LANDSLIDE AND DEBRIS FLOWS

Please note that the foundation messages are included in the previous section: ***Key messages for all-hazards household and family disaster planning****. Separate messages are also available for other specific hazards.*

A landslide or landslip refers to a wide range of ground movement, such as rock falls, deep failure of slopes and shallow debris flows. The action of gravity is the primary driving force though other contributing factors are rainfall, earthquakes, volcanic eruptions, groundwater pressure, erosion, destabilization of slopes as a result of deforestation, cultivation and construction, snow and glacial melt.

Debris flow or mudflow is a fast-moving mass of loose mud, sand, soil, rock, water and air that moves downhill due to gravity. Preconditions for debris flow are: very steep slopes, a lot of loose debris and water, and little vegetation. In very steep areas, debris flow can reach speeds of over 160 kilometres per hour (100 miles per hour). The speed and volume of flow make these very dangerous.

Assess and plan

Key messages	Context-specific details
Learn about local history of landslides	• Familiarize yourself with slopes where debris flows have occurred in the past, as it is likely that this can happen again.

Learn and be alert to early warning signs in the natural environment	• Familiarize yourself with the land around you.
	• Be aware of areas more prone to landslides. For example,
	  ◦ on existing old landslides
	  ◦ on or at the base of slopes
	  ◦ in or at the base of minor drainage hollows
	  ◦ at the base or top of an old fill slope
	  ◦ at the base or top of a steep cut slope
	  ◦ burn areas and canyon, hillside, mountain and other steep areas are vulnerable
	  ◦ developed hillsides where leach field septic systems are used.
	• Be aware of areas that are less prone to landslides. For example,
	  ◦ on hard, non-jointed bedrock that has not moved in the past
	  ◦ on relatively flat-lying areas away from sudden changes in slope angle
	  ◦ at the top or along the nose of ridges, set back from the tops of slopes.
	• Regularly inspect and observe changes in the natural landscape (your property and surroundings) and watch for signs of slope movement. This includes:
	  ◦ places where runoff water converges
	  ◦ increased water flow over soil-covered slopes
	  ◦ small landslides or debris flows
	  ◦ progressively tilting trees
	  ◦ new springs, new cracks, holes or bare spots on hillsides
	  ◦ rapid increase in creek water levels, possibly accompanied by increased turbidity (muddy)
	  ◦ sudden decrease in creek water levels though rain is still falling or just recently stopped
	  ◦ muddy waters
	  ◦ bulging ground appears at the base of a slope
	  ◦ water breaks through the ground surface in new locations or saturated ground in areas that have not typically been wet before
	  ◦ cracked snow, ice or rock
	  ◦ blockages and water build-up behind retaining walls.

Learn and be alert early warning signs from transportation and underground utilities	• Regularly inspect and observe changes in local infrastructure landscape, such as,
	  • slowly developing, widening cracks or new bulges on the ground or on paved areas
	  • underground utility line breaks (e.g. water)
	  • collapsed pavement, mud, fallen rocks, and other indications of possible debris flow can be seen when driving
	  • sunken or down-dropped roadbeds.

Learn and be alert to early warning signs in the built environment	• Regularly inspect and observe changes to the buildings where you live, work and play in. For example,
	  • doors or windows stick or jam
	  • fences, retaining walls, utility poles, or trees tilt or move
	  • visible open spaces indicating jambs and frames out of plumb
	  • new cracks in plaster, tile, brick or foundation
	  • outside walls, walks, or stairs begin pulling away from the building
	  • soil moving away from the foundation
	  • ancillary structures such as decks and patios tilting and/or moving relative to the main house.

Learn and participate in the early warning systems	• Develop and use programmes for reporting local conditions to the authorities. • Be aware that landslides can occur progressively, often some time (hours or days) after a triggering event (e.g. rainstorm or earthquake).
Stay informed about the weather	• Monitor the amount of rain during intense storms. • Be aware of heavy rainfall. More than three to four inches of rain per day, or half an inch per hour, may trigger mudslides. • In mountainous areas, stay away from rivers and gorges during rain. • Short bursts of heavy rain may be particularly dangerous, especially after longer periods of wet weather.

Mitigate risks: physical or environmental

Key messages	Context-specific details
Keep the drainage systems clear	• Keep storm water drainage systems free of dirt, leaves, and debris so that water can flow freely when it rains. • Keep gutters, downpipes and drains clean. • Trim back or remove vegetation blocking drains and gutters.
Seek expert advice before construction	• Do not build in landslide prone areas. • If you are planning on building and believe the site may be affected by landslide, seek advice from an expert, a soil engineer or engineering geologist. • Get a ground assessment of your property and out buildings, including animal shelters.
Seek expert advice about preventative measures	• Consult with experts to minimize potential impacts of landslides. For example, seek advice from a soil engineer or engineering geologist from the university department of geology.
Follow proper land-use procedures	• Avoid building on steep slopes, close to mountain edges, near drainage ways, along natural erosion valleys, at the mouth of steep ravines.
Protect your property	• Plant ground cover on slopes. • Built retaining walls. • Build channels or deflection walls to direct flow around buildings (but do not cause problems for others). • Have flexible pipefittings installed to avoid gas or water leaks.

Prepare to respond: develop skills and store provisions

Key messages	Context-specific details
Implement protection measures during times of high risk	• Board up windows and doors. • Place sandbags to divert water flow.
Stay awake and informed during heavy rainfall	• Monitor rainfall. • Listen to radio or check online for warnings of heavy rainfall.

During a landslide: listen and be alert to signs of imminent threat	• Be alert to unusual sights and sounds, such as,
	  ◦ faint rumbling sound that increases in volume
	  ◦ ground slopping downward in one direction and that may begin shifting in that direction under your feet
	  ◦ trees cracking or boulders knocking together
	  ◦ trickle or flow of falling mud and debris that may precede a large landslide
	  ◦ sudden increase or decrease in water flow or change from clear to muddy water.
	• Be aware that strong shaking from earthquakes can induce or intensify the effects of landslides.
	• Be especially alert while driving. Watch for collapsed pavement, mud and fallen rocks.

During a landslide: get out of the landslide path	• If you learn or suspect that a landslide is occurring or about to happen, evacuate immediately.
	• If you suspect imminent danger:
	  ◦ move away from the path of the landslide
	  ◦ inform your neighbours
	  ◦ contact local officials.

During a landslide: protect livestock and pets	• Bring pets indoors and stay in control. • If you evacuate, take your pets with you. • Consider precautionary evacuation of livestock if you believe there is a risk of landslide. • Ensure livestock are in safe paddocks during heavy rain.

During a landslide: if you cannot evacuate, protect yourself	• When you are inside:
	  • if escape is not possible, curl up into a tight ball and protect your head.
	• If you are outside:
	  • move away from the path of the landslide
	  • go to the highest spot you can find
	  • run to the closest shelter, such as a group of trees or a building.
	• If you are driving:
	  • do not cross flooding streams: turn around since you may be at risk of drowning
	  • avoid river valleys and low-lying areas
	  • and you arrive at a flooded area, turn around and take another direction
	  • and your car stops, leave it and try to immediately reach the highest spot that you can find.

After a landslide: check for hazards	• Stay away from the landslide area (further slides may occur). • Check for injured and trapped persons and animals near the slide, without entering the slide area. Direct rescuers to their locations. • Watch for flooding. • Report broken utility lines and other potential hazards to local authorities. • Check your home's foundation, chimney, and surrounding land for damage.
After a landslide take the following measures	• Replant damaged ground to prevent further erosion. • Seek expert help for reducing risks.
Keep supplies to protect your home	• Keep supplies such as hammer, nails, plywood, sand, sandbags and shovel.