

SC6.5 Geotechnical assessment

SC6.5.1 Application

1. This planning scheme policy applies to development where an applicable code identifies Planning Scheme Policy SC6.5 Geotechnical assessment as supporting an outcome of the Steep land overlay code.

SC6.5.2 Relationship to the planning scheme

1. This planning scheme policy is to be read in conjunction with the assessment benchmarks specified in the Planning Scheme and applies when development is proposed in an area identified as steep slope and very steep slope (i.e. having a slope of at least 15%) on OM11 Steep land overlay map.
2. This policy specifically relates to the assessment of section 8.11 Steep land overlay code and ensuring development is consistent with the purpose and performance outcomes of the code.

SC6.5.3 Purpose

1. The purpose of this planning scheme policy is to:
 - a. ensure that development in any area of steep slope or very steep slope has proper regard to factors affecting land stability;
 - b. identify the qualifications required to be held by the author of a geotechnical stability assessment and landslide management plan;
 - c. provide supporting technical information including any guidelines, standards, information sources and standardised forms, where relevant;
 - d. provide supporting information on who should be consulted regarding adjoining landowners;
 - e. provide a summary on how OM11 Steep land overlay map was generated and any limitations to the data;
 - f. identify the relevant components of landslide management plan and expected information to be supplied;
 - g. assessment consideration for development involving batters and retaining structures;
 - h. identify considerations of geotechnical certification.
2. An information request will be requested where the information required by this policy is not supplied when a development application is made for:
 - a. development in steep slopes; and
 - b. development involving batters and retaining structures.

SC6.5.4 Qualifications

1. A geotechnical stability assessment for a proposed development site should be conducted by a Registered Professional Engineer of Queensland (RPEQ) specialising in geotechnical engineering, with a minimum five years technical experience in assessing and providing advice about steep slopes, unstable land and stability assessment and management.

SC6.5.5 Technical standards

1. The following references are relevant when preparing a geotechnical stability assessment and management plan.
2. A reference in the policy to a specific resource, guideline, standard or document means the latest version of the resource, guideline, standard or document.

SC6.5.5.1 Guidelines

1. The following guidelines are relevant when preparing a slope and stable land assessment:
 - a. Australian Geomechanics Society (2007) '*A National Landslide Risk Management Framework for Australia*' Journal of the Australian Geomechanics Society 42(1);
 - b. Australian Geomechanics Society (2007) '*Practice Note Guidelines for Landslide Risk Management 2007*' Journal of the Australian Geomechanics Society 42(1);
 - c. Australian Geomechanics Society (2007) '*The Australian GeoGuides for Slope Management and Maintenance*', Journal of the Australian Geomechanics Society 42(1).

SC6.5.5.2 Standards

1. The following standards are relevant when preparing a slope and stable land assessment:
 - a. AS.1170.4-2007 Structural design actions Part 4: Earthquake actions in Australia;
 - b. AS.1726:2017 Geotechnical site investigations;
 - c. AS.3700:2001 Masonry structures;
 - d. AS.3798-2007 Guidelines on Earthworks for Commercial and Residential Developments;
 - e. AS.4678-2002 Earth-Retaining Structures;
 - f. AS/NZS.1170:2002 Structural Design Actions;
 - g. Australian Building Codes Board (2015) Landslide Hazards Handbook.
2. Soil testing is required to be undertaken by a NATA certificated laboratory.

SC6.5.5.3 Studies

1. The following study is relevant to the Lockyer Valley:
 - a. Willmott, W.F. (1984) *Slope Stability and its Constraints on Closer Settlement in the Foothills of the Toowoomba Range*, Gatton Shire, Geological Survey of Queensland Record Series 1984/44.

SC6.5.5.4 Information sources

1. The following information source is relevant:
 - a. Queensland Government Water Monitoring Information Portal.

SC6.5.5.5 Forms

1. The following information source is relevant in providing declarations and certifications for development:
 - a. Australian Geomechanics Society (2007) '*Practice Note Guidelines for Landslide Risk Management 2007*' Journal of the Australian Geomechanics Society 42(1);
 - i. Form A Geotechnical Declaration and Verification;
 - ii. Form C Geotechnical Declaration Subdivision
 - iii. Form E Geotechnical Declaration Remediation;
 - iv. Form F Geotechnical Declaration Final Structural/Civil Certificate.

SC6.5.6 Consultation

1. Council may seek third party advice or comment about an application where:
 - a. development may conflict with a code; or
 - b. technical advice is required to assess the development.
2. Where technical advice is outsourced to an independent consultant an additional fee will apply

SC6.5.7 Steep land overlay map methodology

1. Using a basic hazard identification process to develop a hazard identification map involved using latest Digital Elevation model (DEM) available to Council derived from State LiDAR captured in 2022. The DEM provides coverage for the entire LGA and a solid basis for a consistent model. The source LiDAR has a 15pts/m² average capture density with vertical accuracy of 0.15m and in summary provides a higher level of accuracy than previous LiDAR and DEM's used in current flood models for the Local Flood Management Plan.
2. The DEM was used to identify slopes of:
 - a. 5-10%;
 - b. 10-15%;
 - c. 15-20%;
 - d. Greater than 20%.
3. Slopes were generated using a resampled 5m DEM derived from the source 1m DEM. Due to technical limitations (i.e., file sizes, software processing, map rendering etc.) the high level of detail produced for slope outputs generated using the 1m DEM were not practical to use in any platform.
4. The above categories are used for the following reasons:
 - a. slopes greater than 5% can lead to erosion in areas with high risk soils;
 - b. slopes greater than 10% are difficult for heavy vehicles to access;
 - c. slopes less than 10% are suitable for effluent disposal areas;
 - d. slopes greater than 20% are difficult for vehicles, including emergency vehicles, to access;
 - e. slopes greater 35% are subject to potential rapid landslide.
5. While only development on slopes of 15% or more is subject to assessment against the Steep land overlay code, the range of slopes was generated to provide additional administrative information that will be used to inform development

- assessment. For example, effluent disposal sites should not be located on slopes greater than 10% and earthworks in areas with high risk soils and a slope greater than 5% are likely to have significant sediment and erosion control issues.
6. The accuracy of this data is high in areas, to the extent that slopes of waterways, road batters, swale drains, cut and fill slopes for house construction and farm dam walls have been identified. The final mapping that forms the Steep land overlay has been refined to minimise the extent of these features.
 7. OM11 Steep land overlay map is a steep slope extent and not a landslide hazard map. This means developers must undertake a risk assessment as part of the development assessment process.

SC6.5.7.1 Map data assumptions and limitations

1. OM11 Steep land overlay map was generate using the best LiDAR data available flown in 2022 and a grid of 5m.
2. Further improvements in the accuracy of the slope map may be achieved by generating a 1m DEM derived from the source LiDAR.

SC6.5.8 Parts of a landslide management plan

1. When undertaking development for a Material change of use, Reconfiguring a Lot or Operational works where changing the ground level or undertaking infrastructure works, the following form the parts of a landslide management plan:
 - a. landslide risk assessment or susceptibility analysis;
 - b. geotechnical stability assessment;
 - c. assessment against the Steep land code and the Earthworks code (if relevant);
 - d. RPEQ recommendations on landslide management and mitigation measures based on the development design including any bulk earthworks and retaining walls;
 - e. geotechnical certification at planning stage and/or at completion of operational works stage.

SC6.5.9 Landslide susceptibility or risk assessment

1. For proposed development on land within areas of Steep slope, as identified on the OM11 Steep land overlay map (i.e. areas with a slope of 15% or more), there is a risk of landslide that must be assessed by a qualified expert and submitted to Council for assessment.
2. The level of landslide risk depends on several factors including, but not limited to the following:
 - a. ground slope angle and shape;
 - b. characteristic geology;
 - c. strength of geomaterials and its distribution within the subsurface;
 - d. landslide history;
 - e. presence of existing or recent past instability i.e. slips, slumps, hummocky ground etc;
 - f. emergent seepages and depth of groundwater table;
 - g. potential for surface runoff concentration, orientation of rock mass defects etc.
3. The developer needs to assess the risk of landslide which may adversely affect the subject site, adjoining premises and the proposed development.

SC6.5.9.1 Requirements for landslide susceptibility or risk assessment

1. The landslide risk assessment should be carried out using the following:
 - a. site-specific geotechnical information;
 - b. site slope gradient and shape;
 - c. surface features;
 - d. historical landslide information, where available;
 - e. emergent seepages and groundwater table;
 - f. drainage conditions; and
 - g. any other relevant information of the site.
2. For any proposed development or re-development on any site or lot mapped on the OM11 Steep slope overlay, a landslide susceptibility analysis should be carried out first using the Example landslide susceptibility analysis form shown in Figure SC6.5.9-1
3. The calculated relative susceptibility of landslide should then be correlated to susceptibility rating using Table SC6.5.9-1: Correlation between relative susceptibility and susceptibility rating.

Figure SC6.5.9-1: Example landslide susceptibility analysis form

LANDSLIDE SUSCEPTIBILITY ANALYSIS

Analysis No.

Location:

Site No.

Site Name:

1 Natural Surface Slope

Site	Level	Factor
Less than 5 degrees	L	0.1
Between 5 and 15 degrees	M	0.5
Between 15 and 30 degrees	M	0.8
Between 30 and 45 degrees	H	1.2
More than 45 degrees	M	0.8

2 Slope Shape

Site	Level	Factor
Crest or ridge	L	0.7
Planar / Convex	M	0.9
Rough / Irregular	H	1.2
Concave	H	1.5

3 Site geology

Site	Level	Factor
Volcanic Extrusive rock	H	1.1
Sedimentary rock	M	1
Low grade metamorphic rock	M	1
High grade metamorphic rock	L	0.9
Volcanic Intrusive rock	M	1

4 Soils

Site	Level	Factor
Rock at surface	VL	0.1
Residual soil < 1m deep	L	0.5
Residual soil 1-3m deep	M	0.9
Residual soil > 3m deep	H	1.5
Colluvial soil < 1m deep	H	1.5
Colluvial soil 1-3m deep	VH	2
Colluvial soil > 3m deep	VH	4

5 Fill height

Site	Level	Factor
None	L	1.0
Less than 1m	M	1.1
Between 1 and 3m	M	1.3
Between 3 and 6m	H	1.7
More than 6m	VH	2.5

6 Evidence of groundwater

Site	Level	Factor
None apparent	L	0.7
Minor moistness	M	0.9
Generally wet	H	1.5
Surface springs	VH	3

7 Cut height

Site	Level	Factor
None (Go to section 11)	L	1.0
Less than 1m	M	1.1
Between 1 and 3m	M	1.3
Between 3 and 6m	H	1.7
More than 6m	VH	2.5

8 Slope of cut face

Site	Level	Factor
Less than 30 degrees	L	0.5
Between 30 and 45 degrees	M	1
Between 45 and 60 degrees	H	1.5
More than 60 degrees	VH	3

9 Material in cutting

Site	Level	Factor
High strength rock	L	0.5
Medium strength rock	L	1
Low strength rock	M	1.2
Very low strength rock and soil	H	1.5
Soil	VH	2

10 Cut slope support

Site	Level	Factor
Concrete wall	L	0.5
Crib wall	M	0.9
Gabion wall	M	1
Rock wall	H	1.5
Unsupported	H	2

11 Concentration of surface water

Site	Level	Factor
Ridge	L	0.7
Crest	M	0.8
Upper slope	M	0.9
Mid slope	H	1.2
Lower slope	H	1.5

12 Wastewater Disposal

Site	Level	Factor
Fully Sewered	M	1
Onsite disposal – Surface	M	1.2
Onsite disposal – Soak Pit/Trenches	H	1.5

13 Stormwater Disposal

Site	Level	Factor
All stormwater piped into road drainage	L	0.7
Rain water tank with overflows	M	1
Stormwater discharge on site	H	1.5

14 Evidence of instability

Site	Level	Factor
No sign of instability	L	0.8
Soil Creep	H	1.2
Minor irregularity	VH	2
Major irregularity	VH	5
Active instability	VH	10

Summary

	Factor
1 Natural Surface Slope	
2 Slope Shape	
3 Site Geology	
4 Soils	
5 Fill Height	
6 Evidence of Groundwater	
7 Cut height	
8 Slope of Cut Face	
9 Material in Cutting	
10 Cut Slope Support	
11 Concentration of Surface Water	
12 Wastewater Disposal	
13 Stormwater Disposal	
14 Evidence of Instability	
Relative Susceptibility (1x2x3x4x5x6x7x8x9x10x11x12x13x14)	<input style="width: 80px; height: 20px;" type="text"/>

Table SC6.5.9-1: Correlation between relative susceptibility and susceptibility rating

RELATIVE SUSCEPTIBILITY	SUSCEPTIBILITY RATING
Less than 0.2	Very low
0.2-0.6	Low
0.6-2.0	Moderate
2.0-6.0	High

Greater than 6.0	Very High
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SC6.5.9.1.1 When landslide susceptibility rating analysis is 'low' or 'very low'

1. If the result of the landslide susceptibility rating analysis is 'low' or 'very low', then the following is required:
 - a. undertake a geotechnical stability assessment of the proposed development impacting any adjoining buildings or properties; and
 - b. certification from a RPEQ specialising in geotechnical engineering confirming:
 - i. the proposed development site has been assessed with a landslide susceptibility rating of 'low' or 'very low'; and
 - ii. the proposed development will not cause any adverse impact on any adjoining buildings, properties or infrastructure.

SC6.5.9.1.2 When landslide susceptibility rating analysis is 'moderate', 'high' or 'very high'

1. If the result of the landslide susceptibility rating analysis is 'moderate', 'high' or 'very high', a detailed landslide risk assessment following the Australian Geomechanics Society's (AGS) 'Practice Note Guidelines for Landslide Risk Management 2007' should be carried out to determine whether the risk to life and property is acceptable.
2. In this regard a 'low' or 'very low' risk to property and life is acceptable to Council. If the result of the landslide risk assessment following the AGS 2007 method is still 'moderate', 'high' or 'very high', then the following is required to be included in the report:
 - a. detailed risk mitigation measures and engineering recommendations to reduce the landslide risk to 'low' or 'very low'; and
 - b. certification from a RPEQ specialising in geotechnical engineering confirming:
 - i. the proposed development site or lots will achieve a landslide risk rating of 'low' or 'very low'; and
 - ii. the proposed development will not cause any adverse impact on any adjoining buildings, properties or infrastructure, providing the risk mitigation measures and engineering recommendations (if any) of the report are followed.

SC6.5.9.2 Onsite effluent disposal (if applicable)

1. If the proposed development involves an onsite effluent disposal system/s, the risk assessment should consider potential saturation and softening of the soils within the effluent disposal areas and their impacts on the long-term stability of the site.
2. Landslide risk issues differ by the type of development and should be addressed in a geotechnical stability assessment report.

SC6.5.9.2.1 Material change of use

1. For any Material change of use development application on any site or lot identified on OM11 Steep land overlay, the application needs to be supported by a landslide risk assessment and included in the geotechnical stability assessment report.
2. The landslide risk assessment should assess the risk of landslide on the subject site as well as any risk of landslide on any upslope and downslope external properties which may impact the proposed development. If any risk of landslide on any upslope and downslope external properties impacting the proposed development is identified, the risk assessment should provide suitable risk mitigation measures including appropriate buffers to protect the proposed development.
3. If the proposed development is on a portion of a large allotment, the landslide risk assessment may be limited to the proposed development footprint only. In this case, the risk assessment for the proposed building envelope and effluent disposal area of the site may be sufficient, rather than for the entire allotment. The risk assessment should consider availability of a suitable driveway access to the proposed building envelope.
4. If the proposed development is associated with any earthworks, including filling and/or excavation on the site, the landslide risk assessment should consider the proposed bulk earthworks and finished levels and determine the overall risk of landslide including the proposed bulk earthworks. The assessment of the earthworks should be carried out in the form of a global stability assessment.
5. The landslide risk assessment should provide any restrictions on any earthworks including filling and/or excavation in order to achieve and maintain acceptable risk of landslide in the long-term conditions.
6. The landslide risk assessment report should confirm the risk of landslide on the subject site or lot adversely impacting the proposed development and adjoining properties or structures and the risk of landslide on any upslope and downslope external properties impacting the proposed development is 'low' or 'very low'.

SC6.5.9.2.1 Reconfiguring a lot

1. For any Reconfiguring a lot development application, on any site or lot identified on the OM11 Steep land overlay, the

- application needs to be supported by a landslide risk assessment and included in the geotechnical stability assessment report.
2. The landslide risk assessment should assess the risk of landslide for each of the proposed lots. If the proposed lots are large allotments, the landslide risk assessment for each proposed lot may be limited to the nominated building envelope and effluent disposal area only, rather than for the entire allotment. The risk assessment should consider availability of a suitable driveway access to the proposed building envelope of the lot.
 3. The landslide risk assessment should identify any clear exclusion zone (if any) which is deemed not suitable for any future development due to unacceptable risk to life and/or property. In this case, the report should recommend a suitable buffer zone outside the exclusion zone.
 4. If the proposed development is associated with any earthworks, including filling and/or excavation on the site or lots, the risk assessment should consider the proposed bulk earthworks and finished levels and determine the risk of landslide for each of the proposed lots at their proposed finished levels. The assessment of the earthworks should be carried out in the form of a global stability assessment.
 5. The landslide risk assessment should confirm the risk of landslide adversely affecting each of the proposed lots (or their nominated building envelopes and effluent disposal areas) is 'low' or 'very low'. The report should include a completed and signed subdivision landslide encumbrance form for each of the proposed lots.

SC6.5.9.2.1 Operational works

1. For any Operational works development application (for change to ground level or infrastructure works) on any site or lot identified on the OM11 Steep land overlay, the application needs to be supported by a landslide risk assessment and included in the geotechnical stability assessment report.
2. The landslide risk assessment should assess the overall risk of landslide on the subject site or lot considering the proposed bulk earthworks, filling, excavation, retaining walls and the proposed finished level. If the proposed development is on a portion of a large allotment, the landslide risk assessment may be limited to the proposed development footprint only, rather than the entire site or lot.
3. The landslide risk assessment should provide any restrictions on any earthworks including filling and/or excavation in order to achieve and maintain acceptable risk of landslide in the long-term conditions.
4. The landslide risk assessment should confirm the risk of landslide on the subject site or lot after completion of the proposed works is 'low' or 'very low' and will not cause any adverse impact on any adjoining properties or structures.

SC6.5.9.3 Details a landslide risk assessment must address

1. The details of landslide risk assessment must address include:
 - a. **assess the risk of landslide:**
 - i. on the subject site for Material change of use. This may be limited to a proposed development envelope area where on a large site; or
 - ii. for each proposed lot in a Reconfiguring a lot. This may be limited to a proposed development envelope area on benched site/s; or
 - iii. from any proposed bulk earthworks, retaining walls and proposed finished levels to achieve and maintain acceptable risk of landslide in the long-term conditions; and
 - iv. on any upslope and downslope external properties which may impact the proposed development; and
 - v. on driveway or road access to the development, whether internal or external to the development site.
 - b. **identify any risk mitigation measure including:**
 - i. any exclusion area/s (i.e. locations on the development site) that are considered unsuitable for new development due to an unacceptable risk to life and/or property.
 - ii. any buffers to protect the proposed development from an exclusion area/s.
 - iii. proposed bulk earthworks and finished level/s.
 - c. **confirm the risk of landslide is 'low' or 'very low':**
 - i. on the subject site for material change of use. This may be limited to a proposed development envelope area where on a large site; or
 - ii. for each proposed lot in a Reconfiguring a lot. This may be limited to a proposed development envelope area on individual proposed lot/s; or
 - iii. after completion of any Operational works, bulk earthworks and retaining walls and will not cause any adverse impact on any adjoining premise/s or structure/s.

SC6.5.10 Geotechnical stability assessment

1. Where the proposed development requires significant bulk earthworks including cut or fill batters and/or retaining structures to achieve the desired finished levels, a geotechnical stability assessment is required to assess potential sliding, rotational and slip circle failure. The stability assessment of the proposed cut or fill batters and/or retaining structures should be included with the geotechnical stability assessment report.
 2. This section provides guidance on the Council's requirements for a geotechnical stability assessment of cut or fill batters
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and retaining structures associated with any proposed development.

SC6.5.10.1 Presentation of the report

1. The geotechnical stability assessment is to be written as a self-contained document, which does not require the reader to refer to any other documents including Council's reference number, maps, drawings, previous applications or other reports (if any). If the report does require the reader to refer to any other document, a copy of the document should be included as an attachment.
2. The report should include, but is not necessarily limited to, the following:
 - a. a cover page with a title of the report, revision number, property address, real property description (lot and plan numbers), report reference number, author's name and date;
 - b. the body of the report including the context within which the report was commissioned, the purpose of the report, geotechnical site investigation results, landslide risk assessment results and slope stability assessment results for cut or fill batters and/or retaining walls;
 - c. any maps, plans, drawings, cross-sections referred to in the report;
 - d. any relevant borehole records, laboratory and field test results;
 - e. landslide susceptibility rating calculations;
 - f. slope stability calculations for batters and retaining walls;
 - g. geotechnical certifications.
3. The purpose of a geotechnical stability assessment is to describe the values and features of the site that are relevant to the matters to be addressed in a management plan.
4. Each site assessment should comprise:
 - a. standard requirements — such as site locations, address, date, etc.;
 - b. detailed requirements — specific information required.

SC6.5.10.2 Standard requirements for geotechnical stability assessment

1. Each geotechnical stability assessment and landslide management plan should include the following:
 - a. project location and address;
 - b. project title and description;
 - c. the date on which the assessment and any plans were prepared, including any amendments;
 - d. name and relevant professional qualifications of the person/s preparing the assessment;
 - e. for all plans - a north point, scale, location of property boundaries road alignments and street names.

SC6.5.10.3 Detailed requirements for geotechnical stability assessment

1. The geotechnical stability assessment and landslide management plan should also address:
 - a. the existing geological and topographic conditions of the development site;
 - b. the suitability of the site for the proposed development having regard to the prevailing geological and topographic conditions.
2. In particular, the site assessment should include a description of the following matters:
 - a. **the proposed development** — complete details of the proposed development and how it is to be located on the site including full description of site layout, proposed buildings, structures, excavation or fill and any other development components.
 - b. **existing site conditions:**
 - c. information available from published materials, including aerial photography, geological maps and reports (e.g. the Geological Survey of Queensland Record Series);
 - i. existing topography, geology (surface and subsurface materials) and geomorphology (slopes, ground contours, natural features, terrain analysis, landslip features, former mining activities) both locally and regionally in locality;
 - ii. a ground inspection;
 - iii. existing vegetation;
 - iv. existing buildings, structures or other non-natural conditions existing on the site;
 - v. existing surface water and groundwater conditions, including water table, springs and seepage areas in the local area of interest;
 - vi. existing surface drainage patterns and vegetation cover on and around the site;
 - vii. any other relevant features or site improvements, like existing buildings, other structures, earthworks, etc.
 - d. **evidence of potential instabilities**
 - i. location and classification of any existing landslip features (type, severity and mode of failure);
 - ii. extent and type of any existing occurrences of erosion;
 - iii. from field and/or laboratory testing or assessment, classification of surface and subsurface materials to determine:
 - A. erosion potential;
 - B. foundation conditions that could affect structural performance;

- C. suitability for wastewater disposal;
- D. any other relevant characteristics;
- iv. the results of all field and laboratory tests, and the location and level (including datum) of field investigations such as boreholes, trench pits and core penetrometer soundings;
- v. an assessment of the existing stability of the subject land and details of geotechnical constraints on buildings and/or other development works on the site;
- vi. an assessment of existing conditions and the effects or impacts of the development upon slope stability and landslip potential or any other geotechnical constraints to development;
- vii. conclusions about the overall suitability of the land for the proposed development, including suitability in terms of:
 - A. site layout;
 - B. roadworks, driveways, and other pavements;
 - C. earthworks (excavation, materials usage);
 - D. foundations;
 - E. surface drainage;
 - F. wastewater (treatment and disposal);
 - G. overall effect of development on stability.

SC6.5.11 Landslide management plans

1. The purpose of a landslide management plan is to describe how the values and features identified in a site assessment are to be managed to meet the outcomes of the relevant planning scheme code.
2. Each management plan should comprise:
 - a. standard requirements;
 - b. detailed requirements — the specific management steps proposed to be implemented, described below.

SC6.5.11.1 Standard requirements for landslide management plans

1. The landslide management plan should:
 - a. state the purpose, aims and objectives of the landslide management plan;
 - b. summarise the results of the geotechnical assessment and landslide management plan;
 - c. provide justification for any proposed variation from the measures outlined in the related planning scheme code for which planning scheme policy SC6.5 Geotechnical assessment and management plan is a supporting measure;
 - d. include details of any consultation that has occurred. Examples include any discussion with council, state or federal agencies, technical consultants, and any stakeholders, including affected landowners and the public;
 - e. identify the parties to be responsible for any specific actions identified in the Geotechnical assessment and landslide management plan management plan.

SC6.5.11.2 Detailed requirements for landslide management plans

1. The Geotechnical assessment and landslide management plan should also address the siting, engineering and other measures required to ensure a satisfactory form of development, including:
 - a. recommendations on appropriate measures required to avoid, minimise or mitigate risks of instability including:
 - i. preferred locations for buildings, other structures, driveways, etc.;
 - ii. foundation requirements such as bearing pressures, piling parameters, special techniques for expansive clays, etc.;
 - iii. pavement types and design;
 - iv. construction methods to avoid problem areas associated with loose materials and groundwater seepage;
 - v. preferred excavation/retention/stabilisation techniques and suitability of excavated materials for use in on-site earthworks;
 - vi. surface and subsurface drainage requirements;
 - vii. preferred methods of wastewater disposal;
 - viii. vegetation protection and revegetation requirements.

SC6.5.12 Stability assessment of batters

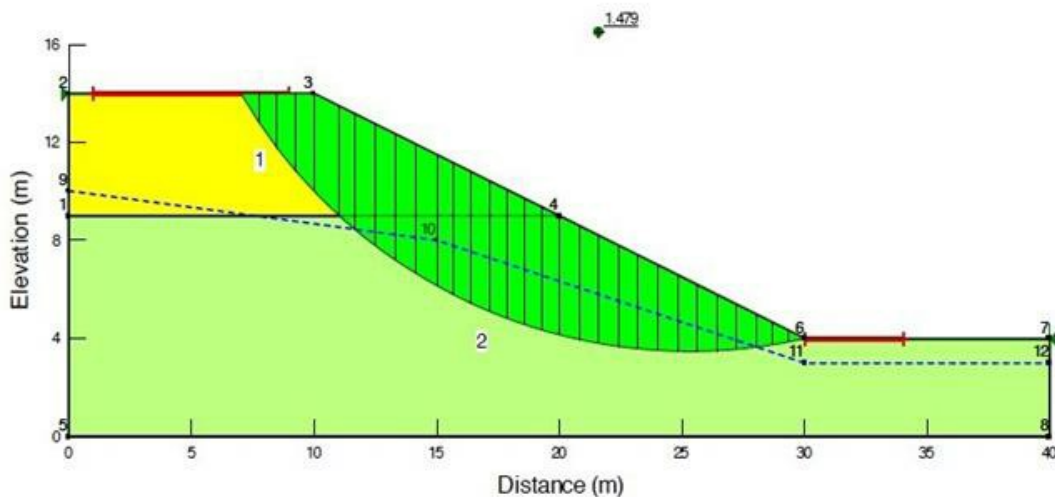
1. The geotechnical stability assessment of all proposed cut or fill batters should be carried out following a conventional slip circle failure analysis method. In this type of analysis, several potential slip circles are assumed, and the factor of safety for each of the assumed slip circles is calculated. The minimum factor of safety amongst those assumed slip circles is the factor of safety for that designed batter. The accuracy of the stability assessment depends on the number of slip circles analysed and the calculation method followed.
2. One particularly important issue in the stability assessment of batters is the estimation of representative shear strengths

for the constituting soil layers. In stability analysis of batters, the worst credible shear strengths of the soil layers expected during the design life of the batters should be used, rather than using the existing shear strengths of the soil layers. If there is prolonged and heavy rainfall, the highest estimated water table and drainage conditions should be used. Another potential worst-case scenario for the stability assessment of batters adjacent to any water body is sudden drawdown of the water table. In this instance, the factor of safety for the sudden drawdown case should be calculated, rather than for the temporary or short-term high-water level condition.

3. The geotechnical stability assessment of the cut or fill batters should achieve a long-term factor of safety of at least 1.5 against geotechnical instability. For rapid drawdown temporary conditions, the stability assessment of the cut or fill batters should achieve a short-term factor of safety of at least 1.3 against geotechnical instability.
4. The stability analysis of batters may be carried out manually, however the use of professional software, such as SLOPE/W by Geoslope (geoslope.com), would be cost effective with much less computational effort and time. Figure SC6.5-3: Typical slope stability analysis using SLOPE/W shows an example of slope stability analysis using SLOPE/W.

Figure SC6.5-3: Typical slope stability analysis using SLOPE/W

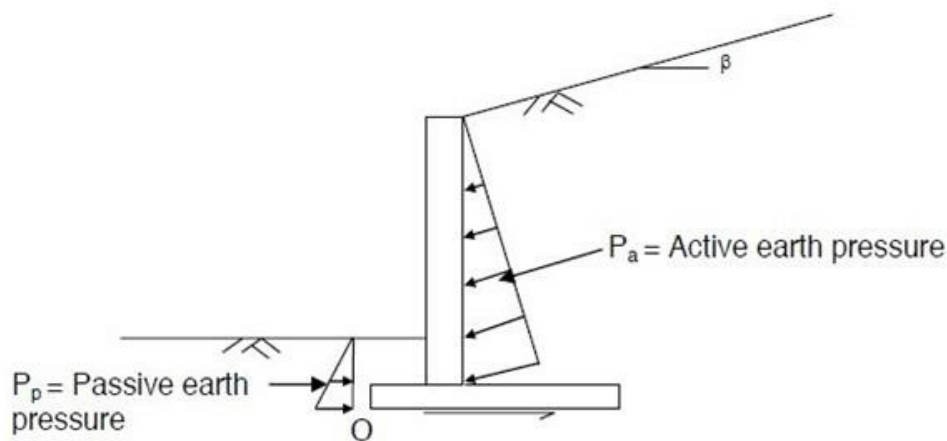
Material number 1:	Unit weight: 15	C: 5	Phi: 20	Model: MohrCoulomb
Material number 2:	Unit weight: 18	C: 10	Phi: 25	Model: MohrCoulomb



SC6.5.13 Stability assessment of retaining structures

1. A geotechnical stability assessment of all proposed retaining structures should be carried out against sliding, overturning and global slope instability through the geomaterials. The proposed retaining structures should also be checked against bearing capacity failure or excessive base settlements. Furthermore, the retaining structure itself must be designed against any potential structural failure such as flexural failure or shear failure.
2. Figure SC6.5.13-1: Typical retaining structure and lateral earth pressure distributions shows a typical retaining structure including lateral earth pressure distributions. The retained soil behind the retaining structure will exert active lateral earth pressure if the retaining structure allows lateral movement. Otherwise, lateral earth pressure at rest 'K0 condition' should be used during the design and stability assessments. The soil in front of the wall will provide passive earth pressure (resistance).

Figure SC6.5.13-1: Typical retaining structure and lateral earth pressure distributions



3. For proposed retaining structures, the developer should assess the factor of safety against the following:
 - a. sliding caused by the active earth pressure and resistance by passive earth pressure and frictional force at the base of the retaining structure;
 - b. overturning about the toe (point 'O' in Figure SC6.5.13-1) because of the driving moment caused by the active earth pressure and resisting moment caused by the passive earth pressure, the self-weight of the retaining structure and weight of the retained soils behind the structure;
 - c. global slope instability considering several large slip circles passing below the base of the retaining structure and the retained soils.
4. The stability assessment should ensure all retaining structures will achieve a factor of safety (FOS) greater than or equal to 1.5 against sliding, overturning and global slope instability. Alternatively, the sliding and overturning stability and global stability assessments for retaining structures can be carried out using Limit State Methods as described in AS 4678-2002 Earth-Retaining Structures.
5. The global stability analysis of retaining walls may be carried out manually, however the use of professional software, such as SLOPE/W by Geoslope: (www.geoslope.com), would be cost effective with much less computational effort and time.

SC6.5.14 Geotechnical certifications

1. In addition to undertaking a landslide risk assessment, the applicant should provide a geotechnical certification from a RPEQ specialising in geotechnical engineering for any proposed development within areas of steep slope (i.e. slope of 15% or more).
2. These certifications will provide assurance of geotechnical stability for the proposed development site and a summary of the complex landslide risk assessment process. These certifications should be prepared using the proforma examples listed in section SC6.5.5.5 Forms.
3. If the landslide risk assessment determines the site or proposed lot or building envelope has a landslide risk rating of 'low' or 'very low', certification is provided from a RPEQ specialising in geotechnical engineering confirming the proposed development is appropriate for:
 - a. the sloping nature of the site;
 - b. the risk of landslide on the subject site (or each of the proposed lots for Reconfiguring a lot) adversely affecting the proposed development and adjoining properties or structures;
 - c. the risk of landslide on any upslope and downslope external properties impacting the proposed development is 'low' or 'very low'.
4. If the landslide risk assessment determines the site or proposed lot or building envelope has a landslide risk rating of 'moderate', 'high' or 'very high', certification from a RPEQ specialising in geotechnical engineering is provided confirming the proposed development is appropriate for:
 - a. the sloping nature of the site,
 - b. the risk of landslide on the subject site (or each of the proposed lot or building envelope for Reconfiguring a lot) adversely affecting the proposed development and adjoining properties or structures;
 - c. the risk of landslide on any upslope and downslope external properties impacting the proposed development will be reduced to 'low' or 'very low', providing the risk mitigation measures and engineering recommendations of the report are followed.