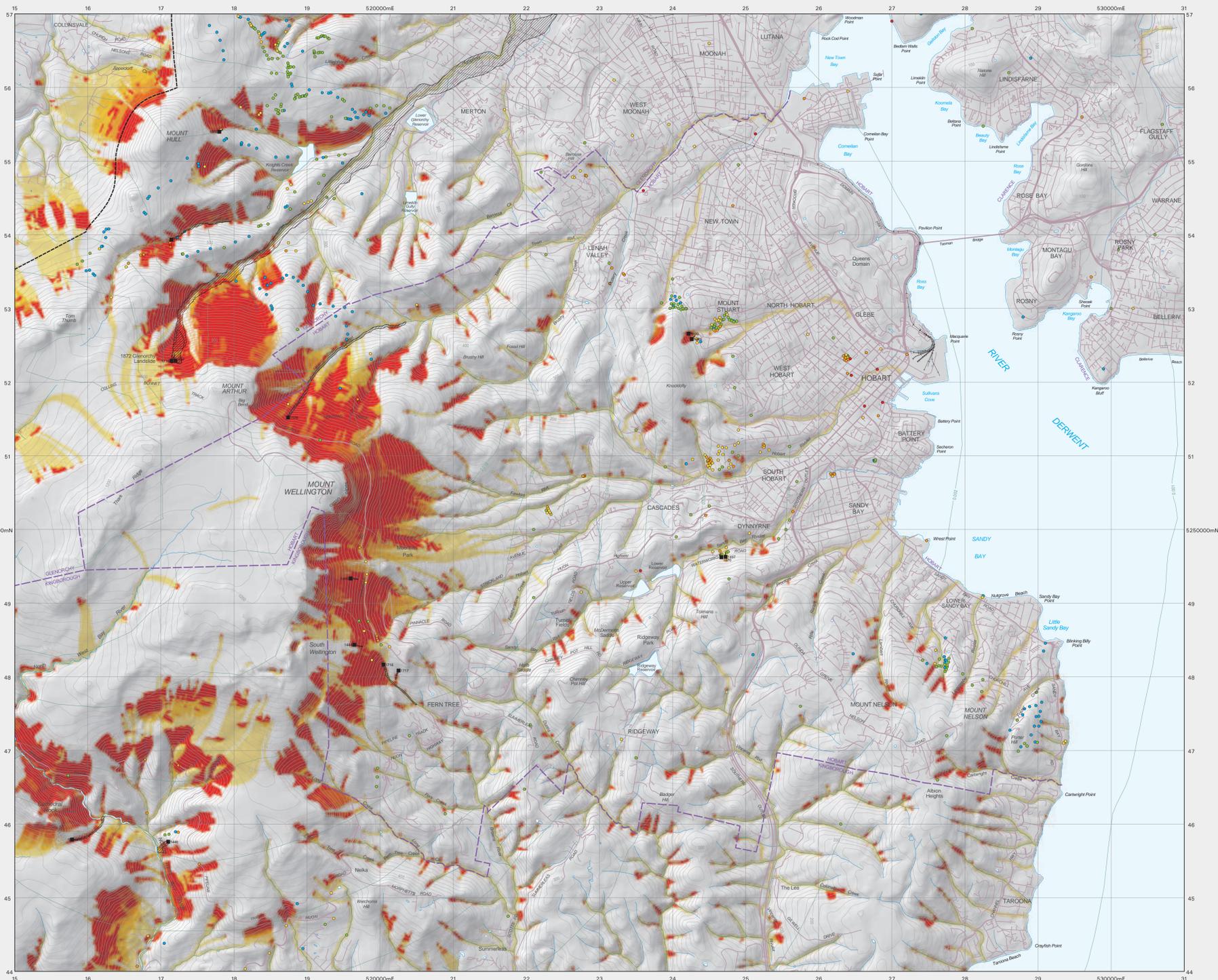


TASMANIAN LANDSLIDE HAZARD SERIES
HOBART – POTENTIAL DEBRIS FLOW HAZARD
(INCLUDES POTENTIAL SHALLOW SLIDES)
MAP 3 OF 5



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 1920s. 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, the 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 or predict current and future landslide processes. 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 (Detrich 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 minimise or reduce the probability of these places becoming source areas. In a few instances, hazard areas identified by the model were marked 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, 30 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 debris-derived colluvial soils. In order to improve clarity, the 5 degree runout paths have been widened through use of a 10m buffer.

Conclusions

Based on historical information and modelling, debris flows are a significant hazard in the Hobart area. The main source areas 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 metres per 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 unhabited Mount Wellington reserves but exceptional events such as the 1972 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.

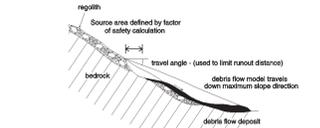
References

- Detrich, 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



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



Citation: Macgregor, C. 2004. Map 3, Hobart - Potential Debris-Flow Hazard. Tasmanian Landslide Hazard Series. Mineral Resources Tasmania, Department of Infrastructure Energy and Resources, Hobart.

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