



CROZIER

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MEMO

DATE	March 20, 2024	PROJECT NO.	2433-6646
RE	D-5-4 Assessment – Residential Development at Lots 7, 8, 9, Concession 10 Township of Puslinch		

TO	Rob Stovel - Stovel & Associates
FROM	Jessica Doherty, P.Eng. - C.F. Crozier & Associates Inc.
CC	Katherine Rentsch, P.Eng. - C.F. Crozier & Associates Inc.

C.F. Crozier & Associates Inc. (Crozier) was retained by Timberworx Custom Homes, Slood Construction, and John Slood Investments (Owners) to complete a nitrate impact assessment for the proposed residential development located at Lots 7, 8, 9, Concession 10 in the Township of Puslinch (Site). The Site encompasses an area of 20.45 ha and is located at the southeast corner of the intersection of Arkell Road and Watson Road South. The Site is proposed to be developed as a residential subdivision with between thirty-five (35) to fifty (50) residential lots. Each lot will be serviced with an onsite sewage system and private water supply well. This memo has been prepared to assess potential impacts from the proposed onsite sewage systems in accordance with Ministry of the Environment, Conservation and Parks (MECP) Procedure D-5-4.

Geological and Hydrogeological Conditions

According to Ontario Geological Survey (OGS) mapping, surficial geology within the vicinity of the Site consists of glaciofluvial sand and gravel deposits. Chung & Vander Doelen Engineering Limited (CVD) was retained by the Owners to excavate test pits across the property. Twelve (12) test pits were excavated in December 2023 to depths of up to 6.10 m 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). CVD's test pit logs are enclosed. These findings are generally consistent with the surficial materials reported in the geological mapping.

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. Groundwater samples were collected in January 2006 from the two (2) monitoring wells (MW1 and MW2). Concentrations of nitrate ranged from 3.34 mg/L (MW1) to 4.18 mg/L (MW2). Monitoring well logs and the analytical laboratory report are enclosed. Refer to the Hydrogeological and Predictive Nitrate Assessment (R.J. Burnside, 2006) for additional details.

The material in this memo reflects best judgment in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. C.F. Crozier & Associates Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

In 2023, ARL Groundwater Resources Ltd. (ARL) completed a groundwater supply assessment for the property, which included a review of the hydrogeological conditions across the Site and assessed the suitability of servicing the development with individual water supply wells. The Groundwater Supply Assessment Report (ARL, March 2023) included a review of local water well records, which identified twelve (12) wells in the vicinity of the property. ARL interpreted that these wells were installed within bedrock, of either the upper Guelph Formation or the lower Goat Island/Gasport Formation. The Guelph Formation (upper bedrock aquifer) is described as unconfined to semi-confined aquifer; whereas the Gasport Formation (lower bedrock aquifer) is considered semi-confined to confined due to the overlying aquitard (Eramosa Formation). The Gasport Formation will be the target aquifer for the new private water supply wells. Refer to the Groundwater Supply Assessment Report (ARL, March 2023) for additional details.

Nitrate Impact Assessment

Municipal sanitary services are not available in the vicinity of the Site; therefore, it is proposed that each residential lot will be serviced by an onsite sewage system. The subdivision will contain between 35 to 50 residential lots. Since the development will contain more than five (5) units with individual onsite sewage systems, an assessment in accordance with MECP Procedure D-5-4 Technical Guidelines for Individual Onsite Sewage Systems: Water Quality Impact Risk Assessment (Procedure D-5-4) is required. This analysis evaluates the cumulative impact of the proposed sewage systems on the local groundwater regime. The potential for impacts to occur depends on the local hydrogeological setting, the volume of effluent discharged as well as the concentration of nutrients discharged in the effluent. The nutrient of concern is typically nitrate-nitrogen.

Procedure D-5-4 outlines a three-step assessment process as follows.

- Step 1 – Assessment considers the minimum lot size for each private lot.
 - For developments where the lot size is one hectare or larger, it is assumed that the attenuative processes will be sufficient to reduce nitrate nitrogen to an acceptable concentration below the adjacent property. If smaller lots are proposed, the assessment proceeds to Step 2.
- Step 2 – System Isolation.
 - This considers the relationship between the individual onsite sewage systems and the groundwater. Developments are considered to be a low risk where it can be demonstrated that the effluent is hydrogeologically isolated from existing or potential supply aquifers. Where it cannot be demonstrated that the systems are isolated from existing or potential groundwater supplies, it is necessary to progress to the third step of the assessment.
- Step 3 – If lots smaller than 1.0 ha are proposed, and system isolation cannot be demonstrated a detailed examination of contaminant loading to the groundwater must be completed.
 - A predictive contaminant attenuation calculation must be completed that demonstrates that the proposed development will not cause concentrations of nitrate nitrogen in the groundwater to exceed the Ontario Drinking Water Quality Standards (ODWQS) value of 10 mg/L at the downgradient development boundary.

Each lot will be below 1 ha, therefore Step 1 cannot be satisfied and Step 2 must be completed. As discussed above, hydrogeological information for the area indicates that there are some water supply wells in the vicinity of the Site installed in the upper unconfined to semi-confined aquifer (Guelph Formation). Therefore, the assessment must progress to Step 3, the predictive contaminant attenuation assessment. It should be noted that the new water supply wells for the development will target the lower semi-confined to confined aquifer (Gasport Formation).

Crozier has completed a mass balance calculation to predict the concentration of nitrate-nitrogen at the development boundary, using the following general assumptions, per D-5-4 guidelines:

- The concentration of nitrate in the effluent is 40 mg/L, typical for conventional septic tank/leaching beds system without advanced treatment.
- The average volume of effluent generated by each dwelling is 1,000 L/day, consistent with MECP Procedure D-5-4.
- The only dilution mechanism is by infiltration of surface precipitation. A conservative infiltration value of 200 mm/year has been assigned, based on the MECP annual infiltration rate for the sandy gravelly soils encountered on the Site.
- Based on the assumption that the entire property area is available for dilution purposes, a background concentration of nitrate (as N) in the groundwater was calculated using the average nitrate groundwater sample concentrations from the 2006 groundwater analytical results for the wells on the Site of 3.76 mg/L.

Using this approach, the resulting concentration of nitrate-nitrogen was calculated for 35, 40, and 50 lot scenarios at the Site development boundary. The calculations were completed considering a conventional system (e.g., conventional septic tank and leaching bed system) or an advanced treatment system (e.g., CAN/BNQ certified Level IV treatment system) with 50% nitrogen removal (i.e., effluent concentration of 20 mg/L) and 75% nitrogen removal (i.e., effluent concentration of 10 mg/L). Results are summarized below in Tables 1 through 3. Detailed calculations are enclosed.

Table 1: D-5-4 Impact Assessment – Conventional System

Lot Scenario	35 Lots	40 Lots	50 Lots
Nitrate Concentration in Wastewater (mg/L)	40		
Total Average Nitrate Loading (mg/day)	1,400,000	1,600,000	2,000,000
Nitrate Concentration at Downgradient Development Boundary (mg/L)	12.40	13.31	14.96

Table 2: D-5-4 Impact Assessment – Advanced Treatment System with 50% Nitrogen Removal

Lot Scenario	35 Lots	40 Lots	50 Lots
Nitrate Concentration in Wastewater (mg/L)	20		
Total Average Nitrate Loading (mg/day)	700,000	800,000	1,000,000
Nitrate Concentration at Downgradient Development Boundary (mg/L)	7.63	8.04	8.78

Table 3: D-5-4 Impact Assessment – Advanced Treatment System with 75% Nitrogen Removal

Lot Scenario	35 Lots	40 Lots	50 Lots
Nitrate Concentration in Wastewater (mg/L)	10		
Total Average Nitrate Loading (mg/day)	350,000	400,000	500,000
Nitrate Concentration at Downgradient Development Boundary (mg/L)	5.25	5.40	5.69

Per MECP Procedure D-5-4, the maximum allowable concentration of nitrate-nitrogen at the development boundary is 10 mg/L. In all lot scenarios, the predicted nitrate-nitrogen concentration at the downgradient property boundary is below 10 mg/L when advanced treatment systems with at least 50% nitrogen removal are incorporated. There are a number of Level IV CAN/BNQ certified treatment systems that can meet the denitrification requirements, including Waterloo Biofilter recirculating basket systems, among others.

Therefore, per MECP Procedure D-5-4, the proposed development can accommodate 50 residential lots with onsite sewage systems that include advanced treatment with at least 50% nitrogen removal.

Conclusions

The Site is proposed to be developed as a residential subdivision with between 35 to 50 residential lots and each lot will be serviced with an onsite sewage system and private water supply well. Impact assessment calculations were prepared in accordance with MECP Procedure D-5-4 requirements, which show that the proposed development can accommodate 50 residential lots with onsite sewage systems that include an advanced treatment system with 50% nitrogen removal.

Should you have any questions or require further information, please do not hesitate to contact the undersigned.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

A handwritten signature in black ink that reads "J. Doherty". The signature is written in a cursive, flowing style.

Jessica Doherty, P.Eng.
Project Manager

Encl. Test Pit Logs (CVD)
 Monitoring Well Logs (MW1 and MW2; R.J. Burnside)
 AGAT Analytical Laboratory Report
 D-5-4 Impact Assessment Calculations – 35, 40 and 50 Lots

J:\2400\2433 - Timberworx Custom Homes\6646 - Arkell Developments\Memos\2024.03.20 MECP D-5-4 Assessment.docx



Test Pit Location Map

Part of Lots 7,8 & 9 Concession 10
Township of Puslinch, Wellington County
Arkell, Ontario

Notes

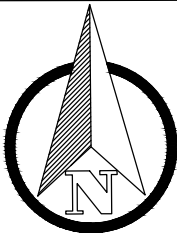
1. This is not a Plan of Survey.
2. Distances shown on this plan are adjusted ground distances and can be converted to grid distances by multiplying by an averaged combined scale factor of 0.999573.
3. Coordinates on this plan are UTM, ZONE 17, NAD83 (CSRS-2010) Adjustment and are based on gps observations 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 

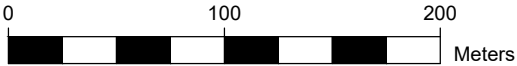


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DRAFT

January 8, 2024



Scale 1:3500

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

PROJECT MANAGER: **RVD**

**CHUNG & VANDER DOELEN
ENGINEERING LTD.**

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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				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)				WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _P W W _L ↗ ○ ↖						
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30						
Ground Elevation:																	
	450 mm TOPSOIL																
0.45	loose, brown, SILT, trace sand, trace clay, trace topsoil moist	0.5		1	BS								○			minor collapsing of sidewalls during test pit advancement	
0.75	compact, brown SAND AND GRAVEL trace silt occ. cobbles damp to moist	1.0		2	BS								○				
	occ. boulders	1.5															
		2.0															
	----- occ. boulders	2.5															
		3.0															
		3.5															
	----- dense	4.0															
		4.5															
4.90	End of Test Pit	5.0														test pit dry at completion	
		5.5															
		6.0															

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

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TEST PIT No. 4



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

Date: **Dec 19 23** TO **Dec 19 23**

[illegible]PROJECT MANAGER: **RVD**

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CVD TEST PIT 1669 ARKELL SUBDIVISION - TEST PITS.GPJ CVD ENG.GDT 24-1-5

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				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
0.30 																

PROJECT MANAGER: **RVD****CHUNG & VANDER DOELEN
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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				SAMPLE			SHEAR STRENGTH (kPa)					WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ ○ ↖						
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30						
Ground Elevation:																	
0.35	350 mm TOPSOIL																
				1	BS								○				
	compact to dense brown	0.5															
	SAND AND GRAVEL trace silt																
	occ. cobbles	1.0															
	damp to moist			2	BS								○				
	----- silt seam	2.0															
	----- occ. boulders																
		2.5															
		3.0															
		3.5															
		4.0		3	BS								○				
		4.5															
		5.0															
		5.5															
		6.0															
6.10	End of Borehole																

occasional collapsing of
sidewalls during test pit
advancement

test pit dry at completion

PROJECT MANAGER: **RVD****CHUNG & VANDER DOELEN
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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)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation:																
0.30	300 mm TOPSOIL															
	trace topsoil	0.5		1	BS								○			frequent collapsing of sidewalls during test pit advancement

	compact, brown															
	SAND AND GRAVEL	1.0		2	BS								○			
	trace to some silt															
	frequent cobbles and boulders															
	damp to moist	1.5														
		2.0														
		2.5			3	BS								○		
	3.0															
		3.5														
		4.0														
		4.5														
		5.0														
		5.5														
		6.0														
6.10	End of Test Pit															test pit dry at completion

PROJECT MANAGER: **RVD**

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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			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _P W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation:																
0.30	300 mm TOPSOIL															
	some silt to silty trace topsoil	0.5		1	BS											

	compact, brown															
	SAND AND GRAVEL trace silt	1.0		2	BS											
	frequent cobbles and boulders															
	damp to moist	1.5														
		2.0														
		2.5														
		3.0														
6.10		3.5														
		4.0														
		4.5														
		5.0														
		5.5														
		6.0														
	End of Test Pit															test pit dry at completion

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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				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
0.25	250 mm TOPSOIL															occasional collapsing of sidewalls during test pit advancement
	some silt to silty trace topsoil	0.5		1	BS							○				
	----- compact to dense brown	1.0		2	BS							○				
	SAND AND GRAVEL trace silt	1.5														
	occ. cobbles and boulders	2.0		3	BS							○				
	damp to moist	2.5														
		3.0														
		3.5														
		4.0														
		4.5														
6.10		5.0														test pit dry at completion
		5.5														
		6.0														
	End of Test Pit															

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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				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _P W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation:																
0.30	300 mm TOPSOIL															occasional collapsing of sidewalls during test pit advancement
	some silt to silty, trace topsoil ----- compact to dense brown	0.5		1	BS											
	SAND AND GRAVEL trace silt	1.0		2	BS											
	occ. to frequent cobbles and boulders	1.5														
	damp to moist	2.0														
		2.5														
		3.0														
		3.5														
		4.0														
		4.5														
		5.0														
		5.5														
		6.0														
6.10	End of Test Pit															test pit dry at completion

PROJECT MANAGER: **RVD****CHUNG & VANDER DOELEN
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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				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE									
							STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
0.30	300 mm TOPSOIL															occasional collapsing of sidewalls during test pit advancement
	some silt to silty trace topsoil/rootlets	0.5		1	BS							○				

	compact, brown															
	SAND AND GRAVEL trace silt	1.0														
	occ. cobbles and boulders															
	damp to moist	1.5		2	BS							○				
		2.0														
		2.5														
		3.0														
		3.5														
		4.0		3	BS							○				
		4.5														
		5.0														
		5.5														
		6.0														
6.10	End of Test Pit														test pit dry at completion	

PROJECT MANAGER: **RVD****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

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**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L ↗ ○ ↖					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80									
											10 20 30					
0.45	450 mm TOPSOIL			1	BS										occasional collapsing of sidewalls during test pit advancement	
	trace topsoil/rootlets															

	compact to dense brown															
	SAND AND GRAVEL trace silt															
	occ. to frequent cobbles and boulders															
	damp to moist															
6.10	End of Test Pit														test pit dry at completion	

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Legend

 MONITORING WELL LOCATION



BURNSIDE

PTA10312 SP.DWG

REFERENCE No: G2547-6-2

BOREHOLE No: 1

CLIENT: 1648253 Ontario Inc.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT: Proposed Residential Development

ENCLOSURE No: 2

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: B.R.F.

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE BLOWS/0.3m				WATER CONTENT %					UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING WELL	NUMBER	TYPE	'N' BLOWS/0.3m										
0.0	Ground Surface	340.5															
0.3	300mm Topsoil	340.2			1	SS	17										
brown, compact to very dense SANDY GRAVEL trace silt, occasional cobble, moist to dry					2	SS	61										
					3	SS	45										
					4	SS	52										
					5	SS	57										
					6	SS	42										
					7.7		332.8										
8.4	grey Dolostone Rock Fragments wet Auger Refusal/Boulder/Bedrock	331.0			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: 10

CLIENT: 1648253 Ontario Inc.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

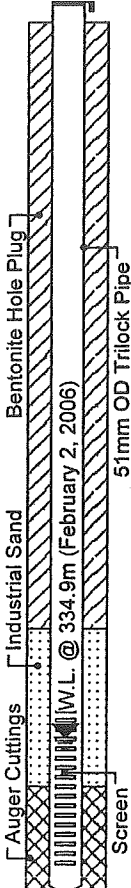
PROJECT: Proposed Residential Development

ENCLOSURE No: 11

LOCATION: Pt. Lots 7, 8 & 9, Con. 10, Twp. of Puslinch, ON

SUPERVISOR: MN

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE BLOWS/0.3m				WATER CONTENT %					UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING WELL	NUMBER	TYPE	'N' BLOWS/0.3m										
0.0	Ground Surface	344.9															
0.8	800mm Topsoil	344.1			1	SS	65										
	brown, very dense GRAVEL AND SAND some silt, occasional cobble, dry				2	SS	64										
					3	SS	50	50mm									
					4	SS	40										
					5	SS	76	275mm									
6.9		338.0			6	SS	52										
	brown, very dense GRAVELLY, SILTY SAND TILL dry				7	SS	91										
					8	SS	74										
10.1		334.8															
11.0	brown, very dense SAND AND SILT trace clay, trace gravel, saturated	333.9			9	SS	68										
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			10	SS	86	250mm									
	End of Borehole																

DRILLED BY: Aardvark Drilling Inc.

HOLE DIAMETER: 210mm

DRILL METHOD: Hollow-Stem Auger

DATUM: Geodetic

DRILL DATE: January 16, 2006

SHEET: 1 of 1



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:

Jonky Takewski



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:

Joel Takewicki



Project Name: Arkell Development
Project Number: 2433-6646
Date: 2023-01-18
Designed By: JD
Checked By: KR

D-5-4 IMPACT ASSESSMENT - CONCEPT PLAN - 35 Lots

Calculate the Nitrate Concentration at a Boundary (Property or Surface Water)

Parameter	Value	Unit	Notes:
Infiltration Volume			
Area of Dilution =	20.4	ha	Total area of site
Background Nitrate Quality in Groundwater =	3.76	mg/L	Average nitrate concentration from January 26, 2006 sampling event (Burnside, 2006)
Annual Infiltration Rate =	200	mm/m2/yr	MECP infiltration rate for sand.
	5,479.45	L/ha/day	
Annual Infiltration Volume =	40,800	m ³ /year	
Total Average Background Nitrate =	420,296	mg/day	
Sewage Effluent Volume			
Proposed Number of Lots	35		
Average Daily Volume of Sewage Effluent =	1,000	L/day	
Number of Days of Operation/Use =	365	days/year	
Annual Volume of Sewage Effluent =	12,775	m ³ /year	
Totals			
Total Dilutant = wastewater V + infiltration V =	53,575	m ³ /year	

Scenario 1 - Conventional System

Nitrate Concentration in wastewater =	40.0	mg/L
Total Average Nitrate Loading =	1,400,000	mg/day
Nitrate Concentration in Percolate =	12.40	mg/L

Scenario 2 - Level IV Treatment with 50% Nitrogen Removal

Nitrate Concentration in wastewater =	20.0	mg/L
Total Average Nitrate Loading =	700,000	mg/day
Nitrate Concentration in Percolate =	7.63	mg/L

Scenario 3 - Level IV Treatment with 75% Nitrogen Removal

Nitrate Concentration in wastewater =	10.0	mg/L
Total Average Nitrate Loading =	350,000	mg/day
Nitrate Concentration in Percolate =	5.25	mg/L



Project Name: Arkell Development
Project Number: 2433-6646
Date: 2023-01-18
Designed By: JD
Checked By: KR

D-5-4 IMPACT ASSESSMENT - CONCEPT PLAN - 40 Lots

Calculate the Nitrate Concentration at a Boundary (Property or Surface Water)

Parameter	Value	Unit	Notes:
Infiltration Volume			
Area of Dilution =	20.4	ha	Total area of site
Background Nitrate Quality in Groundwater =	3.76	mg/L	Average nitrate concentration from January 26, 2006 sampling event (Burnside, 2006)
Annual Infiltration Rate =	200	mm/m2/yr	MECP infiltration rate for sand.
	5,479.45	L/ha/day	
Annual Infiltration Volume =	40,800	m ³ /year	
Total Average Background Nitrate =	420,296	mg/day	
Sewage Effluent Volume			
Proposed Number of Lots	40		
Average Daily Volume of Sewage Effluent =	1,000	L/day	
Number of Days of Operation/Use =	365	days/year	
Annual Volume of Sewage Effluent =	14,600	m ³ /year	
Totals			
Total Dilutant = wastewater V + infiltration V =	55,400	m ³ /year	

Scenario 1 - Conventional System

Nitrate Concentration in wastewater =	40.0	mg/L
Total Average Nitrate Loading =	1,600,000	mg/day
Nitrate Concentration in Percolate =	13.31	mg/L

Scenario 2 - Level IV Treatment with 50% Nitrogen Removal

Nitrate Concentration in wastewater =	20.0	mg/L
Total Average Nitrate Loading =	800,000	mg/day
Nitrate Concentration in Percolate =	8.04	mg/L

Scenario 3 - Level IV Treatment with 75% Nitrogen Removal

Nitrate Concentration in wastewater =	10.0	mg/L
Total Average Nitrate Loading =	400,000	mg/day
Nitrate Concentration in Percolate =	5.40	mg/L



Project Name: Arkell Development
Project Number: 2433-6646
Date: 2024-02-26
Designed By: ZS
Checked By: KR

D-5-4 IMPACT ASSESSMENT - CONCEPT PLAN - 50 Lots

Calculate the Nitrate Concentration at a Boundary (Property or Surface Water)

Parameter	Value	Unit	Notes:
Infiltration Volume			
Area of Dilution =	20.4	ha	Total area of site
Background Nitrate Quality in Groundwater =	3.76	mg/L	Average nitrate concentration from January 26, 2006 sampling event (Burnside, 2006)
Annual Infiltration Rate =	200	mm/m2/yr	MECP infiltration rate for sand.
	5,479.45	L/ha/day	
Annual Infiltration Volume =	40,800	m ³ /year	
Total Average Background Nitrate =	420,296	mg/day	
Sewage Effluent Volume			
Proposed Number of Lots	50		
Average Daily Volume of Sewage Effluent =	1,000	L/day	
Number of Days of Operation/Use =	365	days/year	
Annual Volume of Sewage Effluent =	18,250	m ³ /year	
Totals			
Total Dilutant = wastewater V + infiltration V =	59,050	m ³ /year	

Scenario 1 - Conventional System

Nitrate Concentration in wastewater = 40.0 mg/L
Total Average Nitrate Loading = 2,000,000 mg/day

Nitrate Concentration in Percolate = 14.96 mg/L

Scenario 2 - Level IV Treatment with 50% Nitrogen Removal

Nitrate Concentration in wastewater = 20.0 mg/L
Total Average Nitrate Loading = 1,000,000 mg/day

Nitrate Concentration in Percolate = 8.78 mg/L

Scenario 3 - Level IV Treatment with 75% Nitrogen Removal

Nitrate Concentration in wastewater = 10.0 mg/L
Total Average Nitrate Loading = 500,000 mg/day

Nitrate Concentration in Percolate = 5.69 mg/L