U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
TAHOE REGIONAL PLANNING AGENCY

OPEN-FILE REPORT 94-105

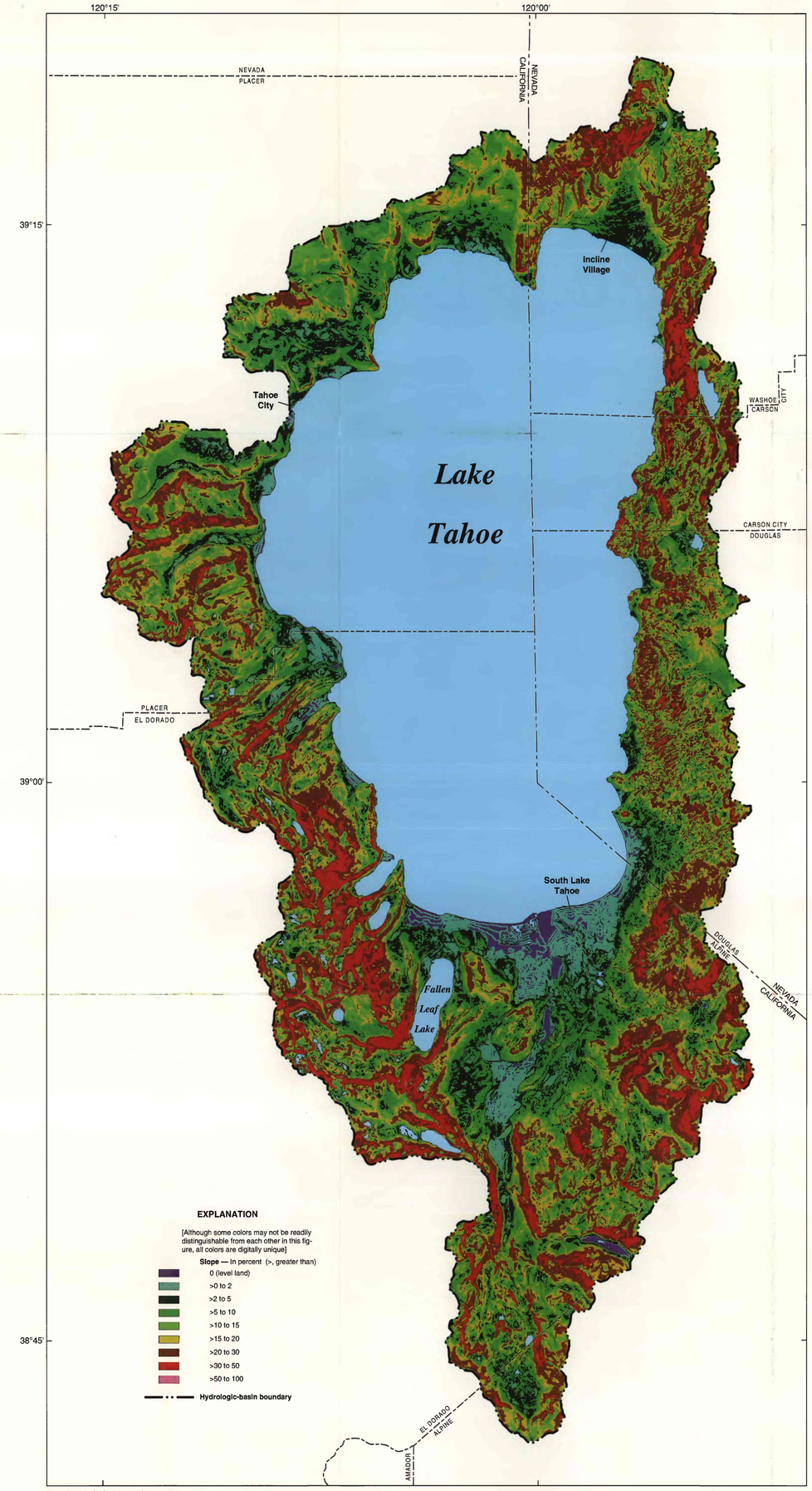

Figure 2.—Slope for Lake Tahoe basin.

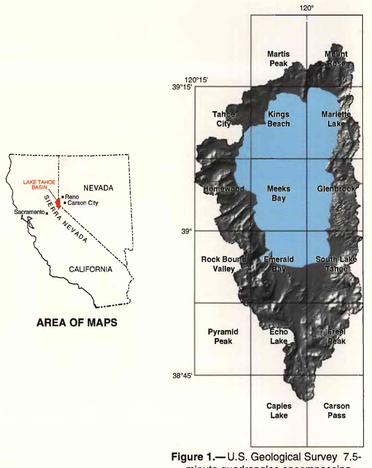

Figure 1.—U.S. Geological Survey 7.5-minute quadrangles encompassing Lake Tahoe basin.

INTRODUCTION

The Lake Tahoe basin encompasses an area of 1,310 square kilometers within the Sierra Nevada of California and Nevada (fig. 1). The area is renowned for the natural beauty of its alpine and subalpine mountains and lakes, particularly Lake Tahoe. Within the Lake Tahoe basin, elevations range from 1,895 to 3,319 meters. As a result of public interest and concern for preservation of the natural resources of the basin, various Federal, State, and local agencies have been collecting environmental data regarding the water and land resources. In the mid-1980's, several of these agencies recognized the need to develop a data-base management system for resources planning and for analysis of the land-use and environmental information collected in the basin.

In 1988, the U.S. Geological Survey (USGS) and the Tahoe Regional Planning Agency (TRPA) initiated a cooperative project to develop a geographic information system (GIS) to meet data-base needs for the Lake Tahoe basin. TRPA is a joint California–Nevada agency that manages and analyzes much of the land-use and environmental data collected in the basin. The U.S. Forest Service and the U.S. Soil Conservation Service also participated informally in the cooperative efforts. The resulting product is referred to as the Tahoe Environmental Geographic Information System (TEGIS). The TEGIS data bases (Cartier and others, 1994) contain vector coordinates stored in the local Universal Transverse Mercator (UTM) zone-11 coordinate system. These data bases include surface geology, soils, timber type, riparian vegetation, land capability, stream channels, water bodies, roads, political boundaries, the Lake Tahoe basin boundary, slope, aspect, drainage-basin boundaries, and hydrologic-monitoring sites.

This report displays the slope (steepness) and aspect (compass-direction) classifications of the Lake Tahoe basin of California and Nevada. At any given location, the surface of the Earth has a characteristic inclination defined by the local topography. The inclination of a surface has two components: slope and aspect. Slope is the steepness, or gradient. Aspect is the orientation, or compass direction toward which the surface faces. Knowledge of slope and aspect is important for many practical applications, including engineering design, land-use planning, and watershed modeling.

The purposes of the TEGIS project were (1) to develop a set of spatial data bases of natural-resources information for the Lake Tahoe basin and (2) to develop efficient techniques for creating spatial data bases.

This report presents slope and aspect information from TEGIS data bases as map layers. The areal scope of these data bases is that of the entire TEGIS project, which was limited to the 16 USGS 7.5-minute-series quadrangles encompassing the Lake Tahoe basin (fig. 1). Thematic layers of slope and aspect data are shown in figures 2 and 3, respectively.

DERIVATION OF SLOPE AND ASPECT DATA

USGS Digital Elevation Model (DEM) data files, derived from 1:24,000-scale maps, are available for the Lake Tahoe basin. The DEM is a digital representation of the irregular surface of the Earth. Each 1:24,000-scale DEM data file contains a regular array of elevations. The stored elevation values are in meters above sea level. The array is based on a 30-meter spacing in the local UTM coordinate system (U.S. Geological Survey, 1987).

Sixteen DEM files were used to generate coverages of slope and aspect for the Lake Tahoe basin. The DEM data were processed by using ARC/INFO[1] software (Environmental Systems Research Institute, 1989) and NASA's ELAS software (Beverley and Penton, 1989). ARC/INFO is a vector-based GIS. ELAS is a raster-based, modular GIS and image-processing system used primarily for processing remotely sensed data, but it also can be used for processing regularly spaced data, such as DEM files.

Several methods can be used to calculate slope and aspect from a regular grid of elevation values (Skidmore, 1989). The ELAS software uses the maximum-gradient method. Using a three-cell-by-three-cell window around each cell or elevation value in the grid, this method compares the center cell with its eight neighbors. Slope is calculated on the basis of cell size and the difference in elevation values between the center cell and its neighbor in the steepest direction. Aspect is defined as the direction of maximum steepness, either up or down, from the center cell to one of the eight nearest cells. In other words, aspect is the direction of the maximum gradient.

CLASSIFICATION OF SLOPE AND ASPECT

Discrete classes for slope were defined as follows: 0 percent, >0 to 2 percent, >2 to 5 percent, >5 to 10 percent, >10 to 15 percent, >15 to 20 percent, >20 to 30 percent, >30 to 50 percent, and >50 to 100 percent. These ranges were selected to satisfy requirements of land-use permitting, computer modeling, and resources management for the Lake Tahoe basin (Deborah Reed, Washoe County Department of Comprehensive Planning, oral commun., 1992).

Classes for aspect were limited to level land and the eight compass points (north, northeast, east, southeast, south, southwest, west, and northwest). The term "level" applies when all nine cells of the window have the same elevation values.

CREATION OF SLOPE AND ASPECT MAPS

The raster files of slope and aspect were transferred in single-variable-file format to ARC/INFO for further processing. These files then were converted into vector-based ARC/INFO polygon coverages and stored as part of the TEGIS data base. Statistical and other information about these two coverages was summarized by Cartier and others (1994).

To produce the maps shown in figures 2 and 3, the original DEM files were reprocessed into ARC/INFO's new raster format called GRID. Raster files of slope and aspect, based on the same classes described above, were created directly from the 1:24,000-scale DEM data files of elevation. Both the original ELAS-processed and the GRID-processed data are available in the TEGIS data base.

REFERENCES CITED

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
meter	3.281	foot
kilometer	0.6214	mile
square kilometer	0.3861	square mile

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929, formerly called Sea-Level Datum of 1929), which is derived from a general adjustment of the first-order leveling networks of the United States and Canada.

[1]Any use of trade names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

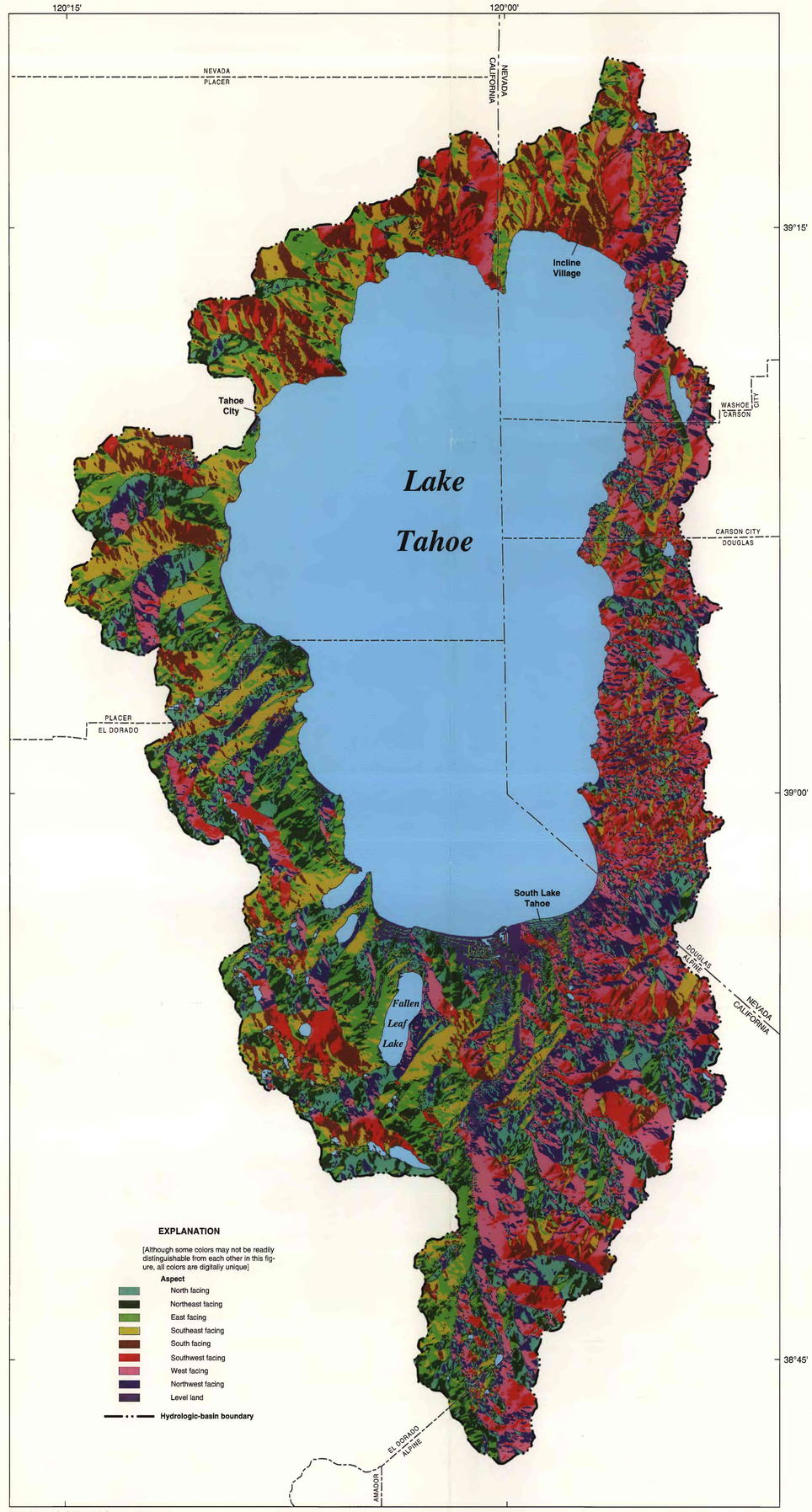

Figure 3.—Aspect for Lake Tahoe basin.

SLOPE AND ASPECT CLASSIFICATIONS OF LAKE TAHOE BASIN, CALIFORNIA AND NEVADA

By

Lorri A. Peltz, J. LaRue Smith, and Kenn D. Cartier

1994

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