9 RELIABILITY OF LANDSLIDE ZONING FOR LAND USE PLANNING

9.1 POTENTIAL SOURCES OF ERROR

9.1.1 Description

There are a number of potential sources of error in the zoning process. These include:

- Limitations in the landslide inventory upon which the susceptibility and hazard zoning maps are based.
- Limitations in the stability of temporal series. For example the relationship between the triggering factor (e.g. rainfall) and the frequency of landslides may change if the area is deforested.
- Limitations in the level of detail available of topography, geology, geomorphology, rainfall and other input data.
- Model uncertainty, meaning the limitations of the methods used to relate the inventory, topography, geology, geomorphology and triggering events such as rainfall to predicting landslide susceptibility, hazard and risk.
- Limitations in the skill of the persons carrying out the zoning.

It must be recognised that landslide zoning is not a precise science and the results are only a prediction of performance of the slopes based on the available data. In general, intermediate or advanced level zoning will be less subject to error than preliminary level zoning with each done at a suitable zoning map scale.

9.1.2 Landslide inventories

Cascini *et al.* (2005) conclude that the greatest source of error is limitations in the inventory. They give examples showing gross mismatch of inventory maps for landsliding from the same area of natural slopes prepared by two groups. They point out that the greatest errors occur when inventories rely on air photo interpretation, particularly of small scale photography. These errors are in part due to the subjective nature of aerial photo interpretation but also to vegetation covering the areas to be mapped. Aerial photographic mapping should be supported by surface mapping of selected areas to calibrate the mapping.

Inventories of landsliding of cuts, fills and retaining walls on roads, railways and urban development will seldom be complete. To get a reasonable estimate of the number of slides the zoning will have to make a judgement about the proportion of the slides which have been recorded.

9.1.3 Topographic maps

Good topographic maps are most important input to zoning at intermediate and advanced levels. Topographic maps facilitate the modelling and mapping of landslide zoning boundaries with an appropriate accuracy. For large scale zoning, contours at 2 metre or at most 5 metre intervals will be required. Even then, zoning boundaries should be checked on the ground because the implications for land owners of errors in boundaries can be significant.

9.1.4 Model uncertainty

Model uncertainty is a fact of landslide zoning and none of the methods are particularly accurate. In general terms hazard and risk zoning based on statistical analyses of the input data using intermediate level inputs will give the best accuracy.

Sophisticated methods for assessing the inputs rely on carrying out calculations (for example of the factor of safety of a slope) which have a theoretical attraction and the appearance of being able to produce better accuracy. In reality the parameter uncertainty is large due to limitations in the knowledge of the input data (such as shear strength and pore pressures) and these make it very difficult to achieve any greater accuracy than other modelling methods.

9.2 VALIDATION OF MAPPING

9.2.1 Peer review

For most zoning studies for land use planning there should be a peer reviewer appointed to provide independent assessment of the susceptibility, hazard and risk zoning. The peer reviewer should have a high level of the skills and experience listed in Section 11.2.The peer reviewer should meet with those carrying out the study at the beginning of the study and, depending on the scale of the projects, perhaps after initial mapping and then as the zoning is being