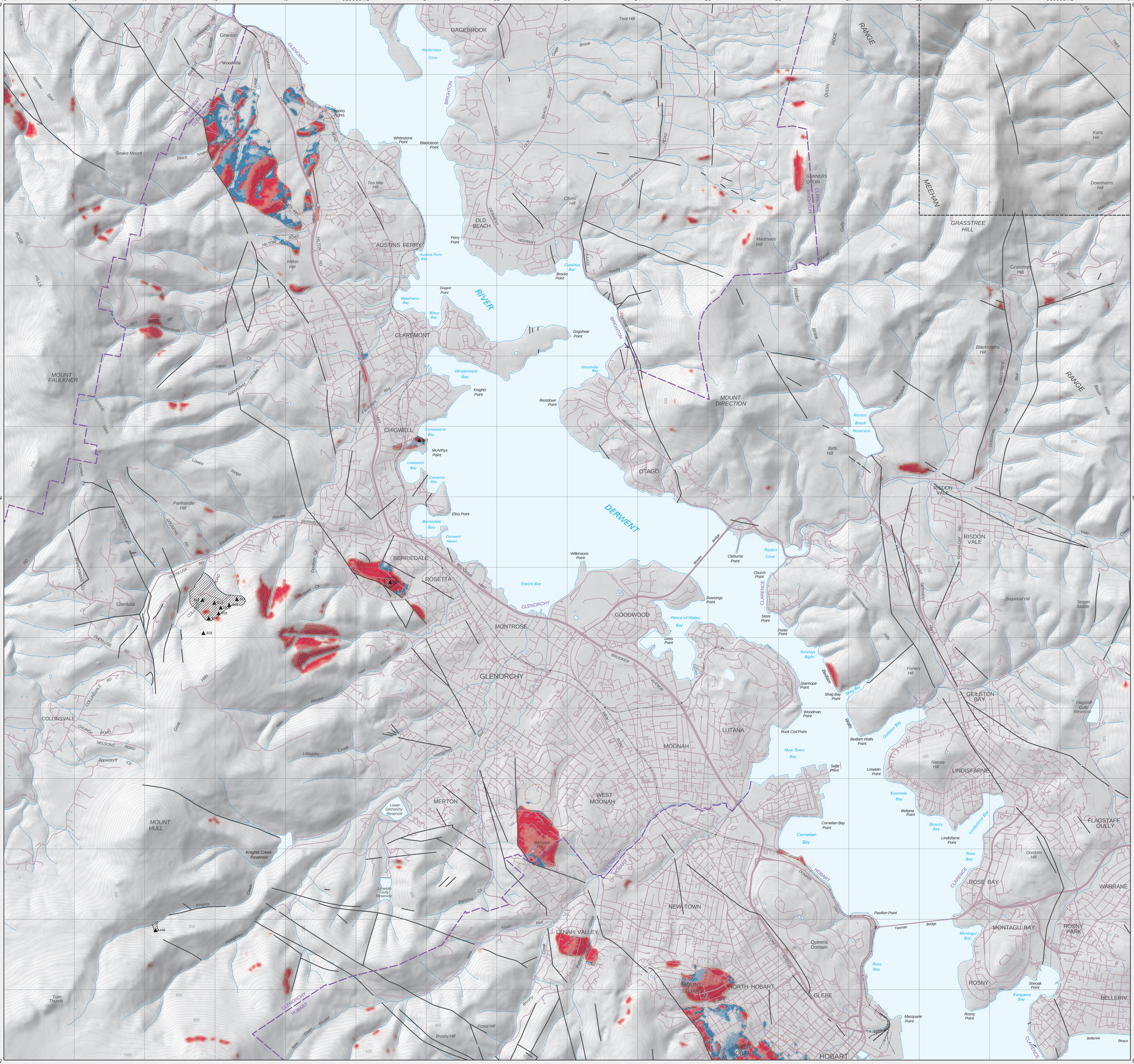
MINERAL RESOURCES TASMANIA
Tasmania
DEPARTMENT of INFRASTRUCTURE ENERGY and RESOURCES

TASMANIAN LANDSLIDE HAZARD SERIES

GLENORCHY – POTENTIAL DEEP SEATED LANDSLIDE HAZARD

MAP 5 OF 5

GLENORCHY CITY
Where ideas happen



Deep Seated Landslide Hazard

Background, Aim and Purpose

Large tracts of land throughout Tasmania are subject to slope instability and about 60 houses have been destroyed by landslides since the 1950s. Fortunately only minimal loss of life has occurred in this time but such events are highly traumatic to those directly affected and the financial cost to individuals, organisations and the State runs into many millions of dollars. Recent disasters such as the Thredbo Landslide in New South Wales, serve to remind society of the potential for loss of life even from relatively small landslides. Fortunately, landslide damage can be avoided when ground conditions are properly understood before construction proceeds and, in already developed areas, this understanding can be used to mitigate the hazard through various measures.

Regional landslide hazard maps are produced to provide an insight into the natural hazards that may potentially affect the area concerned. Mineral Resources Tasmania, in partnership with the Glenorchy City Council has produced a new landslide hazard map of the urban Glenorchy area and surrounds. The information provided is in the public domain and anyone is free to use it provided they read and understand the caveats for use.

Hazard and Risk

According to the joint Australian/New Zealand Standard (AS/NZS 4360:1999) risk is defined as the chance of something happening that will impact upon objectives. It is measured in terms of consequences and likelihood.

The definition of risk is often expressed by the following equation:

RISK = Hazard x Vulnerability x Elements at Risk

A hazard is defined as a source of potential harm or a situation with a potential to cause loss. A hazard, such as a landslide can be measured in terms of location, volume (or area), type, velocity and likelihood with time. Vulnerability refers to the susceptibility and resilience of structures, community and the environment to the hazard. The 'elements at risk' refers to the number of those structures, people, etc exposed to the hazard.

A hazard map attempts to portray the processes operating in an area, conveying all or some of the hazard parameters, generally in a qualitative to semi-quantitative manner. Because of the uncertainties involved, the translation of regional hazard maps into risk maps is challenging and seldom precise. An indication of the likely risk level is provided for each hazard at a regional scale but this will vary in detail. However, provided the limitations of the maps are understood, hazard maps can be used for many purposes in order to achieve the overall goal of safe and resilient communities.

Caveats for Use

The following caveats shall apply to the maps.

- The hazards identified are based on imperfect knowledge of ground conditions and models to represent our current understanding of the landslide process. As this knowledge improves our perception of the hazard and the depiction of the zones on the map may also change.
- These maps can be used as a guide (or flag) to the need for specific assessment in potential hazard areas.
- Planning decisions should not be made solely on the basis of the hazard zones delineated on the map.
- The scale limitations of the data should be considered at all times as exceeding this limit could lead to inaccurate decisions about the hazard.
- Specific assessment of landslide hazard and risk should be undertaken by suitably qualified and experienced practitioners in the fields of engineering geology and geotechnical engineering.
- Practitioners undertaking specific assessments should read the text and appendices attached to the maps and obtain a thorough understanding of the methodology and limitations of the maps.
- Areas where no hazard is shown can still have issues with slope instability.
- Anthropogenic influence on slopes cannot be predicted and the occurrence of slope instability resulting from the influence of human actions is specifically excluded from these maps.
- The identification and performance of cut and filled slopes have not been specifically considered in map production and their scale is such that they often cannot be resolved on the maps. The presence of such slopes should always be considered in specific assessments.

Definition

Deep seated landslides are failures of geological units shown on the accompanying geological map where the failure plane extends below any unmapped surficial soil or regolith material that may exist at the site. The depth of these landslides usually exceeds 5m.

Method

A methodology has been specially developed for these maps and will be used for other urban areas of Tasmania.

The methodology used is based on:

- Recording observations of land instability in–and surrounding–the study area (the landslide database).
- Analysis of the processes that control each landslide type.
- Computer assisted modelling that simulates each of the landslide processes to predict areas that could be affected by future landslides.

For deep seated landslides, the key parameter to determine is a threshold failure angle for each geological rock unit. This parameter represents a slope value at which the probability of a particular rock type failing significantly rises if the value is exceeded. The values assigned are based on a combination of slope analysis, failure angles for known landslides and engineering shear tests.

In a GIS environment, 'source cells' were identified where the slope of the land exceeds the nominated threshold value for the underlying rock unit. A prediction of the uphill extent for each landslide ('setback area') is then calculated by modelling a failure plane extending in the opposite direction to hillside aspect and rising at the designated failure angle for the geological unit(s) involved to where it reaches the surface (see conceptual diagram).

Threshold values for selected rock units:

Jurassic dolerite:	41 degrees	B model
Parmeenar Group		
Sand rich units	41 degrees	B model
Mud(clay) rich units	32 degrees	B model
Tertiary basalt	38 degrees	B model
Tertiary boulder beds		
Taroona scenario	6.5 degrees	– A model
Rosetta scenario	10 degrees	– B model

The model has a number of inherent limitations and must be regarded purely as an indication of likely stability from a regional perspective. The model does not account for spatial variations in groundwater levels, pore pressures, weathering, lithology, fractures, structural orientation etc, all of which may have a significant affect on local stability. A planar failure surface is assumed for simplicity of modelling but in many instances will be curved.

Conclusions

The deep seated landslide hazard map has identified a number of areas, mainly within the urban development, that may have the potential for instability. In particular, Tertiary sedimentary rock units are much more prone to deep seated failure than surrounding units as evidenced by the Casuarina, Rosetta and Taroona landslides (the Taroona Landslide is situated south of the study area). The stability of the Tertiary unit is expected to vary from site to site depending on a number of factors such as pore pressures, faults and fractures, lithology, structural dip, weathering etc. In the worst case scenario the modelling suggests that a large proportion of the Tertiary unit could be affected by future deep seated landslide movements. This proportion is significantly reduced in the more optimistic Rosetta model. However, much more work is required to refine these uncertainties.

Contributing or triggering factors for landslides can be achieved by natural events such as unusually wet seasons, wave attack of coastal cliffs, and undercutting of river banks by stream action. Human activities can also affect stability such as leakage from water services, deforestation, and inappropriate excavations on hill–slopes. Mapped faultlines are depicted to represent zones where the rock mass may be weaker through fracturing and preferential weathering. Faults may also have an influence on groundwater conditions that can lead to instability.

The likelihood of future landslides is difficult to assess. Rainfall models are useful for understanding this process but because each landslide is unique a significant amount of information must be gathered for each site.

The Taroona, Casuarina and Rosetta Landslides provide credible scenarios of landslip consequences. Damage to structures can be significant where differential movement occurs at the surface and for certain construction types, such as unreinforced brick–masonary buildings. The risk to life is probably lower than most normal risks such as car travel and home accidents.

Further Information

Further information on these maps or Tasmanian landslides in general can be obtained from the MRT web site at www.mrt.tas.gov.au or by contacting the agency directly.

Modelled Deep Seated Landslide Hazard

Setback area (A).		Taroona scenario for Tertiary sedimentary units. (worst case)
Area above threshold (A).		Taroona scenario for Tertiary sedimentary units. (worst case)
Setback area (B).		All rock units and Rosetta scenario for Tertiary sedimentary units.
Area above threshold (B).		All rock units and Rosetta scenario for Tertiary sedimentary units.

Landslide Data

Landslide Zone.

▲ 862 Deep seated landslide point.

Tertiary sediments boundary.

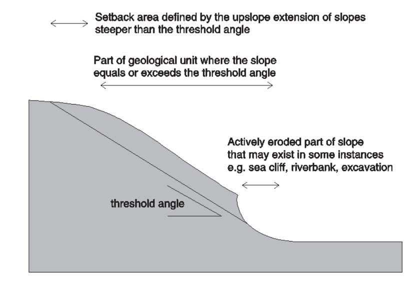
Faults.

Municipality boundary

Limit of study.

Note: Not all landslide points have an associated polygon. Landslide centroid with landslide id from GEOHAZARD (landslide) database.

Conceptual diagram illustrating modelling techniques for identifying Deep Seated Landslide Hazard



Scale: 1:25 000

0 500 1000 1500 2000 2500m

AGD66 – AMG Zone 55. Contour interval 20m

Citation:

Mazengarb, C. 2004: Map 5, Glenorchy – Potential Deep Seated Landslide Hazard. Tasmanian Landslide Hazard Series. Mineral Resources Tasmania, Department of Infrastructure Energy and Resources, Hobart.

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Base data from the LIST, © State of Tasmania.

Map produced by the Data Management Branch, Mineral Resources Tasmania using G.I.S. software.

Disclaimer:

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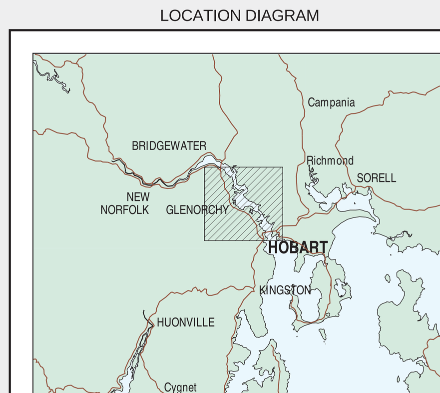
LOCATION DIAGRAM



LANDSLIDE HAZARD SERIES

Data correct & plotfile generated: 18-AUG-2006

WARNING: INKS ARE LIGHT SENSITIVE