MINERAL RESOURCES
TASMANIA

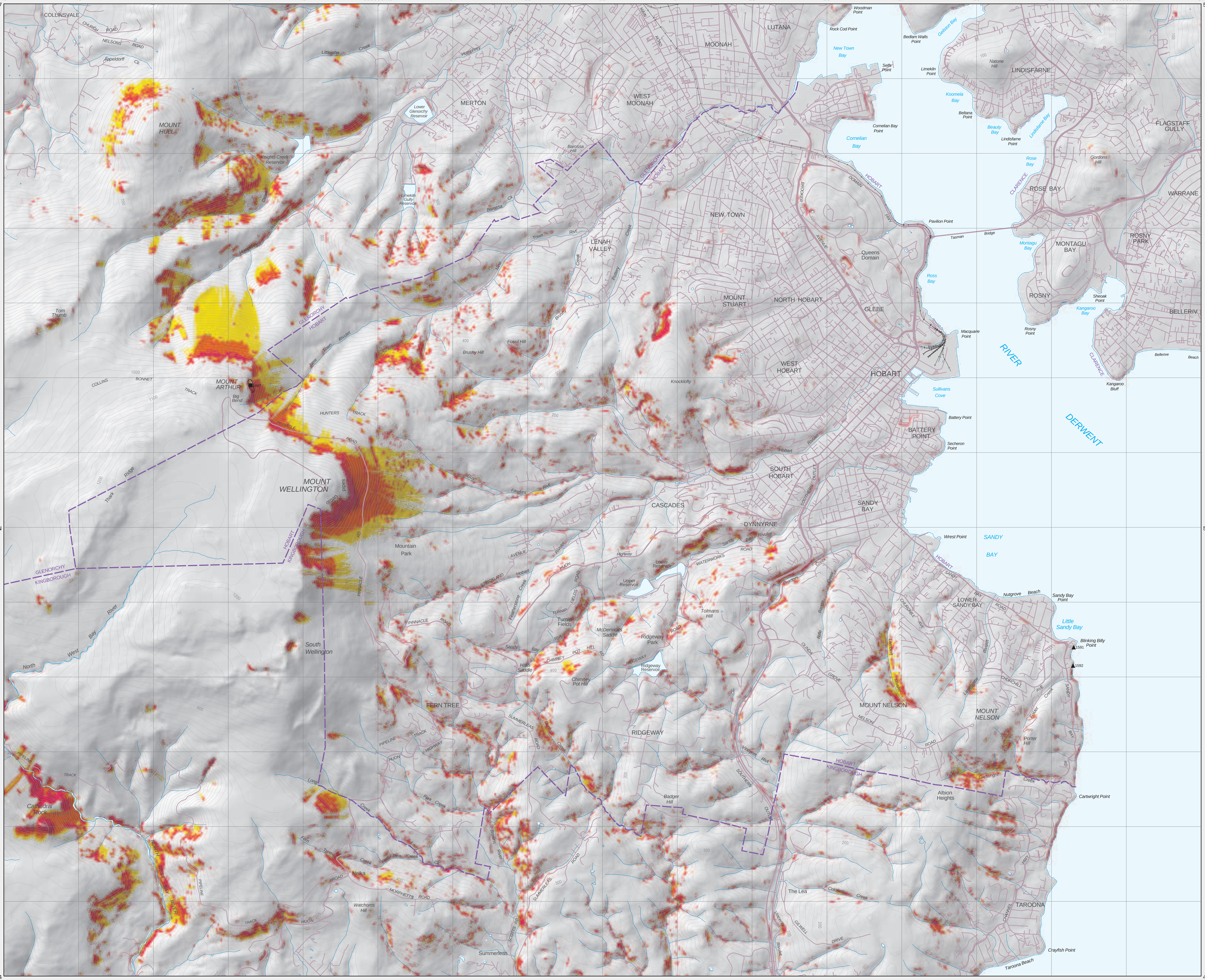
Tasmania

DEPARTMENT of INFRASTRUCTURE
ENERGY and RESOURCES

TASMANIAN LANDSLIDE HAZARD SERIES

HOBART − POTENTIAL ROCKFALL HAZARD

HOBART
CITY COUNCIL



Rockfall 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 Hobart City Council has produced the first of a new landslide hazard map series in Tasmania, using Hobart as a pilot study area. 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

A rockfall is defined as the independent movement of rock or soil fragments through freefall, bouncing, rolling and sliding. They are usually sourced from cliff or steep slopes and are a fast moving type of landslide.

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 inventory).
− 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.

Rockfall source areas were predicted by selecting slopes greater than or equal to 42 degrees. The identification of potential rockfall source areas is constrained by the resolution and quality of the topographic data. In a few instances, hazard areas identified by the model were masked where field observations have shown them to be unrealistic. The choice of angle is based on the angle of repose for dolerite talus (the dominant rockfall process in the study area) as defined in published literature (e.g. Caine 1983) and from unpublished field observations in Tasmania. It is recognised that isolated rockfalls can occur on slopes lower than this value, but this is considered to be generally of lower probability.

Runout paths were modelled from each source cell, travelling in the direction of maximum downhill slope as defined by an aspect grid. This is a simplistic technique that represents the most likely path of boulder(s) travelling downhill. In reality the actual path of material may deviate from this to some degree. The extent of each runout has been defined using the travel angle method with two values, 34 and 30 degrees, representing decreasing probability respectively (see conceptual diagram). These values are based on field studies of dolerite talus fan slope angles in Tasmania. It is possible for rockfalls to run further than what is shown in 'ideal conditions' but the likelihood is considered to be much less. For rockfalls occurring in weaker rock units, the travel angle values chosen may, in many instances, be too low and thus overestimate the runout distance.

In areas adjacent to high cliffs, such as the Organ Pipes of Mt Wellington, the modelling technique will have overestimated the runout because of the shadow effect of the cliff. Fortunately, the overestimation primarily occurs in wilderness areas where people and structures are generally absent. The modelling does not take into account obstacles and small scale topography that are beyond the resolution of the input layers such as trees and structures.

Conclusions

This map identifies a number of places that could be affected by rock fall events in the Hobart area.

The main rockfall areas are associated with topple failure of dolerite columns on Mt Wellington but they also occur on other natural slopes such as oversteepened coastal cliffs and valley walls. Rockfalls will also occur on artificial slopes such as quarry faces and road−cuttings that are spread throughout the study area.

In the most common situation, the consequences of rockfalls on Mt Wellington, (involving dolerite boulders) will cause serious injury or death to unprotected persons and to those in vehicles given the typical mass of individual blocks. Buildings would also receive significant damage from typical sized boulders.

The frequency of rockfall events in the Hobart area is difficult to quantify and needs further work for site specific instances to be able to calculate risk. Rainstorms, ocean waves, frost heaving and human activities are all potential triggers for these events. Seismic shaking (earthquakes) is another potential trigger, but the seismicity of the Hobart area is low and the probability of strong ground shaking is considered to be minimal.

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

Caine, N., 1983. The mountains of Northern Tasmania: Rotterdam, A.A.Balkema, 200 p.

Modelled Rockfall Hazard Zones

Source areas.

Runout area − travel angle 34 degrees. (more likely)

Runout area − travel angle 30 degrees. (less likely)

Landslide Data

Recent or active rockfall landslide.

Fossil or dormant rockfall landslide.

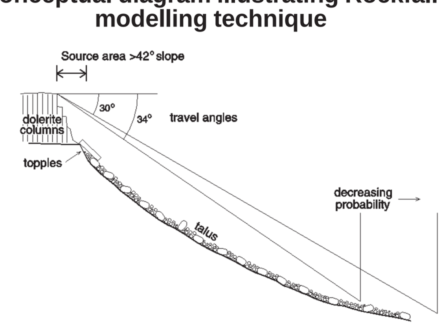
▲1591 Rock Fall, recent or active.

■1447 Rock Topple, fossil or dormant.

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

Municipality boundary.

Conceptual diagram illustrating Rockfall modelling technique



Scale: 1:25 000

0 500 1000 1500 2000 2500m

AGD66 − AMG Zone 55. Contour interval 20m

Citation:

Mazengarb, C. 2004: Map 4, Hobart − Potential Rockfall 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.

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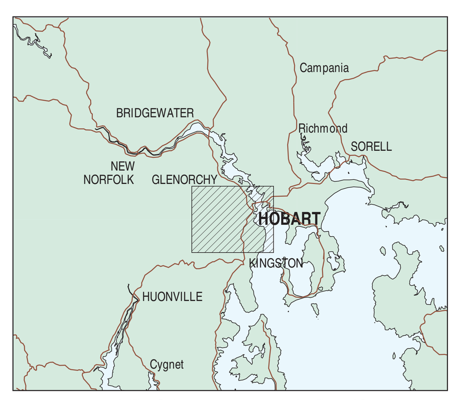
LOCATION DIAGRAM



LANDSLIDE HAZARD SERIES

Data correct & plotfile generated: 24-MAY-2006

WARNING: INKS ARE LIGHT SENSITIVE