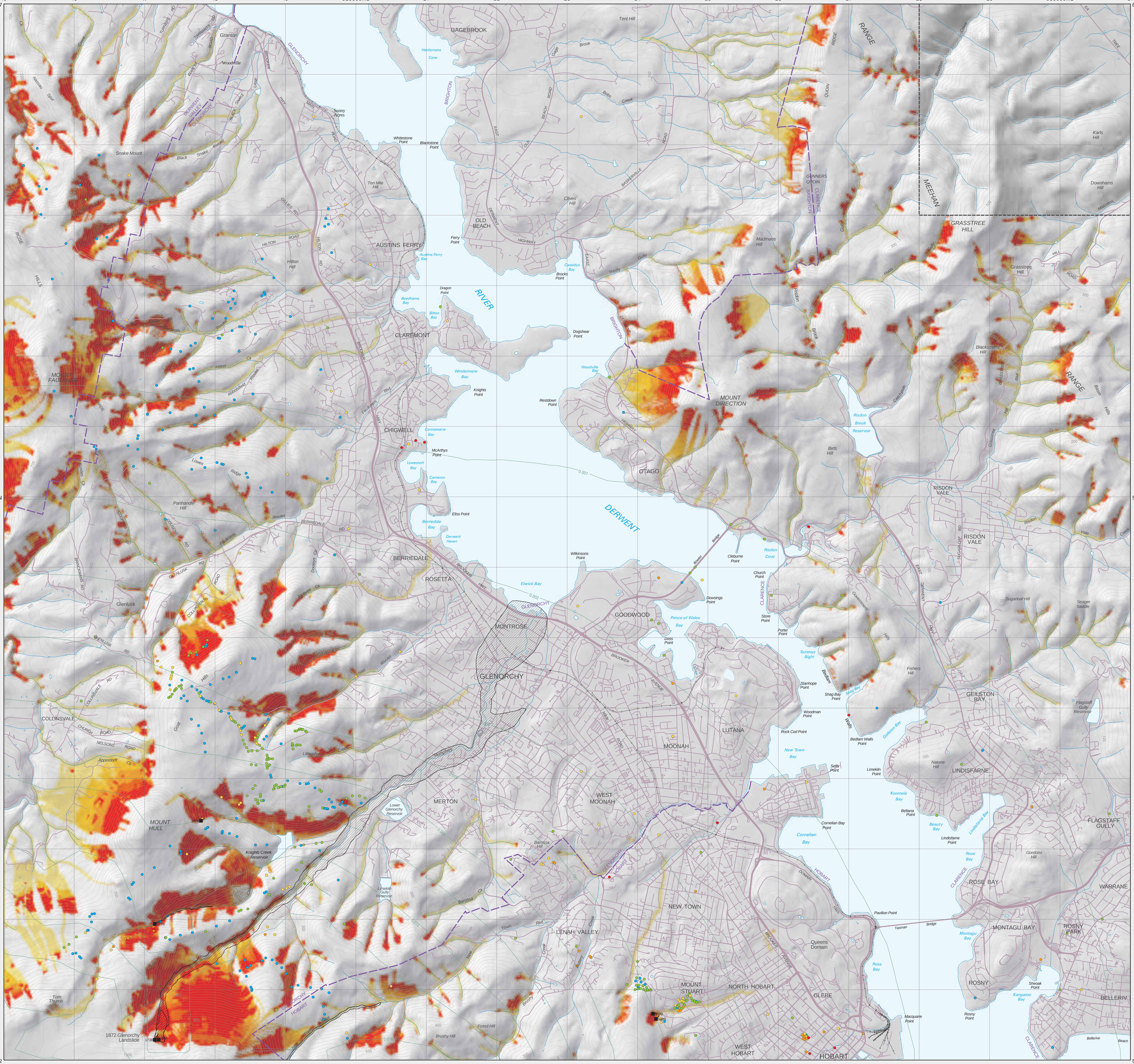
MINERAL RESOURCES TASMANIA
Tasmania
DEPARTMENT of INFRASTRUCTURE ENERGY and RESOURCES

TASMANIAN LANDSLIDE HAZARD SERIES

GLENORCHY − POTENTIAL DEBRIS−FLOW HAZARD

MAP 3 OF 5

GLENORCHY CITY



Scale: 1:25 000

0 500 1000 1500 2000 2500m

AGD66 − AMG Zone 55. Contour interval 20m

Debris Flow 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

Debris flows are a type of landslide triggered by the action of torrential rain on loose material on a mountainside or escarpment. The boulders and finer material, mixed with water, flow down the slope as a torrent with coarser material (the proximal part of the debris flow) deposited near the base of the slope, while the finer material (the distal part of the debris flow) travels further as a flash flood across the floodplain.

Debris−flows may initiate as debris−slides that transform into flows during movement. Alternatively, debris−slides may form dams that in turn fail catastrophically to become debris−flows and flash floods. In lowland areas where the channel is unconfined debris−flows may depart from the channel and deposit lobes of material on the surrounding landscape.

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.

Debris−flow source areas were identified in this study using GIS modelling techniques with reference to known landslides. The SHALSTAB computer programme (Dietrich and Montgomery 1998) was employed to calculate a factor of safety for each cell using the infinite slope technique and a nominated threshold rainfall (200mm/day). The model assumes an even rainfall distribution, minimum soil or regolith thickness of 1.5m, 2.5kPa cohesion, 31.5 degrees friction angle, and a density of 2000kg/m3. Areas with known regolith thickness along with recorded landslides involving earth or debris material are shown on the map as a test of the model. Where soils are less than the minimum thickness this would eliminate or reduce the probability of these places becoming source areas. In a few instances, hazard areas identified by the model were masked where field observations have shown them to be unrealistic.

Runout paths were modelled from each cell (10m cell size) within the source areas and travelling in the direction of maximum slope (defined by an aspect grid). The extent of the runout has been defined using the travel angle concept with four values 5, 22, 26 and 30 degrees indicating increasing likelihood of such events. These values represent statistical quartiles in a study of approximately 270 debris flows in southern Tasmania largely occurring on dolerite derived colluvial soils. In order to improve clarity, the 5 degree runout paths have been widened through use of a 10m buffer.

The modelling does not take into account obstacles that are beyond the resolution of the model such as trees and debris dams where they exist. Runout paths follow the course of stream channels in the lowland whereas in reality debris flows are expected to breach stream banks and affect a larger area than what is shown on the map.

Based on historical information and modelling, debris flows are a significant hazard in the Glenorchy area. The main source area for these landslides are on the long steep slopes surrounding the Mt Wellington escarpment but smaller events are predicted in the headwaters of minor catchments closer to the city.

The consequence of debris flows on people and structures can range from insignificant to catastrophic for people and structures in their path largely depending on the size of the flow. In a worst case scenario, debris flows travelling at velocities of several tens of kilometres/hour will move boulders (ranging up to metres in size) and large trees resulting in fatalities and destruction to structures in its path. Fortunately most debris flows are confined to the uninhabited Mount Wellington reserve but exceptional events such as the 1872 Glenorchy Landslide provide precedent for lowland inundation and destruction.

Rainstorm events are the natural trigger for debris−flows and rainfall information is provided to indicate likely frequency of this process in the study area. Based on records of past storm events, when a threshold rainfall is achieved only a small percentage of the potential source area will actually fail, but this percentage will rise as rainfall intensity increases. Deforestation of the headwaters areas by fire or clear−felling can significantly lower the threshold rainfall required to trigger debris flows.

Individual risk and societal risk criteria should be determined in identified areas to assess what options, if any, are necessary to reduce or eliminate the risk to acceptable levels.

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.

References

Dietrich, W., and D. Montgomery. 1998. Shalstab. A digital terrain model for mapping shallow landslide potential.

SKM, 2004. Assessment of Rainfall Probabilities for Use in Estimation of Landslide Risk, Report for Mineral Resources Tasmania, Sinclair Knight Merz, p.42.

Modelled Debris−Flow Hazard Zones

- Source areas.
- Runout area − travel angle 30 degrees. (most likely)
- Runout area − travel angle 26 degrees.
- Runout area − travel angle 22 degrees.
- Runout area − travel angle 5 degrees, 10m buffer applied to improve visibility. (least likely)

- — 0.010 — 24 hour 200mm rainfall annual exceedance probability.
- Municipality boundary.
- Limit of study area.

Landslide Data

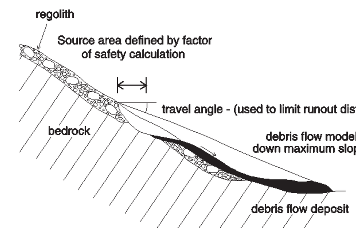
- Recent or active landslide (flows and shallow slides).
- Fossil or dormant landslide (flows and shallow slides).
- ■ 656 Debris−flow point.

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

Regolith Thicknes

- 0 − 0.5m
- 0.5 − 1m
- 1 − 2m
- 2 − 5m
- > 5m

Conceptual model illustrating how Debris Flow Source and Runout areas are defined



Citation:

Mazengarb, C. 2004: Map 3, Glenorchy − Potential Debris−Flow Hazard. Tasmanian Landslide Hazard Series. Mineral Resources Tasmania, Department of Infrastructure Energy and Resources, Hobart.

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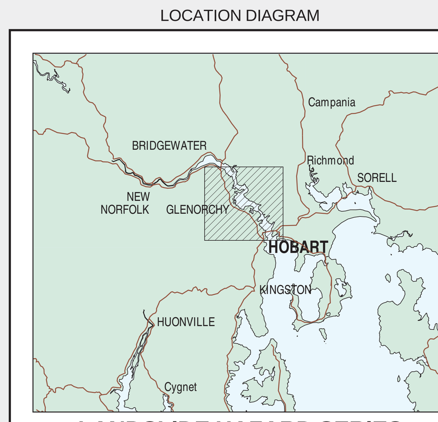
Base data from the LIST, © State of Tasmania.

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

LOCATION DIAGRAM



LANDSLIDE HAZARD SERIES

Data correct & plotfile generated: 18-AUG-2006