L. Arsenic was reported as below the detection limit (<0.001mg/L). Iron was reported at 0.671 mg/L and manganese was reported at 0.0145 mg/L. It was noted that the clarity of the water had improved at the time of sampling compared with what was observed on the first day of sampling.

Based on these results, it is possible that turbidity in the well water at the time of sample collection on the first day may have affected the measured lead and arsenic levels in that sample.

3.0 WATER SUPPLY REQUIREMENTS AND AQUIFER YIELD

The results from the 3 test wells indicate that on average individual wells can easily meet the needs of single-family homes at the site. However, it is important to consider the total number of homes in relation to the expected aquifer yield at the site.

The proposed residential development presently under consideration includes up to 50 single-family residential units. Using the MECP peak flow rate requirement of 15 L/min over a 2-hour period, a daily flow requirement per home can be estimated at 1,800 L/day. At maximum build out (50 homes), maximum water demand can be estimated at 90,000 L/day (62.5 L/min; 1 L/s). Adding a 50% safety factor to the maximum water demand brings the total up to 135,000 L/day (94 L/min; 1.5 L/s).

The pumping rates used for each of the 3 test well pumping tests were identical at 65,520 L/day (45.5 L/min; 0.76 L/s), which is approximately 70% of the estimated maximum demand for all 50 lots, and 49% of the estimated maximum demand with a 50% safety factor added. Review of the pumping test data in more detail is warranted to evaluate whether additional well yield is available above that of the pumping rate used for the well tests. Graphs to facilitate this review are available in **APPENDIX B**.

The pumping test at TW1indicates that the well specific capacity after 6 hours of pumping at 45.5 L/min was approximately 8.6 L/min/m of drawdown. Projecting the drawdown trend out to a hypothetical time of 1 day of continuous pumping indicates that the well specific capacity would have been approximately 6.1 L/min/m of drawdown. The available drawdown to the base of the inner casing at TW1 is approximately 19 m, so the specific capacity information indicates that the one-day yield of TW1 alone (19 m x 6.1 L/min/m x 50% additional S.F. = 58 L/min or 83,450 L/day) can meet about 90% of the expected maximum demand for a 50-lot subdivision.

The pumping test at TW2 indicates that the well water level dropped below the inner well casing approximately 240 minutes into the pumping test, yet the well was still able to sustain the test flow rate for the remainder of the 6-hour test. The projected pumping water level at 1 day would have been approximately 52.1 m, which is about 20 m above the bottom of the test well. However, the test data indicates that the one-day yield of TW2 should not exceed the pumping test rate of 45.5 L/min (65,520 L/day).

The pumping test at TW3 indicates that the well water level declined by 13 m over the first 45 minutes and then recovered for the remainder of the test. As noted previously, the observed recovery during the pumping test may be related to ongoing development of the fractures as the well was being pumped. It could also possibly have reflected interference from another nearby private well in Arkell. The drawdown after 6 hours of pumping had recovered to 8.2 m, and the well water level had essentially reached full recovery to the pre-test condition 75 minutes after the pump shutdown. The specific capacity of TW3 prior to pump shutdown was approximately 5.6 L/min/m of drawdown and the pumping level was measured at 24.1 m. The base of the inner well casing is at a depth of approximately 48 m indicating that an additional drawdown of approximately 24 m was available at the end of the pumping test. Using only 50% of the apparent remaining available drawdown indicates that well capacity is over 110 L/min (158,400 L/day). The results indicate that the well capacity of TW3 can meet the maximum demand for a 50-lot subdivision.

4.0 SUMMARY AND CONCLUSIONS

A review of background information including existing water well record information indicates that a multi-aquifer system exists in the vicinity of the Hamlet of Arkell, including the proposed development property. The multi-aquifer system consists of the following geological units, in descending order:

Guelph Fm. - Upper Aquifer
Eramosa Fm. - Intermediate Aquitard/Aquifer
Gasport Fm. - Lower Aquifer.

It is evident from the water well record information that both the Guelph Fm. and Gasport Fm. aquifers have met the water quantity needs of residences and businesses in the Arkell area for many years.

Three test wells (TW1/2022 - TW3/2022) were constructed and tested as part of a groundwater supply assessment for the proposed development property. The wells were constructed in the lower aquifer (Gasport Fm.) to evaluate whether the lower aquifer alone could meet the water supply requirements of up to 50 new residential lots on the property. The upper aquifer (Guelph Fm.) was not considered in the test well program.

The results from 3 test wells indicate that the Gasport Fm. aquifer (lower aquifer) can meet the water quantity requirements of new individual lots on the proposed development property. Further, interpretation of the test well performance indicates that the aquifer can support the water quantity requirements associated with 50 new residential lots at the site.

Overall, the water quality test results indicate that groundwater produced from the 3 test wells is potable, as most of the parameters tested with an Ontario Drinking Water Standards Maximum Acceptable Concentration (MAC) were within the MAC. The marginally elevated arsenic concentrations reported at TW3, and the marginally elevated lead concentrations reported at TW2 and TW3 may be related to particulate in the water at the time of sampling. Additional well development, sampling and lab testing could be considered to further assess the levels of arsenic and lead in the well water.

Construction of new supply wells associated with a multi-lot residential development on the property has the potential for interference to occur among individual wells as the development is built out. This interference could come in the form of (a) turbidity interference resulting from the process of well drilling and development and (b) water level interference when the wells are operating. The turbidity interference is a temporary problem that should dissipate after the well drilling and development operations are complete. Notification of adjacent well owners and monitoring when each new well is constructed will help to mitigate potential turbidity interference. Measures to minimize the effects of water level interference include optimizing the pump settings to maximize drawdown in each of the individual wells. Consideration could also be given to implementing an outdoor water use bylaw or similar instrument to manage water use during the warm weather months of the year when water demand is higher.

5.0 RECOMMENDATION

Consideration should be given to implementing a well water level monitoring program for new supply wells serving the proposed residential development. The program would require that each well be equipped with an access tube designed to facilitate measuring water levels.

Prepared by:

ARL GROUNDWATER RESOURCES LTD.

[redacted]

A.R. (Tony) Lotimer, M.Sc., P.Geo.
Principal Hydrogeologist

FIGURE 4: Arkell Test Well TW1
Pumping Water Level vs. Elapsed Time

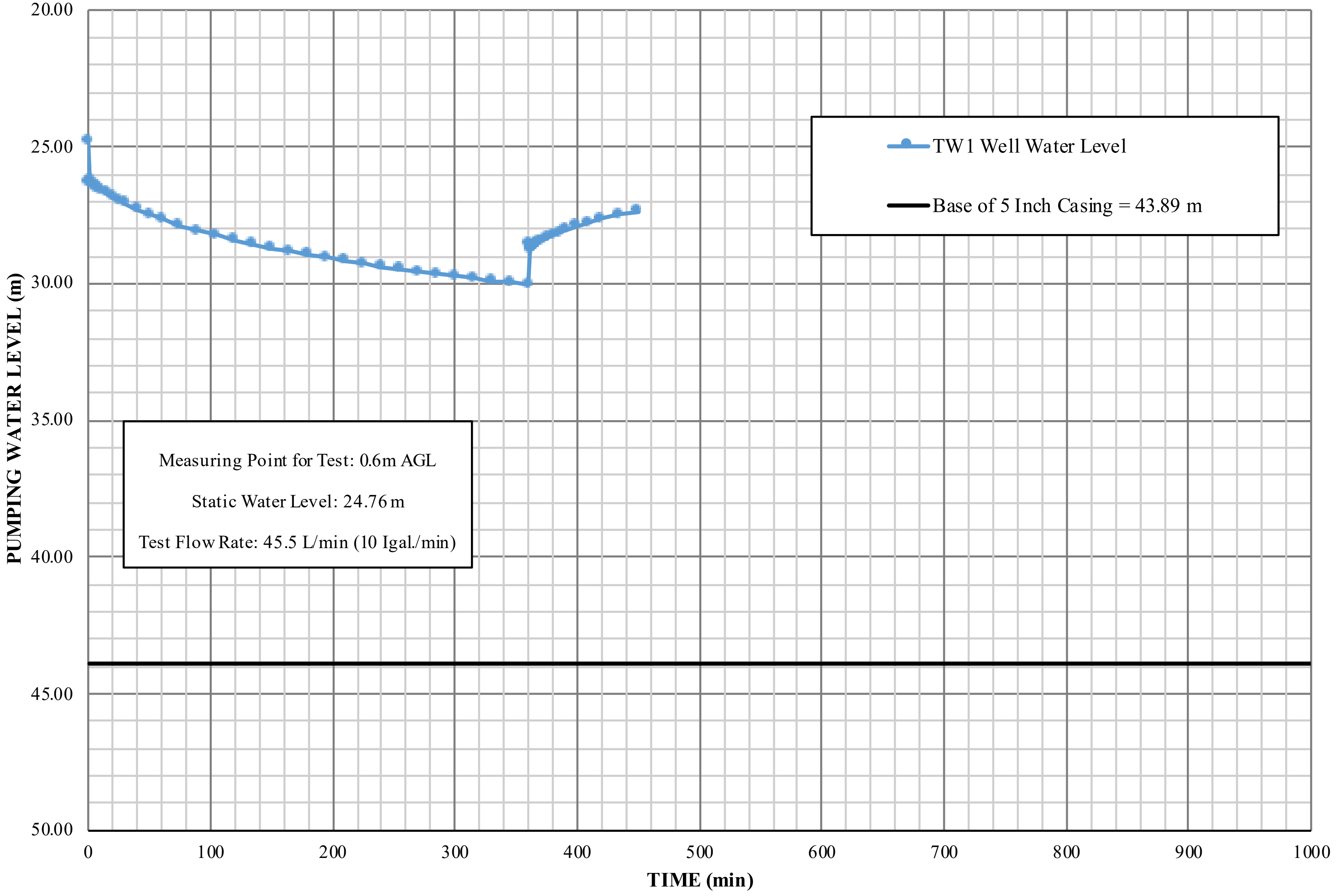


FIGURE 5: Arkell Test Well TW2
Pumping Water Level vs. Elapsed Time

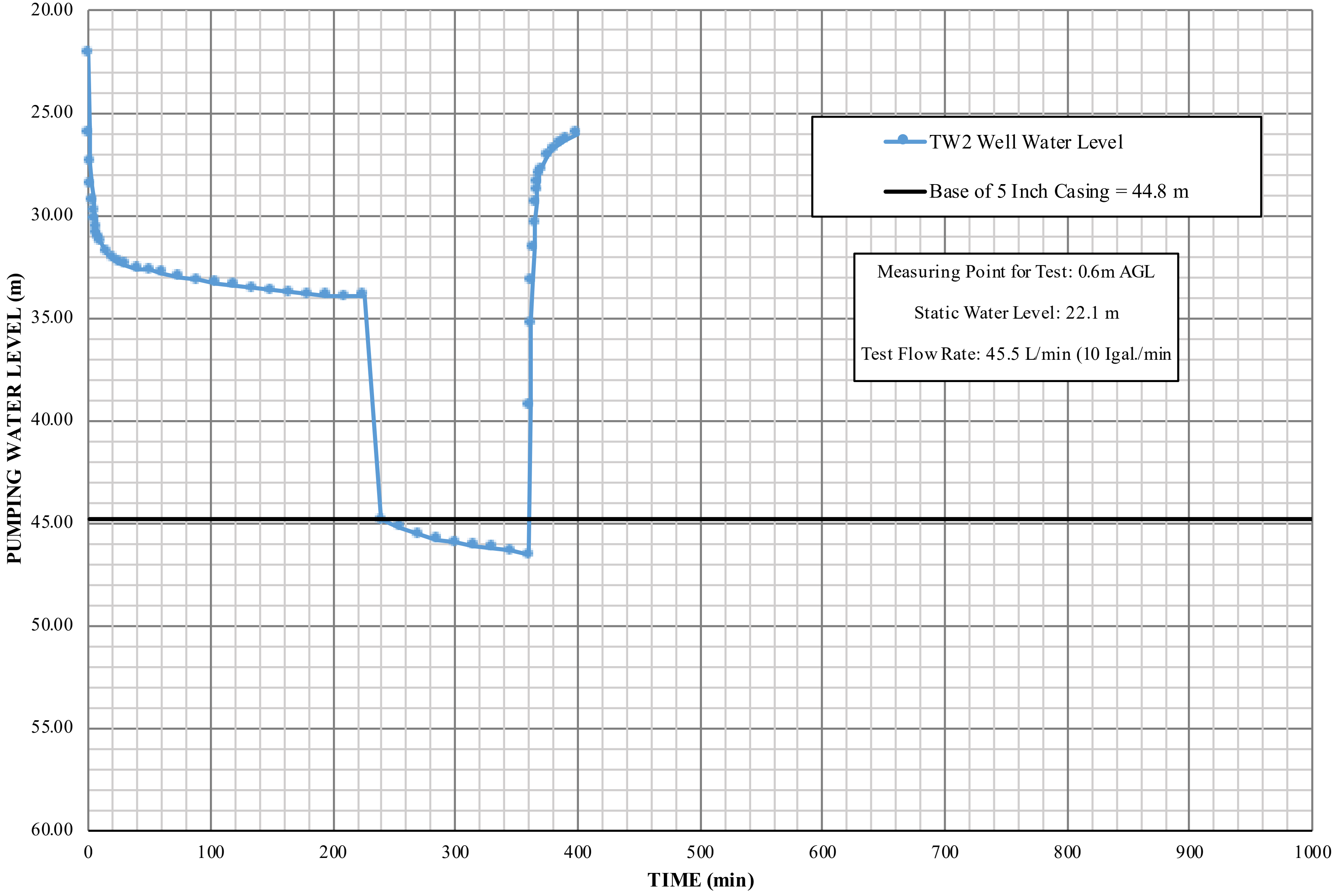
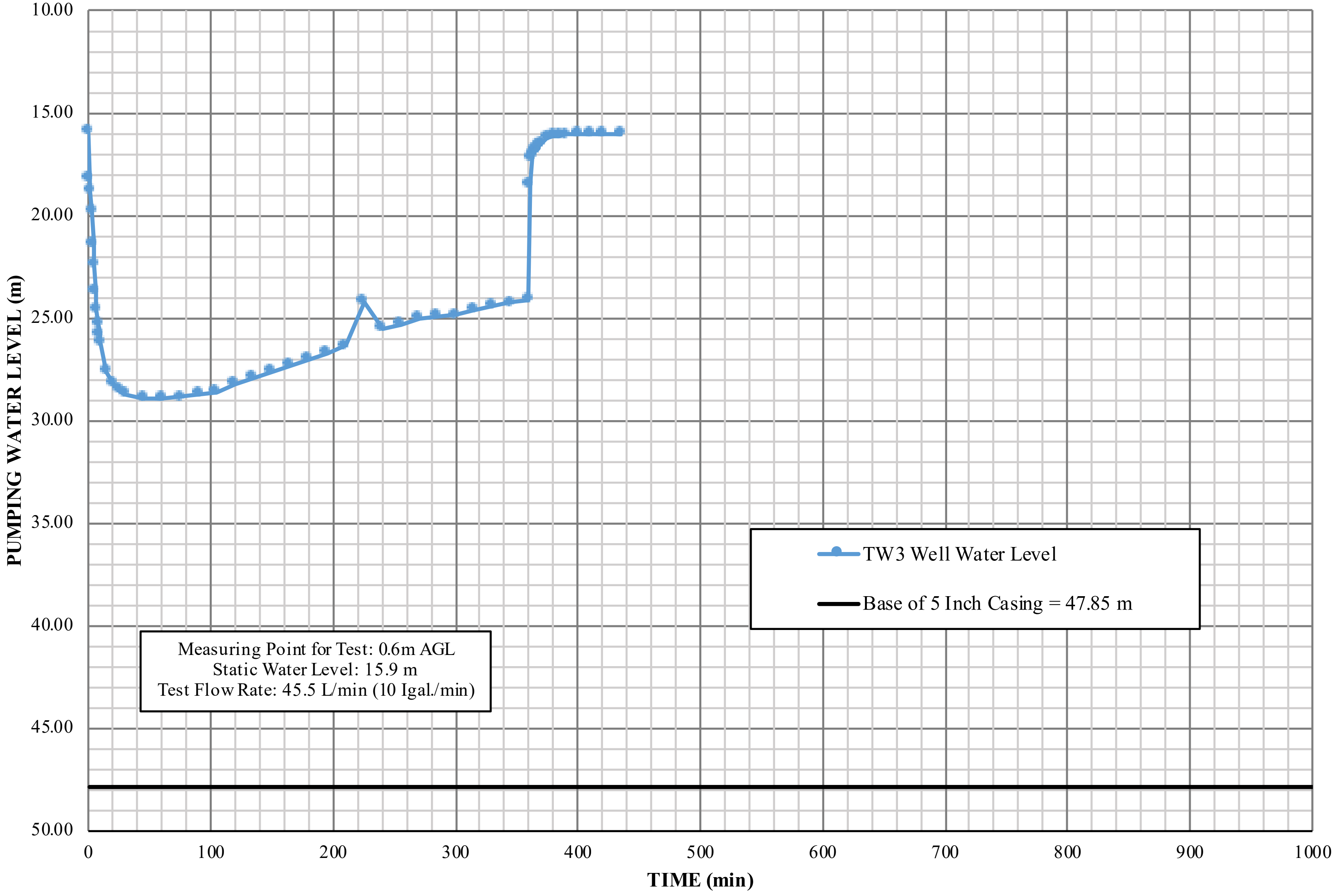


FIGURE 6: Arkell Test Well TW3
Pumping Water Level vs. Elapsed Time



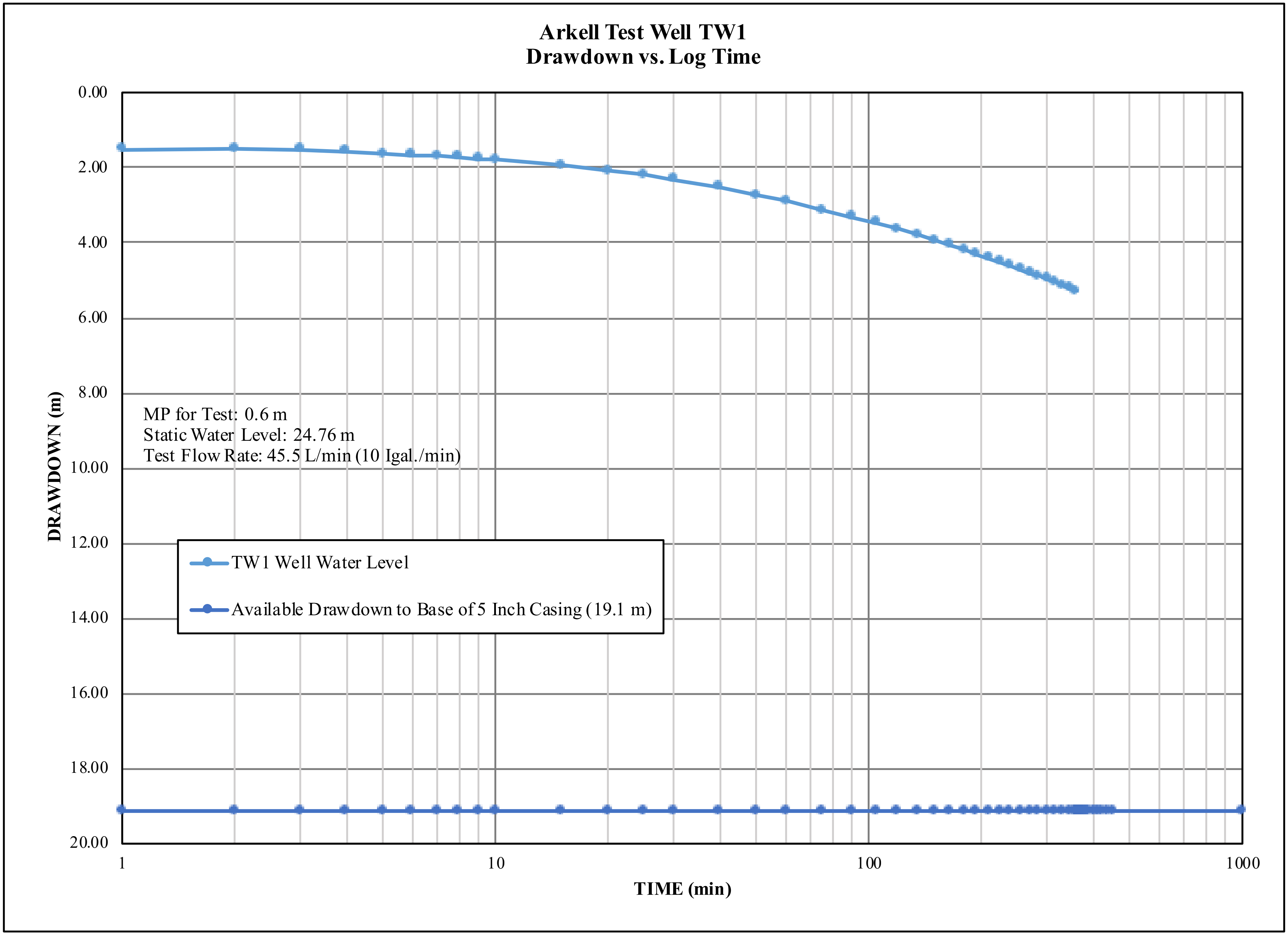
APPENDIX A

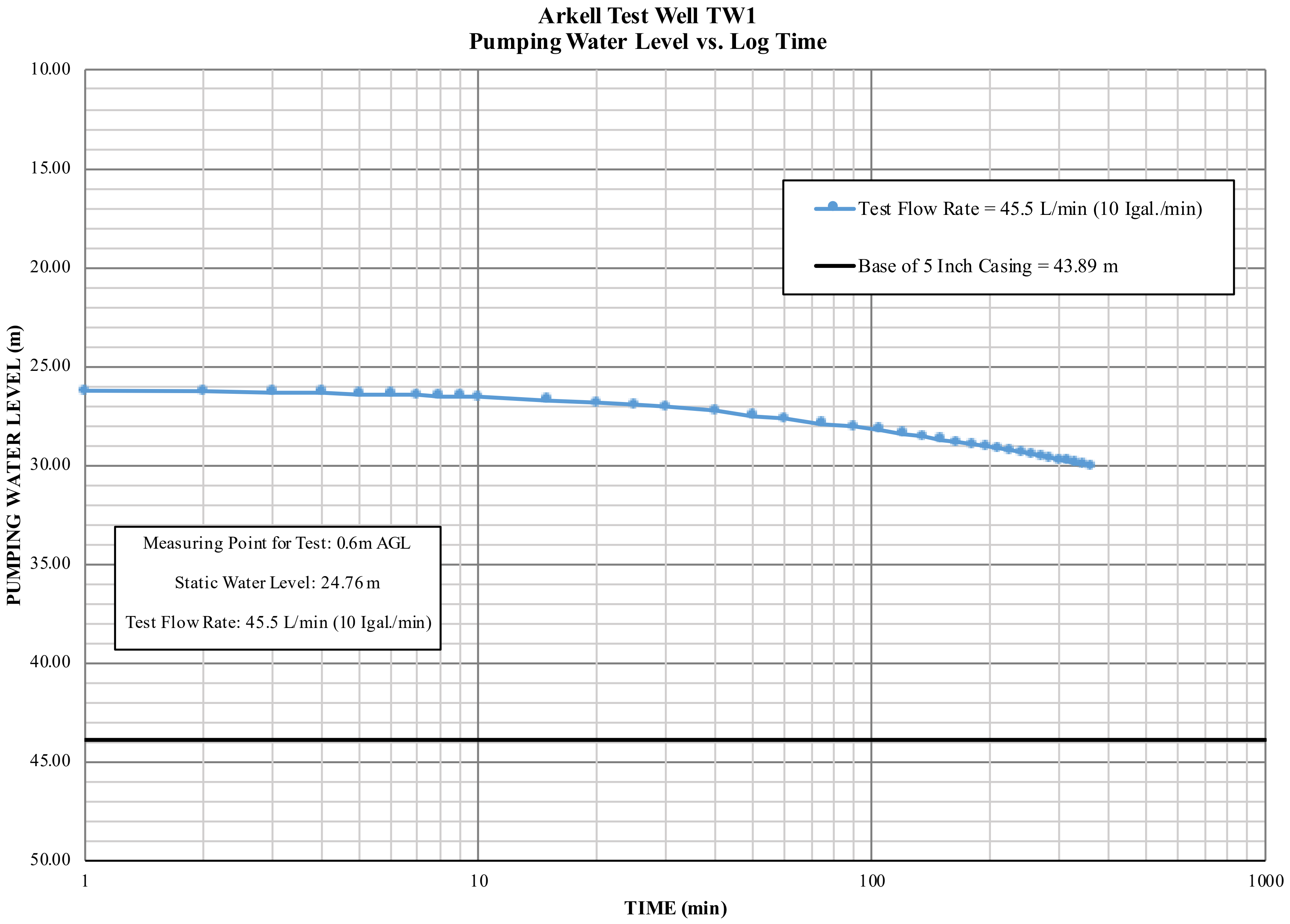
WATER WELL RECORDS

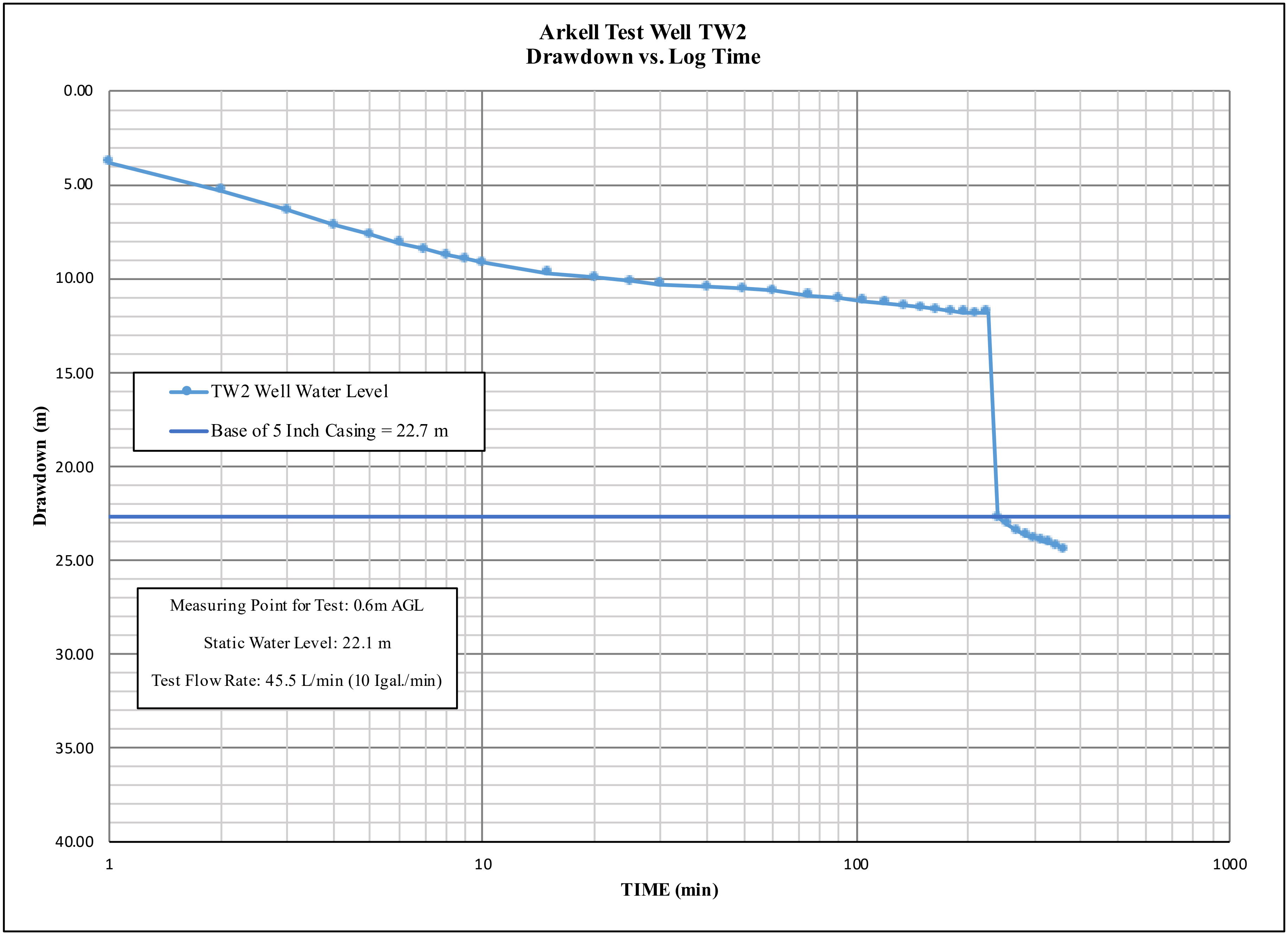
FOR THE TEST WELLS (2022)

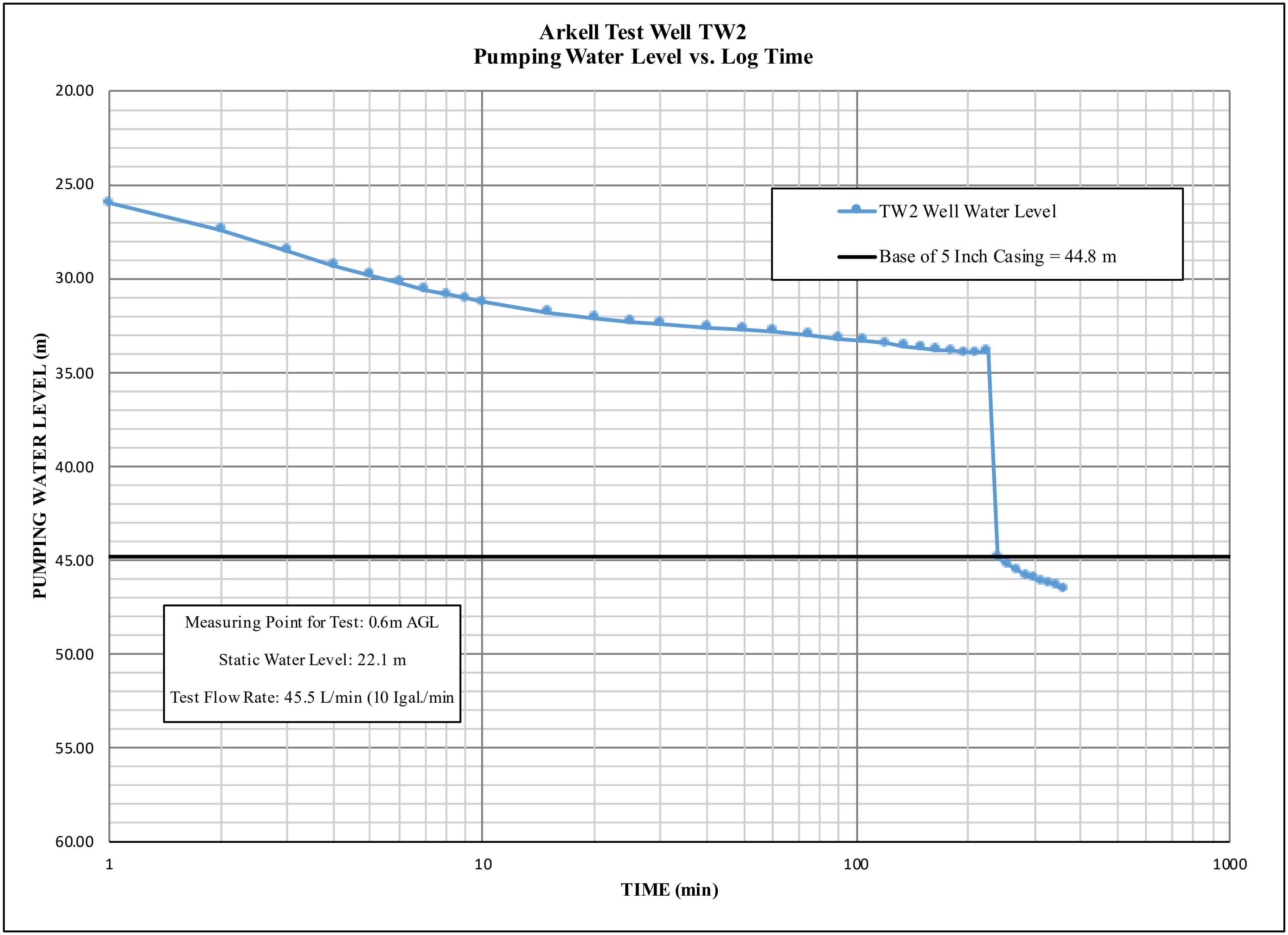
APPENDIX B

ADDITIONAL GRAPHS FROM THE PUMPING TESTS
AT THE TEST WELLS
(NOVEMBER 2022)


Arkell Test Well TW1
Drawdown vs. Log Time
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
DRAWDOWN (m)
MP for Test: 0.6 m
Static Water Level: 24.76 m
Test Flow Rate: 45.5 L/min (10 Igal./min)
TW1 Well Water Level
Available Drawdown to Base of 5 Inch Casing (19.1 m)
1
10
100
1000
TIME (min)


Arkell Test Well TW1
Pumping Water Level vs. Log Time
PUMPING WATER LEVEL (m)
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
1
10
100
1000
TIME (min)
Test Flow Rate = 45.5 L/min (10 Igal./min)
Base of 5 Inch Casing = 43.89 m
Measuring Point for Test: 0.6m AGL
Static Water Level: 24.76 m
Test Flow Rate: 45.5 L/min (10 Igal./min)

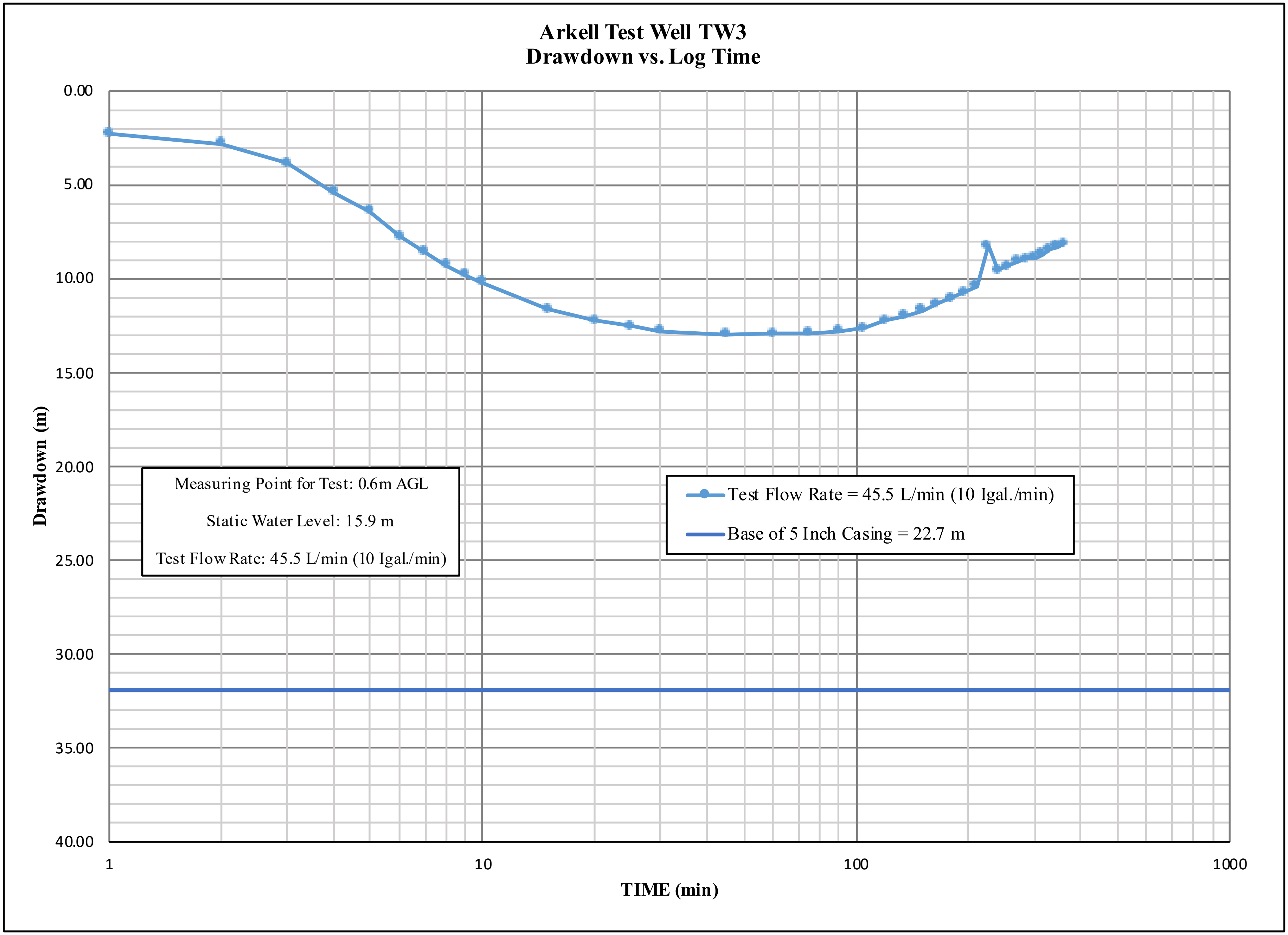

Arkell Test Well TW2
Drawdown vs. Log Time
Drawdown (m)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
1
10
100
1000
TIME (min)
TW2 Well Water Level
Base of 5 Inch Casing = 22.7 m
Measuring Point for Test: 0.6m AGL
Static Water Level: 22.1 m
Test Flow Rate: 45.5 L/min (10 Igal./min)



Measuring Point for Test: 0.6m AGL

Static Water Level: 22.1 m

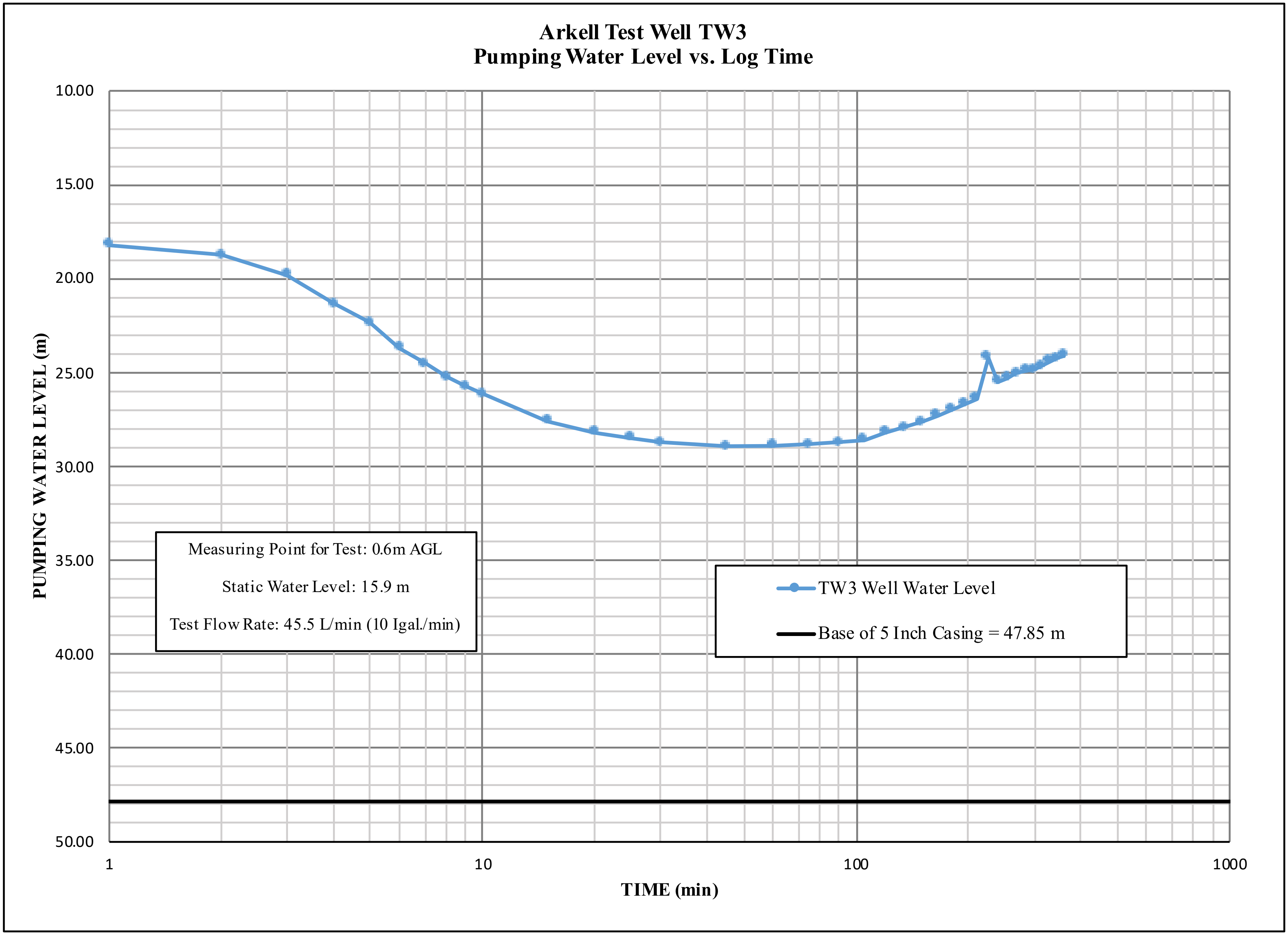
Test Flow Rate: 45.5 L/min (10 Igal./min



Measuring Point for Test: 0.6m AGL

Static Water Level: 15.9 m

Test Flow Rate: 45.5 L/min (10 Igal./min)



Arkell Test Well TW3
Pumping Water Level vs. Log Time

Measuring Point for Test: 0.6m AGL

Static Water Level: 15.9 m

Test Flow Rate: 45.5 L/min (10 Igal./min)

APPENDIX C

LAB REPORTS ON WATER QUALITY TESTING AT THE TEST WELLS (2022)

Results Summary L2741043

Job Reference ARKELL PROPERTY
Report To Scott Stovel , CASH CLIENTS - WATERLOO
Date Received 21-Nov-2022 15:00
Report Date 9-Dec-2022 8:11
Report Version 1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006)

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Physical Tests (Water)							
Color, True		2.0	T.C.U.	3.6	TW 1	3.6	TW 1
Hardness (as CaCO3)	80 -> 100	2.4	mg/L	365	TW 1	365	TW 1
pH	6.5 -> 8.5	0.10	pH units	8.23	TW 1	8.23	TW 1
Total Dissolved Solids	500 (U)	20	mg/L	446	TW 1	446	TW 1
Anions and Nutrients (Water)							
Alkalinity, Total (as CaCO3)	30 -> 500	10	mg/L	226	TW 1	226	TW 1
Ammonia, Total (as N)		0.010	mg/L	0.174	TW 1	0.174	TW 1
Chloride (Cl)	250 (U)	0.50	mg/L	31	TW 1	31	TW 1
Fluoride (F)		0.10	mg/L	0.89	TW 1	0.89	TW 1
Nitrate (as N)		0.020	mg/L	<0.020	TW 1	<0.020	TW 1
Nitrite (as N)		0.010	mg/L	<0.010	TW 1	<0.010	TW 1
Total Kjeldahl Nitrogen		0.050	mg/L	0.252	TW 1	0.252	TW 1
Total Organic Nitrogen		0.050	mg/L	0.078	TW 1	0.078	TW 1
Phosphorus, Total		0.0030	mg/L	0.0066	TW 1	0.0066	TW 1
Sulfate (SO4)	500 (U)	0.30	mg/L	107	TW 1	107	TW 1
Sulphide (as S)	0.05 (U)	0.018	mg/L	0.182	TW 1	0.182	TW 1
Cyanides (Water)							
Cyanide, Free		2.0	ug/L	<2.0	TW 1	<2.0	TW 1
Organic / Inorganic Carbon (Water)							
Dissolved Carbon Filtration Location			-				
Dissolved Organic Carbon	5 (U)	0.50	mg/L	<0.50	TW 1	<0.50	TW 1
Bacteriological Tests (Water)							
Escherichia Coli			MPN/100mL	0	TW 1	0	TW 1
Heterotrophic Plate Count			CFU/mL	58	TW 1	58	TW 1
Total Coliforms			MPN/100mL	0	TW 1	0	TW 1
Total Metals (Water)							

Results Summary L2741043

Job Reference ARKELL PROPERTY
Report To Scott Stovel , CASH CLIENTS - WATERLOO
Date Received 21-Nov-2022 15:00
Report Date 9-Dec-2022 8:11
Report Version 1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Antimony (Sb)		0.60	ug/L	5.5	TW 1	5.5	TW 1
Arsenic (As)		1.0	ug/L	6.1	TW 1	6.1	TW 1
Barium (Ba)		10	ug/L	32	TW 1	32	TW 1
Boron (B)		50	ug/L	<50	TW 1	<50	TW 1
Cadmium (Cd)		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Calcium (Ca)		0.50	mg/L	88.9	TW 1	88.9	TW 1
Chromium (Cr)		1.0	ug/L	1	TW 1	1	TW 1
Magnesium (Mg)		0.50	mg/L	34.7	TW 1	34.7	TW 1
Selenium (Se)		5.0	ug/L	<5.0	TW 1	<5.0	TW 1
Uranium (U)		5.0	ug/L	<5.0	TW 1	<5.0	TW 1
Volatile Organic Compounds (Water)							
Benzene		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Carbon tetrachloride		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Monochlorobenzene	30 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,2-Dichlorobenzene	3 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,4-Dichlorobenzene	1 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,2-Dichloroethane		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,1-dichloroethylene (vinylidene chlorid		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Dichloromethane		5.0	ug/L	<5.0	TW 1	<5.0	TW 1
Ethylbenzene	2.4 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Tetrachloroethylene (perchloroethylene)		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Toluene	24 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Trichloroethylene		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Vinyl chloride		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
o-xylene		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
m/p-xylene		1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Xylenes (Total)	300 (U)	1.5	ug/L	<1.5	TW 1	<1.5	TW 1
4-Bromofluorobenzene			%	89.7	TW 1	89.7	TW 1
1,4-Difluorobenzene			%	97.9	TW 1	97.9	TW 1
Polycyclic Aromatic Hydrocarbons (Water)							
Benzo(a)pyrene		0.0050	ug/L	<0.0050	TW 1	<0.0050	TW 1

Results Summary   L2741043

Job Reference	ARKELL PROPERTY
Report To	Scott Stovel , CASH CLIENTS - WATERLOO
Date Received	21-Nov-2022 15:00
Report Date	9-Dec-2022 8:11
Report Version	1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020

Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Chrysene d12			%	84.3	TW 1	84.3	TW 1
Semi-Volatile Organics (Water)							
Aldrin + Dieldrin		0.14	ug/L	<0.14	TW 1	<0.14	TW 1
N-Nitrosodimethylamine		0.00090	ug/L	<0.00090	TW 1	<0.00090	TW 1
N-Nitrosodimethylamine-d6			%	105	TW 1	105	TW 1
Organochlorine Pesticides (Water)							
a-chlordane		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
g-chlordane		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
pp-DDD		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
pp-DDE		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
op-DDT		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
pp-DDT		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Oxychlordane		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Decachlorobiphenyl			%	116.8	TW 1	116.8	TW 1
Tetrachloro-m-xylene			%	117.1	TW 1	117.1	TW 1
Herbicides (Water)							
AMPA		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Bromoxynil		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,4-D		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Dicamba		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Dinoseb		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Glyphosate		5.0	ug/L	<5.0	TW 1	<5.0	TW 1
MCPA		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Picloram		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,4,5-TP		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,4-Dichlorophenylacetic Acid			%	112	TW 1	112	TW 1
Carbamate Pesticides (Water)							
Aldicarb		0.90	ug/L	<0.90	TW 1	<0.90	TW 1

Results Summary L2741043

Job Reference	ARKELL PROPERTY
Report To	Scott Stovel , CASH CLIENTS - WATERLOO
Date Received	21-Nov-2022 15:00
Report Date	9-Dec-2022 8:11
Report Version	1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020

Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Pesticides (Water)							
Alachlor		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Atrazine		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Atrazine & Metabolites		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Azinphos-methyl		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Carbaryl		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Carbofuran		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Chlorpyriphos		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Diazinon		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
2,4-Dichlorophenol	0.3 (U)	0.30	ug/L	<0.30	TW 1	<0.30	TW 1
Dimethoate		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Diquat		1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Diuron		1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Atrazine-desethyl		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Malathion		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Diclofop-methyl		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Metolachlor		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Metribuzin		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Paraquat		1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Pentachlorophenol	30 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Phorate		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Prometryne		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Simazine		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Terbufos		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,3,4,6-Tetrachlorophenol	1 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Triallate		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
2,4,6-Trichlorophenol	2 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Trifluralin		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
2-Fluorobiphenyl			%	87.7	TW 1	87.7	TW 1
2,4,6-Tribromophenol			%	83.6	TW 1	83.6	TW 1

Qualifier Legend

HTC

Results Summary L2741043

Job Reference	ARKELL PROPERTY
Report To	Scott Stovel , CASH CLIENTS - WATERLOO
Date Received	21-Nov-2022 15:00
Report Date	9-Dec-2022 8:11
Report Version	1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020

Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
DLDS							
SRU							

Exceeds Guideline Limit

Detection Limit Exceeds Guideline

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Results Summary L2741043

Job Reference ARKELL PROPERTY
Report To Scott Stovel , CASH CLIENTS - WATERLOO
Date Received 21-Nov-2022 15:00
Report Date 9-Dec-2022 8:11
Report Version 1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Physical Tests (Water)							
Color, True		2.0	T.C.U.	3.6	TW 1	3.6	TW 1
Hardness (as CaCO3)		2.4	mg/L	365	TW 1	365	TW 1
pH		0.10	pH units	8.23	TW 1	8.23	TW 1
Total Dissolved Solids		20	mg/L	446	TW 1	446	TW 1
Anions and Nutrients (Water)							
Alkalinity, Total (as CaCO3)		10	mg/L	226	TW 1	226	TW 1
Ammonia, Total (as N)		0.010	mg/L	0.174	TW 1	0.174	TW 1
Chloride (Cl)		0.50	mg/L	31	TW 1	31	TW 1
Fluoride (F)	1.5 (U)	0.10	mg/L	0.89	TW 1	0.89	TW 1
Nitrate (as N)	10 (U)	0.020	mg/L	<0.020	TW 1	<0.020	TW 1
Nitrite (as N)	1 (U)	0.010	mg/L	<0.010	TW 1	<0.010	TW 1
Total Kjeldahl Nitrogen		0.050	mg/L	0.252	TW 1	0.252	TW 1
Total Organic Nitrogen		0.050	mg/L	0.078	TW 1	0.078	TW 1
Phosphorus, Total		0.0030	mg/L	0.0066	TW 1	0.0066	TW 1
Sulfate (SO4)		0.30	mg/L	107	TW 1	107	TW 1
Sulphide (as S)		0.018	mg/L	0.182	TW 1	0.182	TW 1
Cyanides (Water)							
Cyanide, Free	200 (U)	2.0	ug/L	<2.0	TW 1	<2.0	TW 1
Organic / Inorganic Carbon (Water)							
Dissolved Carbon Filtration Location			-				
Dissolved Organic Carbon		0.50	mg/L	<0.50	TW 1	<0.50	TW 1
Bacteriological Tests (Water)							
Escherichia Coli	0 (U)		MPN/100mL	0	TW 1	0	TW 1
Heterotrophic Plate Count			CFU/mL	58	TW 1	58	TW 1
Total Coliforms	0 (U)		MPN/100mL	0	TW 1	0	TW 1
Total Metals (Water)							

Results Summary L2741043

Job Reference	ARKELL PROPERTY
Report To	Scott Stovel , CASH CLIENTS - WATERLOO
Date Received	21-Nov-2022 15:00
Report Date	9-Dec-2022 8:11
Report Version	1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020

Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Antimony (Sb)	6 (U)	0.60	ug/L	5.5	TW 1	5.5	TW 1
Arsenic (As)	10 (U)	1.0	ug/L	6.1	TW 1	6.1	TW 1
Barium (Ba)	1000 (U)	10	ug/L	32	TW 1	32	TW 1
Boron (B)	5000 (U)	50	ug/L	<50	TW 1	<50	TW 1
Cadmium (Cd)	5 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Calcium (Ca)		0.50	mg/L	88.9	TW 1	88.9	TW 1
Chromium (Cr)	50 (U)	1.0	ug/L	1	TW 1	1	TW 1
Magnesium (Mg)		0.50	mg/L	34.7	TW 1	34.7	TW 1
Selenium (Se)	50 (U)	5.0	ug/L	<5.0	TW 1	<5.0	TW 1
Uranium (U)	20 (U)	5.0	ug/L	<5.0	TW 1	<5.0	TW 1
Volatile Organic Compounds (Water)							
Benzene	1 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Carbon tetrachloride	2 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Monochlorobenzene	80 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,2-Dichlorobenzene	200 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,4-Dichlorobenzene	5 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,2-Dichloroethane	5 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
1,1-dichloroethylene (vinylidene chlorid	14 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Dichloromethane	50 (U)	5.0	ug/L	<5.0	TW 1	<5.0	TW 1
Ethylbenzene	140 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Tetrachloroethylene (perchloroethylene)	10 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Toluene	60 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Trichloroethylene	5 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Vinyl chloride	1 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
o-xylene		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
m/p-xylene		1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Xylenes (Total)	90 (U)	1.5	ug/L	<1.5	TW 1	<1.5	TW 1
4-Bromofluorobenzene			%	89.7	TW 1	89.7	TW 1
1,4-Difluorobenzene			%	97.9	TW 1	97.9	TW 1
Polycyclic Aromatic Hydrocarbons (Water)							
Benzo(a)pyrene	0.01 (U)	0.0050	ug/L	<0.0050	TW 1	<0.0050	TW 1

Results Summary L2741043

Job Reference	ARKELL PROPERTY
Report To	Scott Stovel , CASH CLIENTS - WATERLOO
Date Received	21-Nov-2022 15:00
Report Date	9-Dec-2022 8:11
Report Version	1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020

Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Chrysene d12			%	84.3	TW 1	84.3	TW 1
Semi-Volatile Organics (Water)							
Aldrin + Dieldrin	0.7 (U)	0.14	ug/L	<0.14	TW 1	<0.14	TW 1
N-Nitrosodimethylamine	0.009 (U)	0.00090	ug/L	<0.00090	TW 1	<0.00090	TW 1
N-Nitrosodimethylamine-d6			%	105	TW 1	105	TW 1
Organochlorine Pesticides (Water)							
a-chlordane		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
g-chlordane		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
pp-DDD		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
pp-DDE		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
op-DDT		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
pp-DDT		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Oxychlordane		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Decachlorobiphenyl			%	116.8	TW 1	116.8	TW 1
Tetrachloro-m-xylene			%	117.1	TW 1	117.1	TW 1
Herbicides (Water)							
AMPA		0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Bromoxynil	5 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,4-D	100 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Dicamba	120 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Dinoseb	10 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Glyphosate	280 (U)	5.0	ug/L	<5.0	TW 1	<5.0	TW 1
MCPA	100 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Picloram	190 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,4,5-TP		0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,4-Dichlorophenylacetic Acid			%	112	TW 1	112	TW 1
Carbamate Pesticides (Water)							
Aldicarb	9 (U)	0.90	ug/L	<0.90	TW 1	<0.90	TW 1

Results Summary L2741043

Job Reference ARKELL PROPERTY
Report To Scott Stovel , CASH CLIENTS - WATERLOO
Date Received 21-Nov-2022 15:00
Report Date 9-Dec-2022 8:11
Report Version 1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Pesticides (Water)							
Alachlor	5 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Atrazine		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Atrazine & Metabolites	5 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Azinphos-methyl	20 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Carbaryl	90 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Carbofuran	90 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Chlorpyriphos	90 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Diazinon	20 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
2,4-Dichlorophenol	900 (U)	0.30	ug/L	<0.30	TW 1	<0.30	TW 1
Dimethoate	20 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Diquat	70 (U)	1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Diuron	150 (U)	1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Atrazine-desethyl		0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Malathion	190 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Diclofop-methyl	9 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
Metolachlor	50 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Metribuzin	80 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Paraquat	10 (U)	1.0	ug/L	<1.0	TW 1	<1.0	TW 1
Pentachlorophenol	60 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Phorate	2 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Prometryne	1 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Simazine	10 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
Terbufos	1 (U)	0.20	ug/L	<0.20	TW 1	<0.20	TW 1
2,3,4,6-Tetrachlorophenol	100 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Triallate	230 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
2,4,6-Trichlorophenol	5 (U)	0.50	ug/L	<0.50	TW 1	<0.50	TW 1
Trifluralin	45 (U)	0.10	ug/L	<0.10	TW 1	<0.10	TW 1
2-Fluorobiphenyl			%	87.7	TW 1	87.7	TW 1
2,4,6-Tribromophenol			%	83.6	TW 1	83.6	TW 1

Qualifier Legend
HTC

Results Summary L2741043

Job Reference ARKELL PROPERTY
Report To Scott Stovel , CASH CLIENTS - WATERLOO
Date Received 21-Nov-2022 15:00
Report Date 9-Dec-2022 8:11
Report Version 1

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
DLDS							
SRU							

🟥 Exceeds Guideline Limit
🟨 Detection Limit Exceeds Guideline

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Results Summary WT2222903

Date Received 23-Nov-2022 17:25
Report Date 30-Nov-2022 11:28
Report Version 1
Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006)

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Physical Tests (Water)							
Color, True			T.C.U.				
Hardness (as CaCO3)	80 -> 100		mg/L				
pH	6.5 -> 8.5		pH units				
Total Dissolved Solids	500 (U)		mg/L				
Anions and Nutrients (Water)							
Alkalinity, Total (as CaCO3)	30 -> 500		mg/L				
Ammonia, Total (as N)			mg/L				
Chloride (Cl)	250 (U)		mg/L				
Fluoride (F)			mg/L				
Nitrate (as N)		0.020	mg/L	<0.020	TW 2	<0.020	TW 2
Nitrite (as N)		0.010	mg/L	<0.010	TW 2	<0.010	TW 2
Total Kjeldahl Nitrogen		0.050	mg/L				
Total Organic Nitrogen		0.050	mg/L				
Phosphorus, Total		0.0500	mg/L	<0.050	TW 2	<0.050	TW 2
Sulfate (SO4)	500 (U)		mg/L				
Sulphide (as S)	0.05 (U)		mg/L				
Cyanides (Water)							
Cyanide, Free			ug/L				
Organic / Inorganic Carbon (Water)							
Dissolved Carbon Filtration Location			-				
Dissolved Organic Carbon	5 (U)		mg/L				
Bacteriological Tests (Water)							
Escherichia Coli		1	MPN/100mL	<1	TW 2	<1	TW 2
Heterotrophic Plate Count		1	CFU/mL	13	TW 2	31	TW 2
Total Coliforms		1	MPN/100mL	<1	TW 2	<1	TW 2
Total Metals (Water)							

Antimony (Sb)		0.10	ug/L	0.3	TW 2	0.67	TW 2
Arsenic (As)		0.10	ug/L	0.95	TW 2	1.87	TW 2
Barium (Ba)		0.10	ug/L	37	TW 2	41.1	TW 2
Boron (B)		10	ug/L	46	TW 2	47	TW 2
Cadmium (Cd)		0.005	ug/L	0.0203	TW 2	0.0621	TW 2
Calcium (Ca)		0.05	mg/L	73.6	TW 2	80.7	TW 2
Chromium (Cr)		0.5	ug/L	1.69	TW 2	1.91	TW 2
Magnesium (Mg)		0.005	mg/L	31.1	TW 2	32.8	TW 2
Selenium (Se)		0.05	ug/L	<0.05	TW 2	<0.05	TW 2
Uranium (U)		0.01	ug/L	0.028	TW 2	0.074	TW 2
Volatile Organic Compounds (Water)							
Benzene			ug/L				
Carbon tetrachloride			ug/L				
Monochlorobenzene	30 (U)		ug/L				
1,2-Dichlorobenzene	3 (U)		ug/L				
1,4-Dichlorobenzene	1 (U)		ug/L				
1,2-Dichloroethane			ug/L				
1,1-dichloroethylene (vinylidene chlorid			ug/L				
Dichloromethane			ug/L				
Ethylbenzene	2.4 (U)		ug/L				
Tetrachloroethylene (perchloroethylene)			ug/L				
Toluene	24 (U)		ug/L				
Trichloroethylene			ug/L				
Vinyl chloride			ug/L				
o-xylene			ug/L				
m/p-xylene			ug/L				
Xylenes (Total)	300 (U)		ug/L				
4-Bromofluorobenzene			%				
1,4-Difluorobenzene			%				
Polycyclic Aromatic Hydrocarbons (Water)							
Benzo(a)pyrene			ug/L				
Chrysene d12			%				
Semi-Volatile Organics (Water)							
Aldrin + Dieldrin			ug/L				
N-Nitrosodimethylamine			ug/L				
N-Nitrosodimethylamine-d6			%				
Organochlorine Pesticides (Water)							
a-chlordane			ug/L				
g-chlordane			ug/L				
pp-DDD			ug/L				
pp-DDE			ug/L				
op-DDT			ug/L				

pp-DDT		ug/L
Oxychlordane		ug/L
Decachlorobiphenyl		%
Tetrachloro-m-xylene		%

Herbicides (Water)

AMPA		ug/L
Bromoxynil		ug/L
2,4-D		ug/L
Dicamba		ug/L
Dinoseb		ug/L
Glyphosate		ug/L
MCPA		ug/L
Picloram		ug/L
2,4,5-TP		ug/L
2,4-Dichlorophenylacetic Acid		%

Carbamate Pesticides (Water)

Aldicarb		ug/L

Pesticides (Water)

Alachlor		ug/L
Atrazine		ug/L
Atrazine & Metabolites		ug/L
Azinphos-methyl		ug/L
Carbaryl		ug/L
Carbofuran		ug/L
Chlorpyriphos		ug/L
Diazinon		ug/L
2,4-Dichlorophenol	0.3 (U)	ug/L
Dimethoate		ug/L
Diquat		ug/L
Diuron		ug/L
Atrazine-desethyl		ug/L
Malathion		ug/L
Diclofop-methyl		ug/L
Metolachlor		ug/L
Metribuzin		ug/L
Paraquat		ug/L
Pentachlorophenol	30 (U)	ug/L
Phorate		ug/L
Prometryne		ug/L
Simazine		ug/L
Terbufos		ug/L
2,3,4,6-Tetrachlorophenol	1 (U)	ug/L
Triallate		ug/L

2,4,6-Trichlorophenol	2 (U)	ug/L
Trifluralin		ug/L
2-Fluorobiphenyl		%
2,4,6-Tribromophenol		%

Qualifier Legend

HTC
DLDS
SRU

Exceeds Guideline Limit

Detection Limit Exceeds Guideline

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Results Summary WT2222903

Date Received	23-Nov-2022 17:25
Report Date	30-Nov-2022 11:28
Report Version	1
	Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
	Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Physical Tests (Water)							
Color, True			T.C.U.				
Hardness (as CaCO3)			mg/L				
pH			pH units				
Total Dissolved Solids			mg/L				
Anions and Nutrients (Water)							
Alkalinity, Total (as CaCO3)			mg/L				
Ammonia, Total (as N)			mg/L				
Chloride (Cl)			mg/L				
Fluoride (F)	1.5 (U)		mg/L				
Nitrate (as N)	10 (U)	0.020	mg/L	<0.020	TW 2	<0.020	TW 2
Nitrite (as N)	1 (U)	0.010	mg/L	<0.010	TW 2	<0.010	TW 2
Total Kjeldahl Nitrogen		0.050	mg/L				
Total Organic Nitrogen		0.050	mg/L				
Phosphorus, Total		0.0500	mg/L	<0.050	TW 2	<0.050	TW 2
Sulfate (SO4)			mg/L				
Sulphide (as S)			mg/L				
Cyanides (Water)							
Cyanide, Free	200 (U)		ug/L				
Organic / Inorganic Carbon (Water)							
Dissolved Carbon Filtration Location			-				
Dissolved Organic Carbon			mg/L				
Bacteriological Tests (Water)							
Escherichia Coli	0 (U)	1	MPN/100mL	<1	TW 2	<1	TW 2
Heterotrophic Plate Count		1	CFU/mL	13	TW 2	31	TW 2
Total Coliforms	0 (U)	1	MPN/100mL	<1	TW 2	<1	TW 2
Total Metals (Water)							

Antimony (Sb)	6 (U)	0.10	ug/L	0.3	TW 2	0.67	TW 2
Arsenic (As)	10 (U)	0.10	ug/L	0.95	TW 2	1.87	TW 2
Barium (Ba)	1000 (U)	0.10	ug/L	37	TW 2	41.1	TW 2
Boron (B)	5000 (U)	10	ug/L	46	TW 2	47	TW 2
Cadmium (Cd)	5 (U)	0.005	ug/L	0.0203	TW 2	0.0621	TW 2
Calcium (Ca)		0.05	mg/L	73.6	TW 2	80.7	TW 2
Chromium (Cr)	50 (U)	0.5	ug/L	1.69	TW 2	1.91	TW 2
Magnesium (Mg)		0.005	mg/L	31.1	TW 2	32.8	TW 2
Selenium (Se)	50 (U)	0.05	ug/L	<0.05	TW 2	<0.05	TW 2
Uranium (U)	20 (U)	0.01	ug/L	0.028	TW 2	0.074	TW 2

Volatile Organic Compounds (Water)

Benzene	1 (U)		ug/L				
Carbon tetrachloride	2 (U)		ug/L				
Monochlorobenzene	80 (U)		ug/L				
1,2-Dichlorobenzene	200 (U)		ug/L				
1,4-Dichlorobenzene	5 (U)		ug/L				
1,2-Dichloroethane	5 (U)		ug/L				
1,1-dichloroethylene (vinylidene chlorid	14 (U)		ug/L				
Dichloromethane	50 (U)		ug/L				
Ethylbenzene	140 (U)		ug/L				
Tetrachloroethylene (perchloroethylene)	10 (U)		ug/L				
Toluene	60 (U)		ug/L				
Trichloroethylene	5 (U)		ug/L				
Vinyl chloride	1 (U)		ug/L				
o-xylene			ug/L				
m/p-xylene			ug/L				
Xylenes (Total)	90 (U)		ug/L				
4-Bromofluorobenzene			%				
1,4-Difluorobenzene			%				

Polycyclic Aromatic Hydrocarbons (Water)

Benzo(a)pyrene	0.01 (U)		ug/L				
Chrysene d12			%				

Semi-Volatile Organics (Water)

Aldrin + Dieldrin	0.7 (U)		ug/L				
N-Nitrosodimethylamine	0.009 (U)		ug/L				
N-Nitrosodimethylamine-d6			%				

Organochlorine Pesticides (Water)

a-chlordane			ug/L				
g-chlordane			ug/L				
pp-DDD			ug/L				
pp-DDE			ug/L				
op-DDT			ug/L				

pp-DDT		ug/L
Oxychlordane		ug/L
Decachlorobiphenyl		%
Tetrachloro-m-xylene		%

Herbicides (Water)

AMPA		ug/L
Bromoxynil	5 (U)	ug/L
2,4-D	100 (U)	ug/L
Dicamba	120 (U)	ug/L
Dinoseb	10 (U)	ug/L
Glyphosate	280 (U)	ug/L
MCPA	100 (U)	ug/L
Picloram	190 (U)	ug/L
2,4,5-TP		ug/L
2,4-Dichlorophenylacetic Acid		%

Carbamate Pesticides (Water)

Aldicarb	9 (U)	ug/L

Pesticides (Water)

Alachlor	5 (U)	ug/L
Atrazine		ug/L
Atrazine & Metabolites	5 (U)	ug/L
Azinphos-methyl	20 (U)	ug/L
Carbaryl	90 (U)	ug/L
Carbofuran	90 (U)	ug/L
Chlorpyriphos	90 (U)	ug/L
Diazinon	20 (U)	ug/L
2,4-Dichlorophenol	900 (U)	ug/L
Dimethoate	20 (U)	ug/L
Diquat	70 (U)	ug/L
Diuron	150 (U)	ug/L
Atrazine-desethyl		ug/L
Malathion	190 (U)	ug/L
Diclofop-methyl	9 (U)	ug/L
Metolachlor	50 (U)	ug/L
Metribuzin	80 (U)	ug/L
Paraquat	10 (U)	ug/L
Pentachlorophenol	60 (U)	ug/L
Phorate	2 (U)	ug/L
Prometryne	1 (U)	ug/L
Simazine	10 (U)	ug/L
Terbufos	1 (U)	ug/L
2,3,4,6-Tetrachlorophenol	100 (U)	ug/L
Triallate	230 (U)	ug/L

2,4,6-Trichlorophenol	5 (U)	ug/L
Trifluralin	45 (U)	ug/L
2-Fluorobiphenyl		%
2,4,6-Tribromophenol		%

Qualifier Legend

HTC
DLDS
SRU

Exceeds Guideline Limit

Detection Limit Exceeds Guideline

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Results Summary WT2223236

Date Received 26-Nov-2022 12:30
Report Date 06-Dec-2022 10:30
Report Version 0

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Ontario DW Aesthetic and Operational Guidelines (June, 2006) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Physical Tests (Water)							
Color, True			T.C.U.				
Hardness (as CaCO3)	80 -> 100		mg/L				
pH	6.5 -> 8.5		pH units				
Total Dissolved Solids	500 (U)		mg/L				
Anions and Nutrients (Water)							
Alkalinity, Total (as CaCO3)	30 -> 500		mg/L				
Ammonia, Total (as N)			mg/L				
Chloride (Cl)	250 (U)		mg/L				
Fluoride (F)			mg/L				
Nitrate (as N)		0.020	mg/L	4.74	TW 3	5.31	TW 3
Nitrite (as N)		0.010	mg/L	<0.010	TW 3	<0.010	TW 3
Total Kjeldahl Nitrogen		0.050	mg/L				
Total Organic Nitrogen		0.050	mg/L				
Phosphorus, Total		0.0500	mg/L	<0.05	TW 3	0.101	TW 3
Sulfate (SO4)	500 (U)		mg/L				
Sulphide (as S)	0.05 (U)		mg/L				
Cyanides (Water)							
Cyanide, Free			ug/L				
Organic / Inorganic Carbon (Water)							
Dissolved Carbon Filtration Location			-				
Dissolved Organic Carbon	5 (U)		mg/L				
Bacteriological Tests (Water)							
Escherichia Coli		1	MPN/100mL	<1	TW 3	<1	TW 3
Heterotrophic Plate Count		1	CFU/mL	6	TW 3	11	TW 3
Total Coliforms		1	MPN/100mL	<1	TW 3	<1	TW 3
Total Metals (Water)							

Antimony (Sb)		0.10	ug/L	0.52	TW 3	0.78	TW 3
Arsenic (As)		0.10	ug/L	20.3	TW 3	50.2	TW 3
Barium (Ba)		0.10	ug/L	59.4	TW 3	69.3	TW 3
Boron (B)		10	ug/L	15	TW 3	17	TW 3
Cadmium (Cd)		0.005	ug/L	0.148	TW 3	0.307	TW 3
Calcium (Ca)		0.05	mg/L	89.3	TW 3	90.7	TW 3
Chromium (Cr)		0.5	ug/L	2.76	TW 3	4.87	TW 3
Magnesium (Mg)		0.005	mg/L	34.9	TW 3	35.3	TW 3
Selenium (Se)		0.05	ug/L	0.22	TW 3	0.23	TW 3
Uranium (U)		0.01	ug/L	0.78	TW 3	1.03	TW 3
Volatile Organic Compounds (Water)							
Benzene			ug/L				
Carbon tetrachloride			ug/L				
Monochlorobenzene	30 (U)		ug/L				
1,2-Dichlorobenzene	3 (U)		ug/L				
1,4-Dichlorobenzene	1 (U)		ug/L				
1,2-Dichloroethane			ug/L				
1,1-dichloroethylene (vinylidene chlorid			ug/L				
Dichloromethane			ug/L				
Ethylbenzene	2.4 (U)		ug/L				
Tetrachloroethylene (perchloroethylene)			ug/L				
Toluene	24 (U)		ug/L				
Trichloroethylene			ug/L				
Vinyl chloride			ug/L				
o-xylene			ug/L				
m/p-xylene			ug/L				
Xylenes (Total)	300 (U)		ug/L				
4-Bromofluorobenzene			%				
1,4-Difluorobenzene			%				
Polycyclic Aromatic Hydrocarbons (Water)							
Benzo(a)pyrene			ug/L				
Chrysene d12			%				
Semi-Volatile Organics (Water)							
Aldrin + Dieldrin			ug/L				
N-Nitrosodimethylamine			ug/L				
N-Nitrosodimethylamine-d6			%				
Organochlorine Pesticides (Water)							
a-chlordane			ug/L				
g-chlordane			ug/L				
pp-DDD			ug/L				
pp-DDE			ug/L				
op-DDT			ug/L				

pp-DDT		ug/L
Oxychlordane		ug/L
Decachlorobiphenyl		%
Tetrachloro-m-xylene		%

Herbicides (Water)

AMPA		ug/L
Bromoxynil		ug/L
2,4-D		ug/L
Dicamba		ug/L
Dinoseb		ug/L
Glyphosate		ug/L
MCPA		ug/L
Picloram		ug/L
2,4,5-TP		ug/L
2,4-Dichlorophenylacetic Acid		%

Carbamate Pesticides (Water)

Aldicarb		ug/L

Pesticides (Water)

Alachlor		ug/L
Atrazine		ug/L
Atrazine & Metabolites		ug/L
Azinphos-methyl		ug/L
Carbaryl		ug/L
Carbofuran		ug/L
Chlorpyriphos		ug/L
Diazinon		ug/L
2,4-Dichlorophenol	0.3 (U)	ug/L
Dimethoate		ug/L
Diquat		ug/L
Diuron		ug/L
Atrazine-desethyl		ug/L
Malathion		ug/L
Diclofop-methyl		ug/L
Metolachlor		ug/L
Metribuzin		ug/L
Paraquat		ug/L
Pentachlorophenol	30 (U)	ug/L
Phorate		ug/L
Prometryne		ug/L
Simazine		ug/L
Terbufos		ug/L
2,3,4,6-Tetrachlorophenol	1 (U)	ug/L
Triallate		ug/L

2,4,6-Trichlorophenol	2 (U)	ug/L
Trifluralin		ug/L
2-Fluorobiphenyl		%
2,4,6-Tribromophenol		%

Qualifier Legend

HTC
DLDS
SRU

🟥 Exceeds Guideline Limit

🟨 Detection Limit Exceeds Guideline

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Results Summary WT2223236

Date Received 26-Nov-2022 12:30
Report Date 06-Dec-2022 10:30
Report Version 0

Guideline: [Suite] - ON-DW-STANDARD+GUIDELINES - Ontario Drinking Water Regulation (ODWQS) JAN.1,2020
Category: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) ▼

Parameter	Guideline Limit	Lowest Detection Limit	Units	Min	Client Sample ID (Min)	Max	Client Sample ID (Max)
Physical Tests (Water)							
Color, True			T.C.U.				
Hardness (as CaCO3)			mg/L				
pH			pH units				
Total Dissolved Solids			mg/L				
Anions and Nutrients (Water)							
Alkalinity, Total (as CaCO3)			mg/L				
Ammonia, Total (as N)			mg/L				
Chloride (Cl)			mg/L				
Fluoride (F)	1.5 (U)		mg/L				
Nitrate (as N)	10 (U)	0.020	mg/L	4.74	TW 3	5.31	TW 3
Nitrite (as N)	1 (U)	0.010	mg/L	<0.010	TW 3	<0.010	TW 3
Total Kjeldahl Nitrogen		0.050	mg/L				
Total Organic Nitrogen		0.050	mg/L				
Phosphorus, Total		0.0500	mg/L	<0.05	TW 3	0.101	TW 3
Sulfate (SO4)			mg/L				
Sulphide (as S)			mg/L				
Cyanides (Water)							
Cyanide, Free	200 (U)		ug/L				
Organic / Inorganic Carbon (Water)							
Dissolved Carbon Filtration Location			-				
Dissolved Organic Carbon			mg/L				
Bacteriological Tests (Water)							
Escherichia Coli	0 (U)	1	MPN/100mL	<1	TW 3	<1	TW 3
Heterotrophic Plate Count		1	CFU/mL	6	TW 3	11	TW 3
Total Coliforms	0 (U)	1	MPN/100mL	<1	TW 3	<1	TW 3
Total Metals (Water)							

Antimony (Sb)	6 (U)	0.10	ug/L	0.52	TW 3	0.78	TW 3
Arsenic (As)	10 (U)	0.10	ug/L	20.3	TW 3	50.2	TW 3
Barium (Ba)	1000 (U)	0.10	ug/L	59.4	TW 3	69.3	TW 3
Boron (B)	5000 (U)	10	ug/L	15	TW 3	17	TW 3
Cadmium (Cd)	5 (U)	0.005	ug/L	0.148	TW 3	0.307	TW 3
Calcium (Ca)		0.05	mg/L	89.3	TW 3	90.7	TW 3
Chromium (Cr)	50 (U)	0.5	ug/L	2.76	TW 3	4.87	TW 3
Magnesium (Mg)		0.005	mg/L	34.9	TW 3	35.3	TW 3
Selenium (Se)	50 (U)	0.05	ug/L	0.22	TW 3	0.23	TW 3
Uranium (U)	20 (U)	0.01	ug/L	0.78	TW 3	1.03	TW 3

Volatile Organic Compounds (Water)

Benzene	1 (U)		ug/L				
Carbon tetrachloride	2 (U)		ug/L				
Monochlorobenzene	80 (U)		ug/L				
1,2-Dichlorobenzene	200 (U)		ug/L				
1,4-Dichlorobenzene	5 (U)		ug/L				
1,2-Dichloroethane	5 (U)		ug/L				
1,1-dichloroethylene (vinylidene chlorid	14 (U)		ug/L				
Dichloromethane	50 (U)		ug/L				
Ethylbenzene	140 (U)		ug/L				
Tetrachloroethylene (perchloroethylene)	10 (U)		ug/L				
Toluene	60 (U)		ug/L				
Trichloroethylene	5 (U)		ug/L				
Vinyl chloride	1 (U)		ug/L				
o-xylene			ug/L				
m/p-xylene			ug/L				
Xylenes (Total)	90 (U)		ug/L				
4-Bromofluorobenzene			%				
1,4-Difluorobenzene			%				

Polycyclic Aromatic Hydrocarbons (Water)

Benzo(a)pyrene	0.01 (U)		ug/L				
Chrysene d12			%				

Semi-Volatile Organics (Water)

Aldrin + Dieldrin	0.7 (U)		ug/L				
N-Nitrosodimethylamine	0.009 (U)		ug/L				
N-Nitrosodimethylamine-d6			%				

Organochlorine Pesticides (Water)

a-chlordane			ug/L				
g-chlordane			ug/L				
pp-DDD			ug/L				
pp-DDE			ug/L				
op-DDT			ug/L				

pp-DDT		ug/L
Oxychlordane		ug/L
Decachlorobiphenyl		%
Tetrachloro-m-xylene		%

Herbicides (Water)

AMPA		ug/L
Bromoxynil	5 (U)	ug/L
2,4-D	100 (U)	ug/L
Dicamba	120 (U)	ug/L
Dinoseb	10 (U)	ug/L
Glyphosate	280 (U)	ug/L
MCPA	100 (U)	ug/L
Picloram	190 (U)	ug/L
2,4,5-TP		ug/L
2,4-Dichlorophenylacetic Acid		%

Carbamate Pesticides (Water)

Aldicarb	9 (U)	ug/L

Pesticides (Water)

Alachlor	5 (U)	ug/L
Atrazine		ug/L
Atrazine & Metabolites	5 (U)	ug/L
Azinphos-methyl	20 (U)	ug/L
Carbaryl	90 (U)	ug/L
Carbofuran	90 (U)	ug/L
Chlorpyriphos	90 (U)	ug/L
Diazinon	20 (U)	ug/L
2,4-Dichlorophenol	900 (U)	ug/L
Dimethoate	20 (U)	ug/L
Diquat	70 (U)	ug/L
Diuron	150 (U)	ug/L
Atrazine-desethyl		ug/L
Malathion	190 (U)	ug/L
Diclofop-methyl	9 (U)	ug/L
Metolachlor	50 (U)	ug/L
Metribuzin	80 (U)	ug/L
Paraquat	10 (U)	ug/L
Pentachlorophenol	60 (U)	ug/L
Phorate	2 (U)	ug/L
Prometryne	1 (U)	ug/L
Simazine	10 (U)	ug/L
Terbufos	1 (U)	ug/L
2,3,4,6-Tetrachlorophenol	100 (U)	ug/L
Triallate	230 (U)	ug/L

2,4,6-Trichlorophenol	5 (U)	ug/L
Trifluralin	45 (U)	ug/L
2-Fluorobiphenyl		%
2,4,6-Tribromophenol		%

Qualifier Legend

HTC
DLDS
SRU

Exceeds Guideline Limit

Detection Limit Exceeds Guideline

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Outlook

Test Pits at Arkell site, CVD File 1669

From Rob Vander Doelen <robv@cvdengineering.com>
Date Mon 2024-01-08 12:19 PM
To Shawn@timberworx.ca <Shawn@timberworx.ca>; Rob Stovel <stovel.associates@outlook.com>
Cc Rob Stovel <robstoveljr@outlook.com>

3 attachments (1 MB)
1669 tp logs.pdf; 1669 grain sizes.pdf; Arkell - Test Pit Locations.pdf;

Hi Shawn and Rob,

Please find the test pit logs, grain size curves and the test pit location plan attached regarding the field work and laboratory work done recently performed for the Arkell Subdivision site.

Quick summary of the subsurface conditions are as follows:

- The surficial topsoil layer at the site was dominantly underlain by permeable sand and gravel which extended to the test pit termination depths between 3.0 and 6.1 m below existing grade
- Minor silt layers were encountered between the topsoil and sand and gravel deposits at two of the twelve test pit locations. Occasional minor silt seams were encountered within the sand and gravel deposit at two test pit locations
- All test pits were dry at completion.

No problems are apparent from the geotechnical perspective.

Please reach out if you have any questions.

Regards

ROB VANDER DOELEN, P.Eng.
SENIOR ENGINEER

CHUNG & VANDER DOELEN
ENGINEERING LTD.

e. robv@cvdengineering.com
w. cvdengineering.com
a. 311 Victoria St N, Kitchener, ON, N2H 5E1
t. 519 742 8979 x2002 | **f.** 519 742 7739

My working hours may not be your working hours. Please do not feel obligated to respond to this e-mail outside of your normal working hours.

Stovel and Associates Inc.
Planners, Agrologists and Environmental Consultants

January 06, 2023

Meagan Ferris, RPP, MCIP, Manager of Planning and Environment
County of Wellington Planning and Development
74 Woolwich Street
Guelph, ON
N1H 3T9

RE: Alternate Site Evaluation – Proposed Expansion of the Hamlet of Arkell
Part of Lots 7, 8 and 9, Concession 10
Township of Puslinch
Related Applications: OP-2006-06, ZBA P10/2006, Draft Plan of Subdivision Application 23T-06003

Dear Meagan:

Stovel and Associates Inc. (“SAI”) is retained by 1000286480 Ontario Inc. and Sloot Construction Inc. (“Sloot”) to address the agricultural concerns associated with the above-mentioned planning applications. Please accept the following with respect to consideration of lower priority agricultural lands.

Background

An application for a residential subdivision was submitted to the County of Wellington in 2006 by Mr. Tom Kukovica. As part of this draft plan of subdivision application, an Official Plan Amendment (“OPA”) and Zoning By-law Amendment (“ZBA”) application was also submitted. Map 1 illustrates the location of the subject property.

Since that time, Sloot purchased a portion of the lands and in 2022, 1000286480 Ontario Inc. acquired an interest in the property.

The lands in question include a portion of the existing Hamlet of Arkell. For this investigation, the lands designated Hamlet will not form part of the agricultural analysis as these lands have already been removed from the Agricultural System. The remaining portion of the site is designated Prime Agricultural and Secondary Agriculture. These lands are approximately 15.2 ha in size and are the focus of this report.

The initial circulation of the application generated a series of comments from agencies. Of note are the comments from the County of Wellington (“County”) Planning and Development Department (November 11, 2006). The County recommended that the applicant consider alternative locations of lower-priority agricultural lands.

Agricultural Analysis

Map 2 illustrates the distribution of agricultural soils and the associated Canada Land Inventory ("CLI") – Soil Capability for Agriculture ratings on the subject property. The subject property is mapped as follows:

- Class 2 soils: 5.9 ha.
- Class 3 (50%) and Class 5 (50%) soils: 9.3 ha.

Map 3 illustrates the Alternate Site Locations for potential hamlet expansion for Arkell. Six properties were selected for comparison purposes. Each parcel immediately abuts the existing Hamlet boundary. All six parcels are comprised of higher-capability agricultural lands than the subject property.

From an agricultural perspective, the subject property represents the lowest priority option for protection.

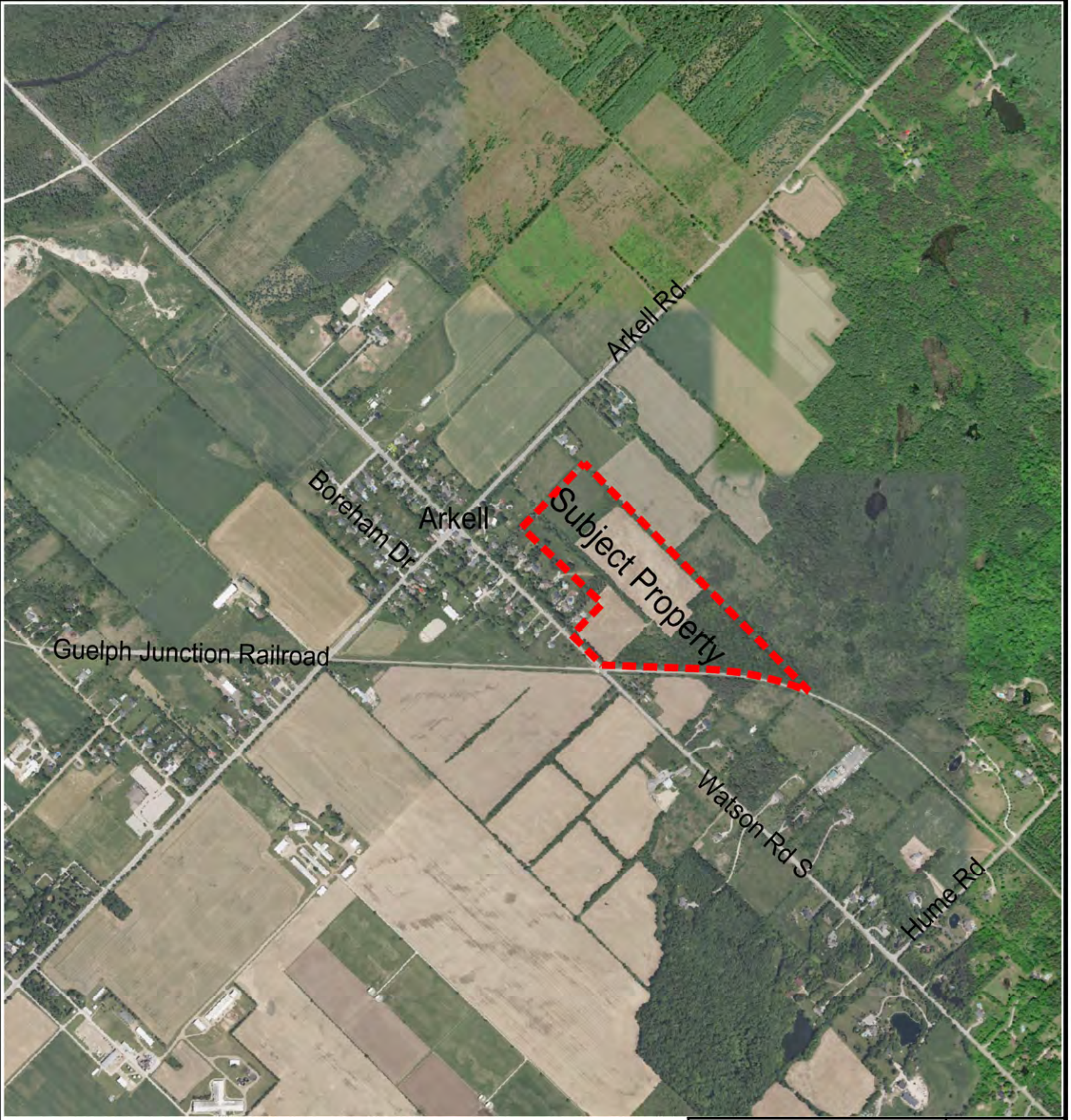
We trust that you will find this report to be of sufficient detail. Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

[redacted]

Robert P. Stovel, M.Sc., M.C.I.P., R.P.P., P. Ag.

cc. 1000286480 Ontario Inc. and Sloot Construction Inc.



Location of Subject Property

Map 1

Part of Lots 7, 8, & 9 Concession 10 Arkell
Alternate Site Evaluation

SAI
Stovel and Associates Inc.
851 Orangeville Road, Fergus On
N1M 1T9
P: 519-766-8042
E: stovel.associates@outlook.com

Client: Sloot Construction Inc.
1000286480 Ontario Inc.
Date: 12-21-2022

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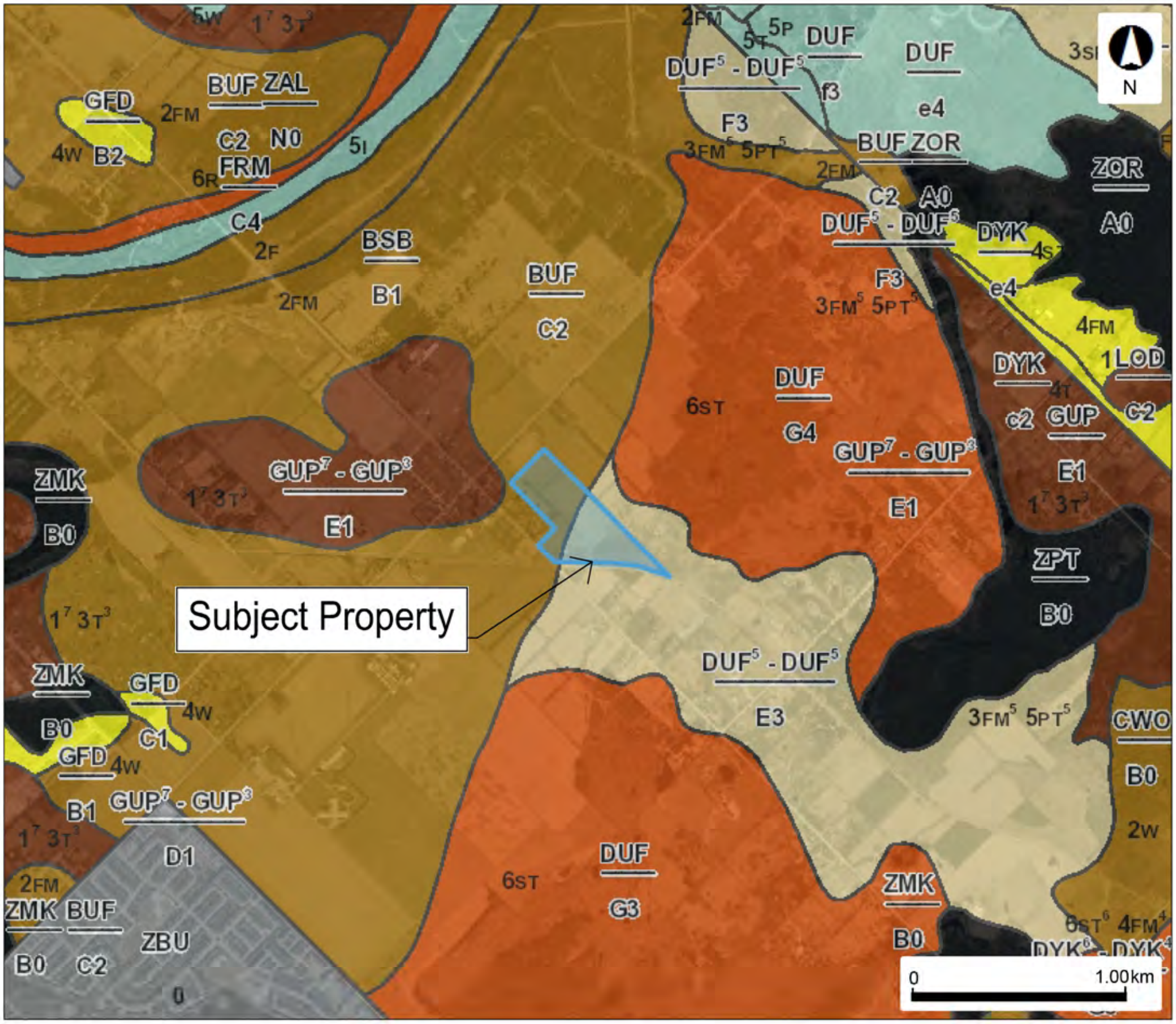
Imagery Provided by Microsoft Corporation - MAXAR Distribution Airbus



This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Legend

- ☐ Soil Name Label
- ☐ Soil Code
- Soil Capability for Agriculture
  - ■ Unclassified
  - ■ Class 1^7 / $3T^3$
  - ■ Class 2FM
  - ■ Class 3FM^5 / 5PT
  - 🟨 Class 4W
  - ■ Class 5I
  - 🟧 Class 6ST
  - ■ Class 7
  - ■ Organic Soil
  - 🟦 Water

Soil Capability for Agriculture

Map 2

Part of Lots 7, 8, & 9 Concession 10 Arkell

Alternate Site Evaluation

Stovel and Associates Inc.
651 Orangeville Road, Fergus On
N1M 1T9

P: 519-766-8042
E: stovel.associates@outlook.com

Client: Sloot Construction Inc.
1000286480 Ontario Inc.

Date: 12-21-2022

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PDF Taken from The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) AgMaps (2022). Derived by Stovel & Associates Inc. Date: 12-21-2022

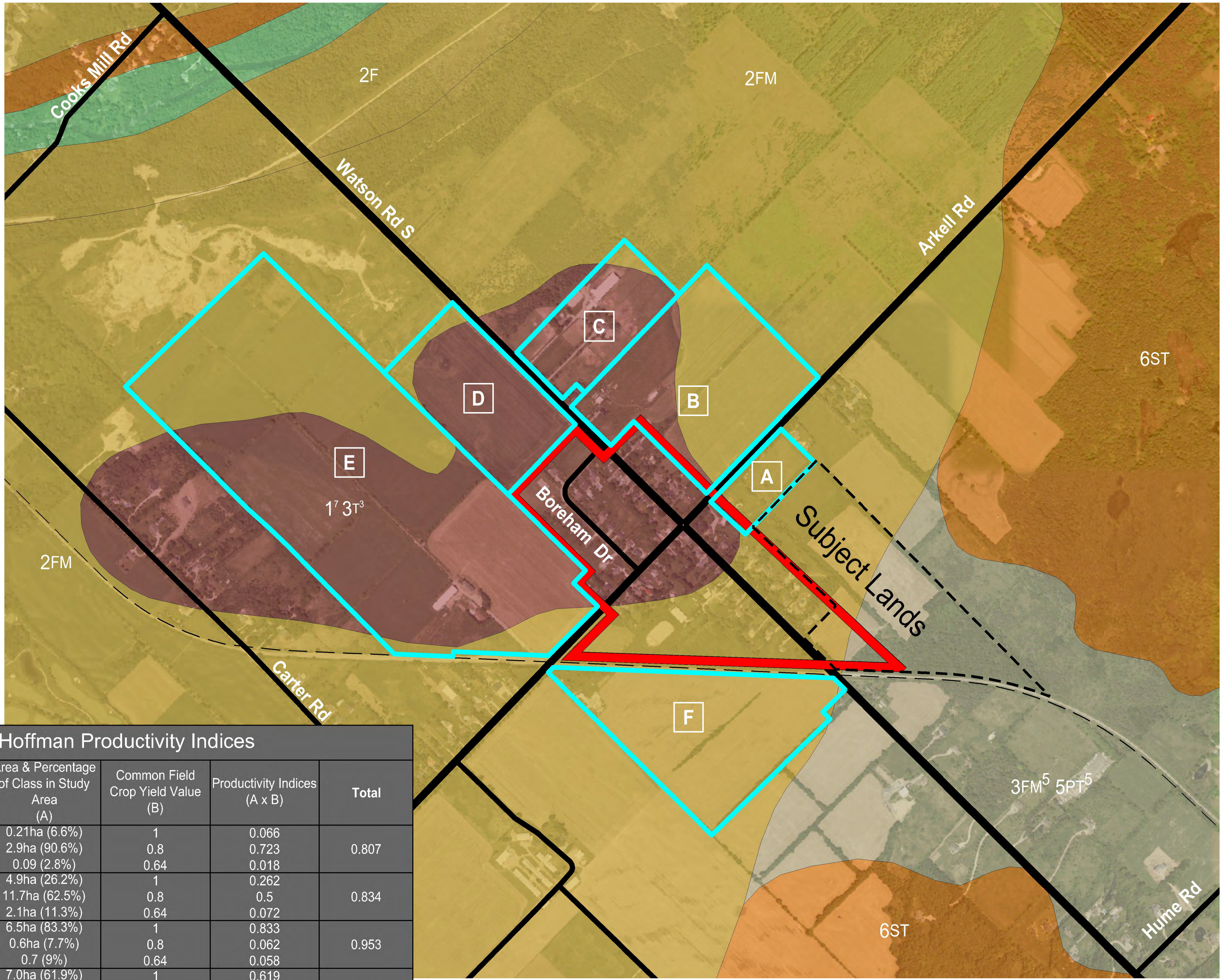

Table 1. Hoffman Productivity Indices

Location	CLI Class	Total Area (ha)	Area & Percentage of Class in Study Area (A)	Common Field Crop Yield Value (B)	Productivity Indices (A x B)	**Total**
Location 'A'	1 2 3	3.2	0.21ha (6.6%) 2.9ha (90.6%) 0.09 (2.8%)	1 0.8 0.64	0.066 0.723 0.018	0.807
Location 'B'	1 2 3	18.7	4.9ha (26.2%) 11.7ha (62.5%) 2.1ha (11.3%)	1 0.8 0.64	0.262 0.5 0.072	0.834
Location 'C'	1 2 3	7.8	6.5ha (83.3%) 0.6ha (7.7%) 0.7 (9%)	1 0.8 0.64	0.833 0.062 0.058	0.953
Location 'D'	1 2 3	11.3	7.0ha (61.9%) 1.3ha (11.5%) 3.0ha (26.6%)	1 0.8 0.64	0.619 0.092 0.170	0.881
Location 'E'	1 2 3	58.2	24.4ha (41.9%) 23.3ha (39.9%) 10.5ha (18.2%)	1 0.8 0.64	0.419 0.319 0.117	0.855
Location 'F'	2 3 5	17.2	17.18ha (99.88%) 0.01ha (0.06%) 0.01ha (0.06%)	0.8 0.64 0.37	0.799 0.00038 0.00022	0.800
Subject Property [1]	2 3 5	15.5	7.2ha (46.4%) 4.15ha (26.8%) 4.15ha (26.8%)	0.8 0.64 0.37	0.371 0.172 0.099	0.642
Notes	1. Area of subject Land does not include the area within the Hamlet Boundary.					

Map 3

Alternate Site Evaluation - CLI Soil Capability for Agriculture Classes

Legal Description

PART OF LOTS 7, 8, & 9 CONCESSION 10
ASSESSMENT ROLL NUMBER 2301000008034800000
ARKELL, ONTARIO

Notes

1. All Coordinates were Determined Using NAD83 CSRS - UTM Zone 17.
2. This is Not a Plan of Survey.
3. Shapefiles Have Been Derived From "AgMaps" - Ontario / Ministry of Agriculture, Food and Rural Affairs

CLI Agricultural Capability Classes

Class 1	Soils in this class have no significant limitations in use for crops.
Class 2	Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.
Class 3	Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices.
Class 4	Soils in this class have severe limitations that restrict the range of crops or require special conservation practices.
Class 5	Soils in this class gave very severe limitations that restrict their capability in producing perennial forage crops, and improvement practices are feasible.
Class 6	Soils in this class are capable only of producing perennial forage crops, and improvement practices are not feasible.
Class 7	Soils in this class have no capacity for arable culture or permanent pasture.
Class 0	Organic Soils (not placed in capability classes).

Legend

- - - - Subject Lands
▬ Existing Hamlet Boundary Limit
A Alternate Site For Hamlet Expansion

Soil Capability For Agriculture

▨ Unclassified
▨ Class 1^7 $3T^3$
▨ Class 2FM & 2F
▨ Class $3FM^5$ $5PT^5$
▨ Class 4W
▨ Class 5I
▨ Class 6ST 6R
▨ Class 7
▨ Organic Soil
▨ Water

Client: Sloot Construction Inc. & 1000286480 Ontario Inc.

SAI
PLANNING, AGROLOGY, ENVIRONMENTAL

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Fergus On
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P: 519-766-8042
E: stovel.associates@outlook.com

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0 350 700
Meters

Approx. Scale 1 : 12,500

Date : 12/21/2022

Stovel and Associates Inc.
Planners, Agrologists and Environmental Consultants

January 06, 2023

Meagan Ferris, RPP, MCIP, Manager of Planning and Environment
County of Wellington Planning and Development
74 Woolwich Street
Guelph, ON
N1H 3T9

RE: Mineral Aggregate Evaluation – Proposed Expansion of the Hamlet of Arkell
Part of Lots 7, 8 and 9, Concession 10
Township of Puslinch
Related Applications: OP-2006-06, ZBA P10/2006, Draft Plan of Subdivision Application 23T-06003

Dear Meagan:

Stovel and Associates Inc. ("SAI") is retained by 1000286480 Ontario Inc. and Sloot Construction Inc. ("Sloot") to address the mineral aggregate resource issues associated with the above-mentioned planning applications. Please accept the following with respect to consideration of mineral aggregate resources.

Background

An application for a residential subdivision was submitted to the County of Wellington in 2006 by Mr. Tom Kukovica. As part of this draft plan of subdivision application, an Official Plan Amendment ("OPA") and Zoning By-law Amendment ("ZBA") application was also submitted. Map 1 illustrates the location of the subject property.

Since that time, Sloot purchased a portion of the lands and in 2022, 1000286480 Ontario Inc. acquired an interest in the property.

The lands in question include a portion of the existing Hamlet of Arkell. For this investigation, the lands designated Hamlet will not form part of the analysis.

The initial circulation of the application generated a series of comments from agencies. Of note are the comments from the Ministry of Natural Resources ("MNR) (January 8, 2007). The MNR noted that the site and surrounding area have been identified as mineral aggregate (sand and gravel) resource area in the Aggregate Resources Inventory Paper ("ARIP") of Puslinch Township (1982) and the Aggregate Resources Inventory Paper of Wellington County (1999). The MNR indicates that:

"*The Provincial Policy Statement is very clear on the need to protect mineral aggrege* *resources from incompatible development. Land uses permitted in and adjacent to mineral aggregate resource areas should be limited to those that would not preclude the option of aggregate extraction and its processing and transportation. The proposed subdivision would sterilize the resource on the site, and potential preclude extraction in the surrounding area. As such the MNR has concerns with the proposed development.*

As part of an application for a land use change that may preclude or constrain the establishment of new mineral aggregate operations, the MNR suggest that the application should be required to submit information to explain why the proposed land use should be permitted. Such amendments should only be considered where the planning authority is satisfied that:

- *The use of the mineral aggregate resource is not feasible, or*
- *The proposed land use or development serves a greater long term public interest, and*
- *Issues of public health, public safety and environmental impact are addressed.*
- *The use does not adversely affect the availability of aggregate resources in adjacent areas.*

The MNR also notes the County's OP contains some policy direction on these issues (policy 6.6.2), which should be applied in this case.

Mineral Aggregate Resources

Map 2 illustrates the distribution of mineral aggregate resources in the local area around the Hamlet of Arkell. This map has been adapted from the Wellington County ARIP. It shows the distribution of mineral aggregate deposits in proximity to Arkell. On the site, there is a deposit of Secondary significance. This deposit includes an outwash deposit in the southern portion of the site. The deposit is assumed to be greater than 8 m in depth.

Areas identified as Secondary significance include esker, outwash, ice--contact and kame deposits. These deposits contain materials similar to those selected at the primary level, however, aggregate quality is more varied and the quantity of available material is limited. Also, the possibility of finding fine-grained material within these deposits is greater. Nevertheless, protective measures should be considered for these resource areas since they provide alternate extraction sites.

Onsite testing has been completed for the subject property. In 2006, geotechnical fieldwork was completed. A series of 10 boreholes were advanced to sampling depths by a track-mounted power auger machine. The results of the investigation were included in a report prepared by V. A. Wood (Guelph) Inc. in a report entitled: "Preliminary Geotechnical Investigation. Proposed Residential Development. Part Lots 7-9, Concession 10, Township of Puslinch (Arkell), Ontario. This report was included in the submission to the Township of Puslinch and The County of Wellington.

SAI completed a review of these data. The following was noted:

- The water table is approximately 7.2 to 10 m below grade (i.e., approximate elevation 333.3 masl to 334.9 masl);
- Boreholes 1-5 inclusive and 8 were underlain by a deposit of brown sandy gravel to a depth of 5.2 m to 6.6 m below grade.
- Boreholes 6, 7, 9 and 10 were underlain by a deposit of gravel and sand ranging in depth from 6.9 to 7.2 m.
- Borehole 1 is underlain by silt.
- Borehole 10 is underlain by a deposit of gravelly, silty and sand till.

Grain size distribution curves were provided in the V. A. Wood report. Several of the samples revealed silt/clay composition more than 10% of the sample, i.e., 6, 7, 8, 9, 10. Borehole 10 is silt. The high concentration of silt makes this portion of the deposit unacceptable for Granular A and Granular B products without blending.

This finding would align with the ARIP assessment of the area as being secondary significance.

In 2022, three wells were drilled onsite. The overburden descriptions from these well records are summarized below:

- A356357: 0-1 m sandy clay, 1-6 m of sand and gravel, 6-13 m silt clay, limestone bedrock below this.
- A356358: 0-1 m sandy clay, 1-7 m of sand and gravel with silt, 7-8 m of sand with silt, 8-15 m silty clay and stones, limestone bedrock below this.
- A356359: 0-1 m sand and clay, 1-9 m sand gravel, 9-17 m silt clay, limestone below this.

Based on this information, the following trends can be identified:

- Over portions of the site, a sand and gravel deposit are evident.
- The southern half of the site, however, reveals silt content over 10 % making the deposit too dirty to meet specifications for granular A and B without blending.
- The water table ranges from 7 to 10 m below the surface.
- Above the limestone bedrock layer is a silty clay deposit of +/- 7 m in thickness.

Feasibility of Commercial Extraction

The feasibility of licensing and operating a commercial aggregate operation on the subject property is limited by the fact that existing sensitive receptors are in close proximity to the site, i.e., less than 100 m from the site. The existing Hamlet designation on the subject land will also be developed for residential land uses. Housing on these lands could be located less than 50 m from the area that could be extracted. Given the small size and shape of the site, it is anticipated that mandatory setbacks and operational restrictions will significantly constrain a commercial aggregate operation.

The final concern relates to the fact that the deposit has no access onto a municipal road. The only road access is associated with the portion of the site that is in the Hamlet and designated for Residential land uses. Without proper commercial access, the deposit cannot be commercially extracted.

Therefore, SAI concludes that extraction on the site is not a long-term viable land use consideration.

Adjacent Mineral Aggregate Operations

There are no active mineral aggregate operations in the local area. The closest operation is approximately 1 km north of the site. This operation will not be impacted by the approval of the proposed site for residential expansion.

Mineral Aggregate Resources on Adjacent Lands

There are significant mineral aggregate resources located north of the subject property (north of Arkell Road). These lands are owned by the City of Guelph. Extraction of these lands is not a viable consideration.

There are mineral aggregate resources located west of the subject property (west of the Guelph Junction Railway). These lands are owned by the University of Guelph and form part of the school's agricultural research activities. In addition, these lands immediately abut a recently developed portion of the City of Guelph. Extraction of these lands is a remote possibility. Development of the subject property will not impact the future extraction of these lands.

The mineral aggregate resource south and east of the subject property is not considered to be significant.

Summary and Conclusion

SAI was retained to examine the mineral aggregate resource onsite and in proximity to the site. The purpose of this report was to determine if the onsite mineral aggregate resources represent a commercially viable deposit worthy of licensing and to determine if the proposed development would impact adjacent mineral aggregate operations and mineral aggregate resources.

Based on the data reviewed, it was determined that the mineral aggregate resource onsite did not represent a commercially viable deposit. The small area, the shape of the parcel, proximity to existing and future sensitive residential land uses, and the absence of access to a municipal road were the main limiting factors.

Further, it was concluded that the approval of a residential subdivision on the subject property would not impact existing mineral aggregate operations or mineral aggregate resources.

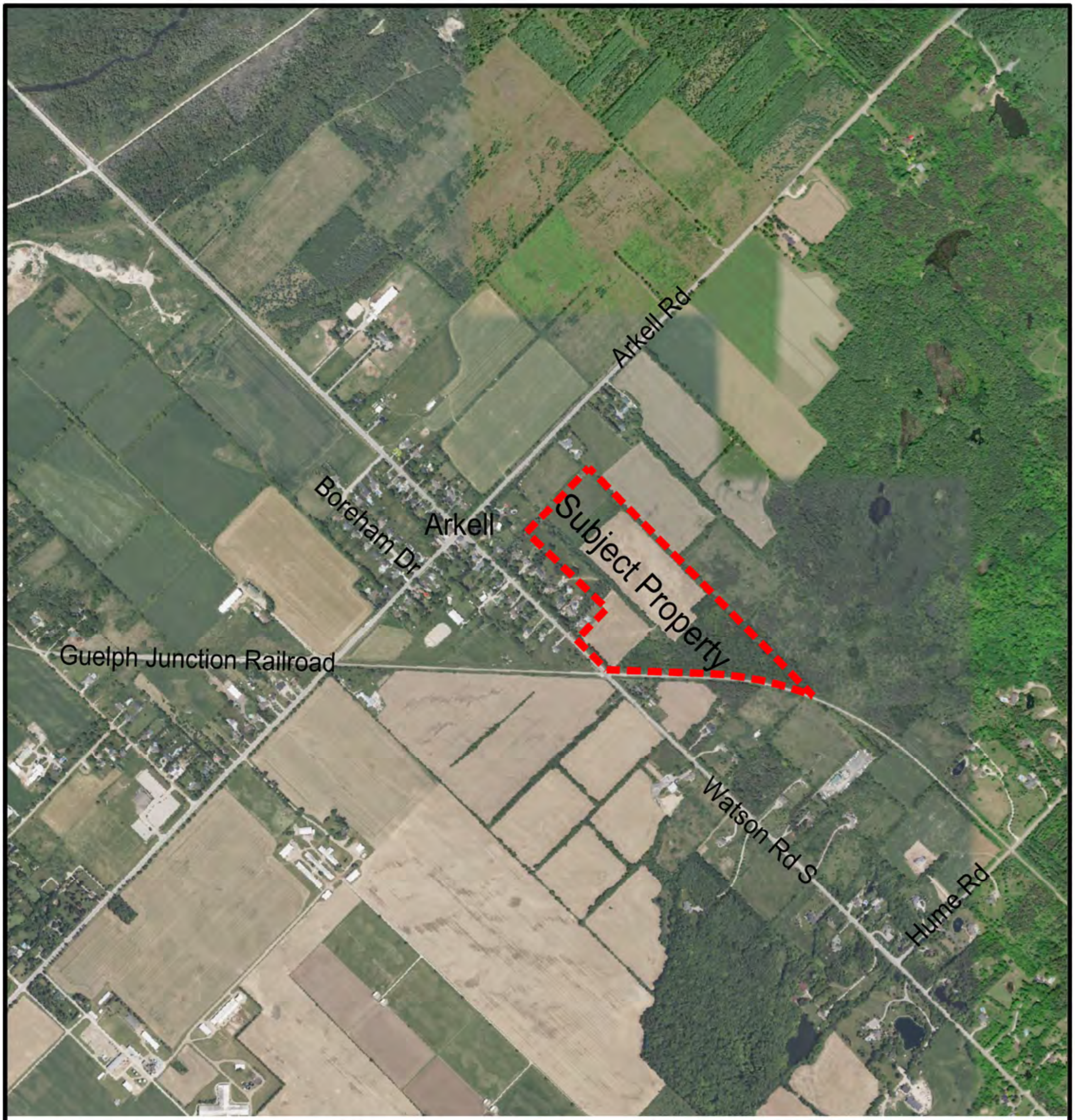
We trust that you will find this report to be of sufficient detail. Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

[redacted]

Robert P. Stovel, M.Sc., M.C.I.P., R.P.P., P. Ag.

cc. 1000286480 Ontario Inc. and Sloot Construction Inc.



Location of Subject Property	Map 1

Part of Lots 7, 8, & 9 Concession 10 Arkell

Mineral Aggregate Evaluation

Stovel and Associates Inc.
651 Orangeville Road, Fergus On
N1M 1T9

P: 519-766-8042
E: stovel.associates@outlook.com

Client: Sloot Construction Inc.
1000286480 Ontario Inc.

Date: 12-21-2022

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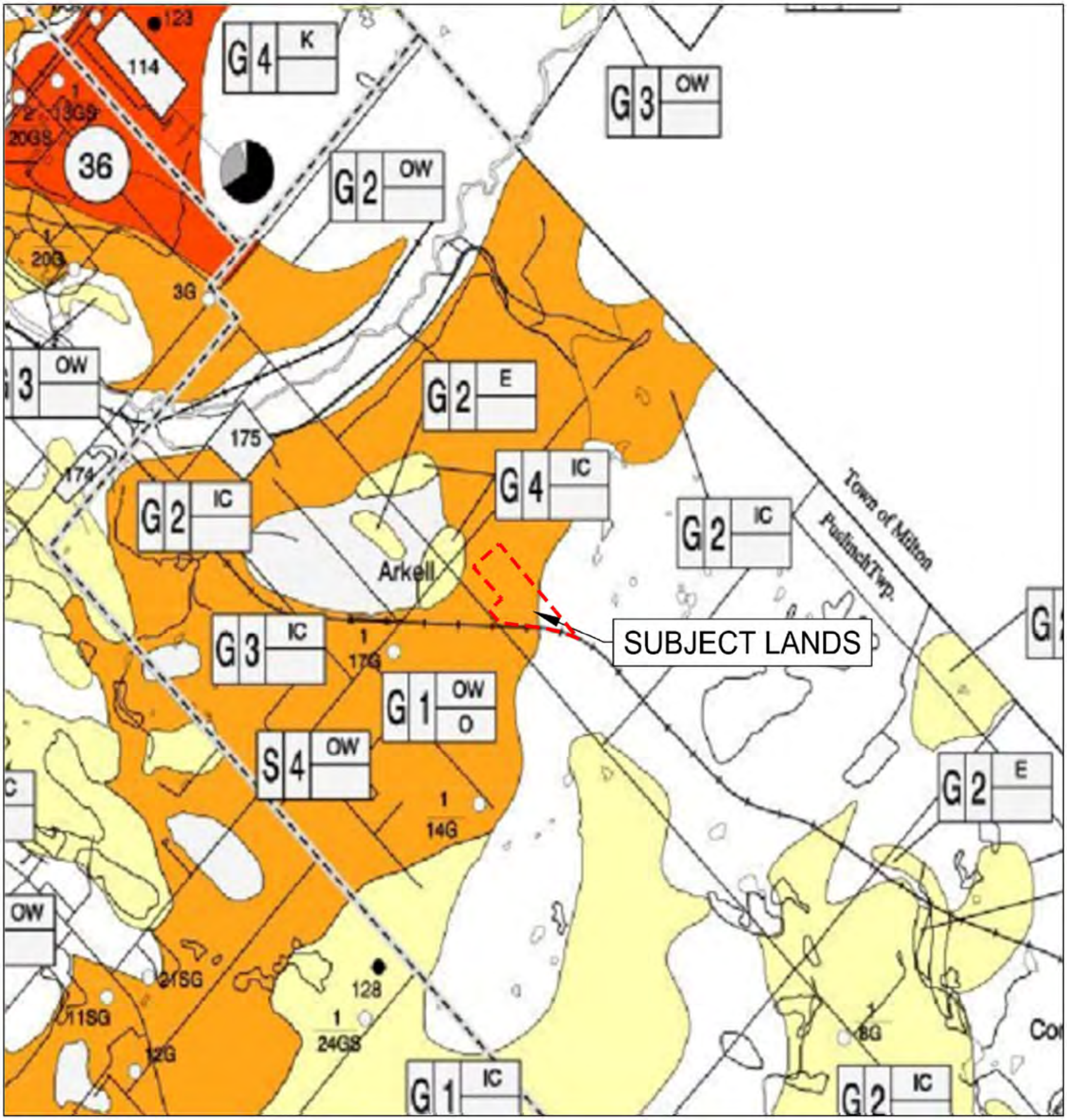
Imagery Provided by Microsoft Corporation - MAXAR Distribution Airbus



ARIP - Arkell Area

Map 2

Part of Lots 7, 8, & 9 Concession 10 Arkell

Mineral Aggregate Evaluation

Stovel and Associates Inc.
651 Orangeville Road, Fergus On
N1M 1T9

P: 519-766-8042

E: stovel.associates@outlook.com

Client: Sloot Construction LTD.
1000286480ONTARIOINC

Date: 12-21-2022

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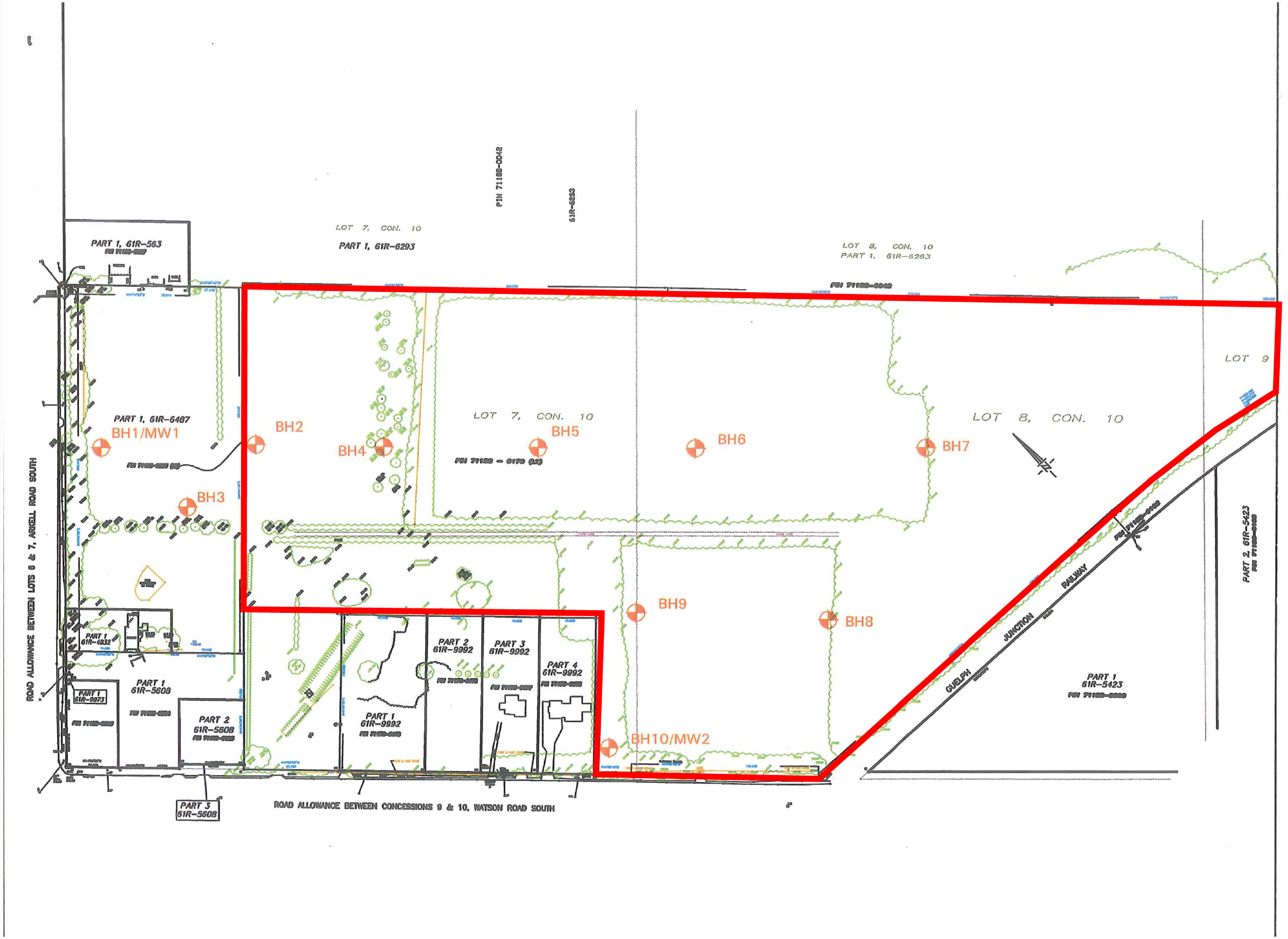
PDF Derived By Stovel and Associates Inc. Date: 12-21-2022



Map 3

Mineral Aggregate Evaluation

Borehole / Monitoring Well Location Plan

Legal Description

PART OF LOTS 7 & 8, CONCESSION 10
ASSESSMENT ROLL NUMBER 2301000008034800000
ARKELL, ONTARIO

Notes

1. All Coordinates were Determined Using NAD83 CSRS - UTM Zone 17
2. This is Not a Plan of Survey
3. PDF Derived from *Burnside Kukovica Subdivision Hydrogeological Assessment "Borehole / Monitoring Well Location Plan"*

Legend

🟥	Subject Lands
⊗	Monitoring Well Location

Client: **Sloot Construction Inc. & 1000286480 Ontario Inc.**

SAI
PLANNING. AGROLOGY. ENVIRONMENTAL.

Stovel and Associates Inc.
651 Orangeville Road,
Fergus On
N1M 1T9
P: 519-766-8042
E: stovel.associates@outlook.com

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0 75 150 Meters

Approx. Scale 1 : 3,000

Date : 12/21/2022

AUTHORIZATION FOR AGENT/SOLICITOR TO ACT FOR OWNER:

The Owner must complete the following to authorize applicant, agent or solicitor to act on their behalf.

NOTE: If more than one owner is listed in item #2 of this application, then all owners must sign this authorization section of the application form or by a letter of authorization duly signed. If the Owner is a corporation, the authorization must be by an officer of the corporation who has authority to bind the corporation.

I, (we), Vic Satzewich and Linda Mahood the Registered Owners of 605 Arkell Road Of the Arkell in the County/Region of Wellington severally and jointly, solemnly declare that TIMBERWORX CUSTOM HOMES / SLOOT CONSTRUCTION

Is authorized to submit an application for consent on my (our) behalf.

[redacted]

Signature(s) of Registered Owner(s) or Corporation's Officer

APPLICANT'S DECLARATION
This must be completed by the Applicant for the proposed amendment

I, (we) TIMBERWORX CUSTOM HOMES (Shawn Marsh) of the ~~City of Guelph~~ LS Township of Puslinch In the County/Region of Wellington **Solemnly declare that all**

the statements contained in this application for (property description) PUSLINCH CON 10 PT LOTS 7 TO 9 File Nos. OP-2006-06, P10/2006, 23T-06003

And all the supporting documents are true, and I, (we), make this solemn declaration conscientiously believing it to be true and complete, and knowing that it is of the same force and effect as if made under oath, and virtue of the CANADA EVIDENCE ACT.

DECLARED before me at the

Township Of

Puslinch In the

County/Region of Wellington

This 29 day of August 20 25

[redacted]

(Owner or Applicant)

(Owner or Applicant)

[redacted]

Commissioner of Oaths

Laura Elizabeth Emery, a Commissioner, etc., Province of Ontario, for the Corporation of the Township of Puslinch.

Printed Commissioner's, etc. Name

Laura Elizabeth Emery, a Commissioner, etc.
Province of Ontario, for the Corporation of the
Township of Puslinch.
Expires August 31, 2026.

APPLICANT'S CONSENT (FREEDOM OF INFORMATION):

In accordance with the provisions of the Planning Act Section 1.0.1, it is the policy of the County Planning and Development Department to provide public access to all development applications and supporting documentation. In submitting this development application and supporting documentation, I, SHAWN MARSH, the applicant, hereby acknowledge the above and provide my consent in accordance with the provisions of the Municipal Freedom of Information and Protection of Privacy Act that the information on this application and any supporting documentation provided by myself, my agents, solicitors, and consultants will be part of the public record and will also be available to the general public.

[redacted]

Signature of Owner(s) or Authorized Agent

Aug/19/2025

Date

THIS APPLICATION PACKAGE IS TO BE SUBMITTED TO:

Director of Planning and Development
Planning and Development Department
County of Wellington
74 Woolwich Street
Guelph, Ontario
N1H 3T9

Phone (519) 837-2600 Ext. 2160

STAGE 1-2 ARCHAEOLOGICAL ASSESSMENT OF THE ARKELL LANDS IN PART OF LOTS 7, 8 & 9, CONCESSION 10, TOWNSHIP OF PUSLINCH, WELLINGTON COUNTY, ONTARIO

SUBMITTED TO

TIMBERWORX CUSTOM HOMES INC.

AND

THE ONTARIO MINISTRY OF CITIZENSHIP AND MULTICULTURALISM

REPORT TYPE: ORIGINAL

ARCHAEOLOGICAL LICENSE NUMBER P1289, KARA ADAMS

PIF P1289-0424-2023

JANUARY 2024

LINCOLN
ENVIRONMENTAL
CONSULTING

Table of Contents

January 2024

Executive Summary

Lincoln Environmental Consulting Corp. (LEC) was retained by Timberworx Custom Homes Inc. to complete a Stage 1-2 archaeological assessment of the Arkell Lands to meet the requirements of the *Planning Act* (Government of Ontario 2014) in advance of a planning permit. The study area measures approximately 16.80 hectares in size and is located in part of Lots 7, 8 & 9, Concession 10, Township of Puslinch, Wellington County, Ontario.

This assessment was triggered by the Provincial Policy Statement that is informed by the *Planning Act* (Government of Ontario 1990a), which states that decisions affecting planning matters must be consistent with the policies outlined in the larger *Ontario Heritage Act* (1990b). According to Section 2.6.2 of the PPS, "*development* and *site alteration* shall not be permitted on lands containing *archaeological resources* or *areas of archaeological potential* unless *significant archaeological resources* have been *conserved*."

In accordance with Section 1.3.1 of the Ministry of Tourism, Culture and Sport's (MHSTCI) 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011), the Stage 1 archaeological assessment of the Arkell Lands has determined that the study area exhibits high potential for the identification and recovery of archaeological resources and a Stage 2 archaeological assessment is recommended.

The Stage 2 assessment was conducted on May 10th and May 11th 2023, under archaeological consulting license P1289 issued to Kara Adams, MSc, of LEC by the MHSTCI. No archaeological resources were identified during the Stage 2 archaeological assessment of the study area, and as such **no further archaeological assessment of the property is recommended.**

The MHSTCI is asked to review the results presented and accept this report into the Ontario Public Register of Archaeological Reports.

Project Personnel

Licensed Archaeologist:	Kara Adams, MSC (P1289)
Project Manager:	Derek Lincoln, MA (P344)
Licensed Field Director:	Carley Adams, MSc (R1319)
Field Technicians:	Owen Gillet, Nick Maharaj, Owen McGrenere, Michael Bagnall, Jayden Duncan, Uluc Yumurutug, Tyler Glanville, Christian Drasovean, Zach Hagarth, Jacob Chrisjohn
GIS Specialist:	Derek Lincoln, MA (P344)
Report Writer:	Carley Adams, MSc (R1319)
Senior Review:	Derek Lincoln, MA (P344)

Acknowledgements

Proponent Contact: Rob Stovel, Stovel Associates

1.0 PROJECT CONTEXT

1.1 DEVELOPMENT CONTEXT

Lincoln Environmental Consulting Corp. (LEC) was retained by Timberworx Custom Homes Inc. to complete a Stage 1-2 archaeological assessment of the Arkell Lands to meet the requirements of the *Planning Act* (Government of Ontario 2014) in advance of a planning permit. The study area measures approximately 16.80 hectares in size and is located in part of Lots 7, 8 & 9, Concession 10, Township of Puslinch, Wellington County, Ontario.

This assessment was triggered by the PPS that is informed by the *Planning Act* (Government of Ontario 1990a), which states that decisions affecting planning matters must be consistent with the policies outlined in the larger *Ontario Heritage Act* (1990b). According to Section 2.6.2 of the PPS, "*development* and *site alteration* shall not be permitted on lands containing *archaeological resources* or *areas of archaeological potential* unless *significant archaeological resources* have been *conserved*."

Permission to enter the study area and document archaeological resources was provided by Rob Stovel of Stovel and Associates Inc.

1.1.1 Objectives

In compliance with the provincial standards and guidelines set out in the Ministry of Heritage, Sport, Tourism, and Culture Industries' (MHSTCI) 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011), the objectives of the Stage 1 Archaeological Overview/Background Study are as follows:

- To provide information about the study area's geography, history, previous archaeological fieldwork, and current land conditions;
- To evaluate in detail the study area's archaeological potential which will support recommendations for Stage 2 survey for all or parts of the property; and
- To recommend appropriate strategies for Stage 2 survey.

To meet these objectives LEC archaeologists employed the following research strategies:

- A review of relevant archaeological, historic and environmental literature pertaining to the study area;
- A review of the land use history, including pertinent historic maps; and
- An examination of the Ontario Archaeological Sites Database (ASDB) to determine the presence of known archaeological sites in and around the project area.

The objective of the Stage 2 assessment was to provide an overview of archaeological resources on the property and to determine whether any of the resources might be archaeological sites with cultural heritage value or interest and to provide specific direction for the protection, management and/or recovery of these resources. In compliance with the provincial standards and guidelines set out in the MHSTCI' 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011), the objectives of the Stage 2 Property Assessment are as follows:

- To document all archaeological resources within the study area;
- To determine whether the study area contains archaeological resources requiring further assessment; and
- To recommend appropriate Stage 3 assessment strategies for archaeological sites identified.

1.2 HISTORICAL CONTEXT

The study area is 16.80 hectares of which approximately 57% consists of active agricultural fields, and 43% consists of manicured lawn and woodlot. The study area is located at the Arkell Lands in part of Lots 7, 8 & 9, Concession 10, Township of Puslinch, Wellington County, Ontario.

1.2.1 Pre and Early Post-Contact Aboriginal Resources

Our knowledge of past First Peoples settlement and land use in Wellington County is incomplete. Nonetheless, using province-wide (MCCR 1997) and region-specific archaeological data, a generalized cultural chronology for native settlement in the area can be proposed. The following paragraphs provide a basic textual summary of the known general cultural trends and a tabular summary appears in Table 1.

The Paleoindian Period

The first human populations to inhabit Ontario came to the region between 12,000 and 10,000 years ago, coincident with the end of the last period of glaciation. Climate and environmental conditions were significantly different than they are today; local environs would not have been welcoming to anything but short-term settlement. Termed Paleoindians by archaeologists, Ontario first peoples would have crossed the landscape in small groups (i.e., bands or family units) searching for food, particularly migratory game species. In the area, caribou may have provided the staple of the Paleoindian diet, supplemented by wild plants, small game, birds and fish. Given the low density of populations on the landscape at this time and their mobile nature, Paleoindian sites are small and ephemeral. They are usually identified by the presence of fluted projectile points and other finely made stone tools.

Archaic

The archaeological record of early native life in Southern Ontario indicates a change in lifeways beginning circa 10,000 years ago at the start of what archaeologists call the Archaic Period. The Archaic populations are better known than their Paleoindian predecessors, with numerous sites found throughout the area. The characteristic projectile points of early Archaic populations appear similar in some respects to early varieties and are likely a continuation of early trends. Archaic populations continued to rely heavily on game, particularly caribou, but diversified their diet and exploitation patterns with changing environmental conditions. A seasonal pattern of warm season riverine or lakeshore settlements and interior cold weather occupations has been documented in the archaeological record. Since the large cold weather mammal species that formed the basis of the Paleoindian subsistence pattern became extinct or moved northward with the onset of warmer climates, Archaic populations had a more varied diet, exploiting a range of plant, bird, mammal and fish species. Reliance on specific food resources like fish, deer and nuts becomes more pronounced through time and the presence of more hospitable environs and resource abundance led to the expansion of band and family sizes. In the archaeological record, this is evident in the presence of larger sites and aggregation camps, where several families or bands would come together in times of resource abundance. The change to more preferable environmental circumstances led to a rise in population density. As a result, Archaic sites are more abundant than those from the earlier period. Artifacts typical of these occupations include a variety of stemmed and notched projectile points, chipped stone scrapers, ground stone tools (e.g. celts, adzes) and ornaments (e.g. bannerstones, gorgets), bifaces or tool blanks, animal bone and waste flakes, a by-product of the tool making process.

Woodland Period

Significant changes in cultural and environmental patterns are witnessed in the Woodland Period (circa 950 B.C to historic times). The coniferous forests of earlier times were replaced by stands of mixed and deciduous species. Occupations became increasingly more permanent in this period, culminating in major semi-permanent villages by 1,000 years ago. Archaeologically, the most significant changes by Woodland times are the appearance of artifacts manufactured from modeled clay and the construction of house structures. The Woodland Period is often defined by the occurrence of pottery, storage facilities and residential areas similar to those that define the incipient agricultural or Neolithic period in Europe. The earliest pottery was rather crudely made by the coiling method and house structures were simple enclosures.

Iroquoian Period

The primary Late Woodland occupants of the area were the Neutral Nation, an Iroquoian speaking population described by European missionaries. Like other known Iroquoian groups including the Huron (Wendat) and Petun, the Neutral practiced a system of intensive horticulture based on three primary subsistence crops (corn, beans and squash). Neutral villages incorporated a number of longhouses, multi-family dwellings that contained several families related through the female line. The Jesuit Relations describe several Neutral centres in existence in the 17th century, including a number of sites where missions were later established. While precontact Neutral sites may be identified by a predominance of well-made pottery decorated with various simple and geometric motifs, triangular stone projectile points, clay pipes and ground stone implements, sites post-dating European contact are recognized through the appearance of various items of European manufacture. The latter include materials acquired by trade (e.g., glass beads, copper/brass kettles, iron axes, knives and other metal implements) in addition to the personal items of European visitors and Jesuit priests (e.g., finger rings, stoneware, rosaries, glassware). The Neutral were dispersed, and their population decimated by the arrival of epidemic European diseases and inter-tribal warfare.

Table 1: Cultural Chronology for Native Settlement within Wellington County

Period			Time Range (circa)	Diagnostic Features	Complexes
Paleoindian	Early		9000 – 8400 B.C.	fluted projectile points	Gainey, Barnes, Crowfield
	Late		8400 – 8000 B.C.	non-fluted and lanceolate points	Holcombe, Hi-Lo, Lanceolate
Archaic	Early		8000 – 6000 B.C.	serrated, notched, bifurcate base points	Nettling, Bifurcate Base Horizon
	Middle		6000 – 2500 B.C.	stemmed, side & corner notched points	Brewerton, Otter Creek, Stanly/Neville
	Late		2000 – 1800 B.C.	narrow points	Lamoka
			1800 – 1500 B.C.	broad points	Genesee, Adder Orchard, Perkiomen
			1500 – 1100 B.C.	small points	Crawford Knoll
	Terminal		1100 – 850 B.C.	first true cemeteries	Hind
Woodland	Early		800 – 400 B.C.	expanding stemmed points, Vinette pottery	Meadowood
	Middle		400 B.C. – A.D. 600	thick coiled pottery, notched rims; cord marked	Couture
	Late	Western Basin	A.D. 600 – 900	Wayne ware, vertical cord marked ceramics	Riviere au Vase-Algonquin
			A.D. 900 – 1200	first corn; ceramics with multiple band impressions	Young- Algonquin
			A.D. 1200 – 1400	longhouses; bag shaped pots, ribbed paddle	Springwells-Algonquin
			A.D 1400-1600	villages with earthworks; Parker Festoon pots	Wolf- Algonquin
Contact		Aboriginal	A.D. 1600 – 1700	early historic native settlements	Neutral Huron, Odawa, Wenro
		Euro-Canadian	A.D. 1700-1760	fur trade, missionization, early military establishments	French
			A.D. 1760-1900	Military establishments, pioneer settlement	British colonials, UELs

1.2.2 Historic Euro-Canadian Resources

The 1878 *Illustrated Historical Atlas of Wellington County's* map of the Township of Puslinch depicts a settled urban landscape with several landowners, structures, early transportation routes, and early town sites. A portion of the 1878 historic map of the Township of Puslinch is depicted in Figure 3, and this part of the Lot is listed as being owned by J. Bell, with a single structure depicted near the study area.

1.3 ARCHAEOLOGICAL CONTEXT

The study area is 16.80 hectares of which approximately 57% consists of active agricultural fields, and 43% consists of manicured lawn and woodlot. The study area is located at the Arkell Lands in part of Lots 7, 8 & 9, Concession 10, Township of Puslinch, Wellington County, Ontario.

1.3.1 The Natural Environment

The project area is located in the Horseshow Moraines physiographic region as identified by Chapman and Putnam (1984:127-129).

> *From the edge of the escarpment in the Town of Caledon the moraines trend somewhat west of the Niagara Escarpment forming a belt of moderately hilly relief… Associated with the moraines is a system of old spillways with broad gravel terraces and swampy floors… Good cross-sections of this landscape may be seen along Highway 7 from Rockwood to Georgetown.*
>
> (Chapman and Putnam 1984:128)

The soils here are comprised of sandy loam, ideal for agricultural practices and aboriginal settlement.

Potable water is the single most important resource for any extended human occupation or settlement and since water sources in southwestern Ontario have remained relatively stable over time, proximity to drinkable water is regarded as a useful index for the evaluation of archaeological site potential. In fact, distance to water is one of the most commonly used variables for predictive modeling of archaeological site location in Ontario. The closest extant source of potable water is the Eramosa River which passes north-west of the study area.

1.3.2 Previously Known Archaeological Sites and Surveys

In order to compile an inventory of archaeological resources, the registered archaeological site records kept by the MHSTCI were consulted. In Ontario, information concerning archaeological sites stored in the ASDB is maintained by the MHSTCI. This database contains archaeological sites registered according to the Borden system. Under the Borden system, Canada is divided into grid blocks based on latitude and longitude. A Borden Block is approximately 13 kilometers east to west and approximately 18.5 kilometers north to south. Each Borden Block is referenced by a four-letter designator and sites within a block are numbered sequentially as they are found.

Information concerning specific site locations is protected by provincial policy and is not fully subject to the *Freedom of Information and Protection of Privacy Act*. The release of such information in the past has led to looting or various forms of illegally conducted site destruction. Confidentiality extends to all media capable of conveying location, including maps, drawings, or textual descriptions of a site location. The MHSTCI will provide information concerning site location to the party or an agent of the party holding title to a property, or to a licensed archaeologist with relevant cultural resource management interests.

An examination of the ASDB has shown that there are 15 archaeological sites registered within a one-kilometer radius of the study area (Sites Data Search, Government of Ontario, May 5th, 2023); Table 2 summarizes the registered archaeological sites within one-kilometer of the study area. None of the sites fall within the current study area, nor within 50m of it.

Table 2: Registered Archaeological Sites within One Kilometer of the Study Area

Borden #	Site Name	Site Type	Cultural Affiliation
AjHa-56		Findspot	Archaic, Middle
AjHa-6	Starkey	Unknown	Post-Contact
AjHb-102		Other site	Woodland, Early
AjHb-103		Findspot	Woodland, Early
AjHb-104		Findspot	Archaic, Middle
AjHb-112		Scatter	Pre-Contact
AjHb-116		Scatter	Pre-Contact
AjHb-119	Haines	Homestead	Post-Contact, Euro-Canadian
AjHb-124	P191	Scatter	Pre-Contact
AjHb-125	Haines 1	Farmstead	Post-Contact
AjHb-95		Findspot	Archaic, Early
AjHb-96		Findspot	Archaic, Early
AjHb-97		Findspot	Archaic, Early
AjHb-98	Arkell 1	Other/discrete refuse Deposit, cabin	Post-Contact, Euro-Canadian
AjHb-99	Arkell 2	Homestead	Post-Contact

1.3.3 Summary of Past Archaeological Investigations within 50 Metres

There have been no documented archaeological investigations within 50 metres of the study area. However, it should be noted that the Ministry of Citizenship and Multiculturalism currently does not provide a complete inventory of archaeological assessments carried out within 50 metres of a property, so a complete inventory of assessments on lands adjacent to the subject property cannot be provided.

1.3.4 Archaeological Potential

Archaeological potential is established by determining the likelihood that archaeological resources may be present on a subject property. LEC applied archaeological potential criteria commonly used by MHSTCI (Government of Ontario 2011) to determine areas of archaeological potential within the region under study. These variables include proximity to previously identified archaeological sites, distance to various types of water sources, soil texture and drainage, glacial geomorphology, elevated topography and the general topographic variability of the area.

Distance to modern or ancient water sources is generally accepted as the most important determinant of past human settlement patterns and, considered alone, may result in a determination of archaeological potential. However, any combination of two or more other criteria, such as well-drained soils or topographic variability, may also indicate archaeological potential. Finally, extensive land disturbance can eradicate archaeological potential (Wilson and Horne 1995).

As discussed above, distance to water is an essential factor in archaeological potential modeling. When evaluating distance to water it is important to distinguish between water and shoreline, as well as natural and artificial water sources, as these features affect sites' locations and types to varying degrees. The MHSTCI categorizes water sources in the following manner:

- Primary water sources: lakes, rivers, streams, creeks;
- Secondary water sources: intermittent streams and creeks, springs, marshes and swamps;
- Past water sources: glacial lake shorelines, relic river or stream channels, cobble beaches, shorelines of drained lakes or marshes; and
- Accessible or inaccessible shorelines: high bluffs, swamp or marshy lake edges, sandbars stretching into marsh.

The closest extant source of potable water is the Eramosa River which passes north-west of the study area. The water resources that exist and existed close to the study area indicate archaeological potential.

Soil texture can be an important determinant of past settlement, usually in combination with other factors such as topography. As indicated previously, the soils within the study area are variable, but include pockets of well-drained and sandy soils that would be suitable for pre-contact Aboriginal agriculture.

An examination of the ASDB has shown that there are 15 archaeological sites registered within a one-kilometer radius of the study area, though none of them lie within it, nor within 50 meters of it.

For Euro-Canadian sites, archaeological potential can be extended to areas of early Euro-Canadian settlement, including places of military or pioneer settlements; early transportation routes; and properties listed on the municipal register or designated under the *Ontario Heritage Act* or property that local histories or informants have identified with possible historical events. The *Illustrated Historical Atlas of Wellington County* demonstrates that the study area and its environs were densely occupied by Euro-Canadian settlers by the later 19th century. Much of the established road system and agricultural settlement from that time is still visible today.

When the above listed criteria are applied to the study area, the archaeological potential for pre-contact Aboriginal, post-contact Aboriginal, and Euro-Canadian sites is deemed to be moderate to high. Thus, in accordance with Section 1.3.1 of the MHSTCI' 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011), the Stage 1 archaeological assessment of the Arkell Lands has determined that the study area exhibits moderate to high potential for the identification and recovery of archaeological resources and a Stage 2 archaeological assessment is recommended.

2.0 FIELD METHODS

The Stage 2 assessment of the Arkell Lands was conducted on May 10th, 2023 under PIF # P1289-0424-2023 issued to Kara Adams, MSc, of LEC by the MHSTCI. The study area is 16.80 hectares of which approximately 57% consists of active agricultural fields, and 43% consists of manicured lawn and woodlot. The study area is located at the Arkell Lands in part of Lots 7, 8 & 9, Concession 10, Township of Puslinch, Wellington County, Ontario.

During the Stage 2 survey, assessment conditions were excellent and at no time were the field, weather, or lighting conditions detrimental to the recovery of archaeological material (Table 4). Photos 1 to 15 confirm that field conditions met the requirements for a Stage 2 archaeological assessment, as per the MHSTCI' 2011 *Standards and Guidelines for Consultant Archaeologists* (Section 7.8.6 Standard 1a; Government of Ontario 2011). Figure 4 provides an illustration of the Stage 2 assessment methods, as well as photograph locations and directions.

Table 3: Field and Weather Conditions

Date	Activity	Weather	Field Conditions
May 10th, 2023	Pedestrian survey and test pit survey	Cool, overcast	Soils dry and friable, screens well; >90% visibility
May 11th 2023	Pedestrian survey and test pit survey	Cool, overcast	Soils dry and friable, screens well; >90% visibility

Approximately 43% of the study area consists of manicured lawn and woodlot. These areas were subject to test pit survey at 5-metre intervals in accordance with Section 2.1.2 of the MHSTCI's 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011). Each test pit was at least 30 centimeters in diameter and excavated five centimeters into sterile subsoil. Test pitting was conducted within one meter of built structures in accordance with Section 2.1.1 Standard 4 of the MHSTCI's 2011 Standards and Guidelines for Consultant Archaeologists (Government of Ontario 2011). The soils and test pits were then examined for stratigraphy, cultural features, or evidence of fill. All soil was screened through six-millimeter (mm) mesh hardware cloth to facilitate the recovery of small artifacts and then used to backfill the pit. No further archaeological methods were employed since no artifacts were recovered during the test pit survey.

Approximately 57% of the study area consists of active agricultural fields. These areas were subject to pedestrian survey at 5-metre intervals in accordance with Section 2.1.1 of the MHSTCI's *2011 Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011). These areas were ploughed and allowed to weather sufficiently. The conditions at the time of assessment were optimal and soil surface visibility was greater than 90%. No further archaeological methods were employed since no artifacts were recovered during the pedestrian survey.

3.0 RECORD OF FINDS

The Stage 2 archaeological assessment was conducted employing the methods described in Section 2.0. An inventory of the documentary record generated by fieldwork is provided in Table 5 below. No archaeological resources were identified during the Stage 2 archaeological assessment of the study area.

Table 4: Inventory of Documented Record

Document Type	Current Location of Document Type	Additional Comments
1 Page1 of field notes	LEC office, London	In original field book and photocopied in project file
1 Hand drawn map	LEC office, London	In original field book and photocopied in project file
1 map provided by Client	LEC office, London	Hard and digital copies in project file
38 Digital photographs	LEC office, London	Stored digitally in project file

4.0 ANALYSIS AND CONCULSION

Approximately 43% of the study area consists of manicured lawn and woodlot. These areas were subject to test pit survey at 5-metre intervals in accordance with Section 2.1.2 of the MHSTCI's 2011 *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011). Each test pit was at least 30 centimeters in diameter and excavated five centimeters into sterile subsoil. Test pitting was conducted within one meter of built structures in accordance with Section 2.1.1 Standard 4 of the MHSTCI's 2011 Standards and Guidelines for Consultant Archaeologists (Government of Ontario 2011). The soils and test pits were then examined for stratigraphy, cultural features, or evidence of fill. All soil was screened through six-millimeter (mm) mesh hardware cloth to facilitate the recovery of small artifacts and then used to backfill the pit. No further archaeological methods were employed since no artifacts were recovered during the test pit survey. Approximately 57% of the study area consists of active agricultural fields. These areas were subject to pedestrian survey at 5-metre intervals in accordance with Section 2.1.1 of the MHSTCI's *2011 Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011). These areas were ploughed and allowed to weather sufficiently. The conditions at the time of assessment were optimal and soil surface visibility was greater than 90%. No further archaeological methods were employed since no artifacts were recovered during the pedestrian survey.

The Stage 2 assessment did not result in the identification of any archaeological resources.

5.0 RECOMMENDATIONS

The Stage 2 archaeological assessment was carried out in accordance with the Ministry of Heritage, Sport, Tourism, and Culture Industries' Standards and Guidelines for Consultant Archaeologists (Government of Ontario 2011).

All work met provincial standards and no archaeological sites were identified during the Stage 2 assessment. If construction plans change to incorporate new areas that were not subject to a Stage 2 field survey, these must be assessed prior to the initiation of construction. In keeping with legislative stipulations, all construction, and demolition-related impacts (including, for example, machine travel, material storage and stockpiling, earth moving) must be restricted to the areas that were archaeologically assessed and cleared by the Ministry of Heritage, Sport, Tourism, and Culture Industries through acceptance of the assessment report into the provincial register.

As no archaeological resources were found on the subject property, no further archaeological assessment of the property is required.

6.0 ADVICE ON COMPLIANCE WITH LEGISLATION

This report is submitted to the Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act*.

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the *Ontario Heritage Act*.

The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

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

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8.0 IMAGES

8.1 PHOTOGRAPHS

Photo 1 : Assessed by 5m Interval Pedestrian Survey Facing North-east

Photo 2 : Assessed by 5m Interval Pedestrian Survey Facing North-west

Photo 3 : Assessed by 5m Interval Pedestrian Survey Facing South-west

Photo 4 : Assessed by 5m Interval Pedestrian Survey Facing North-west

Photo 5: Assessed by 5m Interval Pedestrian Survey Facing South-west

Photo 6 : Assessed by 5m Interval Pedestrian Survey Facing South-east

Photo 7 : Assessed by 5m Interval Test Pit Survey Facing North-west

Photo 8 : Assessed by 5m Interval Test Pit Survey Facing East

Photo 9 : Assessed by 5m Interval Test Pit Survey Facing North

Photo 10 : Assessed by 5m Interval Test Pit Survey Facing South

Photo 11 : Assessed by 5m Interval Pedestrian Survey Facing North-west

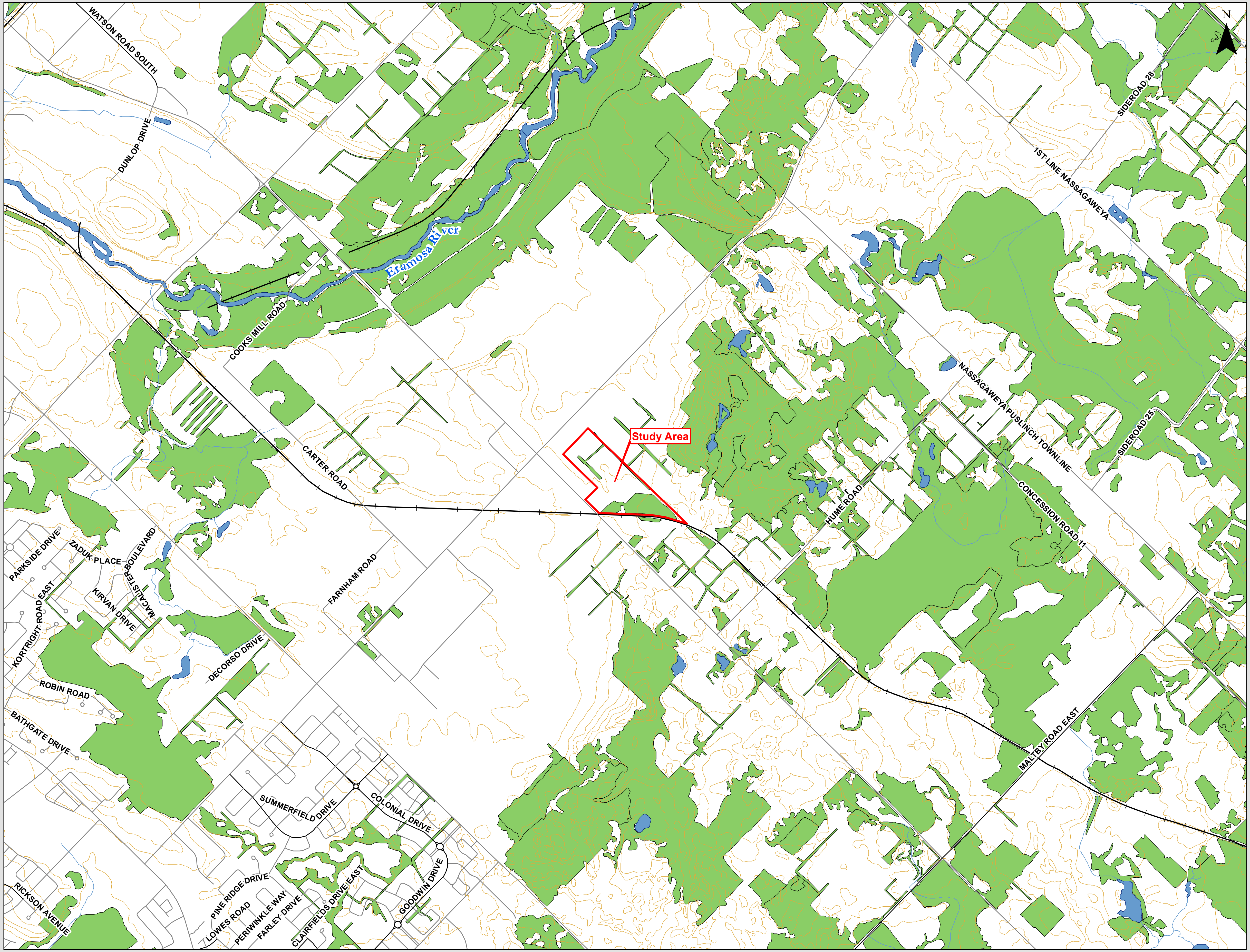
Photo 12 : Assessed by 5m Interval Pedestrian Survey Facing South-west

Photo 13: Typical Test Pit Facing North

Photo 14: Typical Field Conditions Facing North

Photo 15: Typical Field Conditions Facing North

9.0 MAPS



LINCOLN ENVIRONMENTAL CONSULTING

Stage 1-2 Archaeological Assessment of the Arkell Lands, Arkell, Ontario

Figure 1: Topographic Map of Study Area

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Date: July, 2023

Source: OBM
http://www.geographynetwork.ca/website/obm/viewer.htm

Scale 1:25,000

Datum: NAD 1983 UTM Zone 17N

Legend

🟥	Study Area	—	Watercourse
—	Local Road	🟦	Waterbody
—	Major Road	🟩	Wooded Area
┼	Railroad		
—	Contour Lines		

Metres
0 500 1,000

LINCOLN
ENVIRONMENTAL
CONSULTING

Stage 1-2 Archaeological Assessment of the Arkell Lands, Arkell, Ontario

Figure 2: Study Area

Date: July, 2023

Source: Bing Maps

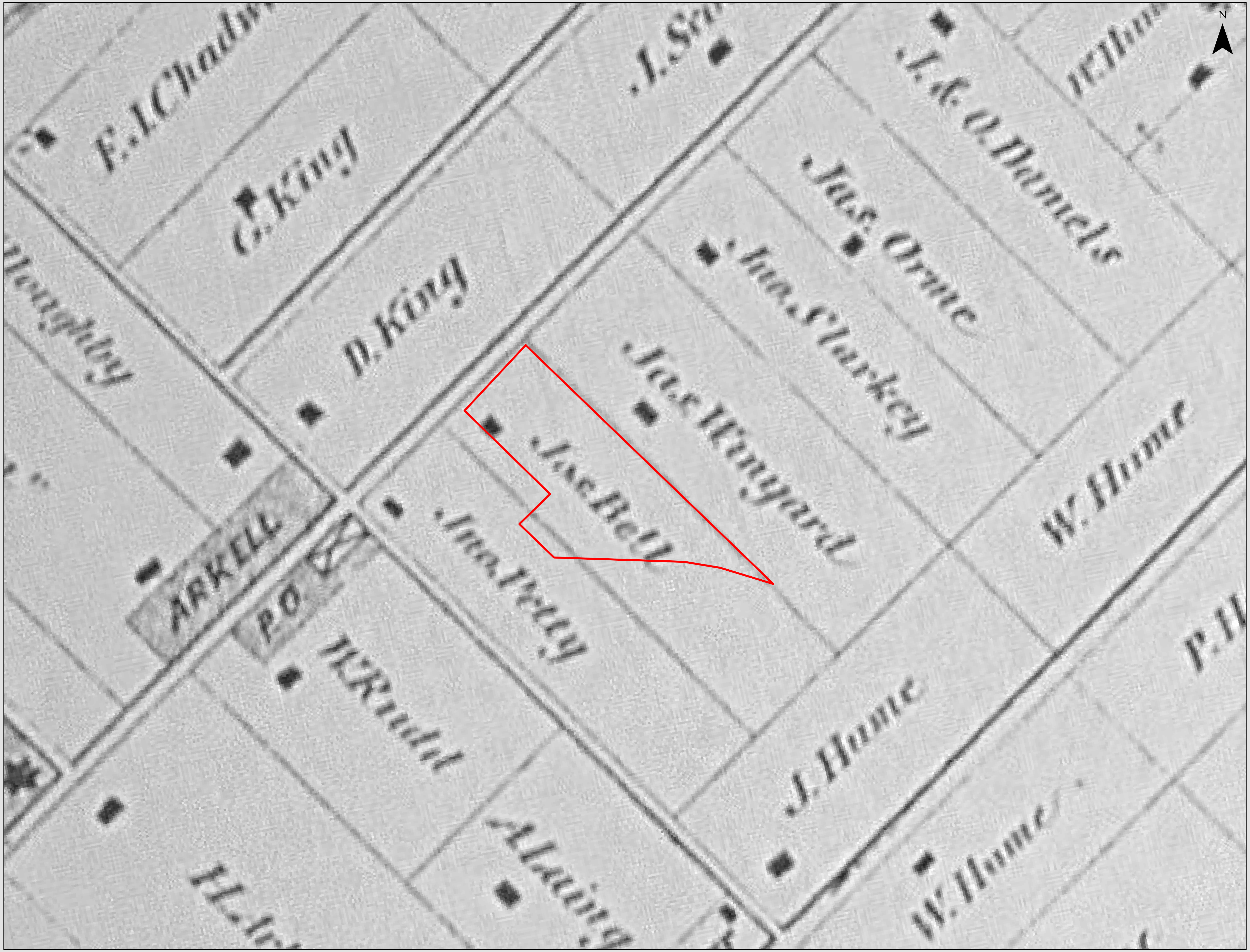
Scale 1:3,000

Datum: NAD 1983 UTM Zone 17N

Legend

▭ Study Area

Metres
0 50 100



LINCOLN ENVIRONMENTAL CONSULTING

Stage 1-2 Archaeological Assessment of the Arkell Lands, Arkell, Ontario

Figure 3: Portion of the Illustrated Historical Atlas of the County of Wellington, Puslinch Township

Date: July, 2023

Source: Illustrated Historical Atlas of Waterloo & Wellington Counties Ontario, Toronto: H. Parsell & Co and Walker & Mile, 1881 & 1877.

NOT TO SCALE

Datum: NAD 1983 UTM Zone 17N

Legend

🟥 Study Area

LINCOLN
ENVIRONMENTAL
CONSULTING

Stage 1-2 Archaeological Assessment of the Arkell Lands, Arkell, Ontario

Figure 4: Assessment Strategies and Results

Date: July, 2023

Source: Bing Maps

Scale 1:3,000

Datum: NAD 1983 UTM Zone 17N

Legend

- ▲ Photo Location
- 🟥 Study Area
- 🟨 Assessed by Pedestrian Survey at 5m Intervals
- 🟩 Assessed by Test Pit Survey at 5m Intervals

Metres
0 50 100

Ministry of Citizenship and Multiculturalism (MCM)

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Toronto ON M7A 2R9
Tél. : (416) 414-7787
Email: Jessica.Marr@ontario.ca

Mar 12, 2024

Kara Adams (P1289)
Lincoln Environmental Consulting Corp
6807 Calvert Strathroy ON N7G 3H5

RE: Review and Entry into the Ontario Public Register of Archaeological Reports: Archaeological Assessment Report Entitled, "STAGE 1-2 ARCHAEOLOGICAL ASSESSMENT OF THE ARKELL LANDS IN PART OF LOTS 7, 8 & 9, CONCESSION 10, TOWNSHIP PUSLINCH, WELLINGTON COUNTY, ONTARIO", Dated Jan 24, 2024, Filed with MCM Toronto Office on Jan 26, 2024, MCM Project Information Form Number P1289-0424-2023, MCM File Number 0019127

Dear Dr. Adams:

This office has reviewed the above-mentioned report, which has been submitted to this ministry as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18.[1] This review has been carried out in order to determine whether the licensed professional consultant archaeologist has met the terms and conditions of their licence, that the licensee assessed the property and documented archaeological resources using a process that accords with the 2011 *Standards and Guidelines for Consultant Archaeologists* set by the ministry, and that the archaeological fieldwork and report recommendations are consistent with the conservation, protection and preservation of the cultural heritage of Ontario.

The report documents the assessment of the study area as depicted in Figure 4 of the above titled report and recommends the following:

The Stage 2 archaeological assessment was carried out in accordance with the Ministry of Heritage, Sport, Tourism, and Culture Industries' Standards and Guidelines for Consultant Archaeologists (Government of Ontario 2011).

All work met provincial standards and no archaeological sites were identified during the Stage 2 assessment. If construction plans change to incorporate new areas that were not subject to a Stage 2 field survey, these must be assessed prior to the initiation of construction. In keeping with legislative stipulations, all construction, and demolition-related impacts (including, for example, machine travel, material storage and stockpiling, earth moving) must be restricted to the areas that were archaeologically assessed and cleared by the Ministry of Heritage, Sport, Tourism, and Culture Industries through acceptance of the assessment report into the provincial register.

As no archaeological resources were found on the subject property, no further archaeological assessment of the property is required.

Based on the information contained in the report, the ministry is satisfied that the fieldwork and reporting for the archaeological assessment are consistent with the ministry's 2011 *Standards and Guidelines for Consultant Archaeologists* and the terms and conditions for archaeological licences. This report has been entered into the Ontario Public Register of Archaeological Reports. Please note that the ministry makes no representation or warranty as to the completeness, accuracy or quality of reports in the register.

Should you require any further information regarding this matter, please feel free to contact me.

Sincerely,

Jessica Marr
Archaeology Review Officer

cc. Archaeology Licensing Officer
rob stovel,stovel and associates
tbd tbd,tbd

[1] *In no way will the ministry be liable for any harm, damages, costs, expenses, losses, claims or actions that may result: (a) if the Report(s) or its recommendations are discovered to be inaccurate, incomplete, misleading or fraudulent; or (b) from the issuance of this letter. Further measures may need to be taken in the event that additional artifacts or archaeological sites are identified or the Report(s) is otherwise found to be inaccurate, incomplete, misleading or fraudulent.*

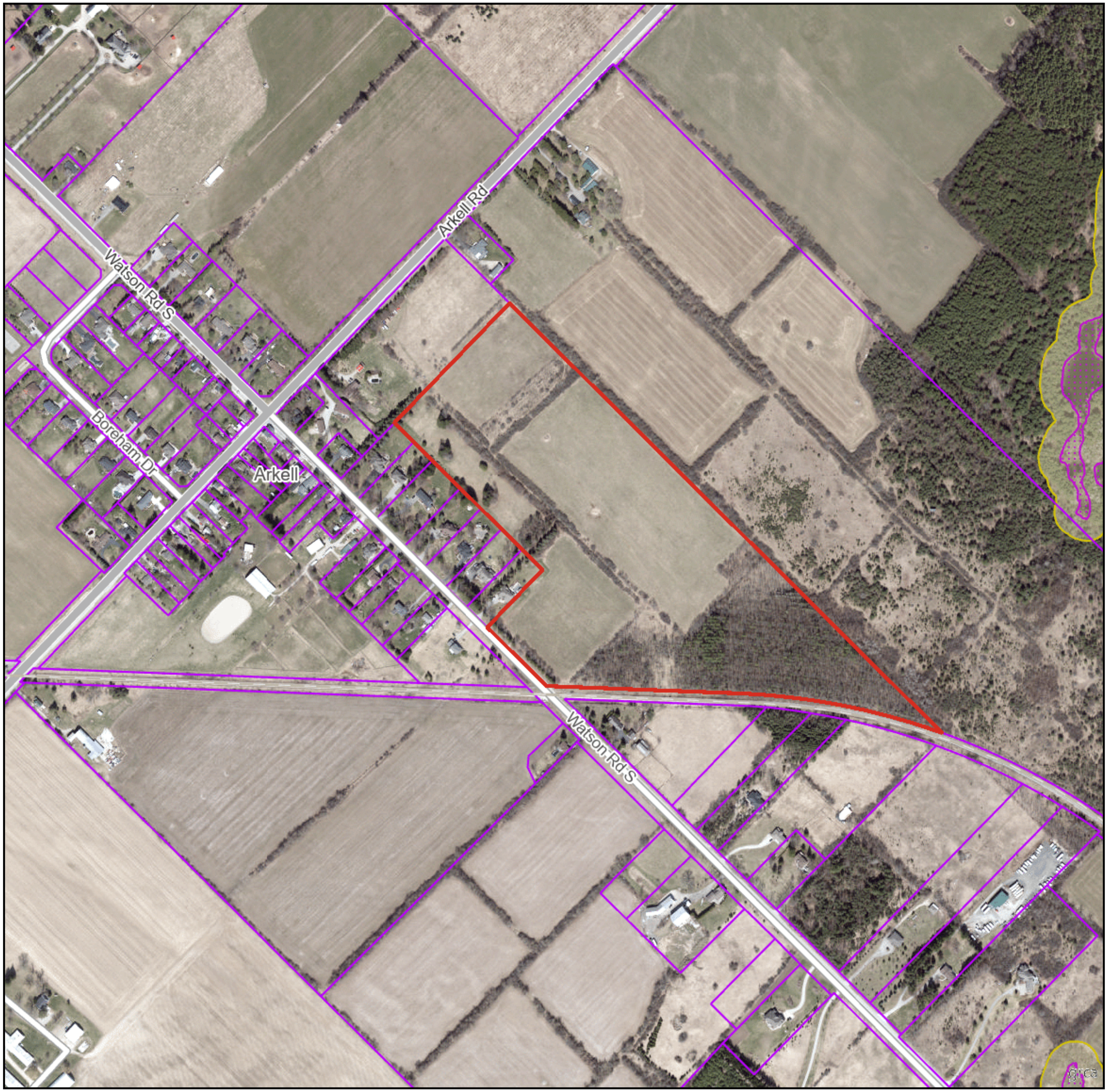
D14-KUK – Kukovica Arkell Development – August 19, 2025 Submission

Comment Summary

Consultant	Comments
Bylaw	No comments
Fire	No comments
GRCA	The property does not contain any GRCA features, and as such we have no objection to the proposal. (Please see our mapping attached)
Ecology – Azimuth	See attached letter
Hydrogeology – Harden	See attached letter
Building Dept	No comments
Public Works Department	No comments
GEI	See attached letter
NPG	See attached letter
County Planning	It is understood that the intent of this circulation is to receive preliminary technical feedback from the Township in order to inform the design of site design for the subject lands. As such, County Planning staff will not be providing comments. Please be aware that there are two County applications under the Planning Act from 2006 as it relates to the subject lands - an Official Plan Amendment to facilitate the expansion to the Hamlet of Arkell and a Draft Plan of Subdivision. These applications have not yet been revived and recirculated. Without the approval of an expansion to the Hamlet through the Official Plan Amendment, the Township should be aware that this development is not feasible. County Planning will provide comments on this overall proposal once a complete resubmission is made, to the satisfaction of the County, for the related County

	applications, in particular the Official Plan Amendment.
Traffic Consultant	See attached letter
Source Water	See attached letter
Guelph Junction Railway	**Traffic Impact Study** • Possibility of additional signals required for new driveway entrance to the development. **39 Residential Lots** • Fire pond preferred at lot 11 closer to tree canopy • No planting of tree canopies lots adjacent to the GJR within 8 meters of the railway property for fire safety reason **46 Residential Lots** • Fire pond preferred 3.1 ha open lot near tree canopy • No planting of tree canopies lots adjacent to the GJR within 8 meters of the railway property for fire safety reason **Fencing Type** • No gates permitted homes developed adjacent to access GJR lands **Noise and vibration study** • May 17, 2006. Report is obsolete. Development standards adjacent to railways have changed. Up to date test 2024 required. The GJR has grown the business considerably since this report was completed. There is no By-Law in place to eliminate train horn use on approaching railway crossing at Watson Rd. Railway gates would be required to even consider the

	cessation By-Law. This By-Law would need to be approved by Puslinch counsel, insurance coverage increased to list GJR and City of Guelph and its railway operator as additional insured. Warning clauses need to be updated to today's standards, In no way or form can residents/owners of the development oppose or form complaints against the GJR, City of Guelph and its operator regarding the operations or planned growth projects within the GJR ROW. Letter from GJR dated March 29, 2005 is obsolete and no longer valid. **Traffic Site Lines** • No planting of tree canopies lots adjacent to GJR within 8 meters of the railway property for fire safety reason • Possibility of additional signals required for new driveway entrance to the development.



Map Centre (X,Y): 567629.38, 4820635.22 | Map Link

This map is not to be used for navigation | 2020 Ortho (ON)

Grand River Conservation Authority

Date: Oct 03, 2025
Author: Ismet Esgin Zorlu

(Arkell Subdivision(23010000008034800000)

Legend

- ☐ Regulation Limit (GRCA)
- Floodplain (GRCA)
  - ▨ Engineered
  - ▨ Estimated
  - ▯ Approximate
- ▨ Floodplain - Special Policy Area (GRCA)
- Slope Erosion (GRCA)
  - 🟨 Steep
  - 🟨 Oversteep
  - 🟫 Toe
- Slope Valley (GRCA)
  - 🟨 Steep
  - 🟨 Oversteep
- — Regulated Watercourse (GRCA)
- 🟦 Regulated Waterbody (GRCA)
- ▦ Wetland (GRCA)
- ☐ Lake Erie Flood (GRCA)
- ☐ Lake Erie Shoreline Reach (GRCA)
- ☐ Lake Erie Dynamic Beach (GRCA)
- ■ Lake Erie Erosion (GRCA)
- ☐ Parcel - Assessment (MPAC/MNRF)
- ☐ Conservation Area Boundary (GRCA)

Scale 1:7,685

NAD83 UTM zone 17 (EPSG:26917)

AZIMUTH ENVIRONMENTAL CONSULTING, INC.
Environmental Assessments & Approvals

October 14, 2025 AEC 21-130

Township of Puslinch
7404 Wellington Road 34
Puslinch, Ontario N0B 2J0

Attention: Monika Farncombe, Planning and Corporate Services Coordinator

Re: **Natural Heritage Review of Application for a Proposed Residential Development, Part of Lots 7-9, Concession 10 (Arkell), Township of Puslinch, County of Wellington**

Monika Farncombe:

Azimuth Environmental Consulting, Inc. (Azimuth) is pleased to provide this natural heritage review letter regarding application for a Proposed Settlement Boundary Expansion, updated Site Plan and related relevant materials on Part of Lots 7-9, Concession 10 (Arkell) in the Township of Puslinch ("Township"), County of Wellington ("County"). It is noted that applications for an Official Plan Amendment (OP-2006-06), Zoning By-law Amendment (P10/2006) and Draft Plan of Subdivision (23T-06003) were previously submitted in 2006.

Azimuth completed a Pre-consultation Ecology Peer Review for the proposed development (File #D00/KUK) on May 11, 2023 that provided a preliminary background review of natural heritage features and functions associated with the property and adjacent lands, and recommended that an Environmental Impact Study (EIS) be prepared including a suite of vegetation and wildlife surveys. It is noted that in the applicant's comment/response matrix updated August 14, 2025, the applicant has indicated an EIS would not be prepared as the property is not mapped as Greenland and the plantation on the property "*is not a significant natural heritage feature*" that is "*in poor condition*".

Azimuth reviewed the following documents relevant to natural heritage matters, on behalf of the Township:

- Cover letter RE: Proposed Settlement Boundary Expansion – Arkell and Residential Development;
- Arkell Development Matrix;
- Conceptual Plan (44 Lots) Par of Lots 7, 8 & 9, Concession 10, Arkell, Ontario;

- Preliminary Grading and Servicing Plan; and,
- Results of Breeding Bird Surveys – 890 Watson Road, Arkell (September 19, 2023; Colville Consulting Inc.).

The above application package did not include an EIS/Environmental Impact Assessment (EIA) or similar documentation, therefore the scope of this natural heritage review was to determine whether the above application would require an EIA in accordance with municipal planning policy. This natural heritage review did not involve a site visit and is therefore prepared with regard for background resources and air photo interpretation.

The section below outlines the policy requirements of the County of Wellington Official Plan (“Wellington OP”) and Provincial Planning Statement (PPS) that would necessitate preparation of an EIS/EIA to accompany the proposed development application. A brief technical review of the Results of Breeding Birds Surveys letter prepared by Colville Consulting Inc. (“Colville”) is also included below, however the results of the breeding bird survey program should ultimately be incorporated into a future EIS/EIA submission.

Recommendations for Submission of an EIS/EIA

Based on a review of the relevant submission materials (listed above), the proposed development plan would primarily occur within existing agricultural lands, however a large plantation (potentially naturalized based on a review of historical and recent aerial imagery) occupies the eastern portion of the property. The Arkell Development Matrix responses state “*An EIS is not forthcoming as no development is proposed in the plantation.*”, however based on a review of Conceptual Plan details a portion of Lots 2, 3, Road B cul-de-sac, potentially Lot 6, and the Drainage Swale (Block 46) appear to be proposed directly within the woodland/plantation limit, which is inconsistent with the applicant’s response. Wooded areas associated with the Road C cul-de-sac may also be of sufficient size and dimensions to be considered woodland.

Significant Woodland

Including portions of the plantation that extend off-property (*i.e.* the entire woodland feature), based on a review of aerial imagery the plantation unit occupies an estimated 7.0-7.5 hectares (ha). As stated in Section 5.5.4 (Woodlands) of the Wellington OP, “*In the Rural system, woodlands over 4 hectares and plantations over 10 hectares are considered to be significant by the County, and are included in the Greenlands system.*” Further to the applicant’s response in the Arkell Development Matrix “*… the plantation is not mapped as Greenland and is not a significant natural heritage feature.*”. If the feature is considered “plantation” Azimuth agrees it would be unlikely to meet the minimum size threshold to be considered Significant Woodland, however if the feature has naturalized to the extent it is considered “woodland”, it would likely qualify as Significant Woodland in accordance with the Wellington OP. A Scoped EIS/EIA would provide rationale as to whether the feature should be considered “plantation” or “woodland” and would assist in providing an informed conclusion regarding the status of the feature. In Azimuth’s opinion, such analysis is recommended within an EIS/EIA, particularly as the proposed development includes direct encroachment within the woodland feature.

Habitat of Endangered and Threatened Species
In accordance with Section 5.4.2 of the Wellington OP:

“*Development and site alteration will not be allowed in significant habitat of endangered or threatened species except in accordance with provincial and federal requirements. Development or site alteration adjacent to significant habitat of endangered or threated species shall require a satisfactory Environmental Impact Assessment that demonstrates there will be no negative impact on the significant habitat of endangered or threatened species or its ecological function.*”

The proposed development involves direct encroachment within woodland areas and connected hedgerows that may contain habitat for Endangered and Threatened species, such as (but not limited to):

- Butternut trees (*Juglans cinerea*; Endangered); and,
- Treed roosting habitat for Endangered bat species.

Notwithstanding the Results of Breeding Bird Surveys (Colville) discussed in further detailed below, there is no information within the applicant’s submission package that addresses whether the proposed development would avoid negative impacts to the habitat of Endangered and Threatened species. Section 4.1.7 of the PPS states “*Development and site alteration shall not be permitted in habitat of endangered species and threatened species, except in accordance with provincial and federal requirements.*” Based on Azimuth’s review of background information and submitted materials to date, it is our opinion that there is reasonable potential for species designated as Threatened or Endangered under the *Endangered Species Act*, 2007 (ESA) to occur within the subject property limits and adjacent lands. It is noted that Section 9 and Section 10 of the ESA afford individual and habitat protection to species designated as Threatened or Endangered in the province of Ontario. As such, it is recommended an EIS/EIA be submitted that adequately addresses the above, in order to demonstrate conformity with Section 5.4.2 of the Wellington OP, Section 4.1.7 of the PPS, and Section 9 and Section 10 of the provincial ESA.

Results of Breeding Bird Surveys (Colville)

Azimuth has undertaken a technical review of the Results of Breeding Bird Studies prepared by Colville (September 19, 2023), and is generally satisfied with the methodology and presentation of results of the survey program provided in the letter. The following minor technical comment is provided at this time:

- Azimuth is satisfied with the dates, times, and weather conditions associated with the breeding bird surveys, however the letter does not outline the specific sampling methodology used to document breeding birds onsite. It would be helpful if the sampling methodology (*e.g.* survey stations/point counts, transects, general observations, or a combination) would be provided for additional understanding/assurance that the field program as appropriately implemented in accordance with Atlas of the Breeding Birds Ontario guidelines.

It is noted that the breeding bird survey program identified a breeding territory for Eastern Wood-pewee (Special Concern) appearing to occur within or directly adjacent to the proposed Road B cul-de-sac illustrated on the Conceptual Plan and related materials. Critical breeding habitats for Special Concern species may be considered Significant Wildlife Habitat (Special Concern and Rare Wildlife Species) and require further consideration in an EIS/EIA. Section 5.1.1 of the Wellington OP states, "*Development and site alteration shall not be allowed in significant wildlife habitat unless it has been demonstrated there will be no negative impact on the habitat or its ecological function.*" This policy is also stated in Section 4.1.5(d) of the PPS. It is recommended an EIS/EIA be submitted that adequately addresses potential impacts to Significant Wildlife Habitat, in order to demonstrate conformity with Section 5.1.1 of the Wellington OP and Section 4.1.5(d) of the PPS.

Summary

The requirement for an EIS/EIA is triggered by presence a woodlot on the property that may meet the definition of Significant Woodland as outlined in Section 5.5.4 of the Wellington OP, proposed direct encroachment within lands potentially providing potential habitat for Endangered and Threatened Species as outlined in Section 5.4.2 of the Wellington OP. Portions of the woodlot may also provide Significant Wildlife Habitat (SWH) for Eastern Wood-pewee (Habitat for Special Concern and Rare Wildlife Species), and possibly other SWH categories.

As such, it is recommended an EIS/EIA be prepared in accordance with Section 4.6.3 of the Wellington OP for the proposed development application to demonstrate conformity with the above OP policies, and parallel policies of the PPS. It is noted that the Results of Breeding Bird Surveys memo is generally sufficient and can be incorporated into a future EIS/EIA report. Further to our initial Pre-Consultation Ecology Review (May 2023), at this time Azimuth recommends the following field surveys are undertaken and incorporated into an EIS/EIA report for the proposed development:

- Evaluate/map vegetation communities based on provincial Ecological Land Classification (ELC) methods for Southern Ontario;
- One (1) vascular plant inventory, particularly with regard for Species at Risk (SAR) plants including Butternut and Black Ash (*Fraxinus nigra*);
- Review of trees and wooded areas for potential SAR bat roosting habitat;
- Assessment of potential SAR habitat on and/or adjacent to the property; and,
- Observations of incidental wildlife while on the property for other surveys.

Please note that in recognition of generally minor encroachments proposed within natural features and that seasonal timing at time of writing (early post-growing season), Azimuth has modified the initial proposed scope of studies to include only a single vegetation inventory/assessment.

Closure

We trust that this peer review is helpful regarding natural heritage requirements associated with the proposed undertaking. If you have any questions, please do not hesitate to contact the undersigned. Azimuth would be pleased to participate in subsequent meeting(s) and/or workshop(s) to review remaining concerns and considerations related to our technical natural heritage review, upon request.

Yours truly,
AZIMUTH ENVIRONMENTAL CONSULTING, INC.

[redacted]

Dan Stuart, M.Env.Sc.
Ecology Lead/Partner

HARDEN

Harden Environmental Services Ltd.
4622 Nassagaweya-Puslinch Townline
Moffat, Ontario, L0P 1J0
Phone: (519) 826-0099 Fax: (519) 826-9099

Our File: 2329

October 17, 2024

Township of Puslinch
7404 Wellington Road 34
Puslinch, Ontario N0B 2J0

Attention: Monika Farncombe
Development and Legislative Coordinator

Re: Arkell Residential Development
Part Lots 7, 8 and 9, Concession 10, Puslinch, Ontario
Hydrogeological Comments – Preconsultation Submission 2

Dear Monika,

1. **Application Support – The application is complete and we are in support of the development.**

2. **If you support the application – See comments below for conditions of approval.**

We have reviewed the following submission materials in preparing these comments:

1. ARL Groundwater Resources Ltd., June 25, 2024, Response Letter

2. Crozier and Associates, August 14, 2025 Water Balance

Supply well construction: The site is underlain by the Guelph Formation and the Goat Island / Gasport Formation aquifer separated by a regional aquitard. Wells that connect these two aquifers (i.e., multiaquifer wells) are not permitted on any lot as part of the development. The onsite supply wells constructed in 2022 were noted to be cased into the Gasport Formation. Newly constructed supply wells for the site should similarly be cased into the Gasport aquifer.

Water balance: We are satisfied with the water balance. LID measures to address the infiltration imbalance must be implemented at the site plan stage.

We appreciate the opportunity to provide these comments. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Harden Environmental Services Ltd.

[redacted]

Stan Denhoed, P.Eng., M.Sc.
Senior Hydrogeologist
sdenhoed@hardenv.com

GEI Consultants

October 14, 2025
GEI Project No. 2402581 – 123006-013

VIA CLOUDPERMIT: Township of Puslinch
Township Application No. D14-KUK

Monika Farncombe
Township of Puslinch
7404 Wellington Road 34
Puslinch, ON N0B 2J0

Re: ZBA 1st Formal Submission
Arkell Subdivision
Puslinch, ON

Dear Ms. Farncombe:

Following our review of first formal submission documents for a Zoning By-Law Amendment application received on September 26, 2025, we are providing comments in support of the proposed development on the subject lands located at Part of Lots 7, 8 & 9, Concession 10, in Arkell in the Township of Puslinch.

It is our understanding that the proposed development includes 44 single-detached residential lots with access from Watson Road South and Arkell Road.

A pre-consultation meeting was held in May 2023, and an initial submission was received in March 2024 based on our (formerly GM BluePlan Engineering Ltd) review letter dated May 15, 2024.

1. Documents Received

All plans and studies required from an engineering perspective have been submitted.

The following documents were received and reviewed as part of this submission:

- Proposed Settlement Boundary Expansion (cover letter).
- Arkell Development Matrix, dated August 15, 2025.
- Conceptual Plan, prepared by Stovel and Associates, dated July 29, 2025.
- Conceptual Plan (with aerial imagery), prepared by Stovel and Associates, dated July 29, 2025.
- Functional Servicing and Stormwater Management Report, prepared by Crozier, dated August 2025, including drawings and figures:

  - C101 – Preliminary Grading and Servicing Plan (Rev. 1), dated August 1, 2025.
  - C102 – Onsite Sewage Servicing Schematic (Rev. 1), dated August 1, 2025.
  - Figure 1 – Study Area.
  - Figure 2 – Pre-Development Drainage Plan.
  - Figure 3 – Post-Development Drainage Plan.
- Water Balance Assessment, prepared by Crozier, dated August 14, 2025.
- Geotechnical information, prepared by CVD Engineering:
  - Summary Email, dated January 8, 2024.
  - Grain Size Distributions, dated January 4, 2025.
  - Test Pit Logs, dated December 19, 2023.
  - Test Pit Location Map, /dated January 8, 2024.

We defer detailed review of the following documents to Township staff and other consultants:

- Addendum Traffic Impact Study, prepared by Crozier, dated August 2025.
- Results of Breeding Bird Surveys, prepared by Stovel and Associates, dated September 19, 2023.
- Groundwater Supply Assessment, prepared by ARL Groundwater Resources, dated March 2023.
- Response to Comments, prepared by ARL Groundwater Resources, dated June 25, 2024.
- Hydrogeological Review and Predictive Nitrate Assessment, prepared by RJ Burnside, dated July 2006.
- Stage 1-2 Archaeological Assessment, prepared by Lincoln Environmental Consulting, dated January 2024.
- Review of Archaeological Assessment, prepared by Ministry of Citizenship and Multiculturalism, dated March 12, 2024.
- Alternative Site Evaluation, prepared by Stovel and Associates, dated January 6, 2023.
- Mineral Aggregate Evaluation, prepared by Stovel and Associates, dated January 6, 2023.
- Minimum Distance Separation (MDS) Analysis, prepared by Stovel and Associates, dated August 13, 2025.

2. Additional Documents Required

All plans and studies required from an engineering perspective have been submitted and additional documents are not required to support the zoning bylaw amendment application.

3. Technical Comments

Based on our previous submission comments and review of documents identified in Section 1, we provide the following technical comments.

3.1. *Deficiencies/Outstanding Matters*

The following comments must be addressed to support the application.

No.	Matter	Document	Comment
2.	Culverts	Grading and Servicing Plan	GEI Comment (May 21, 2024) The Functional Servicing and Stormwater Management Report mentions existing culverts at the Guelph Junction Railway and Arkell Road as part of the proposed stormwater management strategy. Please indicate the location, size and grade of the existing culverts. Applicant Response (August 15, 2025) Existing culverts were observed on-site by Van Haarten. Crozier drawings updated with the information observed by Van Harten. GEI Comment (October 14, 2025) Based on the labelled inverts, the existing culvert at the Guelph Junction Railway appears to drain away from the site whereas the report suggests that it drains towards the site. Please label the size and shape of this culvert. Based on the topographical information shown, the existing culvert at Arkell Road appears to be 400 mm in diameter while the report states it is 300 mm – please clarify and label this culvert on the drawings as it is identified as the drainage outlet. We assume that new culverts will be needed at the Road A and Watson Road South connection and at the Road B and Arkell Road connection. Can these be preliminarily sized and shown on the drawings?
5.	Bypass Swales Maintenance	Grading and Servicing Plan	GEI Comment (May 21, 2024) Given that the proposed roads drain to the bypass swales, the Township would own and maintain the swales. Also, the bypass swales appear to be part of the proposed lots. Please indicate easements for the swales and access roads on the drawings for maintenance purposes. Applicant Response (August 15, 2025) Both the north swale and south swale are intended to promote infiltration. The north swale will have a shallow grade and will receive pre-treatment of runoff from the future municipal roads through an OGS system. We expect that any inspection/maintenance can be conducted via easements which are proposed for each storm sewer outlet. Similarly, the south (by-pass) swale will promote infiltration, but its primary function is to convey clean runoff from upstream lands safely through the subject property. The by-

No.	Matter	Document	Comment
			pass channel will be heavily vegetated and is not expected to erode due to its very shallow longitudinal slope. As such, construction of maintenance access roads should not be required. Our experience with trying to dry sediment is that it can take weeks and a lot of machine effort. Rather than a dedicated drying area, our preferred method is to use a vac truck with hoses that can reach remote locations. The sediment is then transported in a sealed unit to avoid any spillage. GEI Comment (October 14, 2025) Acknowledged. Given that the Township will own the swales, we defer detailed review of maintenance requirements to Township Public Works staff (maintenance method, access locations and width, etc.). Please add an Inspection and Maintenance Section to the FSSWM Report detailing anticipated ongoing inspection and maintenance requirements for the SWM facilities including dry pond, swales and OGSs. This should include details about access, frequency, methods etc. In order to do this, it may be necessary to preliminarily size the OGS units and provide manufacturer information about operations and maintenance. This will be helpful to Township Staff to inform them about anticipated future workload and responsibilities. Fencing for SWM facilities will need to be discussed further at detailed design.
9.	Post-Development Catchment Areas	FSSSWM Report	GEI Comment (October 14, 2025) Catchment UC02 appears to include Lot 2. The percent imperviousness of this catchment should be updated accordingly. It appears that some of Catchment UC01 may flow to the northern bioswale, as opposed to the southern bypass swale as described in the FSSWM Report. Please confirm. Per the preliminary grading plan, Lots 27, 28, 35, 36 and 43 appear to drain to the southern bypass swale. Is this the intent? If so, please update the report and modelling accordingly.
10.	Pond Outlet	Grading and Servicing Plan	GEI Comment (October 14, 2025) The FSSWM report includes an orifice outlet and emergency weir for the dry pond – please show these on the drawings. Additionally, the calculations indicate the top of the pond is 339.90 while the drawings show top of pond as 340.00. Please add additional details to Section 7.3 of the FSSWM Report discussing adequacy of the freeboard for the dry pond and anticipated drawdown time for the dry pond.

No.	Matter	Document	Comment
11.	Minor Errors	FSSWM Report	GEI Comment (October 14, 2025) a. In Table 2, and associated table in the appendices, the additional flow for fixture units should be 2100 L/day, which results in a total flow per unit of 4600 L/day. b. Please ensure consistency throughout the report when referring to the two swales. In general, the northern swale seems to be referred to as the northern bioswale, and the southern swale seems to be referred to as the southern bypass swale, but there are sections where the terms bioswale and bypass swale are used interchangeably, and the directions are inconsistent. For example, when describing Catchment Ext. 3 in Section 6.2.1 runoff is said to be conveyed to the bioswale along the southwest property line. c. Table 9 should be updated with the correct MOE Table 3.2 requirements (343 m^3) and the correct provided treatment volume (672 m^3). d. The fourth column of The Dry Pond Facility table (Depth above PP/ED Orifice) in the appendices does not appear to be correct/relevant. e. The Type A dispersal bed footprint described in Section 9.0 is not correct (368 m^2 rather than 104 m^2).
12.	Hydrologic Modelling and SWM Calculations	FSSWM Report	GEI Comment (October 14, 2025) a. Please ensure that a Guelph Permeameter Test is completed prior to detailed design to confirm the in-situ hydraulic conductivity in the areas of the site where LID facilities will be installed. b. The bioswale calculations in the appendices are based on 17 control weir ponding areas, whereas the drawings show only 11 weirs. Please confirm. There also appears to be some discrepancy between the slopes used for some sections in the calculations and those shown on the drawings. c. Is it possible to describe anticipated depths of flows in the bioswale for the various design storms? d. The SSD Table used in the model for the dry pond does not include the weir outflows. However, this likely won't impact the design or results provided.
13.	Water Balance	FSSWM Report	GEI Comment (October 14, 2025) A Water Balance was provided under separate cover. Could a section be added to the FSSWM Report to discuss the findings of the water balance and how the proposed LID facilities will mitigate the identified deficit?

3.2. *Completed/Approved Matters*

The following previous comments have been addressed.

No.	Matter	Document	Comment
1.	Secondary Access and Adjacent Lands	Grading and Servicing Plan	<u>GEI Comment (May 21, 2024)</u> Please confirm inclusion of the secondary access road. If the secondary access is not to be included, a cul-de-sac may be required per the latest Township of Puslinch Municipal Development Standards. Additionally, please confirm ownership of the lands adjacent to the possible secondary access (lots 922 and 923). An easement may be required for the proposed bypass swale through these lands. <u>Applicant Response (August 15, 2025)</u> The revised Site Plan illustrates a secondary access, although we understand that one is not required. <u>GEI Comment (October 14, 2025)</u> Acknowledged. No further comment.
3.	Rainfall Parameters	FSSWM Report	<u>GEI Comment (May 21, 2024)</u> The Functional Servicing and Stormwater Management Report appears to use outdated rainfall parameters. Please use IDF data from the latest City of Guelph Development Engineering Manual (October 2023). <u>Applicant Response (August 15, 2025)</u> FSSWM Report has been revised to use the IDF data from the latest City of Guelph Development Engineering Manual. <u>GEI Comment (October 14, 2025)</u> Acknowledged. No further comment.
4.	Stormwater Quality Control	FSSWM Report	<u>GEI Comment (May 21, 2024)</u> The proposed treatment train includes bioswales and a dry pond. However, a significant portion of the road network appears to drain directly to the pond. Please consider inclusion of an oil-grit separator at the end of the internal storm sewer network, prior to the dry pond, for treatment of road runoff and easy maintenance / clean-out. The FSSWM report states that the bioswale system falls short of the volume required for 80% TSS removal, and the outstanding treatment capacity will be provided by the dry pond. Furthermore, in addition to providing quality and quantity control for the site, the swales convey drainage from large external areas. Please provide additional discussion on stormwater quantity and quality control,

No.	Matter	Document	Comment
			ensuring that Enhanced level of protection is met (detention time, % TSS removal calculations, etc.). Applicant Response (August 15, 2025) An OGS unit is proposed at each outlet into the dry pond and bioswale. GEI Comment (October 14, 2025) Acknowledged. No further comment.
6.	Sediment Control Pond	FSSWM Report	GEI Comment (May 21, 2024) Given the large area of the site, please include a pond as one of the erosion and sediment controls, to be sized per the Erosion and Sediment Control Guideline for Urban Construction. Applicant Response (August 15, 2025) A detailed ESC plan, including temporary sediment ponds, can be provided as the detailed design progresses. GEI Comment (October 14, 2025) Acknowledged. Given the size of the development, a sediment control pond shall be considered during the detailed design stage.
7.	Fire Water Storage	Grading and Servicing Plan	GEI Comment (May 21, 2024) Please indicate the proposed location of fire water storage on the engineering drawings. Applicant Response (August 15, 2025) Fire Storage tanks have been identified on the servicing plan. Tanks are to be located within the future ROW. GEI Comment (October 14, 2025) Acknowledged. We defer any further fire water storage requirements to the Township fire department. Further refinement of the fire water supply design can be completed at detailed design.
8.	Noise and Vibration Study	N/A	GEI Comment (May 21, 2024) Per our review letter dated May 15, 2023, please provide an updated Noise and Vibration Study to reflect the revised development concept, current rail volume data and to confirm berm and setback requirements from the existing railway. Applicant Response (August 15, 2025) An updated Noise and Vibration Study can be provided as a condition of approval. It is important to get the lot layout finalized before this study is completed as the

No.	Matter	Document	Comment
			recommendations will apply to the closest proposed receptors. <u>GEI Comment (October 14, 2025)</u> Acknowledged. We defer noise study requirements to Township and County planners.

Please note that the Township is currently in the process of applying for a CLI-ECA for stormwater infrastructure. The Township is also in the process of updating their Development Standards. Prior to the commencement of detailed design, Township Staff and Consultants will meet with the Developer's consultants to discuss any design details that should be incorporated where possible to meet any new/updated requirements.

If you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,

GEI Consultants Canada Ltd.

[redacted]

[redacted]

Andrea Reed, P.Eng.
Project Engineer

Parth Lad, E.I.T.
Technical Specialist

October 14, 2025

Monika Farncombe
7404 Wellington Road 34,
Puslinch, Ontario

Dear Monika Farncombe,

RE: **NPG Comments**
605 Arkell Road & Part of Lots 7,8,9 and Concession 10
RE: Application for Zoning By-law Amendment

NPG Planning Solutions Inc. (NPG) has been retained to provide comments regarding a Zoning By-law Amendment application to facilitate the development of a residential subdivision consisting of 44 single detached dwelling lots, and a stormwater management block on lands municipally known as 605 Arkell Road and Part of Lots 7,8,9 and Concession 10 ("Subject Lands"). The Subject Lands are approximately 20.57 hectares in size and have 260 meters of frontage along Arkell Road and 118 meters of frontage along Watson Road South. The Subject Lands contain a single detached dwelling and an accessory structure on the 605 Arkell Road Property, the rest of the Subject Lands are vacant. Surrounding uses consist of agricultural and rural residential uses. In addition, the southwestern portion of the Subject Lands abut the Guelph Junction Railway.

The Subject Lands are located outside of the Grand River Conservation Authority's (GRCA) regulation limit, however, there appear to be woodland features on the Subject Lands in accordance with the GRCA's mapping.

Application Timeline

It is our understanding that applications for an Official Plan Amendment, a Zoning By-law Amendment and Draft Plan of Subdivision were submitted in 2006. The applications were on hold until a pre-consultation meeting occurred on May 18th, 2023. At the pre-consultation meeting, the applicant provided two conceptual plans. The first plan consisted of 39 single detached dwelling lots and a stormwater management block. The second plan consisted of 46 single detached dwelling lots and a stormwater management block.

In this circulation the design has been revised again to 44 single detached dwelling lots and a stormwater management block. The applicant has also identified that there is an opportunity for future parklands at the southern portion of the site.

This is the first submission for a Zoning By-law Amendment application. As part of this submission, NPG has reviewed the following documents:

- Alternate Site Evaluation prepared by Stovel and Associates Inc., dated January 6, 2023;
- Comment Response Matrix;
- Addendum Traffic Impact Study prepared by C.F Crozier & Associates Inc., dated August 2025;
- Concept Plans prepared by Stovel and Associates Inc., dated July 29, 2025;
- Cover Letter;
- Letter from the Ministry of Citizenship and Multiculturalism regarding Archeological Assessment dated March 12, 2024;
- Functional Servicing and Stormwater Management Report prepared by C.F Crozier & Associates Inc., dated August 2025;
- Minimum Distance Separation (MDS) Analysis prepared by Stovel and Associates Inc., dated August 13, 2025;
- Mineral Aggregate Evaluation prepared by Stovel and Associates Inc., dated January 6, 2023;
- Owner permission dated August 29, 2025;
- Preliminary Grading and Servicing Plan prepared by C.F Crozier & Associates Inc., dated August 31, 2025; and
- Stage 1-2 Archeological Assessment prepared by Lincoln Environmental Consulting Corp., dated January 2024.

Application Support/Determination of Completeness:

1. Based on a preliminary review, the application for Zoning By-law Amendment should be deemed incomplete until the following items are provided:

Additional Requirements for a Complete Application:

The following items were identified in the County's pre-consultation comments dated May 18, 2023, but have not yet been received:

2. Planning Justification Report - discussing and providing justifications for the proposed zone change and/or any site-specific relief requested.

3. Draft Zoning By-law Amendment - outlining the proposed zone change, the full list of permitted uses and any site-specific relief needed.

4. Agricultural Impact Assessment – addressing all the requirements outlined in section 4.6.5 of the County of Wellington Official Plan.

5. Environmental Impact Study – the applicant has indicated that this study is not forthcoming, we defer to the Township's ecologist to determine whether this is acceptable.

6. Updated Noise/Vibration Study – the applicant has indicated that this can be provided as a condition. We defer to the Township's noise consultant to determine whether this is acceptable.

<u>Preliminary Comments:</u>

1. A Planning Justification Report has not been submitted within the application for Zoning By-law Amendment. A Planning Justification Report will be required with the application. There are significant policy matters that will need to be justified as follows:
    a. Section 2.3.2 of the Provincial Planning Statement regarding Settlement Area Boundary Expansions, recognizing that an Alternative Site Evaluation and Minimum Distance Separation (MDS) Analysis has been completed. The Planning Justification Report will need to consider the need to designate and plan for additional land to accommodate an appropriate range and mix of land uses.
    b. Section 4.8.4 of the County of Wellington Official Plan regarding Hamlets states: "The hamlets in Wellington are on municipal services and it is the policy of this Plan to limit growth in areas without municipal services. Hamlet expansions of more than 5 residential lots or units will not be allowed. The expansion must be based on a municipal comprehensive review and criteria as set out in Section 4.8.2." Recognizing that the PPS 2024 no longer requires a municipal comprehensive review to expand a settlement area boundary, the proposal should still have regard for preferred locations for accommodating growth within the County. The Planning Justification Report would benefit from consideration of the findings of the on-going County of Wellington Official Plan Review.
    c. Notwithstanding existing policies, as part of Phase 3B Rural Residential Growth of the County of Wellington Official Plan review, there is consideration for expansion to Arkell. A County of Wellington Staff Report dated June 12, 2025, states as follows:
        i. "For Arkell, the County has estimated a potential of about 50 units if expansion were to be realized… additional policy and technical review would be necessary to determine the feasibility of such expansions."

    Any Planning Justification Report should have appropriate regard for the on-going County of Wellington Official Plan Review.

2. While a full technical review has not been completed. Preliminary matters of note are identified as follows:
    a. The cover letter included in this submission noted that 41 single detached dwelling lots are proposed, this is inconsistent with the concept plan that has been provided. The applicant should confirm the number of proposed single detached dwelling lots.
    b. Cash-in-lieu of parkland will be required in accordance with Section 42(1) of the *Planning Act*.

c. In addition to the items noted above the applicant should provide Property Index Map and Parcel Registers (including all PIN Printouts and Legal Instruments).

d. The Mineral Aggregate Evaluation should be revised to address the policies of the Provincial Planning Statement (2024).

The comments provided in this letter are solely related to the Zoning By-law Amendment application, additional comments including additional required studies may be provided with respect to the Official Plan Amendment and Draft Plan of Subdivision applications.

Sincerely,

[redacted]

Jesse Auspitz, MCIP, RPP
Principal Planner
NPG Planning Solutions Inc.
jauspitz@npgsolutions.ca

SALVINI
CONSULTING
Transportation Engineering and Planning

Salvini Consulting Inc.
185 Deer Ridge Drive
Kitchener, ON · N2P 2K5
519-591-0426
julia@salviniconsulting.com

October 10, 2025

Monika Farncombe
Planning and Corporate Services Coordinator
Township of Puslinch
7404 Wellington Road 34
Puslinch, ON · N0B 2J0

Re: Arkell Subdivison, D14-KUK, Roll Number - 2301000008034800000
Traffic Impact Study, August 2025, Crozier
Peer Review Comments, ZBA Application

Dear Monika,

I've reviewed the Traffic Impact Study (TIS) prepared by Crozier for the Zoning By-law amendment application for the lands identified above near the intersection of Watson Road South and Arkell Road and dated August 2025. I had reviewed and commented on a previous version of the TIS and the technical analysis has not changed in the study although some updated context was provided. In addition to my previous comments (attached for reference), I offer the following comments:

- The TIS continues to say that the proposed road connection to Arkell Road is for emergency purposes, but the site concept plan that was included with the application appears to include a fully open public road connection. As Arkell Road is a Wellington County Road, I will defer to the County to comment on the proposed road connection. The addition of a second road connection for the subdivision would result in more routing options for traffic and less traffic at the Watson Road South connection near the railway and reduced impacts on any one traffic movement at the Watson/Arkell intersection.
- The study maintains analysis for 50 units when 44 are now proposed. A reduction in the number of units would result in fewer trips on the road network so the current analysis is conservative.
- The TIS indicates that the sight distance assessment was based on a review of base mapping and aerial mapping. The aerial mapping in the TIS illustrates the available sight distance in plan view, but does not confirm that there are no vertical curves in the road. Were vertical road plans reviewed to confirm the sight distance or did the consultant do a field visit to confirm? How was the available sight distance confirmed?
- Guelph Junction Railway provided comments indicating that additional signals may be required for the new driveway entrance. The consultant team has indicated that traffic signals will not be required at the new road connection to Watson Road, but it's possible

that GJR was referring to railway signals or other technical requirements at the rail/road crossing. I would like to receive a copy of any further comments provided by GJR when and if they become available to understand if they are in agreement with the new road location.

- The changes in the plan to include a new road connection and fewer units would impact how much traffic access the road network and how. Additionally, my previous comment about the routing of traffic applies to this study since the analysis is the same. It is still my opinion that updating the analysis to reflect an additional road connection, fewer units, and a modified assignment of traffic would not materially change the capacity analyses and would not change the recommendations in the report. The two study area intersections are forecast to operate at good levels of service and the traffic volumes generated by the proposal are low.
- The County and their consultant may have additional comments based on their review of the proposed road connection to Arkell Road and the Watson/Arkell intersection.

In response to the Township's request, I offer the following feedback:

1. The Zoning By-law Amendment application can be deemed complete from a transportation perspective and I am in support of the application.
2. Conditions of approval should include:
    a. confirmation of how the sight distance was measured on Watson Road South, and
    b. confirmation from Guelph Junction Railway that they will support the location of the new road connection to Watson Road South adjacent to the at-grade railway crossing.
3. n/a
4. Technical requirements are described in point 2 above.
5. No additional requirements beyond those identified in point 2 above.

Let me know if there is anything further you would like to discuss with respect to this application.

Sincerely,

[redacted]

Julia Salvini, MEng, PEng, FITE
President

Cc: Mike Fowler, Township of Puslinch
Pasquale Costanzo, Wellington County

Attach: April 25, 2025 Peer Review Letter from Salvini Consulting

10/14/2025

Memorandum

To: Monika Farncombe - Planning and Corporate Services Coordinator, Township of Puslinch

From: Keira Martinson - Source Protection Coordinator, Wellington Source Water Protection

Reviewed By: Kyle Davis - Risk Management Official, Township of Puslinch

RE: Concession 10 Pt Lt 7,8,9, Arkell Subdivison, Township of Puslinch
Zoning By-law Amendment (P10/2006)

Wellington Source Water Protection (WSWP) staff have had the opportunity to review the submitted documents in support of the above noted application. This property is located within a vulnerable area and our review was completed to ensure the activities at this property meet the requirements of relevant Source Protection Plan and County of Wellington Official Plan policies.

Clean Water Act Section 59 Notice & Risk Management Plan:

A Section 59 Notice and Risk Management Plan are not required for this proposal. If the nature of the development changes, Notices may apply and Risk Management Plan may be required.

Land Use Planning:

The following comments are in response to the documentation submitted for applications for a Zoning By-law Amendment (P10/2006).

Comments

1. The Township and/or County should give strong consideration to requiring the subdivision to be serviced by a non-municipal residential drinking water system, to reduce the number of potable wells being drilled from the proposed approximate fifty (50) to two (2).

Proposed Zoning By-law Amendment Conditions

WSWP recommends the following conditions be added to the Zoning By-law Amendment:

1. Any potable wells to be installed on the property shall be constructed in a manner that ensures the well is not screened across multiple aquifers, to the satisfaction of the Township hydrogeologist.

2. Any on site sewage disposal systems shall use tertiary (advanced) treatment systems. As noted from ARL's response to comments dated June 25, 2024, this type of system is being proposed for managing wastewater on site.

For more information, please contact sourcewater@centrewellington.ca.

Sincerely,

[redacted] Oct 14, 2025

Keira Martinson
Source Protection Coordinator
519-846-9691 ext 283
kmartinson@centrewellington.ca

[redacted] Oct 14, 2025

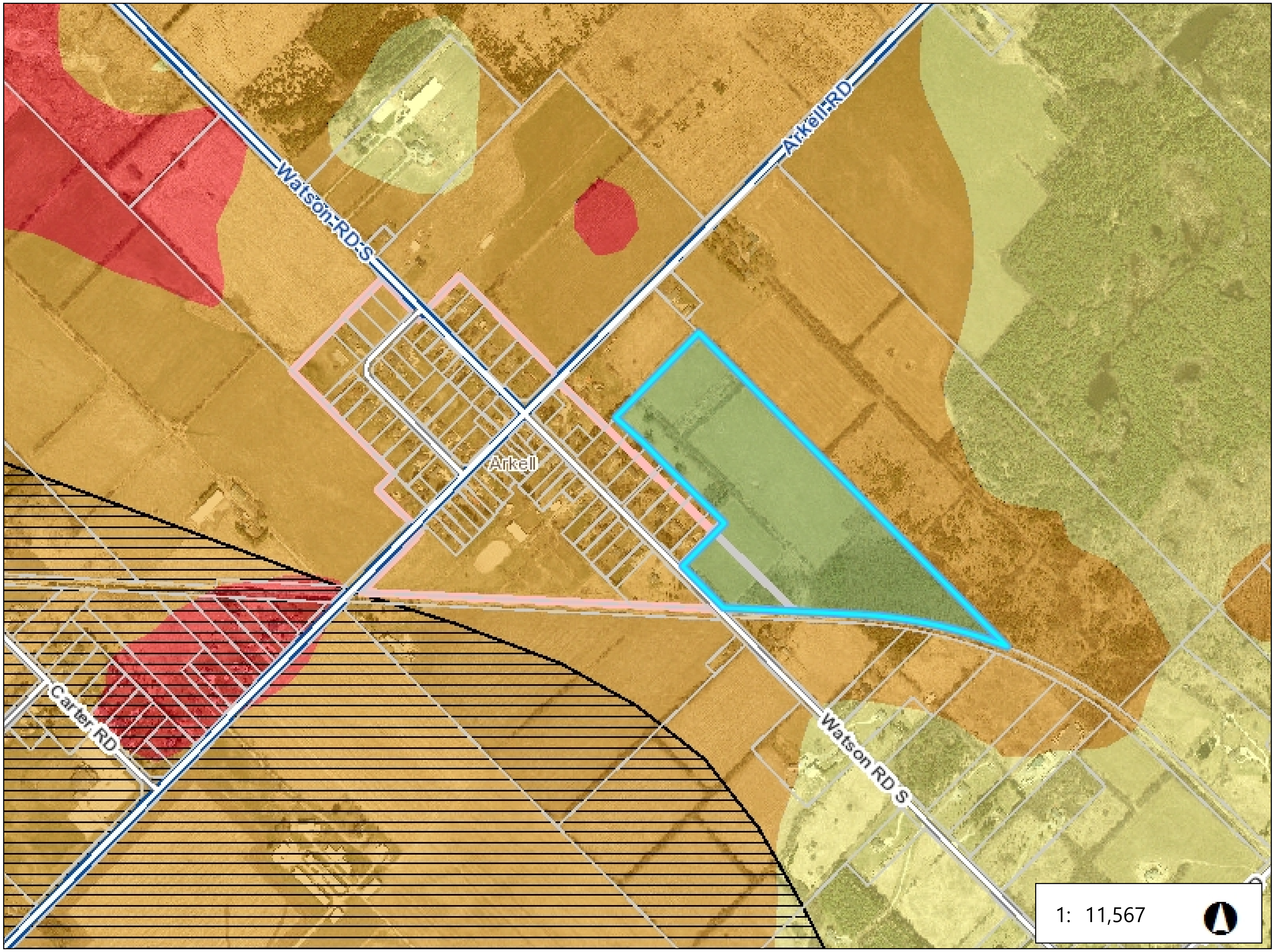
Kyle Davis
Risk Management Official
519-846-9691 ext 362
kdavis@centrewellington.ca

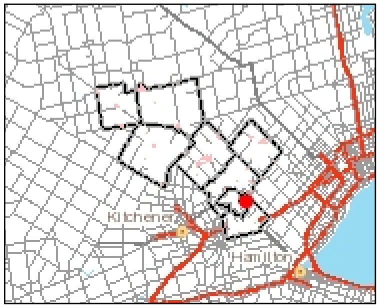
Attachments: Vulnerable Area Maps

Resources: Appendix C: Guidance Documents

Explore Wellington

2301000008034800000, Arkell





Legend

- ☐ Parcels
- Roads
  - ═ Local Road
  - ═ County Road
  - ═ Highway
- ☐ Urban Centres and Hamlets
- Well Locations
  - 💧 Existing
  - 💧 Proposed
- Issue Contributing Area
  - ☐ Chloride
  - ☐ Nitrate
  - ▦ Sodium
  - ☰ TCE
- Wellhead Protection Area
  - ▬ A
  - — B
  - — C
  - _ D
- Vulnerability Score
  - 🟥 10
  - 🟧 8, D; 8; 8, C
  - 🟨 2, 4, 6 (A, B or C)
  - ☐ 2,4,6, D; 2,4, D; 2, 4, 6 (D); 4, D; 6,
- ▨ HVA
- RoadsLookup

0.6 0 0.29 0.6 Kilometers

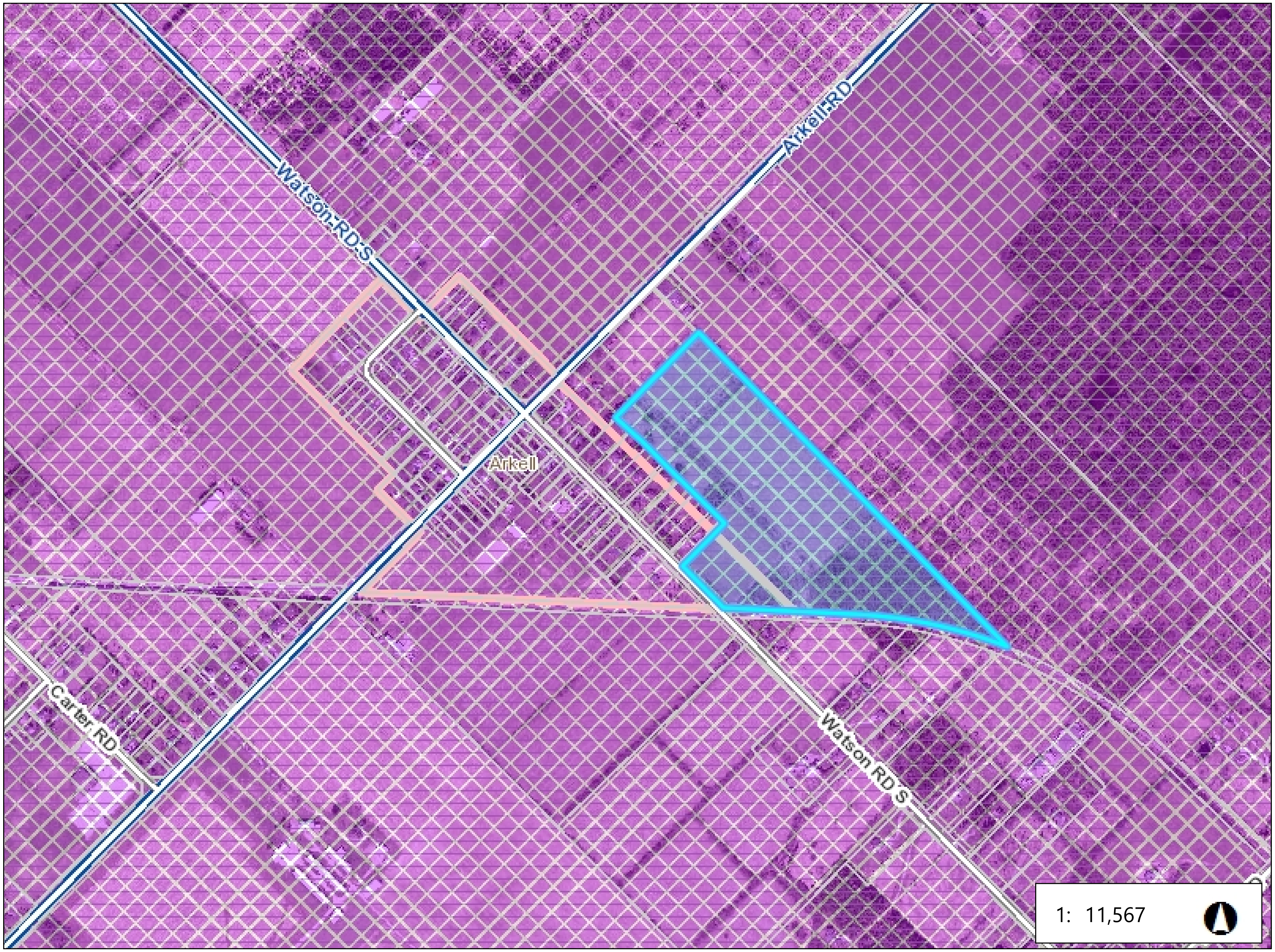
WGS_1984_Web_Mercator_Auxiliary_Sphere

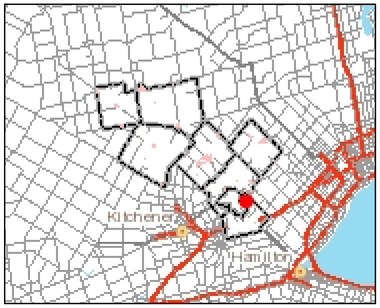
THIS IS NOT SURVEY DATA. Parcels - Teranet 2002, Wellington County 2022

Notes

Explore Wellington

2301000008034800000, Arkell-Quantity





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- ☐ Parcels
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- Well Locations
  - 💧 Existing
  - 💧 Proposed
- ☐ WHPA Q1_Q2_Boundary
- WHPA Q1_Q2
  - ■ Approved
  - ☒ Draft
- ▤ SGRA
- RoadsLookup

0.6 0 0.29 0.6 Kilometers

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THIS IS NOT SURVEY DATA. Parcels - Teranet 2002, Wellington County 2022

Notes

Summary of Standards Regarding Development Adjacent to the Guelph Junction Railway Right of Way

Track Designation: Principal Branch Line

- Less than 5 trains daily
- Low speed
- Light or moderate weight usually with 1 or 2 locomotives but can include heavier units

Minimum Standards for Main Line Trackage

Noise Study

Required within 390 metres of railway right of way for residential, institutional, commercial and office use. Does not apply to unoccupied buildings, manufacturing, and outdoor play areas. Ministry of Environment indoor sound level criteria to apply.

Vibration Study

Required within 75 metres of railway right of way for residential, institutional, commercial and office use. Does not apply to unoccupied buildings, manufacturing, and outdoor play areas. Canadian National Railway vibration standards to be used.

Minimum Setback

15 metres for residential, institutional, commercial and office use.

Warning Clause Registered on Title

Required for all development.

Safety Berm

Required with a minimum height of 2 metres for all use except unoccupied buildings and manufacturing.

Site Specific Risk Assessment

A site-specific risk assessment may be undertaken by the proponent. This assessment may make recommendations for development using modified standards. Such acceptance will be the sole prerogative of the Guelph Junction Railway.

Acoustical Fence
May be required to meet airborne noise standards. Canadian Pacific Railway and Canada Mortgage and Housing construction standards to be used.

Fencing
Required for all residential, institutional, commercial, office and outdoor play areas. Minimum standards to be most recent Transport Canada rail safety directives.

Landscaping/Planting
No trees or vegetation are to be planted within 25 feet of the shared property line unless approved by GJR General Manager. Landscaping must be kept to a minimum mature height of 1.2 meters and not to cross onto adjoining property at full maturity.

Industrial Park Trackage
All the above standards shall apply for any use other than manufacturing.

Last Updated: July 17, 2025

[redacted]

Les Petroczi
General Manager, Guelph Junction Railway