



# Terms of Reference: Geotechnical Study

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## Study Description

A Geotechnical Study is a sub-surface investigation study, prepared by a qualified expert (Geotechnical Engineer) that analyses subsurface conditions to determine its suitability to accommodate the proposed development. The purpose of the study is to determine appropriate locations of structures, roadways and stormwater management features and their design parameters. Based on these conditions and the factors that influence them, appropriate construction methods and materials can be implemented to ensure safety and compatibility of the proposed development with the site and surrounding area. The study may reveal that there may be significant challenges in the conceptual designs, land requirements, detailed design, and construction stages of a development and may be used to supplement Stormwater Management and Servicing Reports.

## Purpose

The purpose of this Terms of Reference (“TOR”) is to establish clear expectations and requirements for the preparation of Geotechnical Studies submitted to the City of Waterloo. Compliance with these guidelines will help to expedite review times and mitigate the need for further revisions and submissions. Failure to satisfy the requirements set out in this TOR may result in an application being deemed incomplete. If an application is deemed incomplete it will be returned to the applicant to satisfy the necessary submission requirements.

## When is it Required?

A Geotechnical Study must be submitted as part of the development design and included in the Complete Engineering Submission. A Geotechnical Study may be required for the following Planning Act applications:

- Plan of Subdivision
- Zoning By-Law Amendment
- Site Plan Control
- Site Alteration
- Consent to Sever
- Other planning applications, as deemed appropriate by the City’s Director of Engineering Services.



Geotechnical Studies are required for the design and construction of municipal roads and all developments.

The need for a Geotechnical Study as part of a complete application will be identified as part of the pre-application consultation review. In the instance where a planning application being advanced does not have a mandatory pre-application consultation process (e.g., Committee of Adjustment applications), the applicant is encouraged to contact the City's Engineering Services Division to discuss the nature of the proposal and to determine if a Geotechnical Study is required.

The detailed design of any infiltration facilities will be based on site specific percolation tests. The number of tests will be dependent on the size of the facility and the different types of soil conditions found within the proposed facility footprint zone of influence.

In addition to a Geotechnical Study, a Hydrological Study to review underground water conditions may also be required. The applicant is responsible for the preparation and cost of these studies.

## Qualified Persons

A Geotechnical Study should be prepared by a qualified Professional Engineer who must be licensed by the Professional Engineers of Ontario as required by the Professional Engineers Act or a qualified Professional Geoscientist who must be licensed by the Professional Geoscientists Ontario as required by the Professional Geoscientists Act.

The Qualified Person must be working under a Certificate of Authorization allowing them to provide engineering services to the public. The firm should also be a member in good standing of the Consulting Engineers of Ontario. The engineer or geoscientist must be qualified and competent to design the proposed works, and must also be acceptable to the City's Director of Engineering Services.

The stamped, completed report must identify and be signed by the author(s) and, where prepared under the direction of a qualified professional, the signature of the reviewer of the report. The qualified professional that has signed the report shall take professional responsibility for its contents and the accuracy of the information contained therein.

## Applicable Legislation

The authority to require or request information or material to evaluate and make a decision on proposed planning applications is provided by the Ontario *Planning Act*, the Provincial Policy Statement, and City of Waterloo Official Plan Section 12.2.14 (“Complete Applications”).

This Terms of Reference document is to be applied in conjunction with all applicable regulations, by-laws, and guidelines, including the City of Waterloo’s Urban Design Manual and Comprehensive Engineering and Landscape Manual.

## Report Contents

This TOR document sets out the minimum requirements that must be included in all reports. More specific scoping of the Geotechnical Study may be identified by appropriate staff during the pre-application consultation process.

### A. Site Context & Background

- Provide a brief description of the existing site conditions, including any existing structures, topography and features relevant to the investigation and/or development
- Provide a brief description of the proposed development, including any proposed buildings, parking garages, structures, significant excavations, utility installations, proposed roadways, and grading alterations

### B. Proposed Investigation

- Discuss the investigation program and data collection methodology, including:
  - Summary of Investigation Program, including date(s) of fieldwork
  - Number, depth and locations of boreholes and monitoring wells
  - Summary of on-going monitoring (if applicable)
  - In-situ permeability testing
  - Environmental/Chemical data analyses
- Establish accurate ground elevations at each of the investigation locations, and provide an appropriate site benchmark

- Identify unusual conditions encountered during investigation

### **C. Geological Conditions**

- Discuss the site's subsurface information, which should include the following:
  - Subsurface soil conditions such as soil stratigraphy, soil type and composition
  - Groundwater levels encountered at the subject site
- For sites with steep or potentially unstable slopes, identify:
  - External loadings such as structures, traffic, trees, fill etc.
  - Site drainage, runoff, seepage
  - Slope configuration, height, inclination, shape and profile
  - Factors of safety in design
  - Erosion considerations
  - Any historical evidence of geotechnical instability on or near the site

### **D. Discussion & Recommendations**

- Construction recommendations, including:
  - Excavation (including OHS soil classifications and the need for de-watering)
  - Design considerations and parameters for selection and design of shoring systems
  - Recommendations on the need for vibration and displacement monitoring during construction
  - Suitability of native soils to reuse on-site for backfilling
  - Recommendations on management of excess materials
- Structural recommendations:
  - Design considerations and parameters for deep and shallow foundations and slabs on-grade
  - Discussion of possible ground improvements as required
  - Lateral earth pressures for design of permanent retaining structures

- Seismic design considerations and parameters
- Foundation subsurface drainage considerations (perimeter drainage and sub slab)
- Waterproofing requirements
- Site servicing (storm, sanitary, water, and other utilities) details and recommendations, including:
  - Corrosion potential from soils below grade for concrete and metallic pipes and fittings
  - Provide frost penetration depths and susceptibility of existing soils to freezing
  - Bedding and trenching recommendations
  - Resistivity of soils for corrosion protection to watermain fittings
  - Define permeability of soils and infiltration potential for passive infiltration systems
- Pavement design
  - Structural design based on anticipated traffic conditions
  - Subsurface drainage recommendations, if required

**E. Conclusions and Recommendations**

- Briefly summarize the recommendations of the study and identify any limitations in the report.
- Provide a reliance clause allowing the City to rely on the contents of the report to make development approval decisions.
- Provide recommendations on further investigations, such as need for Hydrogeological Studies, additional soil characterization, chemical analysis, detailed insitu investigations for site/development specific details, etc.

**Additional Information**

*Note 1:*

If City staff consider the submitted Geotechnical Study to be incomplete, unsatisfactory, inconsistent, insufficient, authored by an unqualified individual, or if it fails to satisfy the requirements set out in this TOR in any other manner, the associated development



application may be deemed incomplete and returned to the applicant.

*Note 2:*

Deeming an application complete does not guarantee that the contents of the study are acceptable to City staff and/or that the application will be approved.

*Note 3:*

If a request for a Geotechnical Study is not made at an earlier stage in the development process, this does not preclude the City from requesting a Geotechnical Study at a later stage. Once an application has been deemed “complete”, the City may require additional information, reports, and/or studies following a more detailed review to assess the implications of an application for approval.

*Note 4:*

The City of Waterloo is committed to complying with the Accessibility for Ontarians with Disabilities Act (AODA). In our everyday work with businesses institutions, and community partners we anticipate the same commitment to AODA compliance. Therefore, the Geotechnical Study must be AODA compliant and must meet the current provincial standard for compliance.

*Note 5:*

The City reserves the right to request an updated study, or an addendum thereto, should staff determine that changes in the development proposal or changes to legislation warrant further/modified planning analysis.

*Note 6:*

City staff reserve the right to require a peer review of submitted materials by an appropriate agency or qualified professional, the cost of which will be borne by the applicant.

*Note 7:*

Documents and all related information submitted to the City as part of a complete development application are considered public documents once submitted.

*Note 8:*

The Geotechnical Study shall be submitted in conjunction with the applicable development application(s), unless otherwise agreed to by the City.

*Note 9:*

This Terms of Reference document is intended to be used for guideline purposes only, and will be used to provide technical direction throughout the planning and development process. Completion of a report in alignment with the requirements of this Terms of Reference will not guarantee approval of the development application in question.

*Note 10:*

This TOR is relevant at the time of publishing and will be updated as necessary to reflect current policy, best practices, and accepted standards. It is the applicant's responsibility to ensure the report is prepared in accordance with the most recent version of the TOR issued by the City.

*This Terms of Reference was prepared by a qualified external consulting firm. For clarification for any information contained within this document, please contact the City of Waterloo staff assigned to the pre-consultation process.*

## Geotechnical Report Submission Requirements and Checklist

This checklist can be completed by the Professional that prepared the Geotechnical Report. Use of the form by the City of Waterloo is not to be construed as verification of engineering/servicing content.

<b>Geotechnical Report Submission Requirements and Checklist</b>		
<b>A. Site Context &amp; Background</b>	<b>Included in Geotech Report (reference page number)</b>	<b>Report includes this information (City Staff Check)</b>
Site Background (review of existing conditions, site location, historical uses etc.)		
Description of proposed development as it relates to geotechnical investigations		
<b>B. Proposed Investigation</b>	<b>Included in Geotech Report (reference page number)</b>	<b>Report includes this information (City Staff Check)</b>
Description of the investigation program and data collection methodology.		
Elevations of boreholes, corresponding to topographic survey.		
Summary of investigation, and description of any unusual conditions encountered during the investigation (flowing sands, liquefaction etc.)		
<b>C. Geological Conditions</b>	<b>Included in Geotech Report (reference page number)</b>	<b>Report includes this information (City Staff Check)</b>
Summary of subsurface stratigraphy		
Summary of groundwater elevations encountered		
Other pertinent information to the development such as steep slopes, erosion etc.		
<b>D. Discussions &amp; Recommendations</b>	<b>Included in Geotech Report (reference page number)</b>	<b>Report includes this information (City Staff Check)</b>
Construction related recommendations, as it relates to proposed development, adjacencies to existing structures and existing conditions to be maintained.		
Structural recommendations to accommodate the anticipated development.		
Site servicing recommendations, including but not limited to frost depth, bedding, corrosion potential, resistivity and suitability for infiltration and LID measures.		
Pavement design recommendations.		





<b>Geotechnical Report Submission Requirements and Checklist</b>		
<b>E. Conclusions and Recommendations</b>	<b>Included in Geotech Report (reference page number)</b>	<b>Report includes this information (City Staff Check)</b>
Provide a summary of findings and recommendations.		
Provide recommendations for further studies that may be required to accommodate the proposed development.		
Provide a reliance clause to allow the City of Waterloo to rely on findings for the purposes of development approvals.		

