U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

OPEN FILE MAP

This map shows the estimated relative abundance of landslides in the San Francisco Bay region. It should serve as a basis for general comparison and evaluation of inferred landslide susceptibility. The map was prepared by D. H. Radbruch and K. C. Crowther, and the text adapted by Wentworth from Radbruch's longer text accompanying "Map Showing Areas of Relative Amounts of Landslides in California" (1970), which shows estimated landslide abundance for the whole state together with simplified geologic units not included on the present map. This larger report should be consulted for further information about compilation methods, limitations of the map, and physical factors that influence landsliding.

Different parts of the region are ranked on an increasing scale from 1 to 6 according to the estimated abundance of landslides in them. This ranking is relative and qualitative, and is based on the estimated area covered by landslides rather than the number of individual landslides. The estimates are based primarily on three factors--the slope of the ground surface, the amount of rainfall, and the various kinds of earth materials in the region--using as interpretive control inferred relations of landslides to those factors, along with limited data on the actual abundance of landslides in some areas.

In this report all downslope movements on local topography directly due to gravity, except for the slow creep of soils and the falling or rolling of individual rocks downhill, are considered landslides.

Use of the Map

The estimated relative abundance of landslides can, of course, be used to compare probable amounts of existing landslides within different parts of the region. Approximate correlation of future landslide susceptibility with abundance of landslides is also possible, because, although past and present activity of landslides are not distinguished on the map, areas of new and renewed landsliding are commonly associated with areas of preexisting landslides. However, the map does not show stability or instability of specific slopes because the ranking of a particular place represents an estimated average amount of landslides for the whole of the ranked area or unit. In addition, the small scale and resultant low resolution of the map restrict the size of individual areas to which the ranking applies to larger than 1/2 mile or more across. Much more detailed information is needed for the evaluation of slope stability of individual sites.

Method of Map Preparation

The region was divided into the 6 ranks of landslide abundance by progressively evaluating and ranking the high and low extremes. Rank 1 represents areas with a very small amount of landslides, and, at the other extreme, rank 6 represents areas that contain a maximum amount of landslides in the region. Areas ranked 5 have a lesser, but still very large amount of landslides, and areas with a limited amount of landslides, but larger than rank 1, are assigned to rank 2. The remaining, intermediate areas are assigned as appropriate to ranks 3 and 4.

Rank 1 is defined as areas that receive less than 10 inches of mean annual precipitation or have slopes of less than 5° (determined from 1:500,000-scale topographic map with 500-foot contour interval). These criteria indicate a very small amount of landslides, because landslides are rare in areas with less than 10 inches of precipitation, and review of a limited number of reports and consultation with other geologists indicates that few landslides occur on slopes of less than 5° (Radbruch, 1970, p. 4-6). Because of the large contour interval on the map from which slopes were determined and the small scale of the final map, sea cliff areas and hilly areas with less than 500 feet of relief may locally contain abundant landslides, although shown on the map as rank 1.

Ranking of the remaining region is based largely on the distribution of earth materials. For this purpose the geologic units in the region that are shown on the 1:250,000-scale Jenkins edition of the Geologic Map of California were grouped into 8 general classes of earth materials. The classes were selected to have as similar landslide characteristics as possible, using readily available literature on landslides in the region as a guide. Major differences in landslide characteristics within individual classes of earth materials resulting from varying topography or bedrock type or structure are used in the ranking where the needed information is available.

Availability of Landslide Information

Detailed information on the amount and distribution of landslides is available for only local parts of the San Francisco Bay region. This map provides information for the whole region in generalized fashion at a small scale. Even at a scale of 1:500,000, however, the map is not of uniform reliability, because of the scarcity of detailed information. As more information becomes available, numerous changes and improvements in the map are anticipated. A relatively uniform and detailed inventory of landslides identifiable on 1:20,000-scale aerial photographs is now underway by the Geological Survey as part of the San Francisco Bay Region Environmental and Resources Planning Study. The resultant preliminary maps at a scale of 1:62,500 will be released to the Geological Survey's open file for public use.

References cited

Olaf, P. Jenkins Edition of the Geologic Map of California, California Div. Mines and Geology, 1:250,000
Jennings, C. W., and Burnett, J. L., 1961, San Francisco Sheet
Jennings, C. W., and Strand, R. G., 1958, Santa Cruz Sheet
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Strand, R. G., and Koenig, J. B., 1965, Sacramento Sheet

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EXPLANATION

Landslide abundance ranks

1 Least abundant

2

3

4

5

6 Most abundant

Ranking is qualitative, based on estimates and extrapolation from available data. Specific safety or hazard for construction is not shown. Landslide distribution within individual map units may not be uniform: parts of the highest ranked units lack landslides, and parts of the lowest ranked units contain landslides. Hilly parts of unit 1 may contain abundant landslides.

Approximate contact between map units

Fault, approximately located, marking zone of possible sheared or shattered rock not represented in the ranking but susceptible to landsliding. Not shown where concealed beneath thick overlying deposits or water

Scale 1:500,000

0 5 10 Miles

Contour interval 500 feet

ESTIMATED RELATIVE ABUNDANCE OF LANDSLIDES IN THE SAN FRANCISCO BAY REGION, CALIFORNIA

by DOROTHY H. RADBRUCH AND CARL M. WENTWORTH

1971

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey standards and nomenclature.

Map compiled by D. H. Radbruch and K. C. Crowther.
Base from U. S. Geological Survey 1:500,000-scale topographic map of California, 1970.