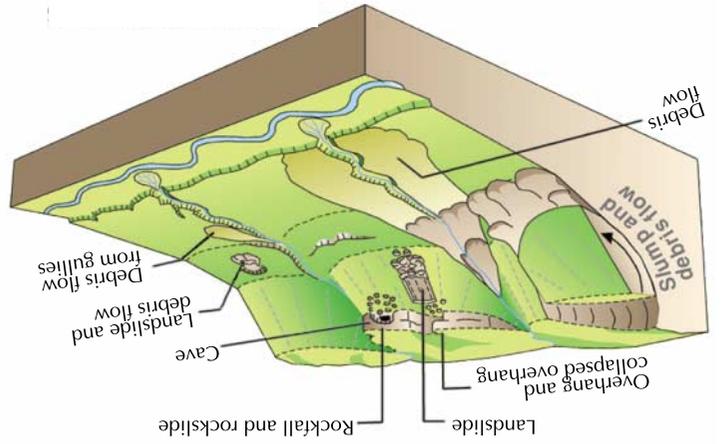


Above: SLOPE PROCESS



- Existing or old landslides.
- Areas at or on the base of slopes.
- Within or at the base of minor drainage hollows.
- At the base or top of a fill slope.
- At the base or top of a cut slope.
- Any sloping ground in an area known to have a landslide problem.

Areas that are generally prone to landslide hazards

- Natural causes include: saturation of slope material from rainfall or seepage; vibrations caused by earthquakes, volcanic eruptions; or undercutting of cliffs and banks by waves or rivers etc.
- Human activity may include the removal of vegetation; interference with or changes to natural drainage; leaking pipes (water, sewer); the modification of slopes by the construction of roads, railways or buildings; mining activities; vibrations from heavy traffic or blasting; or the displacement of rocks etc.

What causes landslides?

A landslide is the movement of a mass of rock, debris or earth down a slope. All landslides have two things in common - they are the result of failure of the soil and rock materials that make up the hill slope and they are driven by gravity. They can vary in size from a single boulder in a rock fall or topple to tens of millions of cubic metres of material in a debris avalanche. Landslides can be triggered by natural causes or by human activity.

- Once a landslide is triggered along a plane of weakness, material is transported by various mechanisms including sliding, flowing or falling.
- Rate of landslide movement varies from extremely slow in landslides moving at only millimetres to centimetres per year to a sudden and extremely rapid (metres per second) avalanche of debris. Sudden and rapid events are the most dangerous because of the lack of warning, the speed at which they can travel down the slope and their size.
- Distance travelled by landslide material, varies greatly, from a few centimetres to many kilometres when large volumes of debris, mud and water flow down river valleys.

Landslide types

Every year in Australia landslides damage many houses and cause millions of dollars damage to buildings, roads, railways, pipelines, agricultural land and crops. Almost half the landslides causing injury or death in Australia were the result of human activity. It is important for engineers and geologists to assess landslides as this can lead to the implementation of effective and timely remedial measures.

- Historically, at least 93 deaths and well over 100 injuries have been caused by landslides in Australia. Australia's most devastating landslides occurred at:
- Thredbo, NSW Alps in 1997 when 18 people were killed.
- Gracetown, WA when a cliff collapsed killing nine people and
- Riverton, Queensland, in 1900 when five men were killed in a tramway cutting cave-in.

How do landslides affect us?



Above: Coladate Landslide, April 1989. Left: Bulli Pass, Wollongong, August 1998.

Your role:

- Request information and assistance from your Local Government Authority prior to land purchase or construction. This information could include, amongst other things, past landslide activity and any known landslide risk assessments.
- Consult a geotechnical engineer or engineering geologist for advice concerning development and slope instability.
- Do not undercut steep banks, develop near the top or base of steep slopes, or place fill on steep slopes.
- Do not stand or seek cover below or near coastal cliffs or overhangs and be aware of potential dangers they represent. Take notice of signs giving warning of loose rocks and debris.
- Learn more about the geological hazards in your area and become familiar with tell-tale signs of ground movement.

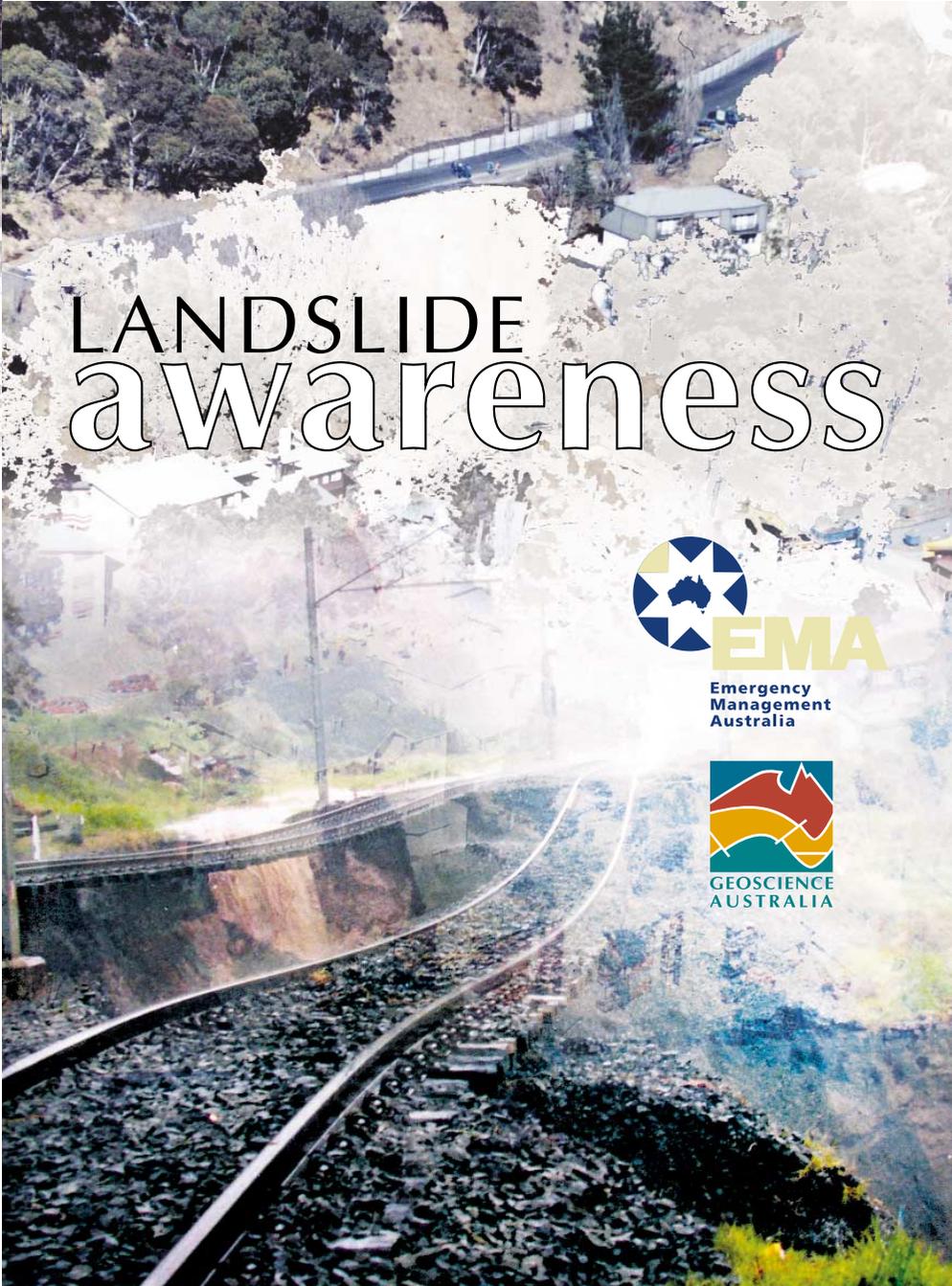
What to do if you suspect imminent landslide danger

- Contact local Emergency Services, police or local council.
- Inform affected neighbours.
- Evacuate.

By providing Geoscience Australia with details of the landslide the Australian Landslide Database can be updated. **Information can be forwarded by phoning 02 62499111, email: landslides@ga.gov.au, or writing to Geoscience Australia, Risk Modelling Group (Attention: Landslides), GPO Box 378, Canberra ACT 2601**

To find out more about Australian landslides, look up the Australian Landslide Database on the Worldwide Web at <http://www.ga.gov.au>.

This pamphlet is jointly produced by Geoscience Australia and Emergency Management Australia (February 2003)



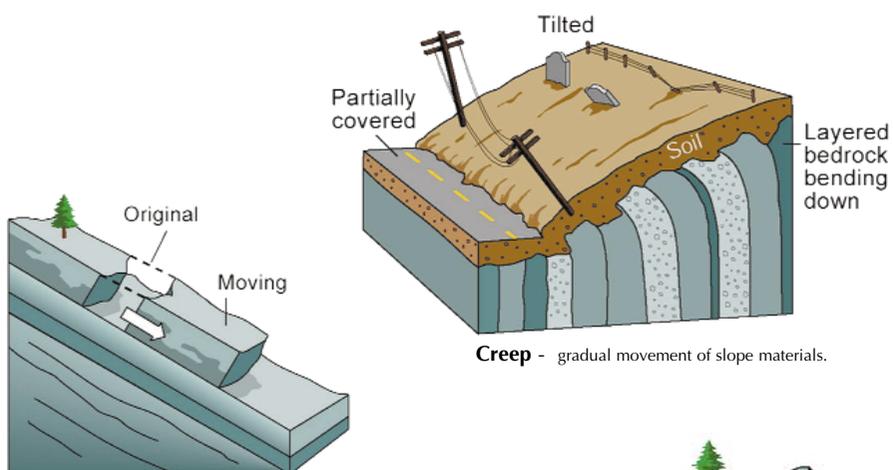
LANDSLIDE awareness





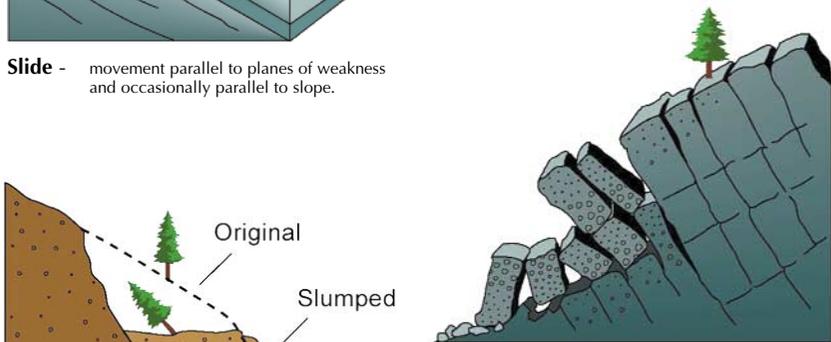
Titled tree.....Displaced gutters.....Cracks in road.....Lumpy ground

Common landslide types



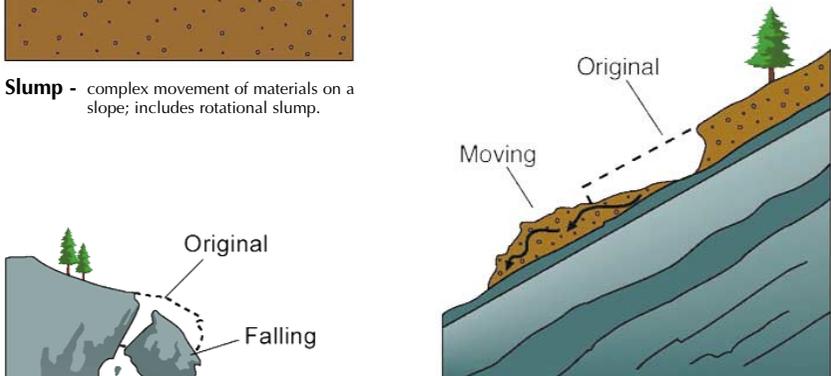
Creep - gradual movement of slope materials.

Slide - movement parallel to planes of weakness and occasionally parallel to slope.



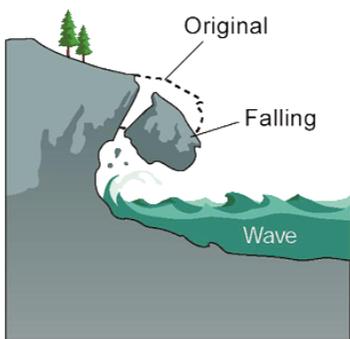
Topple - the end-over-end motion of rock down a slope.

Slump - complex movement of materials on a slope; includes rotational slump.



Flow - viscous to fluid-like motion of debris, often channelled.

Fall - material free falls.



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Below: Thredbo landslide, July 1997.



Indicators of potential landslide activity

- Saturated ground or seeps in areas that are not typically wet.
- New cracks and scarps or unusual bulges in the ground, roads or pavements.
- Movement of ancillary structures such as decks and patios in relation to a house.
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb.
- Tilting or cracking of concrete floors and foundations.
- Broken water lines and other underground utilities.
- Leaning telephone poles, trees, retaining walls or fences.
- Offset fence lines.
- Sunken or displaced road surfaces.
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content).



Above: AUSTRALIAN LANDSLIDE SITES

Australian Landslides – Where do they occur?

In comparison to many other countries, Australia is subject to minimal landslide activity. Generally we receive little rainfall and the landscape has minimal relief being free from the processes of uplift. There are however, isolated areas affected by landslides, these commonly have cliffs or steep colluvial deposits and receive intense rainfall events. Areas include:

- coastal cliffs,
- Great Dividing Range,
- Strzelecki and Otway Ranges of Victoria,
- Mt Lofty Ranges near Adelaide SA, and
- Tamar Valley and north-west coast of Tasmania.

More localised areas also include the Illawarra Escarpment near Wollongong, the 'northern beaches' area of Sydney, the Lake Macquarie and Newcastle suburbs in NSW and the Townsville, Cairns and Mt. Tambourine areas in Queensland.

Minimising the effects – Landslide survival & property protection

Planners and managers:

Some local governments and land managers have learned from past tragic events and now impose stringent planning and design requirements in landslide-prone and unstable areas. These include:

- Implementation of regional hazard and risk assessments into land planning policies. This ensures that appropriate processes are in place whereby new development applications are assessed with respect to slope stability issues and zoning for future development is directed towards areas with a low or very low risk of slope instability.
- Engineering and geotechnical investigations that define the landslide threat at site specific levels of investigation.
- Mapping of landslide vulnerability that can help with the development of emergency response scenarios.