Tasmania
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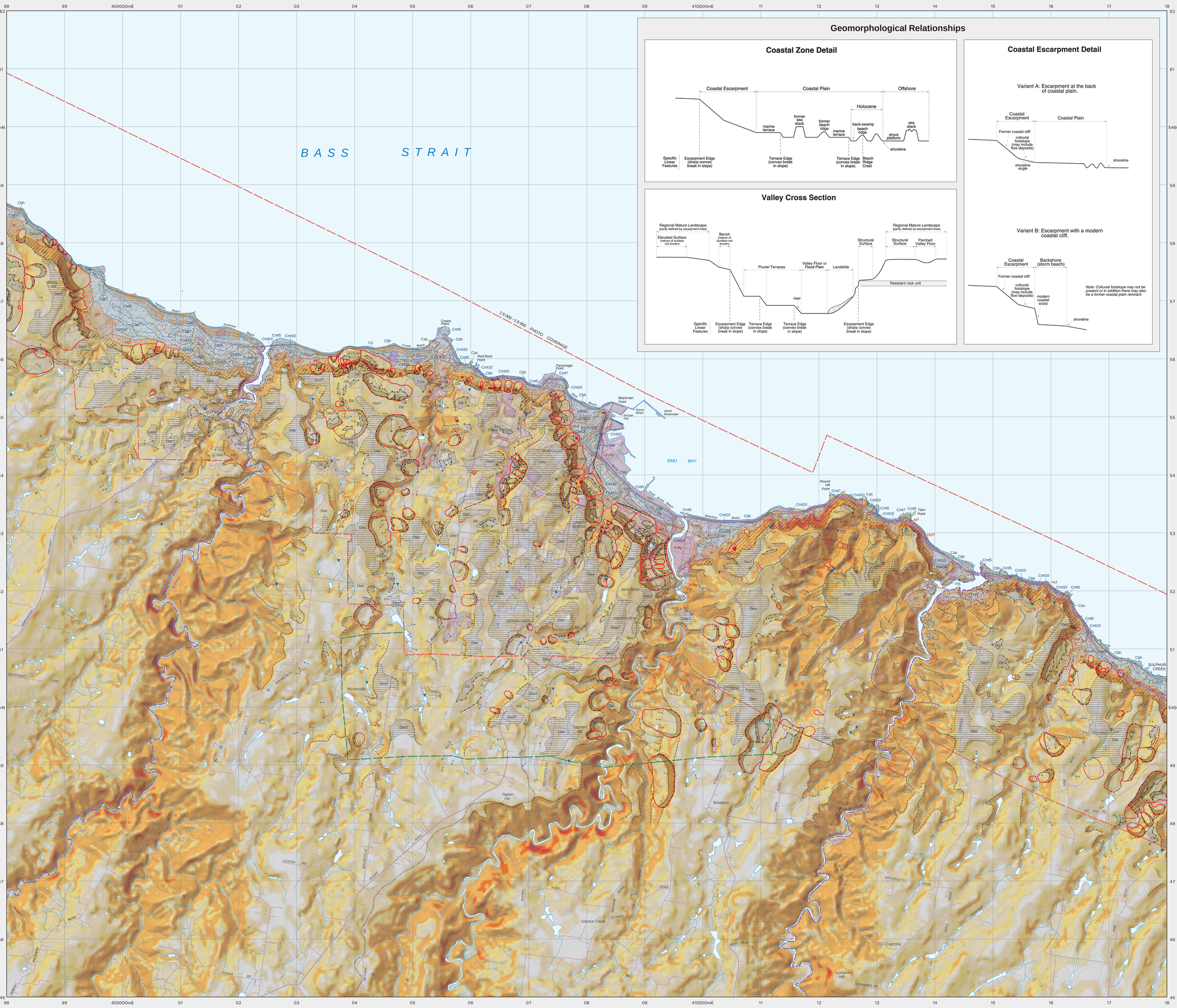
Department of Infrastructure Energy and Resources
MINERAL RESOURCES TASMANIA

TASMANIAN LANDSLIDE MAP SERIES

BURNIE – GEOMORPHOLOGY

MAP 2



Geomorphological Relationships

Coastal Zone Detail

Valley Cross Section

Coastal Escarpment Detail

Variant A: Escarpment at the back of coastal plain.

Variant B: Escarpment with a modern coastal cliff.

Note: Colluvial footslope may not be present or in addition there may also be a former coastal plain remnant.

Landslide Map Series

Background, Aim and Purpose

This map is one of a set of thematic maps addressing regional landslide susceptibility and hazard for urban areas and surrounds in Tasmania. The project is undertaken by Mineral Resources Tasmania, in partnership with Local Government and sponsored by the Natural Disaster Mitigation Programme (involving Federal and State contributions).

Large tracts of land throughout Tasmania are subject to slope instability and over 60 houses have been destroyed by landslides since the 1950s with many more significantly damaged. While only minimal loss of life has occurred 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.

Method

A methodology has been specially developed for this map series and is used for other areas of Tasmania. It can be downloaded from the MRT website although minor changes in approach have been made since the first maps were completed. Furthermore, the Australian Geomechanics Society have published guidelines for landslide zoning (AGS 2007a,b) and changes have been made to conform to these as much as possible.

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.

Caveats for Use

The information provided is in the public domain and anyone is free to use it provided they read and understand the purpose and limitations.

The following caveats shall apply to the maps.

- The landslide features and zones identified are based on imperfect knowledge of ground conditions and models that represent our current understanding of the landslide process. As this knowledge improves the depiction on the maps may also change.
- These maps can be used as a guide (or flag) to the need for site specific assessment within identified zones.
- Planning decisions should not be made solely on the basis of the zones delineated on the maps.
- The scale limitations of the data should be considered at all times as exceeding this limit could lead to inaccurate decisions about the potential for landslides.
- Site 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 site specific assessments should read the map text and associated documents to obtain a thorough understanding of the methodology and limitations of the maps.
- Areas where no susceptibility or hazard is shown may possibly 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 site specific assessments.

Geomorphology

This map shows selected geomorphic features of the Burnie area. These features represent both individual geomorphic units and structural aspects of the landscape that assist in understanding its development and in particular land instability.

The base layer of the map is a hillshade digital terrain model that emphasises landscape relief. Draped on top of this is a slope classification based on Demek (1972) and stability thresholds determined by reference to the local underlying geology.

Manually mapped units are depicted as lines, polygons and points to represent a range of natural and artificial features whose relationships are included in the associated diagrams. The process of mapping made substantial use of older (e.g. 1946, 1969 and 1985) detailed aerial photography viewed in stereo pairs. These photos and their interpretations were orthorectified to a real–world precision better than 5m in many cases. Older photos have the advantage of allowing the identification of features subsequently obscured by urban development, roads or land degradation in intensively farmed areas. Limited field checking accompanied the mapping and the accuracy of the units recognised is reflected in the classification contained in the legend.

Natural features mapped include landslides and their internal features where discernable, as a special category of importance, in addition to fluvial and coastal landforms. Emphasis has been placed on mapping various surfaces such as fluvial and marine terraces that have age significance. This information is used to constrain the age of the landscape and in particular the landslides. Such information in turn allows for an estimation of likelihood of recurrence.

Artificial features mapped include quarries, major road cuts – notably along the Bass Highway, and areas of landfill and reclamation. It should be noted that equivalent units in the accompanying geology map may not always align and be generally less accurate due to different mapping approaches and emphases.

A fuller explanation of the mapped features is contained with the digital dataset associated with these maps.

Geomorphological Setting

There are a range of geomorphological features in the area, many of which reflect the underlying geological structure. The Tertiary basalts (and minor intercalated sediment) are the most dominant regional landform. When they were erupted, the rocks infilled pre–existing valleys and low–lands creating extensive subdued landscapes. In between these areas upstanding blocks of basement (pre–Tertiary) rock occur that were either never covered by basalt or have been uncovered as erosion gradually eroded the landscape. In general the older rock sequences are harder and more erosion resistant than the younger Tertiary units, in large part due to the basalt being more susceptible to weathering, and so it has become deeply weathered with time.

Uplift of the landmass since Tertiary times is believed to have triggered significant rejuvenation of the landscape to leave it substantially dissected. The uplift caused streams to lower their base levels, with incision occurring progressively in a headward fashion. There are many remnants of the mature landscape left and the junction between it and the more youthful incised valleys and streams is typically expressed as knickpoints. There are also knickpoints coincident with some springs.

Other, more direct evidence for uplift is expressed in the form of marine and fluvial terraces whose elevation cannot be explained solely by natural sea–level fluctuations in the Pleistocene. There is an extensive coastal escarpment representing an abandoned coastal cliff occurring discontinuously along the coast in this area. This cliff is degrading with time through mass wasting (flows and slides) resulting in the formation of a colluvial footslope within former coastal embayments. A broad coastal plain comprising marine terraces extends from the abandoned coastal cliff to the modern coastline. The modern coast is generally fronted by Holocene deposits, either a narrow beach or a series of beach ridges and dunes, possibly with a backswamp behind.

Incised valleys and the coastal escarpment formed in basalt are particularly prone to slope failure wherever the parent rock has been largely or completely weathered to clay. In these situations the valley walls are steepened through downcutting and valley widening and the coastal escarpment steepened by coastal erosion, leading to eventual collapse. The same is also true for Permian mudstones where they are deeply weathered and slopes are steeper due to a capping of more resistant geology (e.g. dolerite).

In many instances springs are associated with local land instability, highlighting the importance of groundwater in lowering material strength as clays become saturated. Groundwater is often conducted along thin layers of Tertiary sediment between former basalt lava flows and along sediment filled former gullies that existed on top of individual basalt lava flows – all of which were later covered by further Tertiary basalt lava flows. These sediments probably have a significant influence on landslide susceptibility. However, recognising these features in the landscape is made difficult by the substantial deep weathering of the basalts.

Modern (Holocene) coastal processes include eroding headlands, along which landslides of various forms (rock falls, flows and slides) occur. Extensive rocky shore platforms are common along with occasional sea stacks and islands further offshore. The remnants of former sea stacks can also be found on the emergent marine terraces of the coastal plain.

Beaches vary between sandy, gravely and rocky (in situ bedrock) in composition depending on local circumstances such as proximity to sediment sources like major rivers. River terraces of similar height to the marine terraces are locally extensive such as on the banks of the Mersey. Depending on their source their sediments can range from gravels to silts. Both the Forth and Mersey Rivers flow into confined estuaries which have delta fronts and extensive flood plains.

At least four distinct terrace levels have been observed along the Northwest coast of Tasmania, all of which are thought to be Last Interglacial or younger in age (Murray–Wallace and Goede 1995). These terraces comprise both aggradation (dominant) and erosional surfaces (e.g. former wave–cut platforms). Marine terrace surfaces occur at approximately 20m, 15m and 10m above sea level (ASL) in increasing order of abundance as depicted on the map. Remnants of former beach ridges and dunes can be identified on these terraces in some places. A fourth marine terrace at 5–6m ASL is very poorly preserved along the coast where it is possibly obscured by more recent coastal deposits. Fluvial terraces of equivalent height to the lower two marine terraces are relatively widespread along the lower reaches of the rivers.

References

Demek, J. 1972. Manual of Detailed Geomorphological Mapping. International Geographical Union Commission on Geomorphological Survey and Mapping.

Murray–Wallace, C. V., and Goede, A. 1995. Aminostratigraphy and Electron Spin Resonance Dating of Quaternary Coastal Neotectonism in Tasmania and the Bass Strait Islands. Australian Journal of Earth Sciences, 42:51–67.

AGS (2007a). Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning, Australian Geomechanics, 42:13–36.

AGS (2007b). Commentary on Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning, Australian Geomechanics, 42:37–58.

Further Information

IMPORTANT: This map should be used in conjunction with an understanding of the information contained within the document "Tasmanian Landslide Map Series: User Guide and Technical Methodology".

This document, and other information on this map series 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. Copies of the map images (PDF format) are freely available from the MRT website. GIS layers developed by MRT and shown on the map are supplied to each Council in the area and are available for purchase at a minimal cost of supply.

Hill Country Units

- Cs – Abandoned coastal cliff
- Ccf – Modern coastal cliff
- Hcf – Colluvial footslope
- Ac – Alluvial fan
- Fr – Fluvial terrace 20m (Fr20), Fluvial terrace 15m (Fr15), Fluvial terrace 10m (Fr10), Fluvial terrace 5m (Fr5)
- Fvfp – Valley floor and floodplain
- Fpvf – Perched valley floor upstream of significant knickpoints
- Fapvf – Abandoned perched valley floor
- Db – Bench on midslope (origin uncertain)
- Des – Elevated semiplanar landscape surface of uncertain origin

Approximate terrace height (nearest 5m)

Coastal Units

- Cbh – Holocene beach ridge and dune (sand and gravel)
- Cas – Abandoned sea stack
- Cbp – Pleistocene beach ridge (sand and gravel)
- Cs – Backswamp
- Cmt – Marine terrace 20m (Cmt20), Marine terrace 15m (Cmt15), Marine terrace 10m (Cmt10), Marine terrace 5m (Cmt5)

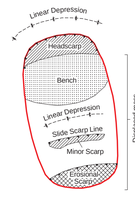
Approximate terrace height (nearest 5m)

Note:
– Mapped marine and fluvial terrace units may include both aggradational and erosional surfaces.
– Units labelled with a question mark (?) indicate uncertainty.

Artificial Units

- Cut
- Fill
- Cut and fill (undifferentiated)
- Quarry
- Quarry (derived from MRT DEPOSITS database) – Includes both active and historic features

Landslide Components



- Affected area of Landslide.
- Affected area of Possible Landslide.
- Landslide shown as a point where too small for map's scale (eg. small earth and debris flows).

Slope Categories

- 0 – 2 degrees
- 2 – 7 degrees
- 7 – 13 degrees
- 13 – 35 degrees
- 35 – 42 degrees
- > 42 degrees

Note: The techniques used to create the slope layer tend to underestimate values along cliffs.

Linear Geomorphic Features

- Beach ridge
- Major convex break in slope
- Minor or rounded convex break in slope
- Top of terrace riser
- Top of terrace riser poorly defined
- Sharp ridge
- Landscape lineation of uncertain origin
- Cut
- Artificial levee

Point Geomorphic Features

- Significant knickpoint
- Spring or seep (may be concealed under dam or fill)

Miscellaneous

- Municipality boundary
- Areas of detailed mapping based on 1:5,000 or 1:6,000 aerial photos
- Areas of detailed mapping based on 1:10,000 or 1:15,000 aerial photos

Note: Most of the area outside the aerial photo boundaries has not been mapped in this map series.

Scale: 1:25 000

0 500 1000 1500 2000 2500m

GDA94 – MGA Zone 55. Contour Interval 20 metres.

GDA

Citation:

Stevenson, M.D. and Mazengarb, C. 2010: Map 2, Burnie – Geomorphology, Tasmanian Landslide Map Series. Mineral Resources Tasmania, Department of Infrastructure Energy and Resources, Hobart.

Acknowledgements:

Contributions to the map from J. Bowerman and C. Calver.

Base data from the Land Information System of Tasmania (LIST), Copyright State of Tasmania.

Map produced by the Geoscience Infromation Branch of Mineral Resources Tasmania using GIS software.

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LOCATION DIAGRAM

LANDSLIDE MAP SERIES

Data correct & plotfile generated: 01-JUN-2010

WARNING:INKS ARE LIGHT SENSITIVE