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1987/56. The potential effect of forestry operations on slope stability and springs in the Mt Clark - Mt Koonya area.

D. J. Sloane

Abstract

The geological configuration of this area is similar to other areas previously investigated for the Forestry Commission with regard to potential instability problems. The main Mt Clark - Mt Koonya plateau is underlain by Jurassic dolerite, with Triassic sandstone and mudstone rocks forming topographic benches at the base of steep, talus-covered escarpment slopes.

Old and recently active landslide areas have been observed in the region. It is considered that if the steep, talus-covered escarpment slopes are clearfelled, potential instability problems could occur.

Springs occur near the base of the escarpment. Their origin is considered to be partially related to rainfall infiltration and joint directions of the dolerite underlying the higher plateau region. If clearfelling occurs on the plateau, it is suggested that spring flow should increase initially. The increased flow may occur for a period of up to five years. If the new forest regrowth is denser than the existing vegetation, the long-term effect may be a reduction in spring flow.

The most essential aim concerning proposed forestry operations in the area is to minimise soil compaction in order to maintain the infiltration capacity of the soils.

INTRODUCTION

At the request of the Forestry Commission, areas of the Mt Koonya - Mt Clark State Forest on the Tasman Peninsula were inspected on 20 October, in the company of Mr Paul Smith. The Forestry Commission was concerned that forest harvesting may have a deleterious effect on slope stability and spring water supplies. Several properties rely on the water from springs for domestic supplies.

GEOLOGY AND TOPOGRAPHY

The geological configuration of this area is similar to other areas previously investigated for the Forestry Commission with regard to potential instability problems. The main Mt Clark - Mt Koonya plateau is underlain by Jurassic dolerite. The dolerite was originally intruded in the form of a sheet or sill. The major escarpments in the area represent the edge of the dolerite outcrop (fig. 1). Slopes are up to 30° (60%) and commonly between 18° (32%) and 25° (47%) on the northern, eastern and southern-facing escarpment slopes of Mt Clark.

Underlying the dolerite is Triassic sandstone and mudstone which commonly forms benches at the base of the escarpment. Dolerite talus and scree deposits mantle the escarpment slopes.

An examination of the topography of the region indicates some NNE-SSW structural control, with a secondary control at right angles. This can be deduced from escarpment and stream directions. Dominant subvertical joints

with a spacing of 1.0 to 0.3 m can be seen in dolerite outcrops adjacent to the Mt Clark access track. Some of the dolerite cliffs associated with the slopes above Grooms Hill Road show joint spacings greater than one metre. The size of scree boulders also tends to reflect a wide, rather than platy, joint spacing. Joints are generally open where observed in outcrops, indicating relaxation due to stress release.

DRAINAGE AND GROUNDWATER SEEPAGE

The drainage divide above the escarpment slopes occurs close to the track running along the slope crest (fig. 1). Seepages are evident along the talus slopes, particularly along the northern face, with occasional ponding at the base of the escarpment. The seepages often appear close to the contact between the dolerite and the underlying sandstone and mudstone. The seepage origin is often masked by the talus cover, with the seepages sometimes appearing lower on the slopes. Seepages often appear and disappear intermittently in the talus cover.

If the talus seepages are purely associated with rainfall infiltration along this slope, it appears unlikely that constant seepage flow can be expected during dry periods, despite the ponding of water in isolated places at the escarpment foot.

The dominant NNE-SSW trending, open vertical joints appear to be related to the predominance of springs on the steep slopes on the northern side of Mt Clark. Some of the groundwater undoubtedly originates from rainfall infiltration on the plateau area to the south of the watershed. The salinity of two seepages tested was 250 mg/l and 150 mg/l. These salinities indicate that the groundwater is not entirely fresh but also indicate that the water has not been in the dolerite bedrock and talus for a long period of time. Therefore the salinities also tend to indicate that the groundwater seepages originate, at least in part, from near-surface dolerite jointing.

The result of forest clearfelling can now be considered in relation to the potential effect on groundwater seepages. It is widely considered that clearfelling will increase rainfall infiltration, provided soil compaction is minimised. This increased infiltration is due to reduced evapotranspiration and interception by vegetation, an increase in depression storage from ground disturbance, and a reduction in litter and resulting increase in the area of bare soil. This effect is likely to occur for a period of approximately five years after clearfelling and reseeded until the new forest has grown sufficiently for the hydrological balance to be restored to a state similar to pre-clearing levels.

Theoretically, the seepages at the base of the Mt Clark escarpment should increase in flow for several years after clearfelling. However the Melbourne Metropolitan Board of Works has prevented the logging of their water supply catchments, not because of increased runoff and sediment yield to streams, but because they consider that the new forest cover will be denser and result in an eventual 25% reduction in runoff. There is not a lot of evidence to support this theory but if it is correct, infiltration on the Mt Clark plateau will eventually be reduced, resulting in a reduced or nonexistent seepage flow.

POTENTIAL INSTABILITY PROBLEMS

With respect to potential instability problems it is probably unwise to clearfell the steep escarpment slopes. The higher scree slopes are considered to be surficially stable due to a high permeability and a lack of clay matrix. However, it is uncertain if the grain-supported structure of the rock scree extends to depth. In other parts of the State exposures in road cuttings have shown that the surface occurrence of boulders does not always reflect the rock component of the underlying talus.

Old landslide features are apparent on the talus-covered northern face of Mt Clark. Inspection of the contour map shows that the talus slopes are topographically complex, indicating a history of previous instability. The presence of seepages on the talus slopes indicates that the moisture content of the talus is probably high. The presence of sandstone boulders on the middle to lower talus slopes indicates that the underlying Triassic rocks are probably at shallow depth. Previously investigated landslide problems occur in similar situations elsewhere in the State, and at these locations, slopes steeper than about 15° (27%) are considered to be potentially unstable (Sloane 1978; 1982; 1986).

Existing landslides have been mapped at the northern end of Grooms Hill and at locations adjacent to the Nubeena Back Road (Cromer et al., 1979). The landslides are associated with both the Jurassic dolerite and Triassic sandstone and mudstone, including the talus and scree deposits derived from the parent bedrock. Cromer et al. (1979) considered that most earth movements tend to develop either in the head region of gullies or on more moderate slopes lower down the hillside. At these locations a thicker accumulation of weathered material, soil or talus, combined with the emergence of springs and seepages issuing onto the slope, is prone to instability.

RECOMMENDATIONS

The geological configuration of the steep escarpment slopes of Mt Clark and Mt Koonya is similar to other areas of the State where instability problems have occurred. Old and recently-active landslide areas have been observed in the region. It is therefore considered that if the steep, talus-covered escarpment slopes are clearfelled, potential instability problems could occur. For planning purposes elsewhere, slopes steeper than 15° (27%) are considered potentially unstable. Figure 1 indicates those areas steeper than this angle. The areas considered to be underlain by Jurassic dolerite have been indicated. These areas are considered to be more stable than areas underlain by talus and located close to the dolerite-sandstone and mudstone boundary. Cable logging methods are possibly more suitable in these more stable regions.

The origin of springs near the base of the escarpment is considered to be partially related to rainfall infiltration and joint directions of the dolerite underlying the higher plateau region. If clearfelling occurs on the plateau, and the theory of the spring origins is correct, then spring flow should initially increase. The increased flow may occur for a period of up to five years. If the new forest regrowth is denser than the existing vegetation, the long term effect may be a reduction in spring flow, again provided that the dolerite joint control theory of some component of the spring water is correct.

The most essential aim concerning proposed forestry operations in the area is to minimise soil compaction in order to maintain the infiltration capacity of the soils.

REFERENCES

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FIGURE 1. Mount Koonya - Mount Clark State Forest.

BASE MAP. Scale 1:25 000

Slope map - areas steeper than 15° (27%).

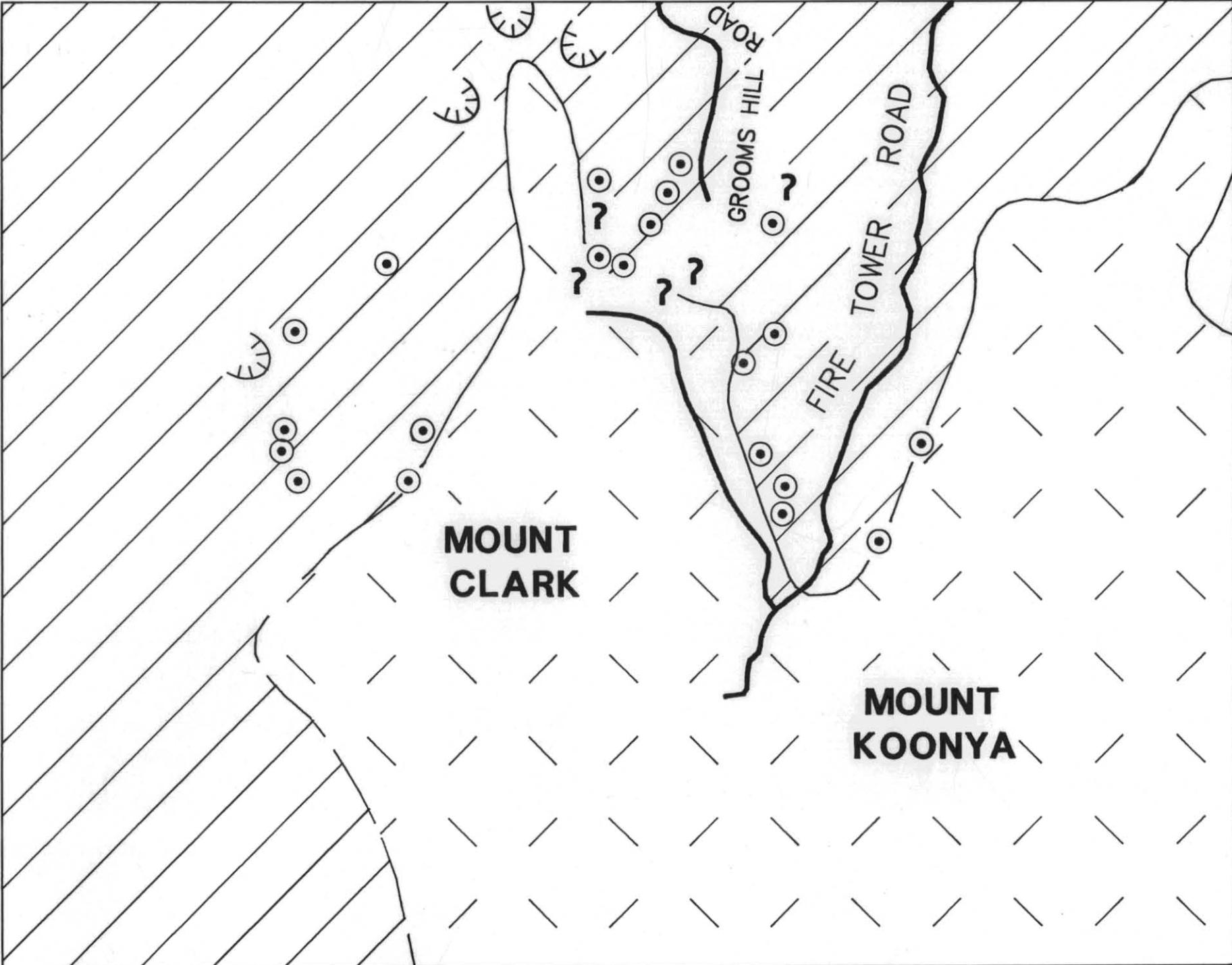
-  Underlain by talus and scree. Close to geological boundary.
-  Underlain by Jurassic dolerite.

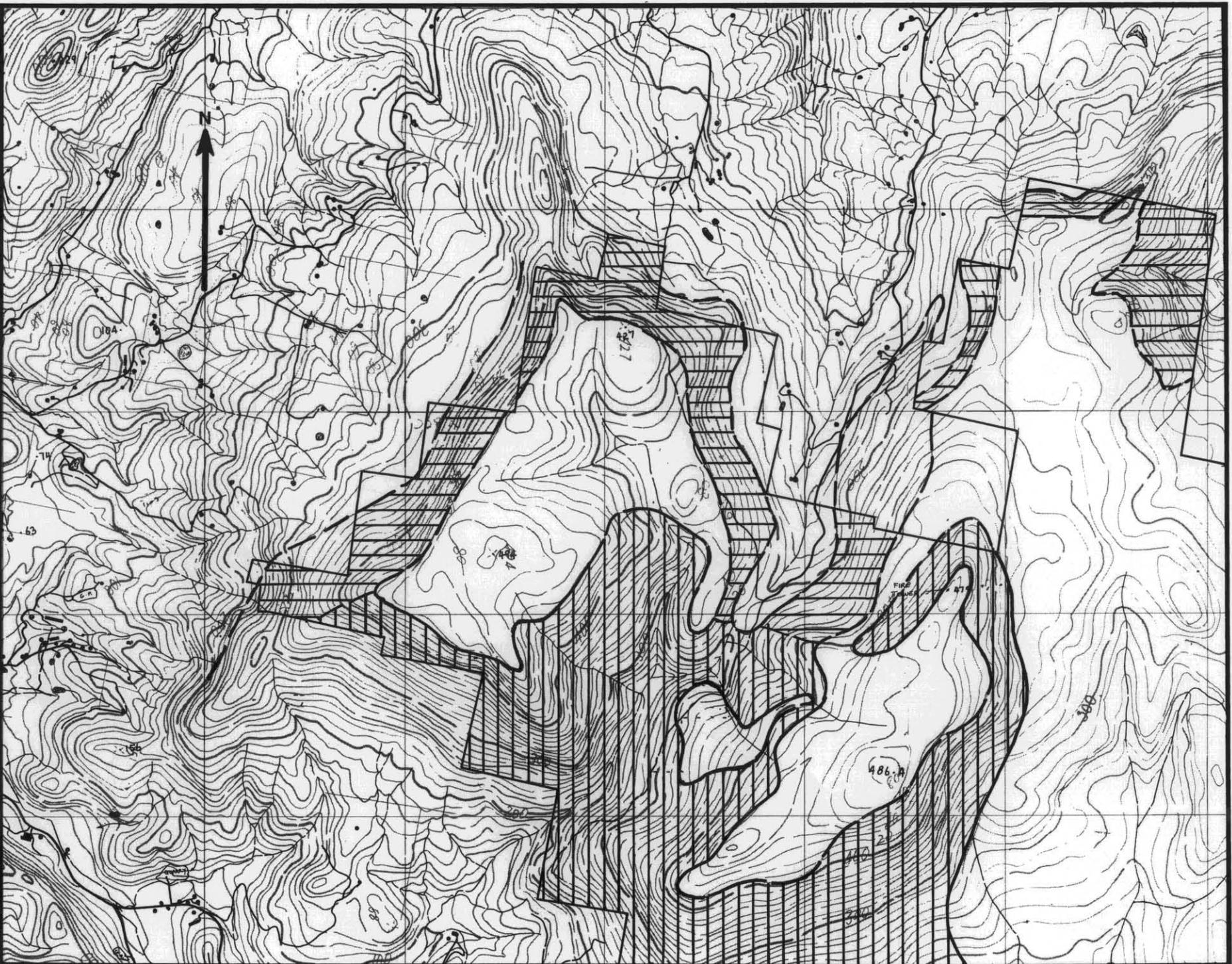
OVERLAY

Geological sketch map adapted from Cromer *et al.* (1979).

-  Triassic sandstone and mudstone.
-  Jurassic dolerite.
-  Location of springs
-  Location of landslides
-  Areas of old landslides

5 cm





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5 cm