

DATE June 27, 2011**PROJECT No.** 11-1121-0059**BY EMAIL – PDF****TO** Frank Cairo
Caivan**FROM** Mike Cunningham, P.Eng.**EMAIL** Mike_Cunningham@golder.com**PERMISSIBLE GRADING
PROPOSED RESIDENTIAL SUBDIVISION SITE
RICHMOND VILLAGE
OTTAWA, ONTARIO**

This memo provides an assessment of the permissible grading, from a geotechnical perspective, for a proposed residential development site located near the village of Richmond in Ottawa, Ontario. This assessment is provided based on a technical review of existing geotechnical data for the site (by others).

Background

This site is located on the west side of the village, extending both north and south of Franktown Road / Perth Street. The overall site is about 550 metres wide (approximately east-west) and 1.3 kilometres long (approximately north-south). Air photographs indicate the current land use to be agricultural (cultivated fields). The site is relatively level, with about 1 metre of relief (with a gentle downward slope from both the north and south towards the central portion of the site).

A geotechnical investigation was previously carried out by Jacques Whitford Limited on the larger overall site which includes the Caivan property addressed by this memo. The results of that investigation were provided in a report to Mattamy Homes titled "Preliminary Geotechnical Investigation Report, Proposed Residential Subdivision, Perth and Ottawa Streets, Richmond Area, Ottawa, Ontario" dated June 22, 2007 (report number 1026929). Caivan's property includes essentially the north half of the site investigated by Jacques Whitford. Section 4.0 of that report identifies that the investigation/assessment was carried out at a preliminary level, for due diligence purposes associated with property acquisition.

The Jacques Whitford investigation included the following investigation program across the Caivan portion of the site:

- 9 boreholes, with conventional soil sampling and in situ testing, and including the installation of several standpipes for groundwater level measurement.
- 4 CPT (i.e., piezocone) soundings.



- 15 test pits.
- Laboratory testing on the soil samples consisting of water content and Atterberg limit determinations.

Boreholes 07-4 and 07-16, CPT 07-8, and test pit 07-12, which were all to be located in the northwest part of the site, are shown on the Test Hole Location drawing but were not drilled/excavated due to that portion of the site being deleted from project property.

The report also indicates that laboratory oedometer consolidation testing was carried out on two Shelby tube samples from the site; however those results were not included in the report (since the testing was not complete at the time) and were not available for this review.

The results of the Jacques Whitford investigation indicate that the subsurface conditions consist of a clay deposit overlying sand and silt, over glacial till. The clay thickens to the north, where it is up to about 8 metres thick. Over the south portion of the Caivan property, the clay deposit is only about 2 to 3 metres thick.

The available data provided for this review indicates that the clay deposit is generally firm in consistency. A summary of the available undrained shear strength data is provided on the attached Figure 1, along with a summary of the water content and Atterberg limit data. The CPT data is not included in the summary because the Jacques Whitford report does not provide the interpreted results of that testing (e.g., shear strengths), but rather just the raw data (e.g., probe tip resistance, friction, etc.).

Assessment of Permissible Grade Raise

It is understood that the site is proposed for development with a conventional suburban subdivision, consisting of traditional one or two storey housing, with basements.

The silty clay deposit that exists across the site is somewhat compressible and has a limited capacity to support additional stress, such as could be imposed by:

- The foundation loads of buildings/houses;
- The weight of grade raise fill placed on the site; and,
- The effects of groundwater level lowering (which reduces the buoyant forces that act between the soil particles), which could result from servicing and development of the site.

An increase in stress, if excessive (i.e., if raising the stress above, or even close to, the clay's preconsolidation pressure), could lead to significant consolidation settlements. Due to the low hydraulic conductivity of the clay, and the need to expel water for those settlements to occur, the settlements would be long-term in nature, possibly taking many months or years to complete. The grade raise for this area will therefore need to be restricted, based on leaving sufficient remaining capacity for the clay to also support the structure foundation loads and the effects of groundwater level lowering, without being overstressed. If the grade is raised excessively, then settlements could occur.

It is conventional practice to allow the stress *increase* on the silty clay to be about 80 percent of the difference between the existing natural stress level and the preconsolidation pressure (i.e., of the overconsolidation). This margin (of 20 percent) is left between the final stress level and the preconsolidation pressure because the effects of 'secondary compression' can cause large settlements even at stress levels just slightly below the preconsolidation pressure. The margin also allows for some uncertainty in the actual value of the preconsolidation pressure, the groundwater levels, the unit weight of the fill, etc.

Because the results of the laboratory oedometer consolidation testing were not included in the Jacques Whitford report, the preconsolidation pressure of the silty clay can only be estimated from the reported undrained shear strengths. Given the wide range in the undrained shear strengths indicated by the in situ vane test results (see Figure 1), there is significant uncertainty in the interpreted preconsolidation pressure, and a conservative assessment has been used.

Based on the available data, the following parameters/assumptions were used in the assessment:

- A thickness of stiff weathered surficial clay crust of about 2.5 metres.
- Preconsolidation pressure for the underlying unweathered clay of no less than 130 kilopascals, applying over the depth range of 2.5 to 4.0 metres, and increasing below 4 metres depth.
- A long term groundwater level no deeper than 2.5 metres depth.
- The fill used for site grading would consist of conventional earthen fills. If heavier material were used, such as crushed rock, the permissible grade raise would be lower.

Based on these interpreted parameters, it is considered that grade raises of up to 2 metres are likely feasible for this site.


If this permissible grade raise cannot be accommodated, then alternatives could be considered, subject to further review, such as the use of light weight fill, preloading the site, or using piled foundations.

The following limitations should be noted in regards to this assessment:

- The results of the laboratory oedometer consolidation testing carried out by Jacques Whitford (referenced in Sections 5.3 and 6.3 of the report) were not attached to the report or provided for this review, and therefore the results of this assessment should be reviewed/confirmed once those results are available.
- Some additional investigation and laboratory testing may be required at the detailed design stage, to confirm this assessment, once the design grading is known.
- The assessment discussed in this memo is based on the site being developed with a conventional suburban subdivision (i.e., one or two storey housing, of wood-frame construction, with basements). If other forms of development are proposed, the permissible grade raise could need to be re-evaluated.
- The assessment discussed in this memo relates only to the grading design for this development. Issues associated with site servicing, pavement construction, foundation construction, etc. were not reviewed for this assessment.

We trust that this memo provides sufficient information for your present requirements. If you have any questions concerning this memo, please don't hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.


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Associate

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Attachment: Figure 1

