

TERMS OF REFERENCE FOR REPORT PREPARATION

1.0 GENERAL

A comprehensive geotechnical report is required on ALL sites.

Note: Additional geotechnical reports may be required for Building Permit applications.

- 1.1 Reports are to be prepared as per the attached Terms of Reference for Professional Reports to the City of Kelowna.
- 1.2 The assessment must be prepared by a Registered Professional Geotechnical Engineer licensed in BC.
- 1.3 The geotechnical engineer must sign and seal each report submitted to the City.
- 1.4 As part of the assessment consider and integrate relevant findings and recommendations from other studies completed or underway that relate to the site.
- 1.5 Depending on the site conditions and proposed activities hydrogeological (Appendix C2), stormwater management (Appendix C3), or flood impact assessment reports may also be required.
- 1.6 Reports are to be prepared as per the attached Terms of Reference for Professional Reports to the City of Kelowna.

2.0 GEOTECHNICAL STUDY

The geotechnical study(s) will include the following:

- 2.1 Identify and illustrate topography and features showing natural slope contours in 1 to 5-meter contour intervals, spot elevations, swales, knolls, ridgelines, bedrock outcrops, cliffs and slope transitions, seasonal and permanent wet areas, seasonal and permanent watercourses, drainage routes, vegetation, top of bank and break lines.
- 2.2 The topographic survey will include current and proposed roads, site grading and post development contours.
- 2.3 The geotechnical engineer will determine whether the proposed development is feasible in a safe manner (as defined in Section 3.0).
- 2.4 The geotechnical report will identify potential hazards to the subject land and to neighbouring properties from existing or proposed development.
- 2.5 No net decrease in overall slope stability (including seismic and static stabilities) resulting from the proposed development should occur, and off-site slope instabilities are mitigated to provide for safe (as defined in Section 3.0) occupation and use of nearby lands.
- 2.6 Where a potential hazard is identified, a construction management plan must be developed and monitored by the geotechnical engineer.

2.7 The initial geotechnical report prepared at the time of subdivision must address each of the items listed below.

- 2.7.1 Introduction
- 2.7.2 Physical Properties of soil and rock
- 2.7.3 Hydrology (Surface Water)
- 2.7.4 Hydrogeology (Ground Water)
- 2.7.5 Slope Stability
- 2.7.6 Conclusions and Recommendations

Geotechnical reports, at subsequent stages, should include any material changes or omissions to the earlier report specific to the site and the proposed development.

2.7.1 Introduction

- The scope and intent of the proposed development.
- A description of the specific information reviewed and onsite tests conducted to arrive at the conclusions and recommendations.
- The report's scope and terms of reference.

2.7.2 Physical Properties of Soil and Rock

- Site soil characteristics (i.e., fill areas, sulphate content, unsuitable soils, low permeability/poor drainage, shallow bedrock, etc.).
- All geotechnical exploration data (i.e., boring logs, test pit logs, trench logs, laboratory tests, etc.) conducted on the property, plus a statement explaining the sufficiency in number and depth in order to evaluate site conditions and acquire data to justify all conclusions and recommendations.
- Special requirements for construction of roads, utilities and building structures.
- Additional soil and rock characteristics information is discussed in Section 2.7.4 and in Appendix C2.

2.7.3 Hydrology (Surface Water)

- Pre-development surface water characteristics including seasonal overland surface flows, springs and existing drainage paths. ▪ Potential post-development stormwater flow paths.
- Suitability for on-site disposal of storm water and sanitary waste, including effects upon adjoining and downslope lands. (Note: The City expects that where geotechnical, hydrologic and hydrogeologic studies demonstrate suitable conditions, water should be contained within individual lots or within subdivision boundaries without runoff unless there is a legal right of way registered).
- The size and location of proposed stormwater detention facilities will be identified at the time of subdivision. Identify any monitoring required.
- Additional hydrology and stormwater management investigation and planning requirements are provided in Appendix C3.

2.7.4 Hydrogeology (Ground Water)

- Pre-development groundwater characteristics including soil types, drainage characteristics, seepage zones, springs and seasonally saturated areas, depth to groundwater, groundwater flow direction and pathways, and shallow bedrock.
- The suitability for site soils to accept stormwater infiltration and post-development landscape irrigation.

- The likely effects from site irrigation and stormwater disposal, site and subdivision grading, utility trench construction on site drainage and downslope groundwater flow.
- Additional hydrogeologic investigation and planning requirements are provided in Appendix C2.

2.7.5 Slope Stability

- Slope and seismic stabilities, rock fall hazard and slippage including the effects of stormwater infiltration, irrigation recharge and septic tank effluent within the site.
- Identification of the potential for natural rock fall hazard. Rock fall run out zone must be determined for any site where an existing rock face is greater than 3 m in height.
- Any special requirements that the proposed subdivision should undertake so that it will not impact the slope(s). The report must consider erosion and structural requirements.
- Where watercourses are present, top of bank assessment and location including recommendations for property line locations, septic field locations, building setbacks, and ground water disposal locations (see Appendices C2 and C3).

2.7.6 Rock Cuts / Rock Slope Design / Rock Fall Catchment

- Rock cut design shall include stability analyses, ditch design for rock fall containment and provide recommendations for any stabilization measures necessary to optimize the stability and rock fall control for the design life of the project. Detailed design involves site specific slope angles, site specific slope stabilization measures, site specific catchment widths, hydraulic considerations and conformance with seismic design policy. Detailed design shall also encompass risk assessment, and comparison of catchment widths and slope stabilization measures.
- All rock slope designs assume smooth wall controlled blasting techniques and scaling as minimum slope construction and stabilization techniques. Rock slope construction and slope stabilization methods such as slope mesh and rock bolting are to be undertaken as necessary to reduce risk.
- Identify potential for rock fall hazard. Rock fall run out zone must be determined for any site where an existing rock face is greater than 3m in height.
- The ditch/rock fall catchment area design needs to consider rock fall volume, particle sizes and the potential for rock fall hazards originating from above new cut slopes. Mitigation measures for rock fall hazards originating from slopes above the design rock cut shall be considered and incorporated into the design.
- Rock fall ditches/catchment areas below rock cuts should be designed to achieve a minimum 95% retention rate for potential rock fall. For high traffic volume areas or sites with potential higher frequency rock fall activity, higher retention rates should be considered.

2.7.7 Hillside Development Guidelines

- Demonstrate that hillside development guidelines are incorporated into project design and implementation.
- Specific guidelines relating to geotechnical considerations include Sections 3.1, 3.2, 3.3 & 3.4.
- Refer to <https://www.kelowna.ca/our-community/planning-projects/2040-official-community-plan/ch-19-hillside-development>

2.7.8 Conclusion and Recommendations

- Site suitability for development (before earthworks).
- If the site is determined suitable for development:
 - A statement regarding the change in overall slope and soil stability as a result of the proposed development. Note: the changes should comply with the aforementioned level of safety.
 - Recommendations for items that should be included in Restrictive Covenant(s).
 - Recommendations for erosion and sediment controls for water (Appendix C3) and wind.
 - Any special requirements for construction of roads, utilities, and building structures.
 - Recommendations for roof drains and perimeter drains (Appendices C2 and C3).
 - Recommendations for construction of detention or infiltration ponds, if applicable (Appendices C2 and C3).
 - Statement that off-site slope instabilities will be mitigated by the owner/developer to provide for the safe (as defined in Section 3.0) occupation and use of the development lands and adjacent nearby lands.
 - Other factors which the professional geotechnical engineer considers relevant to the review, including an assessment of risk, potential consequences, and recommendations to ensure slope/soil stabilities over time.
 - A construction management plan for erosion and sediment control prepared by the Approved Professional which includes the monitoring and reporting requirements by the professional geotechnical engineer (e.g., erosion, sediment control). For example, site grading should be completed to minimize the potential for wet soils to slide or dry soil to blow away in a wind storm. Temporary measures may need to be undertaken (e.g., silt fencing, hydro seed, etc).
 - Lot grading plans are to include recommendations from the professional geotechnical engineer and all items listed on the Lot Grading Plan Checklist.

The Geotechnical Engineer must sign and seal each report submitted to the City.

3.0 LEVEL OF SAFETY

The City requires all development to include a level of safety for any and all geotechnical failures with a 2.0% probability of failure occurring in a 50 year period (annual probability of exceedance of $1/2475$), or adhere to the prevailing standard as set by the B.C. Building Code, whichever is greater. The City reserves the right to modify this standard to suit the proposed development.

The City will rely on the geotechnical engineer's analysis and report to prevent any damage to property and/or injury to persons from occurring as a result of problems with soil slippage, soil instability, stormwater management or groundwater seepage related to the proposed project.

The professional engineer shall consider if the extent of property damage and damage/harm to life and limb which occurs is not likely to be in any way greater than the damage or harm which would occur prior to the development taking place when determining whether a property is "safe" or can be "safely used":

A detailed geotechnical report and onsite investigation shall be undertaken by qualified professional geological or geotechnical engineers in order to determine whether the proposed development can occur in a safe manner and describe mitigation requirements to be employed, where appropriate.

4.0 ASSURANCES & LETTER OF NOTICE

The professional geotechnical engineer shall provide in writing the following specific geotechnical assurances to the City. City - ***this is a mandatory requirement for all geotechnical reports submitted for development approvals:***

- 4.1 The professional geotechnical engineer has completed all necessary surface and subsurface investigations that the engineer considers necessary to provide the review and design recommendations.
- 4.2 The professional geotechnical engineer will provide the review, design and supervision such that, in the engineer's opinion, the site is suitable for the proposed development and the proposed development does not compromise nor is likely to reduce the stability of the soil on-site or soil on lands which are adjacent or nearby, and will not cause or contribute to such soils becoming susceptible to land slip, land slide, rock fall, mud/land flow, debris flow, torrent, erosion, slumping, creeping, settling, avalanches or other such occurrence.
- 4.3 In the professional geotechnical engineer's opinion, in the event of any land slip, land slide, rock fall, mud flow, debris flow, debris torrent, erosion, slumping, settling, groundwater seepage, surface water accumulation, or other such occurrence, which occurs after the proposed development is completed, the extent of the property damage and damage to life and limb which occurs is not likely to be in any way greater than the damage or harm which would occur prior to the development taking place.
- 4.4 The professional geotechnical engineer shall provide notice in writing to the City of Kelowna of the following:
- 4.5 Each practicing professional engineer acting behalf of an owner, developer or contractor shall notify the City upon being commissioned by their client.
- 4.6 Each geotechnical report provided to the City shall be accompanied by a letter from the owner/developer advising the City the professional geotechnical engineer had free, uninterrupted and complete access to the property and he/she has been provided the necessary information by the owner/developer, including previous geotechnical investigations conducted on the property or nearby lands.
- 4.7 The professional geotechnical engineer shall notify the City if he/she becomes aware of changes or new information which could affect the outcome of their geotechnical review.
- 4.8 In the event the retainer is terminated for any reason by the owner/developer, the Engineer shall be obligated to immediately notify the City in writing of that fact.

5.0 GEOTECHNICAL COMPLETION REPORT

Geotechnical completion reports are required for all subdivisions prior to subdivision approvals (the reports must be prepared after completion of site grading and installation of services). Earthworks during land development significantly change the characteristics of sites and as a result recommendations provided in the predevelopment geotechnical report may no longer be relevant once grading is complete. Therefore, a Geotechnical Completion report will provide a complete reference of additional requirements and revised recommendations moving forward.

Provide the following information within the Geotechnical Completion Report:

Provide confirmation of compliance with the pre-development geotechnical assessment and identify changes to the initial plan and revised recommendations moving forward, additionally provide specific confirmation of the following:

- Provide Appendix D: Landslide Assessment Assurance Statement (for Subdivision)
- Confirm Foundation Bearing Capacity for each lot
- Confirm Earthworks Compaction requirements
- Confirm Site grading (Slope Stability/Slope angles) are safe and functional and confirm with the Civil Engineer that elevations are satisfactory for roof/perimeter drainage to the municipal storm system.
- Confirm Minimum Building Platform Elevations as per design (for flood mitigation scenarios).
- Confirm with the Civil Engineer that Lot Drainage/Storm water and Effluent Disposal systems are installed as per pre-development geotechnical design criteria.
- Confirm all geotechnical covenant setbacks and detail where those should be throughout the subdivision.
- Confirm that rock slope/rock catchment areas have been built to specifications.
- If unexpected groundwater or surface water were encountered during construction - specify how those issues were mitigated.
- Confirm Retaining Wall/Engineered Slope construction design standards meet Engineers and Geoscientists of BC Professional Practice Guidelines for all walls/slopes over 1.2 meters high, which include wall systems of more than one tier (Provide sealed As-built drawings, Schedules D, B and C-B and substantial completion reporting, confirmation of minimum global stability factor of safety of 1.5 and confirmation of Building Permit).
- As per the Engineers and Geoscientists of British Columbia Association Guidelines for Independent Reviews of Retaining Walls - Retaining walls including but not limited to gravity, piling, cantilever, anchored, mechanically stabilized earth (MSE), and geosynthetic reinforced soil (GRS) walls when over 3.0 m high or deemed to be high risk are required to have documented independent reviews conducted by a qualified professional. Engineering Professionals carrying out structural design must meet the requirement of Bylaw 14 (b) (4) by having independent reviews of any structural designs they prepare carried out by another qualified Engineering Professional, before the documents are issued for construction.

CONCLUSIONS AND RECOMMENDATIONS SECTION OF THE GEOTECHNICAL COMPLETION REPORT

- Statement the development meets a level of safety for any and all geotechnical failures with a 2.0% probability of failure occurring in a 50-year period (annual probability of exceedance of 1/2475), or adhere to the prevailing standard as set by the B.C. Building Code, whichever is greater.
- Statement of professional opinion as to the geotechnical suitability of the land for building.
- Statement that off-site slope instabilities have been mitigated to provide for the safe occupation and use of the development lands and adjacent nearby lands (for any and all geotechnical failures with a 2.0% probability of failure occurring in a 50-year period (annual probability of exceedance of 1/2475)).
- Comment on other factors which the professional geotechnical engineer considers relevant to the review, including an assessment of risk, potential consequences, and recommendations to ensure slope/soil stabilities over time.

- Confirm the professional geotechnical engineer has completed all necessary surface and subsurface investigations that the engineer considers necessary to provide the review and design recommendations.
- Attach the as-built grading plan and servicing plan and the final site plan and "No Build Covenant" plan to the completion report (the Geotechnical Completion Report must specifically reference these drawings as being reviewed by the Geotechnical Engineer and meeting the Geotechnical requirements of the pre-development Geotechnical Assessment or identified changes to the initial plan and revised recommendations. The drawings must be signed/sealed by the Civil Engineer).

6.0 INSURANCE

The professional geotechnical engineer shall provide the City with evidence of professional liability insurance coverage which does not lapse in the amount of at least \$2,000,000 as provided to their client.

7.0 COVENANTS

The owner/developer may be required by the City to register a covenant against the property title at the Land Titles Office as a notification to future land owners. The covenant will incorporate provisions included in the geotechnical report(s) and indemnify the City against all claims. It must be in a form as required by the City, granted to the City in priority of all liens, charges and encumbrances and executed in registrable form by the person who owns the land. During the construction phase enforcement of the covenant provisions are the responsibility of the owner/developer and the professional geotechnical engineer.

8.0 BONDING

It is anticipated the works recommended by the geotechnical engineer will be adhered to. If the City has concerns – site grading for example – the owner/developer may also be required by the City to provide bonding as security for performance of the on-site and off-site construction works and the provisions outlined in the geotechnical report(s) pertaining to that construction.

Refer to City of Kelowna Bylaws, including but not limited to Bylaw No. 7900 and No. 8140 for specific bonding requirements.

9.0 PEER REVIEW

The City may require a professional geotechnical engineer peer review for conformance to good engineering practice and adherence to these guidelines on a case by case basis. The peer review shall be completed by a qualified professional geotechnical engineer with the City selecting from a list of consultants proposed by the applicant. Any costs incurred by the City to conduct a peer review shall be borne by the owner/developer. The engineer engaged by the City shall notify the professional geotechnical engineer in writing of the peer review.

The peer review may identify deficiencies in field investigations, analysis and/or reporting. All deficiencies will need to be resolved prior to issuance of permits.