CHUNG & VANDER DOELEN
ENGINEERING LTD.

Geotechnical Engineering, Construction Inspecting
& Testing, Environmental Services

311 Victoria Street North
Kitchener, Ontario, N2H 5E1
Telephone: 519-742-8979
Facsimile: 519-742-7739
E-Mail: info@cvdengineering.com

GEOTECHNICAL INVESTIGATION
PROPOSED TOWNHOUSE DEVELOPMENT
233 JANEFIELD AVENUE
GUELPH, ONTARIO

Submitted to:

Rockwater Group
P.O. Box 38017
256 King Street North
Waterloo, Ontario
N2J 4T9

Attention: Mr. Pete Waters

Submitted by:

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario
N2H 5E1

File No.: 14-08-K05
September 26, 2014

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Attention: Mr. Pete Waters

**Re: GEOTECHNICAL INVESTIGATION
PROPOSED TOWNHOUSE DEVELOPMENT
233 JANEFIELD AVENUE
GUELPH, ONTARIO**

We take pleasure in enclosing two (2) copies of our Geotechnical Investigation Report carried out at the above-referenced Site.

If you have any questions or clarifications are required, please contact the undersigned at your convenience. We thank you for giving us this opportunity to be of service to you.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Eric Y. Chung, M.Eng., P.Eng.
Principal Engineer

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LIST OF ENCLOSURES

1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by Rockwater Group to carry out a geotechnical investigation for a proposed townhouse development to be located at 233 Janefield Avenue in Guelph, Ontario. This is in addition to a previous investigation on this site which included seven (7) boreholes, completed by Dominion Soil Investigation Inc. (DSII) in June 1988; this report is included in Appendix 'B'.

The site is located on the south west side of Janefield Avenue and has plan area of approximately 11,000 m^2. It is understood that the proposed townhouse development will be 4 storeys high. One basement level for underground parking is proposed and it will be located at approximately 4.5 m below exterior site grade.

The purpose of the investigation was to determine the subsurface conditions at the site and, based on the findings, make geotechnical recommendations for the design and construction of the foundations, excavation, floor slabs and pavement areas. Infiltration rates of the various soil deposits encountered during the investigation will also be provided for the design of infiltration galleries.

2.0 FIELD WORK

To supplement the subsurface information obtained from the seven (7) boreholes completed by the Dominion Soil Investigation report "Subsurface Investigation, Proposed Speed River Housing Co-operative" from June 1988, three (3) boreholes (numbered 101 to 103) were advanced on August 27, 2014 at the site to depths of 8.08 to 9.60 m below existing grades.

The borehole sampling was completed under the supervision of a member of our engineering staff who logged the subsurface conditions in the field, effected the subsurface sampling and monitored the groundwater conditions. The locations of the boreholes from the previous investigation and the present investigation are shown on Drawing No. 1, Borehole Location Plan.

The boreholes were advanced using a power auger drilling rig equipped with continuous flight hollow stem augers and standard soil sampling equipment. Standard penetration tests (SPTs) were carried out at frequent intervals of depth and the results are shown on the Borehole Logs as Penetration Resistance or "N"-values. The compactness condition of the soil strata has been inferred from these test results. Monitoring well was installed in each borehole to establish groundwater table.

Soil samples obtained from the in situ tests were examined in the field and subsequently taken to our laboratory for detailed description and moisture content determination. Two (2) grain size distribution analyses were performed on the major soil deposits.

Ground surface elevations at the borehole locations were surveyed by this office and are referenced a temporary benchmark (TBM) established as:

TBM:	Top Nut of Fire Hydrant opposite side of Janefield Avenue, as shown on Borehole Location Plan
Elevation :	326.69 m (Geodetic)

3.0 EXISTING SITE CONDITIONS

The site is located on the south west side of Janefield Avenue near the intersection with Scottsdale Drive. The site is vacant with typical field vegetation and a few trees along the edges of the property. There is a multi-unit residential development across Janefield Avenue, a bank and a hotel towards the east property lines and the south property abuts vacant land that extends to the intersection of Stone Road and the Hanlon Parkway. A church exists to the west of the site.

The new boreholes that are located across the site have ground surface elevations from 323.53 to 327.84 m with a ±4.3 m grade difference between the boreholes and a ±6.0 m grade difference between the highest point on the east side of the site to the lowest point on the northwest corner of the site.

It is noted that there was a large topsoil stockpile on the southwest portion of the site in 1988 and it has since been removed.

4.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the boreholes are detailed on the Borehole Log Sheets, Enclosures 1 to 3 of this report and in the DSII report in Appendix B. The following notes are intended to amplify and comment on the subsurface data.

Topsoil and fill materials were contacted at the ground surface and extended to depths of 0.3 to 2.3 m. Below the fill materials and topsoil, a major deposit of brown, compact to very dense sand with variable amounts of silt and gravel was encountered to the full depth of the DSII boreholes and to depths of 5.0 to 5.5 m in Boreholes 102 and 103. Compact to dense, brown sandy silt or sand and silt was encountered below the sand in Boreholes 102 and 103 and below the fill in Borehole 101, and extended to the full depth of these boreholes.

Groundwater was not encountered during and at completion of sampling at Boreholes 1, 2, 3, 5, 6 and 7 to a depth of 5.0 m and Borehole 101 to a depth of 9.6 m. Groundwater was not present at Borehole 101 to a depth of 6.10 m (depth of monitoring well). At Boreholes 102 and 103, the stabilized groundwater levels were at depths of 6.61 and 5.09 m, corresponding to elevations 320.19 and 318.75 m respectively. At Borehole 4, saturated condition was observed at a depth of 4.65 m, corresponding to elevation 320.84 m. Based on the above, the groundwater level drops gradually in a northwesterly direction. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

4.1 Topsoil and Fill

The boreholes penetrated topsoil and fill at the ground surface at Boreholes 1 to 4, 7 and 101 to 103. A distinct topsoil layer with a thickness of 300 to 700 mm was encountered at the ground surface at Boreholes 1, 7, 101, 102 and 103.

Fill materials, consisting of brown to dark brown sand to sandy silt, were contacted to depths of 0.3 to 2.3 m below ground surface. Standard penetration testing within the fill yielded "N"-values of 1 to 28 blows per 300 mm, thus indicating very loose to compact state of compactness. Natural moisture content was measured at 4 to 20%, indicative of moist moisture conditions in materials varying from sand to topsoil.

4.2 Sand

Below the fill materials and topsoil, a major deposit of brown sand with variable amounts of silt and gravel was encountered to the full depth of the DSII boreholes and to depths of 5.0 to 5.5 m in Boreholes 102 and 103. Two (2) grain size distribution analysis were performed on samples from Boreholes 102 and 103 and the results are presented graphically on Enclosures 4 and 5 of this report.

Standard Penetration testing within the sand deposit yielded "N"-values from 7 to greater than 100 blows per 300 mm, thus indicating loose to very dense compactness condition. Loose condition was encountered in the upper stratum, immediately below the upper fill materials. The natural moisture contents were measured between 3 and 19%, indicative of damp to saturated moisture conditions.

4.3 Sandy Silt to Silt and Sand

The sand deposit was underlain by brown sandy silt at Boreholes 102 and 103 and extended to full depth of the boreholes. Silt and Sand underlay the fill at Borehole 101 and extended to the full depth of the borehole.

Standard penetration testing within the sandy silt or sand and silt yielded "N"-values of 12 to 31 blows per 300 mm, thus indicating compact to dense compactness condition. Natural moisture contents were measured between 7 and 23%, indicative of moist to saturated moisture condition.

4.4 Groundwater Condition

The groundwater conditions were monitored during and following completion of borehole sampling. Groundwater was not encountered during and at completion of sampling at Boreholes 1, 2, 3, 5, 6 and 7 to a depth of 5.0 m and Borehole 101 to a depth of 9.6 m.

Monitoring wells were installed in Boreholes 101 to 103. The groundwater levels in the monitoring wells were measured on August 29, 2014, September 8, 2014 and September 23, 2014. The groundwater levels in the monitoring wells are listed in the following table:

Date	BOREHOLE 101	BOREHOLE 102	BOREHOLE 103
August 29, 2014	Dry at 321.74	320.27	318.88
September 8, 2014	Dry at 321.74	320.24	318.84
September 23, 2014	Dry at 321.74	320.19	318.75

Groundwater was not present at Borehole 101 to a depth of 6.10 m (depth of monitoring well). At Boreholes 102 and 103, the stabilized groundwater levels were at depths of 6.61 and 5.09 m, corresponding to elevations 320.19 and 318.75 m respectively. At Borehole 4, saturated condition was observed at a depth of 4.65 m, corresponding to elevation 320.84 m. Based on the above, the groundwater level drops gradually in a northwesterly direction.

It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

5.0 DISCUSSION AND RECOMMENDATIONS

It is understood that the proposed townhouse development will be 4 storeys high. One basement level for underground parking is proposed and it will be located at approximately 4.5 m below exterior site grade.

Topsoil and fill materials were contacted at the ground surface and extended to depths of 0.3 to 2.3 m. Below the fill materials and topsoil, a major deposit of brown, compact to very dense sand with variable amounts of silt and gravel was encountered to the full depth of the DSII boreholes and to depths of 5.0 to 5.5 m in Boreholes 102 and 103. Compact to dense, brown sandy silt or sand and silt was encountered below the sand in Boreholes 102 and 103 and below the fill in Borehole 101, and extended to the full depth of these boreholes.

Groundwater was not encountered during and at completion of sampling at Boreholes 1, 2, 3, 5, 6 and 7 to a depth of 5.0 m and Borehole 101 to a depth of 9.6 m. Groundwater was not present at Borehole 101 to a depth of 6.10 m (depth of monitoring well). At Boreholes 102 and 103, the stabilized groundwater levels were at depths of 6.61 and 5.09 m, corresponding to elevations 320.19 and 318.75 m respectively. At Borehole 4, saturated condition was observed at a depth of 4.65 m, corresponding to elevation 320.84 m. Based on the above, the groundwater level drops gradually in a northwesterly direction. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

5.1 Foundations

The proposed 4-storey townhouses can be supported with conventional spread and strip footings founded on the native compact to dense sand, sand and silt or sandy silt. The footings should be founded below any surficial fill materials and the upper loose native sand stratum.

The footings can be designed using a Geotechnical Reaction at SLS of 200 kPa (4,000 psf). The SLS value given above is based on a maximum differential settlement of 25 mm. The Factored Geotechnical Resistance at ULS is 300 kPa (6,000 psf). These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The majority of the settlements will take place during construction and the first loading cycle of the building.

Spacing between adjacent footing steps should not be steeper than 10 horizontal to 7 vertical. Footings in unheated portions of the building should be provided with a soil cover of not less than 1.2 m or equivalent synthetic thermal insulation for adequate frost protection. The footing subgrade must be protected from frost penetration during winter construction.

The following table summarizes the highest founding level and elevation for the footings at each borehole location:

Borehole	Elevation of Borehole (m)	Highest Depth Below Existing Grade (m)	Highest Footing Bearing Elevation (m)
1	323.49	3.29	320.20
2	324.99	1.79	323.20
3	327.59	1.59	326.00
4	325.49	2.39	323.10
5	324.69	0.69	324.00
6	327.79	0.79	327.00
7	324.19	1.79	322.40
101	327.84	2.24	325.60
102	326.80	2.40	324.40
103	323.84	1.64	322.20

A lean concrete mat is recommended over the approved subgrade to prevent disturbance resulting from construction activities and the elements if the founding subgrade is in wet to saturated condition.

It is recommended that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

5.2 Earthquake Consideration

In accordance with The Ontario Building Code 2012 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8.

Based on the soil condition encountered at the boreholes, the site can be classified as a Site Class C as per OBC Table 4.1.8.4.A (Page B4-24).

5.3 Slab-On-Grade Basement Floor

The highest groundwater level as indicated by the monitoring wells was at elevation 320.17 m in Borehole 102 and at elevation 318.88 m in Borehole 103. The monitoring well was dry to 6.1 m (elevation 321.74 m). At Borehole 4, saturated condition was observed at a depth of 4.65 m, corresponding to elevation 320.84 m.

The basement floor level is recommended to be established at least 0.6 m above the observed groundwater level. Further, the installation of footing drains, water-proofing the below grade basement walls are recommended. In addition, underfloor drains should installed at 5 m centres to ensure that surface water infiltration does not become a water penetration problem.

At the time of floor slab construction, the exposed subgrade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer. Any soft and/or unstable areas detected should be replaced with excavated granular soil which should be compacted to at least 95% SPMDD. The backfill should be thoroughly compacted in thin lifts to at least 95% SPMDD.

Following the proof-rolling of the subgrade, it is recommended that a minimum 150 mm thick layer of OPSS Granular "A" be placed and compacted to at least 100% SPMDD beneath the concrete floor slabs to provide uniform support.

A modulus of subgrade reaction (k_s) of 40 MN/m^3 may be used for the design of the floor slab, considering a silt or sand subgrade.

5.4 Construction and Groundwater Control

Based on the proposed development, the anticipated depths of excavations for footings and site servicing will be in the order of 2 to 5 m. The excavation will penetrate the loose fill materials and loose to dense granular soils. These soils are considered to be Type 3 Soils in accordance with the latest Occupational Health and Safety Act. Excavations in the Type 3 soils are expected to remain stable during the construction period provided that side slopes are cut to 1H : 1V throughout and the groundwater is adequately controlled. The slope surface should be suitably protected from erosion processes.

No major groundwater control requirements are necessary in light of the anticipated depth of excavation and the groundwater table. Any surface water runoff and seepage (possibly from water perched in the upper fill materials) into the excavations may be handled by conventional sump pumping techniques, as and where required. The sump pits should be filtered.

Care should be taken to ensure that the backfill against the foundation wall and around the interior columns are placed in thin layers and each layer compacted to at least 95% SPMDD. Backfilling these types of confined areas with the excavated sand soils is advised.

5.5 Lateral Earth Pressure

The below grade walls and any other soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used to calculate the unfactored earth pressure distribution. The factored resistance can be calculated by using a factor of 0.8.

$P = K(\gamma H + q)$

where:

$P =$	lateral earth pressure	kPa
$K =$	earth pressure coefficient, 0.5 for non-yielding foundation wall earth pressure coefficient, 0.3 for yielding retaining wall	
$\gamma =$	unit weight of granular backfill, compacted to 95% SPMDD	21 kN/m^3
$H =$	unbalanced height of wall	m
$q =$	surcharge load at ground surface	kPa

The backfill for the foundation walls and retaining walls should be free-draining granular materials which should have less than 8% silt particles (OPSS Granular "B" Type 1). The backfill should be placed in thin layers and compacted to 95% SPMDD. Over-compaction should be avoided. Weeping tiles or weep holes should be installed to effect drainage behind the retaining wall. The excavated sand soil can be reused as free-draining backfill.

The sliding resistance of the footings should be checked. The unfactored horizontal resistance against sliding between concrete and undisturbed sand or silt can be calculated using a friction coefficient of 0.4. The unit weight of the sand/silt is 19 kN/m^3, and a unit weight of 21 kN/m^3 may be expected for the granular backfill compacted to 95% SPMDD.

5.6 Asphalt Pavement

The subgrade for pavement construction is anticipated to consist of existing fill and sand/silt backfill materials. Assuming the subgrade material likely to be sandy silt and the existence of adequate drainage, the following flexible pavement structures are recommended:

Component	Light Duty Pavement (mm)	Heavy Duty Pavement (mm)
HL3	40	40
HL8	40	50
Granular "A" Base	150	150
Granular "B" Sub-base	250	300

It is recommended that the pavement construction be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable, additional granular sub-base may be required.

Prior to placement of the granular base, the subgrade should be stripped of any obvious deleterious materials and the exposed subgrade thoroughly recompacted with a heavy vibratory compactor and inspected by a qualified geotechnical inspector. Any soft spots encountered during the process should be excavated to the level of competent soil. The required grades can then be achieved by placing approved on-site soils in maximum 200 to 300 mm thick lifts which should be compacted to 95% SPMDD.

The Granular "A" and Granular "B" materials should meet the gradational requirements of OPSS Form 1010 and should be compacted to no less than 100% SPMDD. The placing and rolling of the asphalt mixture should conform to OPSS Form 310 or equivalent and should be compacted to between 92.0 and 96.5% of the Marshall density. The surface course of the asphaltic concrete should be placed at least one (1) year after trench backfill is completed so as to allow any minor settlements to occur within any trench backfill.

The prepared earth subgrade and final pavement surfaces should be graded to direct water runoff away from buildings, sidewalks and other similar pertinent structures. Positive drainage outlets should be provided at all low points of the prepared earth subgrade, such as stub drains extending 3 m from the catch-basins.

5.7 Infiltration Rates

On-site infiltration of roof water is proposed for the site. Two (2) grain size distribution analyses were conducted on the major sand deposit and the results are provided in Enclosures 4 and 5.

Based on the grain size distribution analyses and our past experience, the coefficient of permeability and infiltration rate of the native soil deposits are estimated and provided in the following table:

MATERIAL	PERMEABILITY (K) (cm/sec)	Infiltration Rate (mm/hr)
Fine Sand	5×10^{-3}	50
Silty Sand	1×10^{-3}	30
Sandy Silt	1×10^{-4}	10

The sandy silt and sand and silt deposits have low permeabilities and infiltration rates and, therefore, they are not suitable for the installation of infiltration gallery. Any infiltration gallery should be installed in the sand deposit.

6.0 CLOSURE

The Limitations of Report, as quoted in Appendix "A", is an integral part of this report.

We trust that the information presented in this report is complete within our terms of reference. If there are any further questions concerning this report, please do not hesitate to contact our office.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

LICENSED PROFESSIONAL ENGINEER
J. F. DWORATZEK
90374661
Sept 29, 2014
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
E.Y. CHUNG
8345506
Sept 29, 2014
PROVINCE OF ONTARIO

Hans Dworatzek, P.Eng.
Project Engineer

Eric Y. Chung, M. Eng., P.Eng.
Principal Engineer

Appendix "A"

Statement of Limitations

APPENDIX "A"

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report. The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Appendix “B”

Previous Report

Dominion Soil Investigation Inc.
Consulting Engineers

SUBSURFACE INVESTIGATION

PROPOSED SPEED RIVER HOUSING CO-OPERATIVE

JANEFIELD DRIVE

GUELPH, ONTARIO

REFERENCE NO.: 88-6-K1

JUNE, 1988

REPORT PREPARED FOR:

Waterloo-Wellington Non-Profit Homes
c/o Fryett, Shifflett Associates
45 Speedvale Avenue, East
Guelph, Ontario
N1H 1J2

Distribution:
- 2 copies - Waterloo-Wellington Non-Profit Homes
- 2 copies - Fryett, Shifflett Associates
- 1 copy - Dominion Soil Investigation Inc. (Toronto)
- 1 copy - Dominion Soil Investigation Inc. (Kitchener-Waterloo)

DOMINION SOIL

104 Crockford Blvd.
Scarborough, Ontario
M1R 3C6
(416) 751-6565
Fax: (416) 751-7592

440 Phillip Street
Waterloo, Ontario
N2L 5R9
(519) 885-6220
Fax: (519) 885-3490

805 Consortium Court
London, Ontario
N6E 2S8
(519) 681-2400
Fax: (519) 668-1754

3953 Riberdy Road
Windsor, Ontario
N8W 3W5
(519) 969-7530
Fax: (519) 969-0160

440 Balmoral Street
Thunder Bay, Ontario
P7C 5G8
(807) 623-2929
Fax: (807) 623-1792

110 Kendall Street
Sarnia, Ontario
N7V 4G5
(519) 337-5409
Fax: (519) 337-2514

Reference No.: 88-6-K1

TABLE OF CONTENTS

ENCLOSURES

1.0 INTRODUCTION

Dominion Soil Investigation Inc., Consulting Geotechnical Engineers, has been retained by Fryett, Schifflett Associates to conduct a subsurface investigation for the proposed 39 unit Speed River Housing Co-Operative to be located at the corner of Janefield Drive and Torch Lane, in the City of Guelph, Ontario.

Authorization to proceed with the investigation was received from Mr. Brian McCullloch, in his letter dated May 31, 1988.

The purpose of the investigation has been to determine the subsurface conditions at the site and, based on the findings, to make recommendations pertaining to the geotechnical design of the foundations of the proposed structure.

2.0 FIELD WORK

In order to investigate the subsurface conditions at the site, seven (7) boreholes were drilled at the locations shown on the appended Borehole Location Plan, Drawing No. 1.

The field work for this project was carried out on June 17, 1988, under the supervision of a field engineer, who located the boreholes in the field, determined their ground surface elevations, and effected the subsurface sampling and testing.

The boreholes were advanced to the sampling depths using a power auger drilling rig equipped with continuous flight augers and standard soil sampling equipment. Standard penetration tests were carried out at frequent intervals of depth, and the results are shown on the Borehole Logs as Penetration Resistances or `N'-values. The compactness condition or consistency of the soil strata has been inferred from these test results. Samples obtained from the in situ tests were examined in the field and subsequently taken to our laboratory for detailed description and moisture content determination.

The ground surface elevations at the borehole locations are referenced to a temporary benchmark established as the top of the fire hydrant located on Janefield Drive, as shown on the Borehole Location Plan. The elevation of this temporary benchmark is assigned a local datum of 100.0 m.

3.0 SITE DESCRIPTION

The subject site is located at the southwest corner of Torch Lane and Janefield Drive in Guelph. The southwestern portion of the site is occupied by a topsoil stockpile which is some 2.5 m high. Otherwise, the site slopes down towards the west from Elevations 101.1 to 96.8 m at the borehole locations.

4.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes are detailed on the Borehole Log Sheets, Enclosures 2 to 8, inclusive. An explanation of terms and symbols used on the borehole logs is presented on Enclosure 1. The following notes are intended to amplify and comment on the subsurface data.

4.1 Fill

The site has been graded and is covered by an extensive layer of fill material which is composed of a mixture of mostly sand and silt. Occasional inclusions of topsoil pockets and rootlets were also noted. This fill layer was contacted at Boreholes 1, 2, 3, 4 and 7 and extended to depths of between 1.4 and 2.3 m below grade. Surficial topsoil was contacted at Boreholes 1 and 7. Neither fill nor topsoil were encountered at Boreholes 5 and 6.

Standard penetration tests conducted within these fills provided 'N' values ranging from 1 to 46 blows per 300 mm, indicating a variable compactness condition ranging from very loose to dense. Natural moisture contents range from 4 to 13%, revealing a damp to moist condition.

4.2 Sand

The fill at Boreholes 1, 2, 3, 4 and 7 and the ground surface at Boreholes 5 and 6 are underlain by a major sand deposit which extends to at least 5.0 m below grade, ie. the maximum depth of exploration. The sand deposit grades from a fine sand with a trace of silt to silty fine sand at depth. The silty sand at Borehole 6 contains some gravel and has a "till" texture. Standard Penetration testing carried out in the sand deposit yielded "N" values from 6 to over 100 blows per 300 mm. The upper 1.0 m of the sand deposit at Boreholes 1, 4 and 7 is loose, and the remainder of the stratum becomes compact to very dense at depth. Natural moisture contents are measured between 3 and 16%.

4.3 Groundwater

Groundwater conditions were monitored during and on completion of the drilling of each borehole. Groundwater was not contacted in any of the boreholes. Detailed tactile examination of the soil samples reveals that the sand deposit becomes saturated at a depth of 4.7 m below grade in Borehole 4. It is therefore, considered that the groundwater table lies at a depth of at least 4.7 m.

5.0 DISCUSSION AND RECOMMENDATIONS

It is our understanding that a 39 unit townhouse complex is to be developed at the subject site. There will be three unconnected structures, each two storeys high, with full basements provided. The finished floor elevation of the structures have not been determined at the time of this investigation.

5.1 Summarized Subsurface Conditions

The subject site is overlain by an extensive layer of fill materials, consisting mostly of a mixture of sand and silt soils, except in Boreholes 5 and 6. Native, inorganic soils were contacted below these fills at a depth ranging from 0 to 2.4 m, which consists of typically a compact to very dense brown sand. Localized loose layers were encountered at the upper 1.0 m of the sand deposit at Boreholes 1, 4 and 7.

All boreholes were dry upon their completion and it is considered that the groundwater table lies at least 4.7 m below existing grade.

5.2 Foundation Design

The surficial fill and the loose native sand layers are considered unsuitable for the support of the anticipated building loads. It is recommended that all exterior and interior foundations be extended into the native compact to dense sand stratum. An allowable bearing pressure of 150 kPa (3000 psf) may be used for design of conventional spread footings cast at or below the depths/elevations indicated in the following table:

Borehole No.	Existing Ground Elevation	Minimum Depth	Founding Elevation
1	96.8	2.8	94.0
2	98.3	1.7	96.6
3	100.9	1.6	99.3
4	98.8	2.0	96.8
5	98.0	1.0	97.0
7	97.5	at least 1.8	below 95.7

The selection of the bearing pressure given above presumes that the bearing surface will be composed of undisturbed inorganic native soil, and that the width of footings will not be less than

0.5 m. In order to limit the maximum anticipated settlement to 25 mm the width of footings should not exceed 1.8 m.

Frost protection to exterior footings and footings in unheated portions of the buildings should be provided with a soil cover of not less than 1.2 m.

The Geotechnical Engineer should be retained to inspect the excavated bearing surfaces, to ensure material adequacy and surface preparation. Any zones of somewhat weaker soil which may outcrop onto the bearing surface should be suitably treated.

5.3 Slab-On-Grade

Based on the information obtained at the borehole locations, the existing fills will adequately support the lightly loaded basement floor slab anticipated for this structure, provided some treatment of the fill is undertaken. Differential settlements of these fill materials may result in minor floor slab cracking, however, the following steps can be undertaken to minimize potential cracking:

1. Remove surficial topsoil, organic and any deleterious material from the floor slab area.

2. Proof-roll and compact the exposed subgrade with a large vibratory roller. The subgrade materials should be compacted to a dry density of not less than 95% of the material's standard Proctor maximum dry density (SPMDD). The proof-rolling should be conducted under the supervision of the Geotechnical Engineer. Any soft or unstable zones detected should be excavated and replaced with suitable compacted materials.

3. Any grade adjustments required below the slab-on-grade area should be made with approved on-site material or imported O.P.S.S. Granular B or C materials, compacted to minimum of 98% SPMDD.

4. A 150 mm layer of O.P.S.S. Granular A compacted to a density of 100% SPMDD, should be constructed immediately below the floor slab to provide uniform support and to act as a vapour barrier.

5.4 Basement Wall Design

The basement walls should be designed to resist the lateral earth pressure given by the formula:

$$P = K(\gamma H + q)$$

where p = lateral earth pressure — kN/m^2
K = coefficient of lateral earth pressure — 0.4
γ = unit weight of backfill — $21\ kN/m^3$
q = surcharge loading
H = unbalanced height of wall — m

Use of the above formula presumes that the groundwater table will be below the founding elevation. The groundwater table lies at least 4.7 m below existing grade, however we recommend that perimeter drainage tiles be included in the construction as a precautionary measure.

The excavated on-site sand/silt fill soils will be suitable for general bulk grading purposes. Imported free-draining granular material (such as O.P.S.S. Granular "B" or "C") is recommended for interior and exterior basement wall backfill.

5.5 Pavement Design

Provided some small degree of distortion maintenance of the pavement surface can be accommodated, we consider that the pavement can be constructed on top of the existing fill. In this case, subgrade preparation would consist of trimming to reference elevation, compacting the surface of the fill to 95% SPMDD and shaping to promote base drainage. Any incompactible soil and organic topsoil should be removed and replaced with well compacted backfill. It would be advantageous to delay paving asphaltic concrete 1 year after construction since some settlement within the fill is expected.

Considering the traffic requirement, the generally loose fill or native sand subgrade and the groundwater condition, the following pavement designs are recommended:

	Passenger Car Parking (mm)	Access Road (mm)
Hot Mix Asphaltic Concrete	65	75
Granular "A" Base Course	150	150
Granular "B" Sub-Base Course	200	300

All granular components of the pavement should be compacted to not less than 98% SPMDD. The asphaltic concrete should be placed and compacted in accordance with current OPSS requirements. Stub collectors should be provided at catch basins at the subgrade level to effect drainage.

5.6 Construction

As noted, groundwater was not encountered within the expected depth of excavation. Ingress of surface run off may cause some local sloughing in of the sides of excavation, and this can be controlled by sump pumping, as and where required. Otherwise, excavations constructed in accordance with Provincial Regulations will be satisfactory.

6.0 CLOSURE

The limitations inherent in carrying out soil investigations are given in Appendix `A', which is an integral part of this report.

Yours truly,
DOMINION SOIL INVESTIGATION INC.

Eric Y. Chung, P. Eng.
Kitchener-Waterloo
Branch Manager

REGISTERED PROFESSIONAL ENGINEER
E. Y. CHUNG
PROVINCE OF ONTARIO

EYC/vo
encls.

APPENDIX "A"

Limitations of This Report

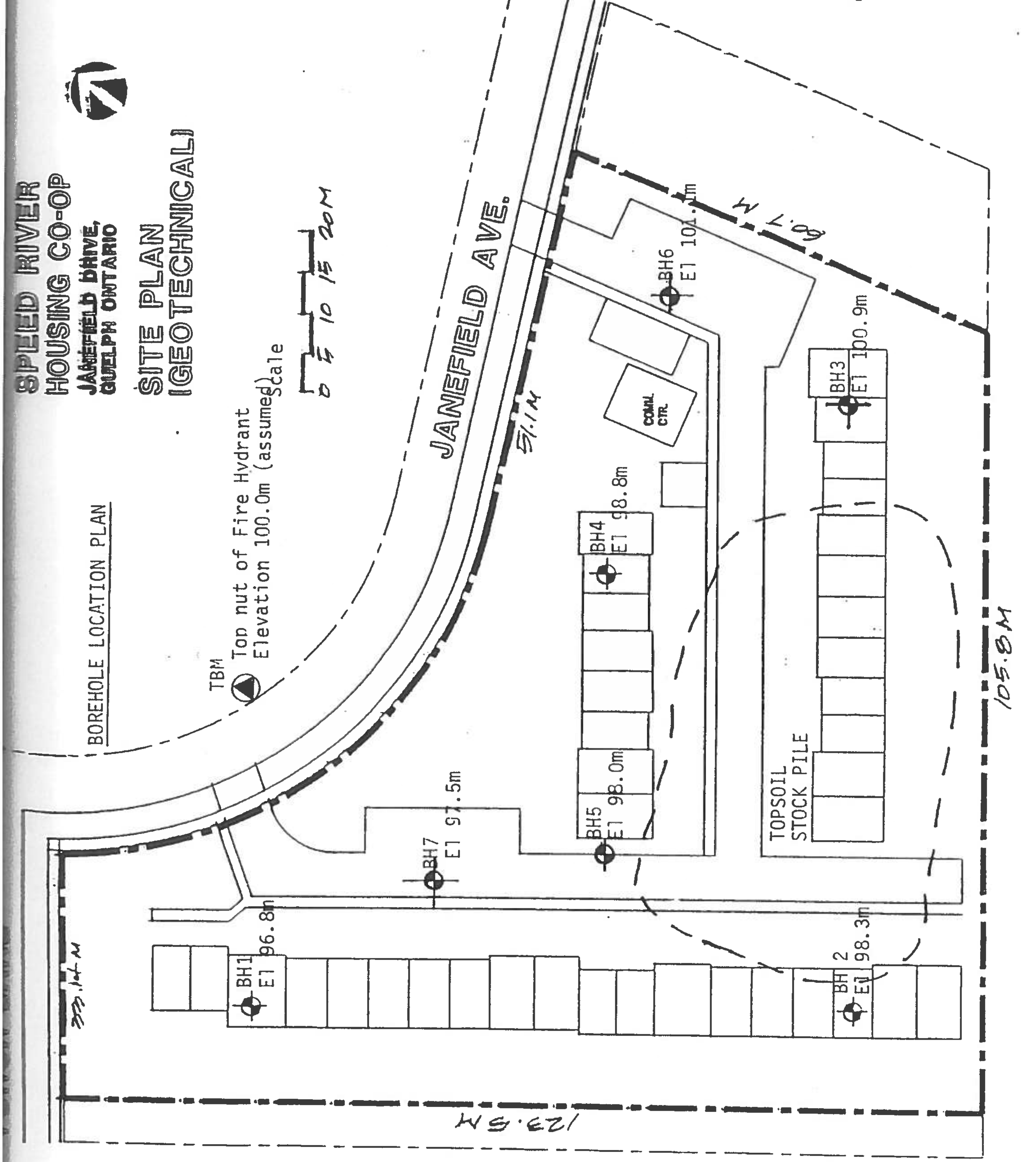
The conclusions and recommendations presented in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. It is recommended that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the test and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil of fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

REFERENCE NO. 88-6-K1

Drawing No. 1



ENCLOSURES

Enclosure No. 1

LIST of SYMBOLS, ABBREVIATIONS and NOMENCLATURE

SOIL COMPONENTS and GROUND WATER CONDITIONS

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANIC	BEDROCK	FILL	GROUND WATER LEVEL
		coarse	fine	coarse	medium	fine						

204mm 102 20 4.76 2.0 0.42 0.074 0.002mm no size limit

SAMPLE TYPES

AS	Auger Sample	SS	Split Spoon Sample
RC	Rock Core	TP	Piston, thin walled tube sample
%	Recovery	TW	Open, thin walled tube sample

PENETRATION RESISTANCES

SYMBOL

DYNAMIC CONE PENETRATION RESISTANCE : The value given is the number of blows of a 63.5 kg. weight, free falling 760 mm, required to advance a 51mm diameter, 60° steel cone, attached to the end of the drilling rods, into the ground expressed in blows per 305mm (or indicated depth)

STANDARD PENETRATION RESISTANCE 'N' : The value given is the number of blows of a 63.5 kg. weight, free falling 760mm, required to advance a 51mm outside diameter split spoon sampler into the ground, expressed in blows per 305 mm (or indicated depth) O O O

SOIL PROPERTIES

W %	Water content	k	Coeff. of permeability	
LL %	Liquid limit	C	Shear strength	in terms of total stress
PL %	Plastic limit	ϕ	Angle of inter'l friction	
γ	Natural bulk density (unit wt.)	C'	Cohesion	in terms of effective stress
Cv	Coeff. of consolidation	ϕ'	Angle of inter'l friction	

UNDRAINED SHEAR STRENGTH

— DERIVED FROM —

COMPRESSION TEST		VANE TEST		POCKET PENETROMETER TEST
TRIAXIAL	UNCONFINED	LABORATORY	FIELD	
⊖	● St	X	+	▼ St

20% 15% 5% 10% Strain at failure is represented by direction of stem.

$$St = sensitivity = \frac{\text{shear strength in undisturbed state}}{\text{shear strength in remolded state}}$$

DOMINION SOIL INVESTIGATION INC.

LOG OF BOREHOLE 1

ENCL. No.: 2

REF. No. 88-6-K1	DRILLING DATA
CLIENT: Fryett,Shifflett Associates	Field Supervisor: Brad Cunningham
PROJECT: Speed River Housing Co-operative	Method: Auger
LOCATION: Janefield Avenue, Guelph, Ontario	Diameter: 150 mm
DATUM: Local	Date: June 17th, 1988

323.49

ATTERBURG LIMITS PL %	NMC %	LL %	UNDRAINED SHEAR STRENGTH Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	SAMPLES No.	TYPE	N-VALUE	SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
										GROUND SURFACE 96.8 m				
										180mm of TOPSOIL				
										Very loose,dark brown, fine Sand FILL				
												-96-		
	10					1	SS	4			1			
						2	SS	1				-95-		
											2			
	3					3	SS	7		Loose,coarse Sand occ. cobbles		-94-		
										-------	3			
						4	SS	12		compact				
	6					5	SS	>100				-93-		'N'=50 blows for 150mm
											4			
						6	SS	>100						'N'=60 blows for 150mm Borehole DRY upon completion
										End of Borehole	5	-92-		
											6	-91-		

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Waterloo, Ontario N2L 5R9

Checked: EYC

SHEET 1 OF 1

LOG OF BOREHOLE 2

ENCL. No.: 3

REF. No. 88-6-K1	DRILLING DATA
CLIENT: Fryett,Shifflett Associates	Field Supervisor: Brad Cunningham
PROJECT: Speed River Housing Co-operative	Method: Auger
LOCATION: Janefield Avenue, Guelph, Ontario	Diameter: 150 mm
DATUM: Local	Date: June 17th, 1988

324.99

ATTERBURG LIMITS PL %	NMC %	LL %	UNDRAINED SHEAR STRENGTH Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	SAMPLES No.	TYPE	N-VALUE	SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
										GROUND SURFACE 98.3 m				
										460mm of Sand and Gravel FILL		-98-		
	13					1	SS	6		Loose,brown to dark brown, fine Sand FILL damp	1	-97-		
						2	SS	26		Greyish brown, fine SAND	2			
	5					3	SS	39		compact ------- dense damp		-96-		
						4	SS	32			3	-95-		
	4					5	SS	52		dense ---------- very dense some gravel	4			
						6	SS	>100				-94-		'N'=50 blows for 150mm
										End of Borehole	5	-93-		Borehole DRY upon completion
											6	-92-		

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SHEET 1 OF 1

LOG OF BOREHOLE 3

ENCL. No.: 4

REF. No. 88-6-K1	DRILLING DATA
CLIENT: Fryett,Shifflett Associates	Field Supervisor: Brad Cunningham
PROJECT: Speed River Housing Co-operative	Method: Auger
LOCATION: Janefield Avenue, Guelph, Ontario	Diameter: 150 mm
DATUM: Local	Date: June 17th, 1988

327.59

ATTERBURG LIMITS PL %	NMC %	LL %	UNDRAINED SHEAR STRENGTH Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	SAMPLES No.	TYPE	N-VALUE	SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
										GROUND SURFACE 100.9 m				
										460mm of Sand and Gravel FILL				
										Compact,dark brown, silty Sand FILL, occ. gravel				
	4					1	SS	46			1	-100-		Sampler on cobble
						2	SS	24		Compact,brown to light brown, SAND trace gravel				
											2	-99-		
	3					3	SS	32		----- dense				
										fine SAND, some silt	3	-98-		
						4	SS	22						
	6					5	SS	37			4	-97-		
						6	SS	37						
											5	-96-		Borehole DRY upon completion
										End of Borehole				
											6	-95-		

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LOG OF BOREHOLE 4

ENCL. No.: 5

REF. No. 88-6-K1	DRILLING DATA
CLIENT: Fryett,Shifflett Associates	Field Supervisor: Brad Cunningham
PROJECT: Speed River Housing Co-operative	Method: Auger
LOCATION: Janefield Avenue, Guelph, Ontario	Diameter: 150 mm
DATUM: Local	Date: June 17th, 1988

325.49

ATTERBURG LIMITS PL %	NMC %	LL %	UNDRAINED SHEAR STRENGTH Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	SAMPLES No.	TYPE	N-VALUE	SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
										GROUND SURFACE 98.8 m				
										Compact,sandy Silt FILL, trace gravel , occ. cobble				
	7					1	SS	26			1	98		
						2	SS	8		Loose to dense, brown, fine SAND, occ. gravel		97		
	6					3	SS	14			2			
						4	SS	18			3	96		
	8					5	SS	32			4	95		
						6	SS	25		moist --------- saturated		94		Borehole DRY upon completion
										End of Borehole	5			
											6	93		

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SHEET 1 OF 1

LOG OF BOREHOLE 5

ENCL. No.: 6

EF. No. 88-6-K1	DRILLING DATA
LIENT: Fryett,Shifflett Associates	Field Supervisor: Brad Cunningham
ROJECT: Speed River Housing Co-operative	Method: Auger
CATION: Janefield Avenue, Guelph, Ontario	Diameter: 150 mm
ATUM: Local	Date: June 17th, 1988

324.69

TTERBURG IMITS PL %	NMC %	LL %	UNDRAINED SHEAR STRENGTH Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	SAMPLES No.	TYPE	N-VALUE	SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
										GROUND SURFACE 98.0 m		98		
										Compact to dense, light brown, fine SAND				
						1	SS	26			1	97		
	5					2	SS	28						
											2	96		
						3	SS	27						
										damp	3	95		
	16					4	SS	35		----- moist				
						5	SS	>100		occ. cobbles				'N'=50 blows for 40mm (sampler on cobble)
											4	94		
						6	SS	>100						'N'=60 blows for 25mm (sampler on cobble)
										End of Borehole				Borehole DRY upon completion
											5	93		
											6	92		

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Checked: EYC

SHEET 1 OF 1

LOG OF BOREHOLE 6

ENCL. No.: 7

F. No. 88-6-K1	DRILLING DATA
IENT: Fryett, Shifflett Associates	Field Supervisor: Brad Cunninghan
OJECT: Speed River Housing Co-operative	Method: Auger
CATION: Janefield Avenue, Guelph, Ontario	Diameter: 150 mm
TUM: Local	Date: June 17th, 1988

327.79

TERBURG MITS			UNDRAINED SHEAR STRENGTH			SAMPLES			SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
L %	NMC %	LL %	Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	No.	TYPE	N-VALUE						
										GROUND SURFACE 101.1 m				
	5					1	SS	95		Very dense, silty SAND, trace to some gravel, occ. cobble Till-like		-101-		
	6					2	SS	51		damp	1	-100-		
	9					3	SS	34						
										End of Borehole	2	-99-		
											3	-98-		Borehole DRY upon completion
											4	-97-		
											5	-96-		
											6	-95-		

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SHEET 1 OF 1

LOG OF BOREHOLE 7

ENCL. No.: 8

No. 88-6-K1		DRILLING DATA	
T: Fryett,Shifflett Associates		Field Supervisor:	Brad Cunningham
CT: Speed River Housing Co-operative		Method:	Auger
ION: Janefield Avenue, Guelph, Ontario		Diameter:	150 mm
: Local		Date:	June 17th, 1988

324.19

URG S MC %	LL %	UNDRAINED SHEAR STRENGTH Field Pen. kPa	Field Vane kPa	Lab. Compr kPa	SAMPLES No.	TYPE	N-VALUE	SYMBOL	MATERIAL DESCRIPTION	DEPTH m	ELEV. m	WATER DATA	REMARKS
									GROUND SURFACE 97.5 m				
8					1	SS	19		Topsoil FILL		-97-		
13					2	SS	5		Loose,dark brown, fine Sand FILL damp	1			
11					3	SS	6						
									Compact,light brown, fine SAND		-96-		Borehole DRY upon completion
									End of Borehole	2			
											-95-		
										3			
											-94-		
										4			
											-93-		
										5			
											-92-		
										6			
											-91-		

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SHEET 1 OF 1

Enclosures

Enclosure No.: 1
Sheet 1 of 1

FILE No: 14-08-K05 — BOREHOLE No. 101

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client:	**Rockwater Group**
Project:	**Proposed Townhouse Development**
Location:	**233 Janefield Avenue, Guelph**

EQUIPMENT DATA

Machine:	**Dietrich D50-T**
Method:	**Hollow Stem Auger**
Size:	**200 mm O/D**
Date:	**Aug 27 / 14** TO **Aug 27 / 14**

SOIL LITHOLOGY

Ground Elevation: **327.84 m**

ELEV./DEPTH (m)	DESCRIPTION
	200 mm TOPSOIL
	compact, brown sand and silt FILL some gravel moist ------- thin topsoil layers
326.04 / 1.80	compact to dense brown SAND AND SILT silty sand and sandy silt layers moist ------- wet ------- till-like
318.24 / 9.60	End of Borehole

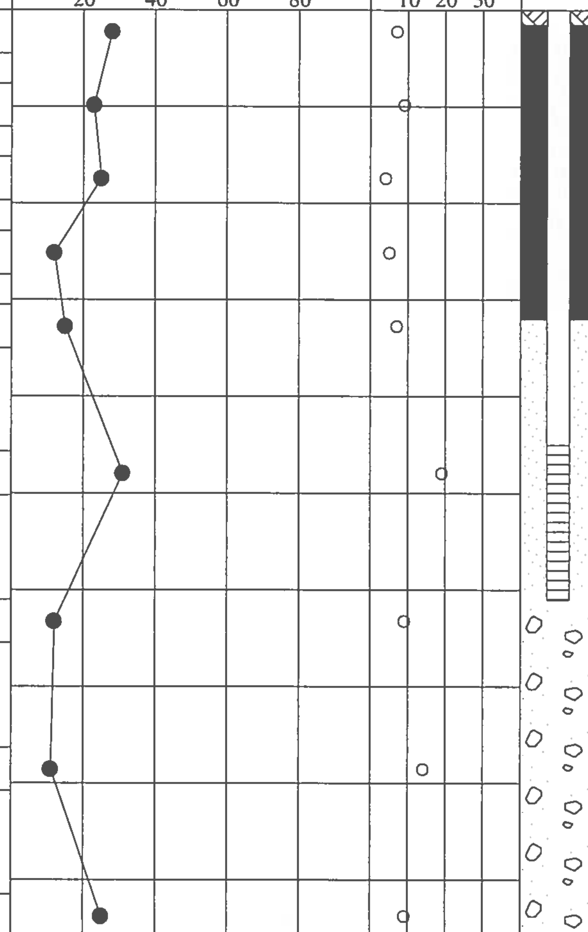
SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	28
2	SS	23
3	SS	25
4	SS	12
5	SS	15
6	SS	31
7	SS	12
8	SS	11
9	SS	25

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

DEPTH (m)	REMARKS
0.0	- steel casing and concrete seal
1.0	- bentonite seal
2.0	- 50 mm PVC pipe
3.5	- silica sand pack
5.0	- 1.5 m long well screen
10.0	no water measured on August 29, 2014
11.0	no water measured on September 8, 2014
12.0	no water measured on September 23, 2014

PROJECT MANAGER: **EYC**

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

FILE No: 14-08-K05

BOREHOLE No. 102

Client: **Rockwater Group**

Project: **Proposed Townhouse Development**

Location: **233 Janefield Avenue, Guelph**

EQUIPMENT DATA

Machine: **Dietrich D50-T**
Method: **Hollow Stem Auger**
Size: **200 mm O/D**
Date: **Aug 27 / 14** TO **Aug 27 / 14**

SOIL LITHOLOGY

Ground Elevation: **326.80 m**

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
326.50 / 0.30	300 mm TOPSOIL	1	SS	10	- steel casing and concrete seal
	compact to dense brown fine SAND trace to some silt trace gravel damp to moist	2	SS	10	- bentonite seal
		3	SS	11	
		4	SS	13	
		5	SS	15	
					- 1.5 m long well screen
	------- wet	6	SS	45	
321.30 / 5.50	compact, brown SANDY SILT saturated	7	SS	12	
					- silica sand pack
		8	SS	26	- 50 mm PVC pipe
		9	SS	27	
317.20 / 9.60	End of Borehole				water level measured at 6.53 m on August 29, 2014
					water level measured at 6.56 m on September 8, 2014
					water level measured at 6.61 m on September 23, 2014

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

PROJECT MANAGER: **EYC**

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

Enclosure No.: 3
Sheet 1 of 1

FILE No: 14-08-K05 BOREHOLE No. 103

Client: **Rockwater Group**
Project: **Proposed Townhouse Development**
Location: **233 Janefield Avenue, Guelph**

EQUIPMENT DATA

Machine: **Dietrich D50-T**
Method: **Hollow Stem Auger**
Size: **200 mm O/D**
Date: **Aug 27 / 14** TO **Aug 27 / 14**

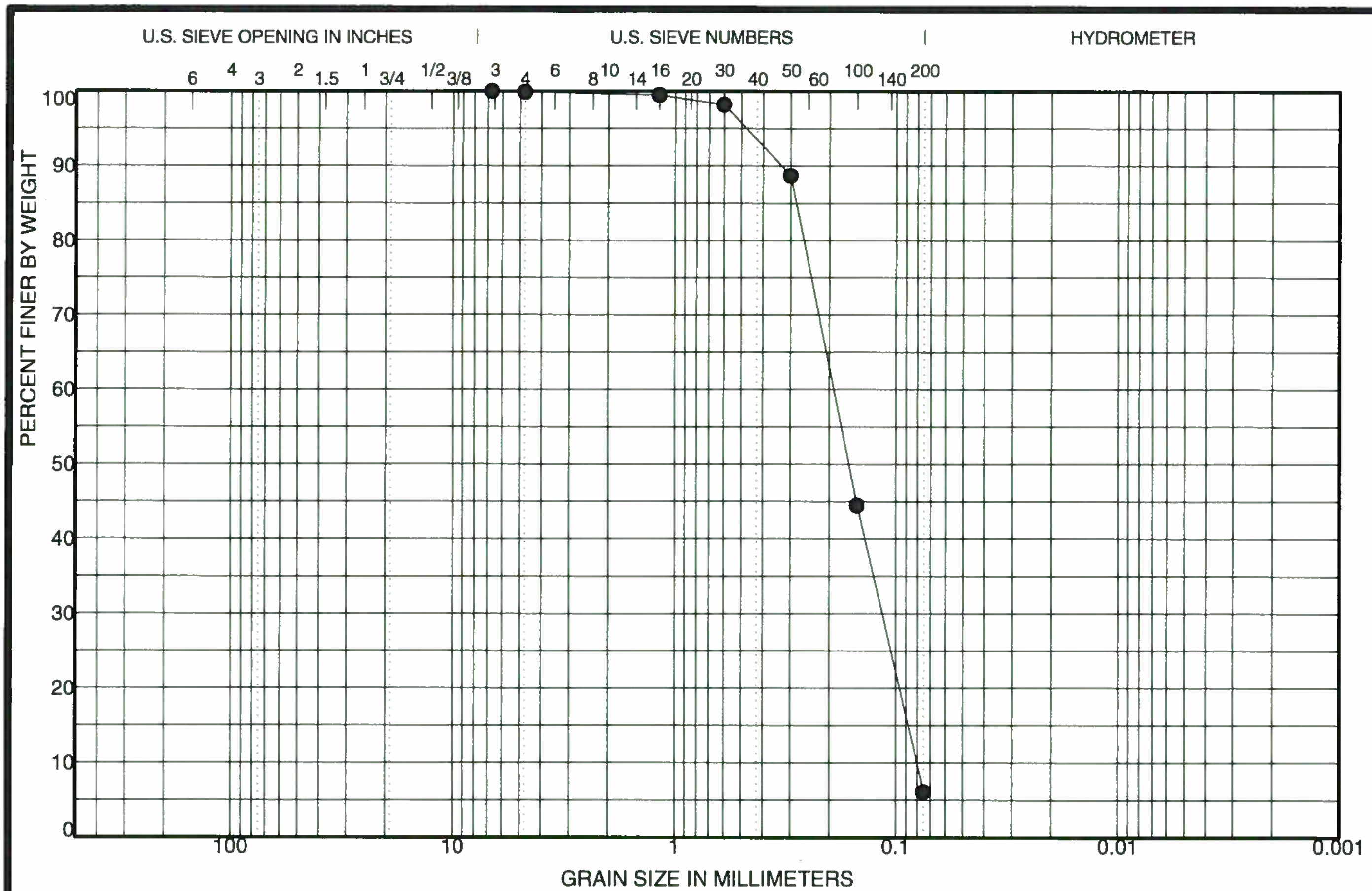
Ground Elevation: **323.84 m**

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)

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	200 mm TOPSOIL compact, brown sand and silt FILL trace gravel, trace topsoil moist	1 2	SS SS	6 6	- steel casing and concrete seal - bentonite seal
322.34 1.50	compact to very dense brown SAND some gravel trace to some silt damp to moist ------- wet	3 4 5 6	SS SS SS SS	21 16 51 33	- 50 mm PVC pipe - 1.5 m long well screen
318.84 5.00	compact, brown SANDY SILT saturated	7 8	SS SS	27 26	- silica sand pack
315.76 8.08	End of Borehole				water level measured at 4.96 m on August 29, 2014 water level measured at 5.00 m on September 8, 2014 water level measured at 5.09 m on September 23, 2014

PROJECT MANAGER: **EYC**

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



<table>
<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td rowspan="2">SILT OR CLAY</td></tr>
<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
</table>

Specimen Identification		Classification		LL	PL	PI	Cc	Cu
LAB. NO.:	1789						0.87	2.38

FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	6.7	0.191	0.115	0.08	0.1	93.8	6.1	

Type of Material: Fine Sand
Sample No. 102 - 4
Source:
Sampled From: Borehole 102 Sample 4 (2.3 to 2.7 m depth)
Date: 24/09/2014
Client: Rockwater Group
Contractor:
Sampled By: CS
Date Sampled: 27/08/2014
Tested By: HC
Date Tested: 4/09/2014

SIEVE SIZES mm	PERCENT PASSING	No Specifications

NO SPECIFICATIONS 14-08-K05 ROCKWATER GUELPH.GPJ LAW_LNDN.GDT 27/9/14

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

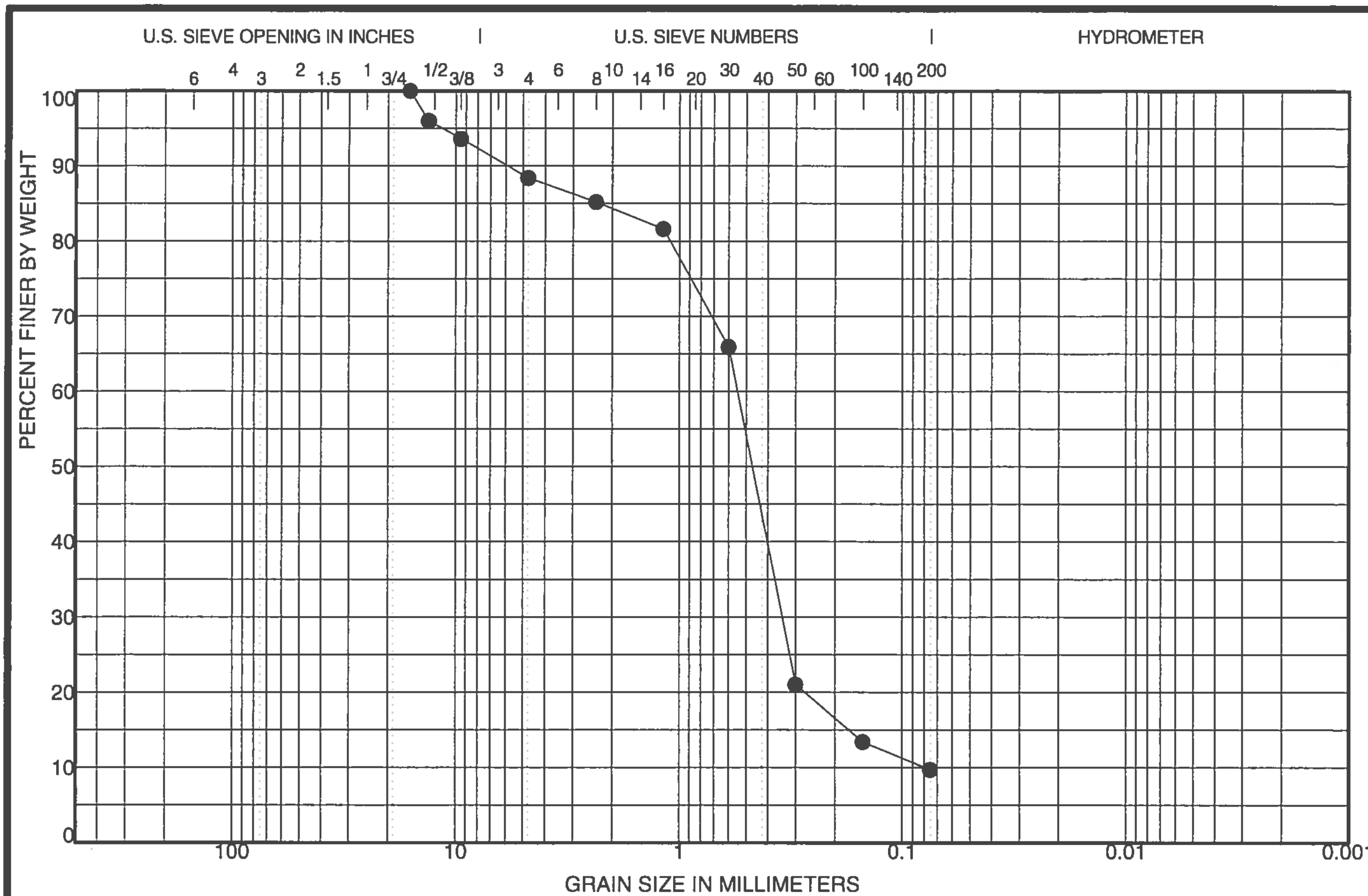
GRAIN SIZE DISTRIBUTION

Project: Proposed Townhouse Development

Location: 233 Janefield Avenue, Guelph

File No.: 14-08-K05

Enclosure No.: 4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification		LL	PL	PI	Cc	Cu
LAB. NO.:	1790						2.73	6.90

FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	16	0.548	0.345	0.079	11.6	78.7	9.7	

Type of Material: Sand, some gravel
Sample No. 103 - 4 & 5
Source:
Sampled From: Borehole 103, Samples 4 & 5 (2.3 to 3.5 m depth)
Date: 24/09/2014
Client: Rockwater Group
Contractor:
Sampled By: CS
Date Sampled: 27/08/2014
Tested By: HC
Date Tested: 4/09/2014

SIEVE SIZES mm	PERCENT PASSING	No Specifications

NO SPECIFICATIONS 14-08-K05 ROCKWATER GUELPH.GPJ LAW_LNDN.GDT 27/9/14

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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: Proposed Townhouse Development

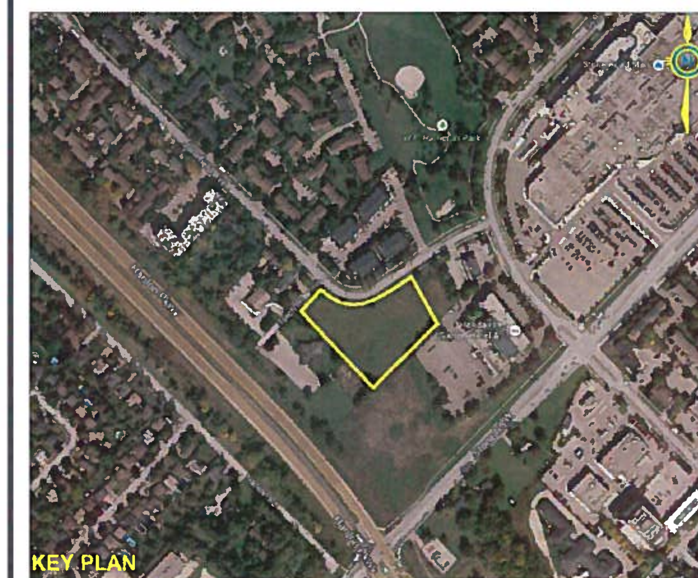
Location: 233 Janefield Avenue, Guelph

File No.: 14-08-K05

Enclosure No.: 5

-5.0 0 10.0 20.0

SCALE METRES



- TBM: Top Nut of Fire Hydrant Elevation: 326.69
- June, 1988 Borehole Locations
- August, 2014 Borehole Locations

BOREHOLE LOCATION PLAN

Proposed Stacked Townhouse Development

233 Janefield Avenue
Guelph, Ontario

CHUNG & VANDER DOELEN ENGINEERING LTD.

311 Victoria Street North
Kitchener, ON N2H 5E1
Phone:(519)742-8979 Fax:(519)742-7739
E-mail:info@cvdengineering.com

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