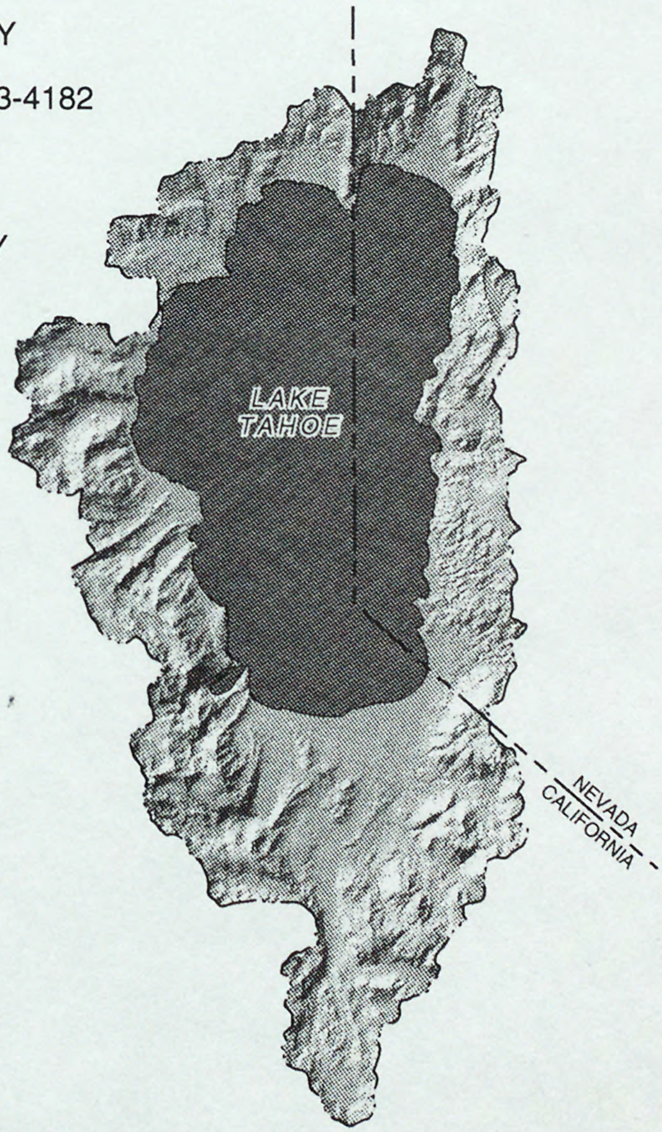
(200)
WRi
no. 93-4182

Development and Documentation of Spatial Data Bases for the Lake Tahoe Basin, California and Nevada

UNITED STATES GEOLOGICAL SURVEY

Water-Resources Investigations Report 93-4182

Prepared in cooperation with the
TAHOE REGIONAL PLANNING AGENCY



U.S. GEOLOGICAL SURVEY
RESTON, VA.
FEB 22 1994
SR
LIBRARY

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849

Development and Documentation of Spatial Data Bases for the Lake Tahoe Basin, California and Nevada

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

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 93-4182

Prepared in cooperation with the
TAHOE REGIONAL PLANNING AGENCY

Carson City, Nevada
1994

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
ROBERT M. HIRSCH, Acting Director

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

For additional information write to:

District Chief
U.S. Geological Survey
333 West Nye Lane, Room 203
Carson City, NV 89706-0866

Copies of this report can be purchased from:

U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, CO 80225-0046

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ACRONYMS

Multiply	By	To obtain
meter	3.281	foot
square meter	10.76	square foot
kilometer	0.6214	mile
square kilometer	0.3861	square mile
hectare	2.471	acre

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.

AML	Arc Macro Language
CDMG	California Division of Mining and Geology
DEM	Digitial Elevation Model
DLG	Digital Line Graph
ELAS	Science and Technology Laboratory Applications Software, developed by National Aeronautics and Space Administration
ESRI	Environmental Systems Research Institute
GIS	Geographic information system
LWQCB	Lahontan Water Quality Control Board
NASA	National Aeronautics and Space Administration
NDEP	Nevada Division of Environmental Protection
PLSS	Public Land Survey System, often referred to as township, range, and section boundaries
RMS	Root mean square, a statistical estimate of error
SCS	U.S. Soil Conservation Service
SVF	Single-variable file
TEGIS	Tahoe Environmental Geographic Information System
TRPA	Tahoe Regional Planning Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator map-projection and coordinate system

Development and Documentation of Spatial Data Bases for the Lake Tahoe Basin, California and Nevada

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

Abstract

A set of spatial data bases consisting of natural-resources and planimetric-base layers has been developed and documented for the Lake Tahoe basin, California and Nevada. The data bases, in the form of geographic information system coverages, 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. The data bases were developed from existing thematic maps, digital data, and hydrographic records. Data were compiled from maps and records of Federal, State, and local agencies. The scale of source materials ranged from 1:24,000 to 1:125,000 and their release dates, from 1964 to 1989. Documentation and summary information are included for each spatial data base.

INTRODUCTION

The Lake Tahoe basin encompasses an area of 1,310 square kilometers of alpine and subalpine land within the Sierra Nevada of California and Nevada (fig. 1). The area is renowned for the natural beauty of its mountain ranges and lakes, particularly Lake Tahoe. As a result of public interest and concern for preservation of the natural resources of the basin, various Federal, State, and local agencies collect environmental data regarding the water and land resources of the basin. In the mid-1980's, many 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 recent years, people have been increasingly concerned about the effects of development on the water clarity and quality of Lake Tahoe. Resources assessment, basic research, and land and resources management in the Lake Tahoe basin have been hampered by the lack of a consistent and common data base for the basin. In the past, the environmental data for the basin were stored in a large variety of formats by individual agencies in numerous locations with differing reporting conventions and standards. None of these agencies could efficiently compile, analyze, describe, and display geographically referenced environmental data.

In 1988 the U.S. Geological Survey (USGS) and the Tahoe Regional Planning Agency (TRPA) began a cooperative project to develop a geographic information system (GIS) to meet the 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 (USFS) and the U.S. Soil Conservation Service (SCS) also informally participated in the cooperative efforts. The resulting product is referred to as the Tahoe Environmental Geographic Information System (TEGIS).

The goals 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. (In this report, the term "data base" refers to a set of information stored in digital form on a computer. A data base consists of a single layer, or type of information, such as vegetation or soils. When stored in a

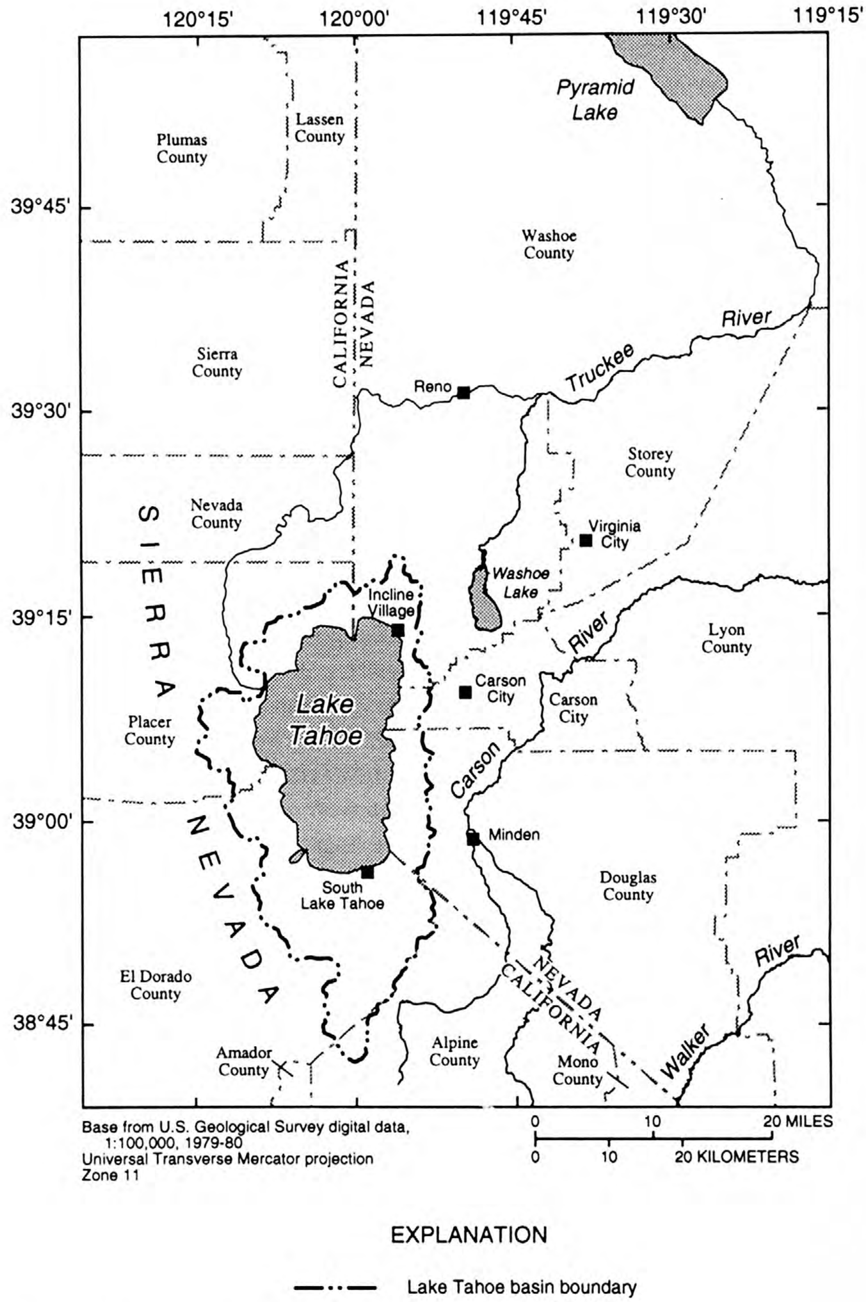


Figure 1. Location of Lake Tahoe basin study area.

GIS, each layer typically is referred to as a coverage. A coverage consists of attributes, or information, that relate to the Earth's surface by their spatial coordinates. In this report, the term "coverage" refers to a spatial data base that is organized into a specific group of files and directories.)

The TEGIS project was limited in area to the 16 USGS 7.5-minute-series quadrangles encompassing the Lake Tahoe basin (fig. 2). (Henceforth in this report, the term "map quadrangle" refers to the area covered by a USGS 1:24,000-scale, 7.5-minute-series topographic map.)

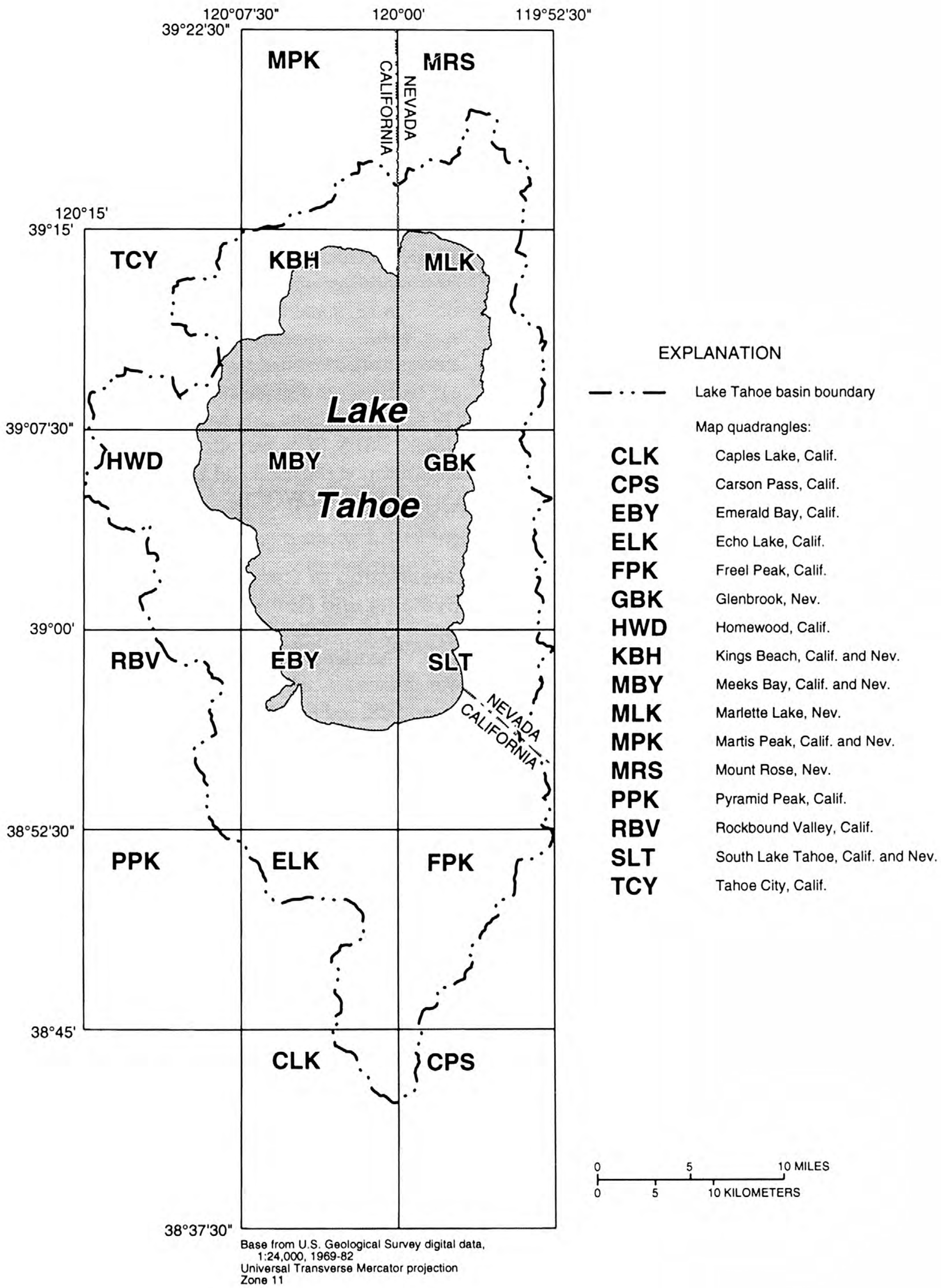


Figure 2. Index of 1:24,000-scale map quadrangles for Lake Tahoe basin.

Purpose and Scope

This report documents (1) the sources of data in the spatial data bases, (2) the methods used to develop the TEGIS coverages, and (3) the contents of the coverages in the TEGIS data base. The report documents the 22 coverages representing the Lake Tahoe basin that were created for the TEGIS project. The report contains descriptions of the data sources, a discussion of data-base creation and editing, and statistical summaries of the spatial data bases.

The natural-resources layers include geology, soils, timber type, riparian vegetation, land use, stream channels, water bodies, the Lake Tahoe basin boundary, slope, aspect, drainage-basin boundaries, and hydrologic- monitoring sites.

The coverages were compiled from the largest scale and most recent maps and digital data files that were available for each data layer. Because the data were compiled from a variety of sources, it was not possible to create all coverages with a consistent map scale or resolution. Map scales ranged from 1:24,000 to 1:125,000. Release dates for the maps ranged from 1964 to 1989.

General Description of Lake Tahoe Basin

Lake Tahoe and the Lake Tahoe basin are drained by the Truckee River, which flows into Pyramid Lake in northwestern Nevada. Lake Tahoe has a surface area of 500 square kilometers and is renowned for its strikingly blue color and water clarity.

The geology of the Lake Tahoe basin is dominated by igneous rock, chiefly granodiorite, andesite, and granite. The basin was glaciated during the Pleistocene epoch and contains spectacular landforms produced by glacial erosion and deposition.

The Lake Tahoe basin encompasses parts of six counties: Alpine, El Dorado, and Placer Counties in California and Carson City, Douglas, and Washoe Counties in Nevada. Sixteen USGS 1:24,000-scale map quadrangles cover the basin: Caples Lake, Calif.; Carson Pass, Calif.; Echo Lake, Calif.; Emerald Bay, Calif.; Freel Peak, Calif.; Glenbrook, Nev.; Homewood, Calif.; Kings Beach, Calif. and Nev.; Marlette Lake, Nev.; Martis Peak, Calif. and Nev.; Meeks Bay, Calif. and Nev.; Mount Rose, Nev.; Pyramid Peak, Calif.; Rockbound Valley, Calif.; South Lake Tahoe, Calif. and Nev.; and Tahoe City, Calif. (fig. 2).

Previous Investigations

The natural resources of the Lake Tahoe basin have been extensively mapped and studied by numerous agencies and individuals. The geology of the basin was mapped mainly by Thompson and White (1964), Burnett (1971), Bonham and Burnett (1976), Loomis (1981), Armin and John (1983), Armin and others (1984), and Grose (1985, 1986). The soils were mapped by the SCS and USFS (Rogers, 1974). The forest and riparian vegetation were mapped by the USFS in 1979 and 1988, respectively (U.S. Forest Service, written communs., 1990, 1991). Land-capability classes were identified by TRPA (Bailey, 1974). Drainage basins were delineated by Jorgensen and others (1978). Hydrologic data have been collected by the USGS, USFS, SCS, Nevada Division of Environmental Protection (NDEP), and Lahontan Water Quality Control Board (LWQCB).

Description of Geographic Information Systems and Computer Equipment

The spatial data bases developed for this study were created by using ARC/INFO software, a vector-based GIS, and ELAS software, a raster-based GIS. A GIS is an "organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information" (Environmental Systems Research Institute, 1989). A vector-based GIS stores data or features as points, lines, or polygons that are defined by a set of Cartesian coordinates. Each feature in a vector layer may have many attributes. A raster-based GIS stores data as a regular array of cells. Each cell in a raster layer has a single value. All spatial data bases developed for this study were stored in final form as ARC/INFO coverages.

The ARC/INFO software was installed on Prime minicomputers and Data General Aviion workstations in the USGS office in Carson City, Nev. ELAS software was installed on the Prime minicomputers. Some maps were digitized manually on a Calcomp 9100 digitizing table connected to the Prime minicomputers. Other maps were scanned and vectorized using a Tektronix 4991 electronic scanner and TekScan software on a Tektronix 4325 workstation at the USGS Regional GIS Laboratory in Menlo Park, Calif.

Acknowledgments

The authors acknowledge Elizabeth A. Frick of the USGS for establishing the goals of the project and for doing the initial work. Data were provided by the TRPA, USFS, SCS, NDEP, and LWQCB. The authors thank H.K. Berger of the TRPA, Joseph Oden and Karen Hoffman of the USFS, and Michael Whiting of the SCS. The authors also acknowledge the Comprehensive Planning Department of Washoe County, Nev., for assistance in data collection during the early phases of the project.

SOURCES OF GEOGRAPHIC INFORMATION

Spatial data bases for the TEGIS project were created from three general sources of geographic information: thematic maps, digital maps, and hydrographic data records. Thematic maps were compiled from Federal and State agencies. Digital maps were obtained from the Earth Science Information Center of the USGS. Hydrographic data were compiled by Federal, State, and other agencies.

Sources of Thematic Data

Thematic maps were obtained for five natural-resources layers: geology, soils, timber type, riparian vegetation, and land capability. The largest scale maps available for each thematic layer were used. When available, mylar maps were used in preference to paper maps to minimize media distortion. When available, thematic separate maps were used to simplify the digitizing process.

Examples from thematic source maps that were obtained from the USFS and SCS are shown in figure 3. The examples depict part of the South Lake Tahoe map quadrangle. Each of these maps contains hundreds of individual map polygons, or discrete areal features, and is representative of the complexity of natural-resources maps for the basin. Thematic composite maps (fig. 3*B*) contain many extraneous features, such as place names and political boundaries. This extraneous material was removed when the coverages were edited (fig. 5).

Geologic Maps

Geologic and related maps were available for the Lake Tahoe basin at map scales ranging from 1:24,000 to 1:125,000. Some areas of the basin were mapped at different scales. Information about these source maps, including map name, mapped area, author, scale, and form, is summarized in table 1.

The geology of the Lake Tahoe basin was mapped at a scale of 1:125,000 in 1968 in northern and southern halves, by R.A. Matthews and J.L. Burnett, respectively. This work was published in a report by Burnett (1971). In 1974, the TRPA compiled a natural-hazards map of the basin from the 1:125,000-scale geologic mapping and other sources. This thematic information was recompiled at a scale of 1:24,000. For this study, mylar copies of these unpublished map sheets were obtained from the TRPA (H.K. Berger, written commun., 1990).

Geologic maps at 1:24,000 scale were available for only 3 of the 16 map quadrangles for the Lake Tahoe basin (Bonham and Burnett, 1976; Grose, 1985, 1986). Geologic maps at 1:62,500 scale were used for seven other map quadrangles (Thompson and White, 1964; Loomis, 1981; Armin and John, 1983; Armin and others, 1984). For the remaining six map quadrangles, the geologic data from the natural-hazards map were used. A map of the distribution of these largest scale source maps is shown in figure 4. With one exception, these source maps were available on mylar; the mapped linear geologic features for the Freel Peak quadrangle were available only on paper. Due to the variety of map scales and authors, it was beyond the scope of this study to resolve all the differences in mapped geology. The location or classification of geologic features does not match across many of the borders between adjacent maps. These discrepancies, inherited from the source maps, remain in the composite coverages of geology.

Soil Maps

Thematic maps of soil units were obtained from the published soil survey of the Lake Tahoe basin area (Rogers, 1974). The 1:24,000-scale maps were developed cooperatively by the SCS and USFS and include 49 separate mapping units.

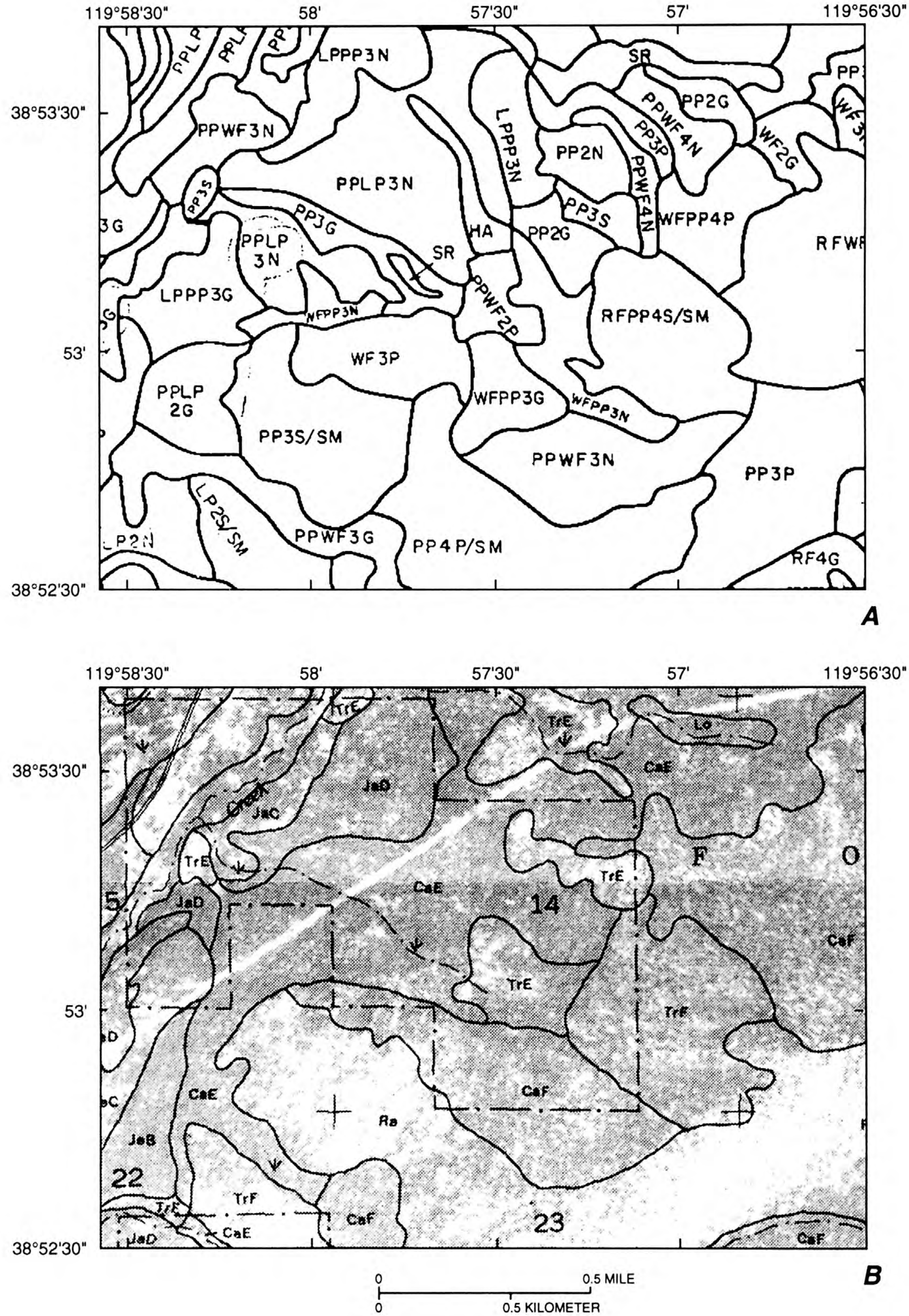


Figure 3. Examples of thematic source maps for part of South Lake Tahoe map quadrangle, showing original linework and extraneous features such as boundaries, labeling, and other notations to be excluded from the digital products. *A*, U.S. Forest Service timber-type map. *B*, U.S. Soil Conservation Service soil-survey map.

Table 1. Geologic and related maps used as source material for compiling geology of Lake Tahoe basin

[Map identifier: Code used in figure 4 to show area for which map was main or only source of information used in compiling geology. Corresponding USGS quadrangles: U.S. Geological Survey 7.5- or 15-minute-series topographic quadrangles that cover area of source map. do., ditto]

Map identifier	Source maps					Corresponding USGS quadrangles
	Type of map	Reference citation	Scale	Medium	Number of sheets	
A	Natural hazards.	Tahoe Regional Planning Agency, written commun., 1990.	1:125,000 (recompiled at 1:24,000)	Mylar	4	Caples Lake, Calif. Carson Pass, Calif. Echo Lake, Calif. Emerald Bay, Calif. Freel Peak, Calif. Glenbrook, Nev. Homewood, Calif. Kings Beach, Calif. and Nev. Marlette Lake, Nev. Martis Peak, Calif. and Nev. Meeks Bay, Calif. and Nev. Mount Rose, Nev. Pyramid Peak, Calif. Rockbound Valley, Calif. South Lake Tahoe, Calif. and Nev. Tahoe City, Calif.
B	Geologic	Thompson and White, 1964	1:62,500	do.	1	Mount Rose, Nev.
C	do.	Grose, 1986	1:24,000	do.	1	Marlette Lake, Nev. Kings Beach, Calif. and Nev. (part)
D	do.	Grose, 1985	1:24,000	do.	1	Glenbrook, Nev.
E	do.	Loomis, 1981	1:62,500	do.	1	Echo Lake, Calif. Emerald Bay, Calif. Pyramid Peak, Calif. Rockbound Valley, Calif.
F	do.	Bonham and Burnett, 1976	1:24,000	do.	1	South Lake Tahoe, Calif. and Nev.
G	do.	Armin and John, 1983	1:62,500	Mylar Paper	1 1	Freel Peak, Calif.
H	do.	Armin and others, 1984	1:62,500	Mylar	1	Carson Pass, Calif.

The SCS maps were available only as folded paper maps. The maps are composed of a black separate layer printed over a pale-green orthophotoquad background. The black separate layer contains thematic linework and labels as well as political borders, stream channels, and transportation and other features.

Timber-Type Maps

Timber-type units of the Lake Tahoe basin were mapped by the USFS on low-altitude aerial photographs taken in the summer of 1978. The linework was transferred to 1:24,000-scale mylar maps (Joseph Oden, U.S. Forest Service, oral commun., 1991). These maps group timber-type units by major species, crown size, crown density, and understory vegetation. Categories and examples of timber-type unit symbols used by the USFS for the Lake Tahoe basin are shown in table 2. The timber-type units have a complex alphanumeric symbol that groups mapped areas into three principal categories: (1) areas with woody vegetation, (2) areas with nonwoody and shrub vegetation, and (3) nonvegetated areas.

Of the 16 timber-type maps, 13 were available from the USFS as thematic map separates. Composite maps with a pale-gray topographic background layer were obtained for the other three map quadrangles (Emerald Bay, Calif.; Homewood, Calif.; and Meeks Bay, Calif. and Nev.).

Riparian-Vegetation Maps

Riparian-vegetation units of the Lake Tahoe basin were mapped by the USFS on infrared, low-altitude aerial photographs taken in 1987. The linework was transferred to 1:24,000-scale mylar maps. By using categories shown in table 3, the riparian vegetation was classified into plant communities of at least

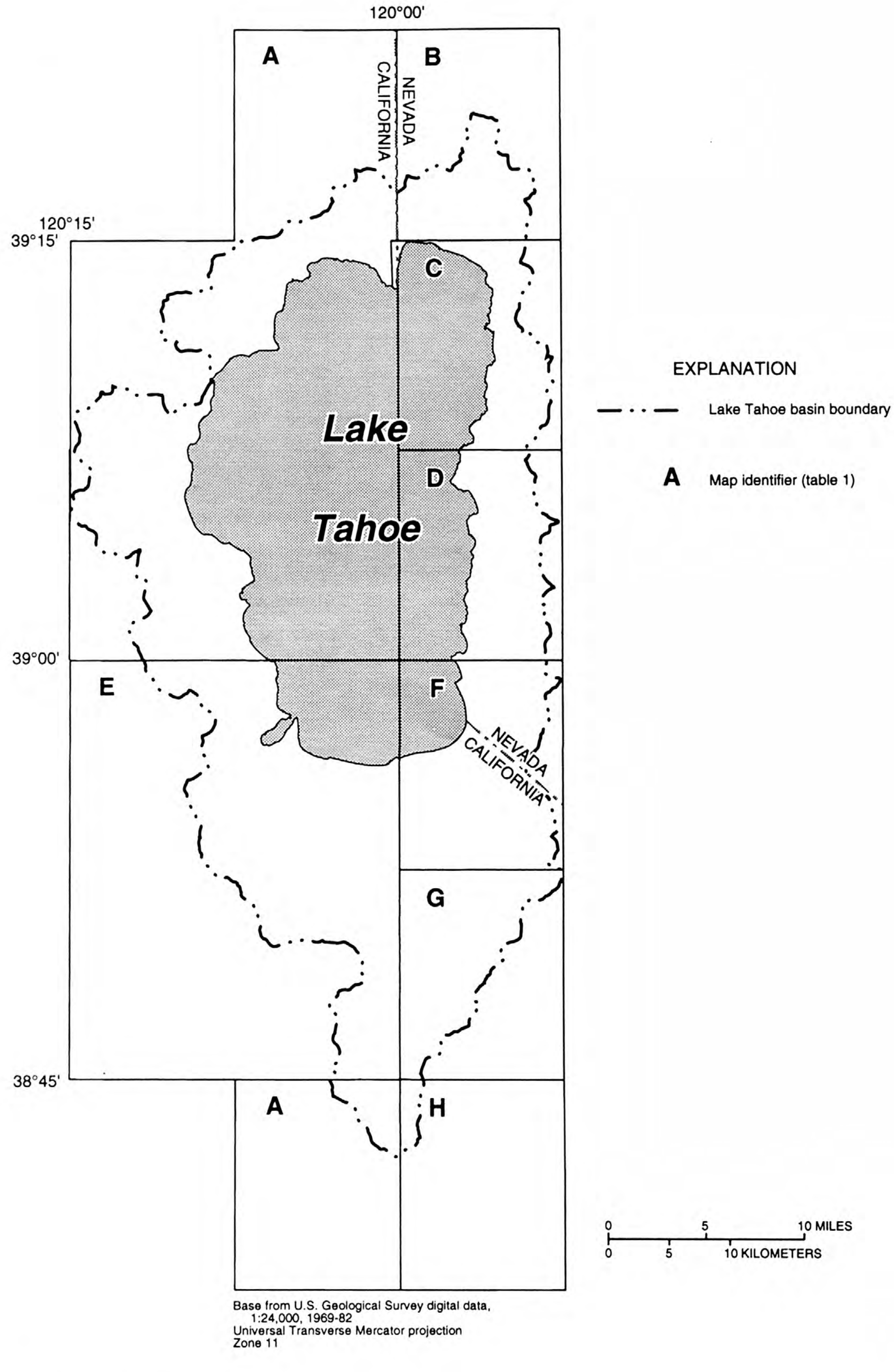


Figure 4. Index map indicating largest scale geologic and related maps for compiling geology of Lake Tahoe basin. Individual maps are listed in table 1 by map identifier.

Table 2. Classification categories used by U.S. Forest Service on timber-type maps

[Information from Joseph Oden, U.S. Forest Service (written commun., 1992). Alphanumeric symbols used for timber-classification categories consist of as many as five components: First two letters designate primary species or nonvegetated area; next two letters denote secondary species; next number indicates crown size; next letter indicates crown density; and final two letters (preceded by "/") denote type of understory vegetation. For example, symbol PPWF3S/SM indicates primary species is ponderosa or Jeffrey pine, secondary species is white fir, crown diameter (primary species) is 13 to 24 feet, crown density (primary species) is 10 to 19 percent of area, and understory type is montane shrub]

Classification basis	Class symbol	Class definition
	Woody-vegetation areas	
Primary and secondary commercial conifers.	LP	Lodgepole pine.
	MH	Mountain hemlock.
	PP	Ponderosa or Jeffrey pine.
	RF	Red fir.
	SP	Sugar pine.
	WF	White fir.
	WP	Western white pine.
Primary and secondary noncommercial conifers.	WB	Whitebark pine.
Primary and secondary noncommercial hardwoods.	HA	Aspen.
	HX	Miscellaneous hardwoods.
Crown size of primary conifers or hardwoods.	1	0- to 5-feet diameter.
	2	6- to 12-feet diameter.
	3	13- to 24-feet diameter.
	4	25- to 40-feet diameter.
	5	Greater than 40-feet diameter.
	6	Two storied (overstory two size classes larger than understory).
Crown density of primary conifers or hardwoods.	S	10- to 19-percent crown cover.
	P	20- to 39-percent crown cover.
	N	40- to 69-percent crown cover.
	G	Greater than or equal to 70-percent crown cover.
Understory vegetation........	/NC	Noncommercial conifers.
	/NG	Herbs and grasses.
	/SA	Chaparral (manzanita and associated shrubs).
	/SB	Sagebrush.
	/SC	Bush (chinquapin).
	/SM	Montane (buckbrush, chokecherry, whitethorn).
	/SR	Streamside (wet-meadow or bog shrubs).
	/SX	Miscellaneous shrubs (bitterbrush, mountain mahogany).
	Nonwoody- and shrub-vegetation areas	
Dominant vegetative cover....	GH	Herbaceous cover.
	GL	Grasses.
	NG	Herbs and grasses.
	SA	Chaparral (manzanita and associated shrubs.
	SB	Sagebrush.
	SC	Shrub (chinquapin).
	SM	Montane (buckbrush, chokecherry, whitethorn).
	SR	Riparian vegetation (wet-meadow or bog shrubs).
	SX	Miscellaneous shrubs (bitterbrush, mountain mahogany).
	Nonvegetated areas	
Dominant characteristic or feature.	NB	Barren, rocky.
	ND	Urban development (settlements, quarries, roads).
	NW	Water body (lakes, permanent snowfields).

Table 3. Classification categories used by U.S. Forest Service on riparian-vegetation maps

[Modified from Joseph Oden (U.S. Forest Service, written commun., 1990)]

Class-unit symbol	Class name	Class description
1	Coniferous riparian	Fir, hemlock, pine; usually occupies narrow zones bordering perennial or intermittent streams.
2	Deciduous riparian	Aspen, alder, cottonwood, willow; commonly occurs in linear distributions along streams but also occupies some broad open areas.
3	Deciduous/coniferous riparian	Mix of classes 1 and 2 (deciduous trees in understory, conifers in overstory).
4	Wet meadow	Sedges, rushes, aquatic plants, wet-site grasses; usually occurs in broad extensive areas but also occupies some smaller sites along streams or near lakes.
5	Moist meadow	Forbs, grasses, some sedges or rushes.
X	Nonriparian	Nonriparian plant communities enclosed by areas of riparian vegetation.
W	Water	Bodies of water surrounded by areas of riparian vegetation.

0.4 hectare in size (Joseph Oden, U.S. Forest Service, oral commun., 1991). The riparian-vegetation maps are composed of black thematic linework, labels, and numerous leaders or connecting lines. Mylar copies of these maps were obtained from the USFS.

Land-Capability Maps

As part of a regional planning framework for the Lake Tahoe basin, the TRPA uses a land-classification system based on land capability, "the level of use an area can tolerate without sustaining permanent damage through erosion and other causes" (Bailey, 1974). Using SCS soil-survey maps, Bailey evaluated the major factors affecting land capability and grouped soil units into seven classes of land capability (table 4). Class 1, consisting of the land least tolerant of use, contains three subclasses, making a total of nine distinct types of land in the basin.

Sources of Digital Data

Two sets of USGS digital data bases, derived from 1:24,000-scale maps, were available for the Lake Tahoe basin: Digital Line Graph (DLG) and Digital Elevation Model (DEM). The relevant map quadrangles are listed in table 5.

Digital Line Graph Files

The DLG data files are grouped into planimetric-base categories: boundaries, hydrography, Public Land Survey System (PLSS), and transportation (U.S. Geological Survey, 1986). These four data categories, which do not necessarily correspond to the separate plates used to print the published USGS topographic maps, are described briefly as follows:

Boundaries.—Political boundaries of States, counties, and cities or other municipalities, and administrative boundaries of areas such as national and State forests.

Hydrography.—Hydrographic features of flowing water, intermittent water, standing water, and wetlands.

PLSS.—Rectangular system of land surveys that is administered by the U.S. Bureau of Land Management for the Western United States.

Transportation.—Major transportation systems in three classes: (1) roads and trails, (2) railroads, and (3) pipelines, transmission lines, and miscellaneous transportation features.

Table 4. Categories used in land-capability classification

[Modified from table 4 of Bailey (1974, p. 20). do., ditto; --, not applicable or not determined]

Land capability		Classification basis					
Class	Subclass	Relative tolerance for use	Slope (percent)	Relative erosion potential	Relative runoff potential	Disturbance hazard	Other
1	1a	Least	30+	High	Moderately high to high.	High	--
	1b	--	--	--	--	do.	Poor natural drainage.
	1c	--	--	--	--	do.	Fragile flora and fauna.
2	--	--	30-50	High	Low to moderately low.	do.	--
3	--	--	9-30	Moderate	Moderately high to high.	Moderate	--
4	--	--	9-30	do.	Low to moderately low.	do.	--
5	--	--	0-16	Slight	Moderately high to high.	Low	--
6	--	--	0-16	do.	Low to moderately low.	do.	--
7	--	Most	0-5	do.	do.	do.	--

Digital Elevation Model Files

A 1:24,000-scale DEM data file contains a regular array of elevations and covers one map quadrangle. The stored elevation values are in meters above sea level. The array is based on a 30-meter spacing in the local Universal Transverse Mercator (UTM) coordinate system (U.S. Geological Survey, 1987).

Sources of Hydrographic Data

Hydrographic data for mapping drainage-basin boundaries, hydrologic-monitoring sites, water bodies, and stream channels came from several sources. The drainage-basin boundaries were identified on topographic maps of the basin. Monitoring-site locations were obtained from records of several government agencies. Coordinates of water bodies and stream channels were derived from USGS DLG files, as described in the section "Digital Line Graph Files."

Drainage-Basin Boundaries

Jorgensen and others (1978) delineated drainage-basin boundaries on the basis of 1:62,500-scale maps for an earlier study. They delineated drainage basins for major tributaries to Lake Tahoe and above selected surface-water monitoring sites.

For this study, drainage-basin boundaries were delineated on USGS 1:24,000-scale topographic maps. Drainage basins were delineated for major tributaries to Lake Tahoe, above all stream confluences shown on the maps, and above selected surface-water monitoring sites. The 1978 map was not digitized for this study, although the drainage-basin coding system used by Jorgensen was retained.

Hydrologic-Monitoring Sites

Tabulated information about hydrologic-monitoring sites was obtained from Federal, State, and local agencies working in the Lake Tahoe basin. These agencies include the USGS, USFS, SCS, NDEP, and LWQCB. Data were compiled for surface-water and ground-water monitoring stations and for snow-measurement courses.

The USGS has collected surface-water data in the Lake Tahoe basin since 1895 (Eisenhuth, 1968). Some of the surface-water monitoring sites have more than 90 years of streamflow record; most of the sites

Table 5. Map quadrangles used as source maps for Digital Line Graph and Digital Elevation Model computer files

[All maps: 1:24,000 scale; polyconic projection. --, no revision]

Map quadrangle	Publication dates	
	Original	Revised edition
Caples Lake, Calif.	1969	1979
Carson Pass, Calif.	1976	1979
Echo Lake, Calif.	1955	1969
Emerald Bay, Calif.	1955	1969
Freel Peak, Calif.	1955	1969 1980
Glenbrook, Nev.	1955	1982
Homewood, Calif.	1969	--
Kings Beach, Calif. and Nev.	1969	--
Marlette Lake, Nev.	1955	1982
Martis Peak, Calif. and Nev.	1955	1969 1973
Meeks Bay, Calif. and Nev.	1969	--
Mount Rose, Nev.	1968	1982
Pyramid Peak, Calif.	1969	--
Rockbound Valley, Calif.	1969	--
South Lake Tahoe, Calif. and Nev.	1982	--
Tahoe City, Calif.	1969	--

have less than 5 years of record. The USGS has collected ground-water data in the basin since the 1960's and predominantly since 1986. Water-quality data have been collected at both surface- and ground-water monitoring sites. Many of the USGS sites are also used by the USFS, NDEP, or LWQCB. The USFS (written commun., 1991) collects data on water quality, streamflow, and ground-water and lake-surface levels. The NDEP (written commun., 1991) operates 10 surface-water monitoring sites in the vicinity of Incline Village, Nev., and collects data on water quality, streamflow, and lake-surface levels. The LWQCB (written commun., 1991) maintains ground-water monitoring sites in the vicinity of South Lake Tahoe, Calif., and collects data on water quality and ground-water levels. Also, the SCS (written commun., 1991) has maintained snow-course monitoring sites in the Lake Tahoe basin since 1913. As of 1991, the SCS snow-telemetry network included eight sites in the basin.

DEVELOPMENT OF SPATIAL DATA BASES

Digital spatial data bases were created as GIS coverages for 22 thematic layers. The data were derived from thematic maps, digital maps, and hydrographic data. The coverages developed for the TEGIS project are listed in table 6.

Development of Thematic Maps

Eight coverages were created from thematic maps. The source maps were digitized both automatically by using an electronic scanner and manually on a digitizing table. The coverages are named GEOL_COMP (composite geology), GEOL_COMP_LIN (linear features of composite geology), GEOL_TRPA (geology from TRPA's natural-hazards map), GEOL_TRPA_LIN (linear features of geology from TRPA's natural-hazards map), LAND_CAP (land capability), RIPARIAN_VEG (riparian-vegetation units), SOIL (soil-survey units), and TIMBER_TYPE (timber-type units). The coverages of composite geology were created by appending coverages derived from the best available maps. The resulting composite coverages contain map features derived from source maps at different scales: three at 1:24,000; seven at 1:62,500; and six at 1:125,000.

Source maps were digitized by using the electronic scanner if the available map copy was substantially free of unwanted extraneous features such as cartographic text or topographic contour lines. Wherever possible, automatic digitizing was used in preference to manual digitizing because the product obtained from the electronic scanner was considered to have lower cost of production and comparable or better positional accuracy.

The manually digitized coverages were edited by using software commands available in ARC/INFO. The automatically digitized coverages were edited by using both ARC/INFO commands and software routines developed for this study.

Examples of coverage line features (scanned and edited) for timber-type and soil units are shown in figure 5, which depicts part of the South Lake Tahoe, Calif. and Nev., map quadrangle. The coverages were processed from the maps represented in figure 3.

Registering Maps

The x–y coordinates of all digitized features were transformed from digitizer units to map units. The digitizing equipment used in this study records initial coordinates in digitizer inches, which must be converted by linear transformation to the coordinate system of the projection of the source map. This transformation requires at least four control points with x–y values that are known in both coordinate systems—digitizer inches and map units. For this study the registration marks at the four corners of each map, corresponding to the 7.5-minute grid of latitude and longitude, were used as control points.

During manual digitizing, maps were registered before digitizing their features. If necessary and when possible, the maps were reregistered until the root-mean-square (RMS) error of the transformation was equal to or less than 0.003 digitizer inches (approximately 0.08 millimeters). Maps that were scanned electronically could not be registered prior to digitizing. Features from these maps were transformed after initial editing.

All digitized features were transformed from digitizer inches directly into UTM coordinates. In theory, to minimize distortion, features should be transformed into the coordinate system of the source map (commonly polyconic) and then projected into UTM coordinates. In practice, for maps covering relatively small areas, the maximum distortion that results from transforming directly to UTM coordinates does not exceed 0.05 millimeters (Snyder, 1987, p. 127). For this study, this maximum potential error was within acceptable limits.

After map data are converted to coverages in a common coordinate system, they may be combined. Coverages from adjacent maps may be appended, or mosaicked, into a larger coverage. For this study, all final coverages are stored in units of meters referenced to the UTM, zone 11, coordinate system.

Digitizing Spatial Features

The maps used for the geologic, timber-type, and riparian-vegetation thematic layers required no preparation prior to digitizing. The maps used for the soils thematic layer were available only on folded paper. Prior to digitizing, the maps were heated and smoothed using a household clothing iron. This process removed most of the paper creases and introduced minimal paper distortion.

The TRPA natural-hazards map and three of the soils maps were unsuitable for automatic scanning. These maps were digitized manually by following techniques described by the Environmental Systems Research Institute (1989), the developer of the ARC/INFO software.

The remaining map sheets for the geologic, soils, timber-type, and riparian-vegetation layers were scanned electronically at a resolution of 300 dots per inch. The scanner generated raster-format files, which were converted automatically to a vector format. The vector files contained point-to-point coordinates in digitizer inches. Techniques for operation of the scanner and conversion software are described in a manual by Soller and others (1990).

For each thematic layer, several test areas on a representative map were selected and scanned. Scanner settings were adjusted to minimize the number of undesired spatial features, such as unwanted cartographic features and shading patterns, and to maximize the continuity of linework and positional fidelity of the scanned product to the source map.

Most of the maps were scanned twice, without changing the registration, prior to removal from the scanner. For one of the scans, settings were adjusted to produce the best set of single arcs. For the other scan, settings were adjusted to produce a set of two parallel arcs, corresponding to the outer edge of each line on the source map. The resulting "hollow-line" coverage contains information about the source linework that can aid in adjusting the vectorized coordinates of its single-line counterpart.

Editing Digital Spatial Data

The coverages derived from thematic maps were edited for continuity and spatial positioning by using ARC/INFO. Scanned coverages also were edited to remove unwanted spatial features that were not pertinent to the thematic layer and scanning artifacts (such

Table 6. Spatial data bases developed from thematic maps, digital data, and hydrographic data

[DEM, Digital Elevation Model; DLG, Digital Line Graph; Do. or do., ditto; GIS, geographic information system; LWQCB, Lahontan Water Quality Control Board; NDEP, Nevada Division of Environmental Protection; PLSS, Public Land Survey System (township-range grid, including section lines); SCS, U.S. Soil Conservation Service; TRPA, Tahoe Regional Planning Agency; USFS, U.S. Forest Service; USGS, U.S. Geological Survey]

GIS coverage		Description of contents of data base	
Name	Type	Information type	Derivation
Thematic source maps			
GEOL_COMP	Polygon	Areal geology	Composited from digital data bases developed from maps by Thompson and White (1964); Bonham and Burnett (1976); Loomis (1981); Armin and John (1983); Armin and others (1984); and Grose (1985, 1986); and from TRPA natural-hazards maps (Tahoe Regional Planning Agency, written commun., 1989). (See fig. 4 and table 1 for information on coverage of individual source maps.)
GEOL_COMP_LIN	Line	Geologic linear features.	Do.
GEOL_TRPA	Polygon	Areal geology	Digitized from TRPA natural-hazards maps (Tahoe Regional Planning Agency, written commun., 1989).
GEOL_TRPA_LIN	Line	do	Do.
LAND_CAP	Polygon	Land capability	Derived from soil-survey GIS by aggregating SCS soil units (Bailey, 1974; Rogers, 1974). (See table 7.)
RIPARIAN_VEG	do	Riparian-vegetation units.	Digitized from U.S. Forest Service (Joseph Oden, written commun., 1990) riparian-vegetation maps.
SOIL	do	Soil-survey units	Digitized from SCS soil-survey maps (Rogers, 1974).
TIMBER_TYPE	do	Timber-type units	Digitized from U.S. Forest Service (Joseph Oden, written commun., 1989) timber-classification maps.
Digital source data			
CHANNEL	Line	Stream channels and canals.	Derived from DLG hydrography file.
COUNTY	do	County boundaries	Derived from DLG boundaries file.
LAND_ASPECT	Polygon	Land-aspect zones	Derived from USGS DEM files and processed in raster format.
LAND_SLOPE	do	Land-slope zones	Do.
PLSS	Line	Public Land Survey System.	Derived from DLG PLSS file.
ROAD	do	Roads and trails	Derived from DLG transportation file.
STATE_LINE	do	State boundaries	Derived from DLG boundaries file.
TAHOE_LAKE	Polygon	Lake Tahoe shoreline.	Derived from DLG hydrography file.
WATER_BODY	do	Water bodies other than Lake Tahoe.	Do.

Table 6. Spatial data bases developed from thematic maps, digital data, and hydrographic data—Continued

GIS coverage		Description of contents of data base	
Name	Type	Information type	Derivation
		Hydrographic source data	
BOUND_BASIN.....	Polygon...	Lake Tahoe basin boundary.	Digitized from drainage-basin delineation on 1:24,000-scale topographic maps.
BOUND_OUTER.....	...do.....	Outermost extent of combined Lake Tahoe basin and TRPA administrative boundaries.	Derived from BOUND_BASIN and BOUND_TRPA GIS coverages.
BOUND_TRPA......	...do.....	TRPA administrative boundary.	Digitized from drainage-basin delineation on 1:24,000-scale topographic maps and adjusted by using PLSS and COUNTY spatial data bases.
HYD_BASIN.......	...do.....	Hydrologic drainage-basin boundaries.	Digitized from drainage-basin delineation on 1:24,000-scale topographic maps.
MONITOR_SITE....	Point.....	Hydrologic-monitoring sites.	Compiled from records from LWQCB, NDEP, SCS, USFS, and USGS.

as false linework from shaded areas on the map or feature labels). Arcs were selected manually by using a graphic-interface device, such as an electronic mouse or cursor, or automatically by using computer routines written in the Arc Macro Language (AML). Macro routines identified coverage arcs by using topological characteristics such as arc length, number of intersecting arcs, and adjacency to closed or open polygons. The macro routines were designed to decrease processing time and increase efficiency of cleaning large coverages that were created by using electronic scanners (Cartier, 1992).

Verification plots of each coverage were created at original scale on stable-base mylar film by using 0.3-millimeter ink pens. The verification plots were overlaid on the source map and visually examined for accuracy according to the criterion described by Campbell and Mortenson (1989). Corrections were made to the coverage where an ink-free space could be detected between the map and verification plot and the error exceeded 0.3 millimeters.

Coverages created by electronic scanning also were verified by using a computer monitor. Each coverage was compared with its corresponding hollow-line coverage. Linework was corrected wherever it lay outside the hollow lines or formed webbing patterns. These webs are a common artifact of scanning and vectorizing, especially near multiple-line intersections or where lines join at an angle of less than 10 degrees.

Further processing of the thematic coverages included replacing the scanned water-body boundaries with those derived from the DLG files and adding a boundary arc for the Lake Tahoe basin. These standardized arcs were used in the coverages so that the coordinates for water bodies and the Lake Tahoe basin would be identical on each thematic layer. First, the scanned linework for water bodies was removed by selecting and deleting the unwanted arcs interactively. Arcs from the DLG files then were added to the remaining arcs in the coverage. Where the standardized arcs did not join with the scanned linework, connecting arcs were added. Where the linework from the thematic maps extended beyond the standardized basin boundary, the extensions were deleted. Where the standardized basin boundary was positioned beyond the linework of the thematic map, both the standardized and scanned arcs were preserved and the intervening polygon was assigned a null value.

After editing, including replacing the arcs for water bodies and the basin boundary, the 16 quadrangle-based coverages of each layer were appended to each other to form single thematic coverages for the entire basin. Along many of the coverage boundaries, the linework from adjacent maps was found to be misaligned. This discrepancy is a common consequence of merging adjacent maps. The process of resolving the discrepancies is referred to as edgematching (Nebert, 1989). Coverage edgematching was performed inter-

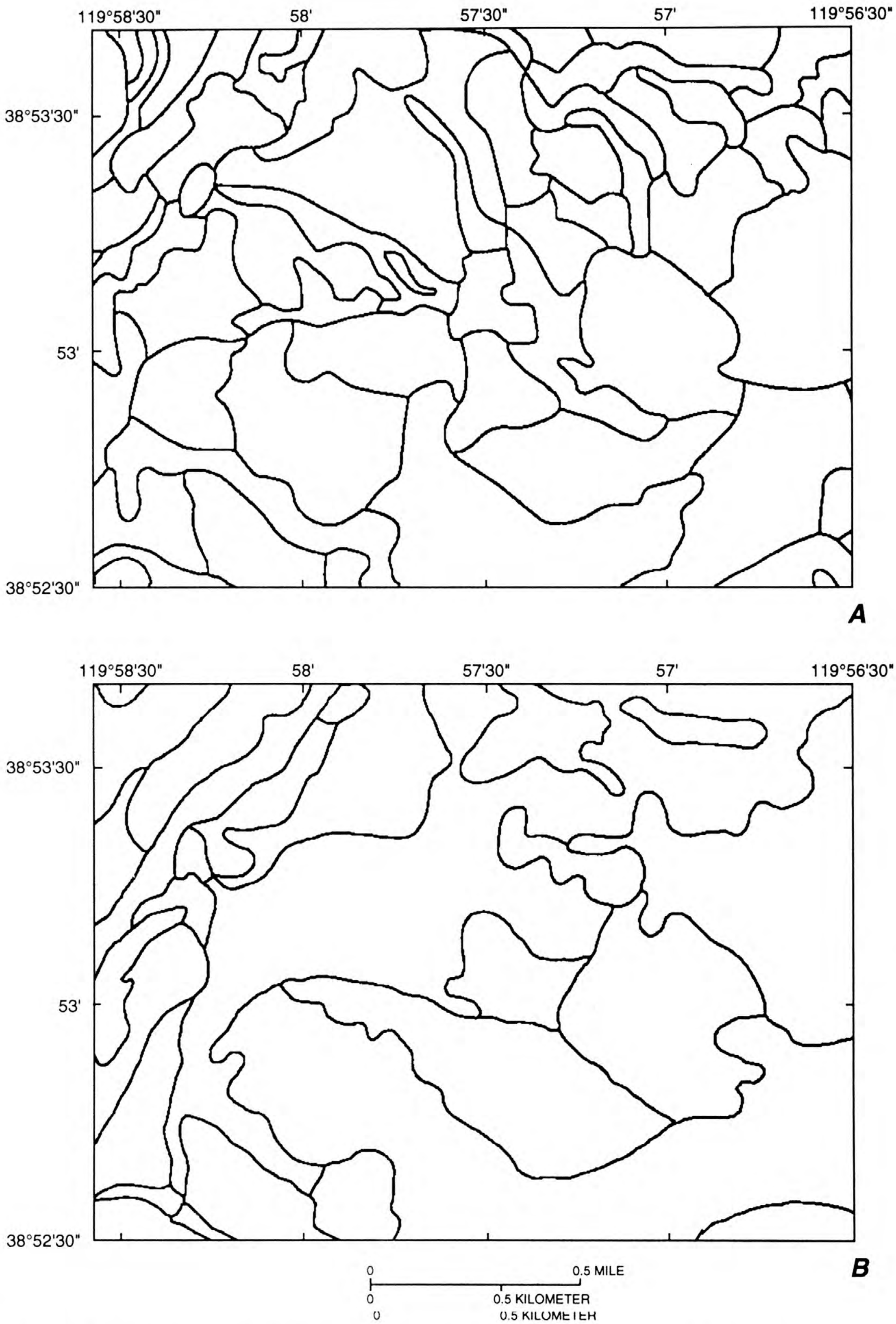


Figure 5. Example plots of digital maps developed from thematic source maps for part of South Lake Tahoe map quadrangle. Plots contain spatial features without feature labels and represent same geographic area and thematic layers as portrayed in figure 3. *A*, Data base from U.S. Forest Service timber-type map. *B*, Data base from U.S. Soil Conservation Service soil-survey map.

actively using the ArcEdit subsystem of ARC/INFO. The linework along the edges of adjacent maps was connected topologically by using the following rules:

(1) If the misalignment between connecting arcs was small (equivalent to less than 10 meters in UTM coordinates), the arcs were automatically joined, or snapped, to each other.

(2) If the misalignment was moderate (10 to 15 meters), the source maps were inspected to resolve the discrepancy. If the discrepancy could be resolved, the arcs were moved accordingly so that they matched.

(3) If the misalignment was large (greater than 15 meters) or if a discrepancy could not be resolved, the arcs were not moved and a connecting line was added between the two arc ends.

Assigning Attributes to Map Features

Attributes are the numeric and textual information associated with spatial features in a coverage. For example, map-unit codes for timber types (table 19; figure 3*A*) are attributes. Coverage features were assigned attribute values according to map units that were labeled on the source maps. The attribute data were verified by comparing scaled plots of the coverages to the source maps. Any necessary corrections were made to the coverage, and the verification procedure was repeated until no further errors were detected.

Attribute errors on the original maps included unknown or missing attribute labels for polygons, more than one attribute label per polygon, and adjacent polygons with the same attribute value. Attribute errors were identified for the digitized layers of geology, soil, timber type, and riparian vegetation. The number of errors ranged from 2 to 148 per layer for the entire study area. Polygon features having these errors were brought to the attention of the agency from which the original maps were obtained. A specialist within each organization determined the correct attribute values for mislabeled features, and coverages were updated accordingly.

Deriving Land-Capability Classification

The land-capability layer was derived from the digitized SCS soil-survey maps according to criteria specified by Bailey (1974). Each of the 49 types of soils was assigned to one of 9 types of land capability. Polygons of soil units that had the same land capability were merged to create the coverage called LAND_CAP. The system of land-capability classification and corresponding SCS soil-unit symbols are shown in table 7.

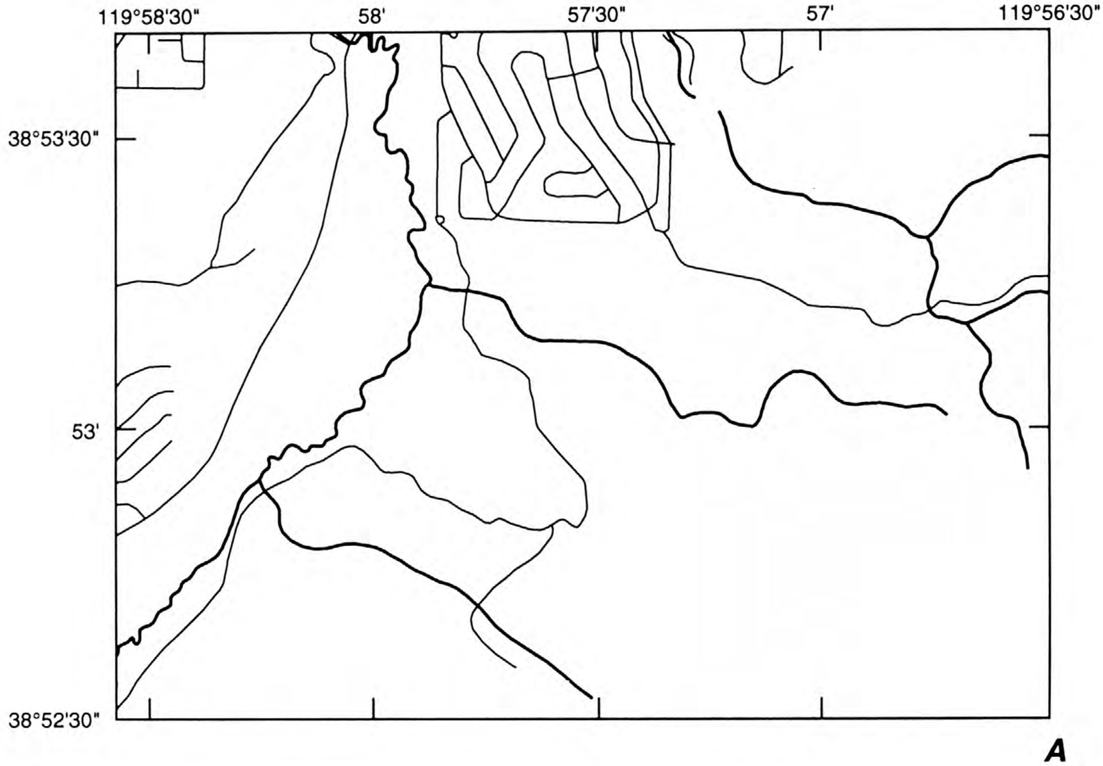
Development of Digital Data

Nine coverages of planimetric data were derived from DLG or DEM files. The seven coverages derived from DLG files are CHANNEL (stream channels and canals), COUNTY (county boundaries), PLSS (Public Land Survey System), ROAD (roads and trails), STATE_LINE (California–Nevada State line), TAHOE_LAKE (Lake Tahoe boundary), and WATERBODY (boundaries of water bodies other than Lake Tahoe). The two coverages derived from DEM files are LAND_SLOPE (slope classes) and LAND_ASPECT (aspect classes). Examples of some of the coverages derived from DLG and DEM files for part of the South Lake Tahoe, Calif. and Nev., map quadrangle are shown in figure 6.

Table 7. Cross-reference for land-capability types and U.S. Soil Conservation Service soil units

[Modified from Bailey (1974, p. 29-32). See table 18 for explanation of U.S. Soil Conservation Service soil-unit codes. --, not applicable]

Land capability: Class	Land capability: Subclass	Corresponding U.S. Soil Conservation Service soil-unit codes
1	1a	CaF, GsF, MsE, MsG, MtE, MtG, RcF, RcG, RtF, RtG, ShE, SkF, TeG, TmE, TmF, TrE, TrF, UmF, WaF, WcF.
	1b	Be, Co, Ev, Fd, Gr, Lo, Mh.
	1c	MxE, MxF, Px, Ra, Rx, Sm.
2	--	CaE, JwF.
3	--	FuE, JaD, JbD, JeD, MkD, MsD, TeE, UmE, WaE, WcE.
4	--	CaD, EbE, EcE, GeD, IsD, IsE, JwE.
5	--	FuD, IgB, JaC, JeB, JgC, JhC, MkB, MmB, TcB, TcC, TdD, TkC, UmD.
6	--	EbC, GeC, IsC, JtD, JwD, TaD, TbD.
7	--	EfB.



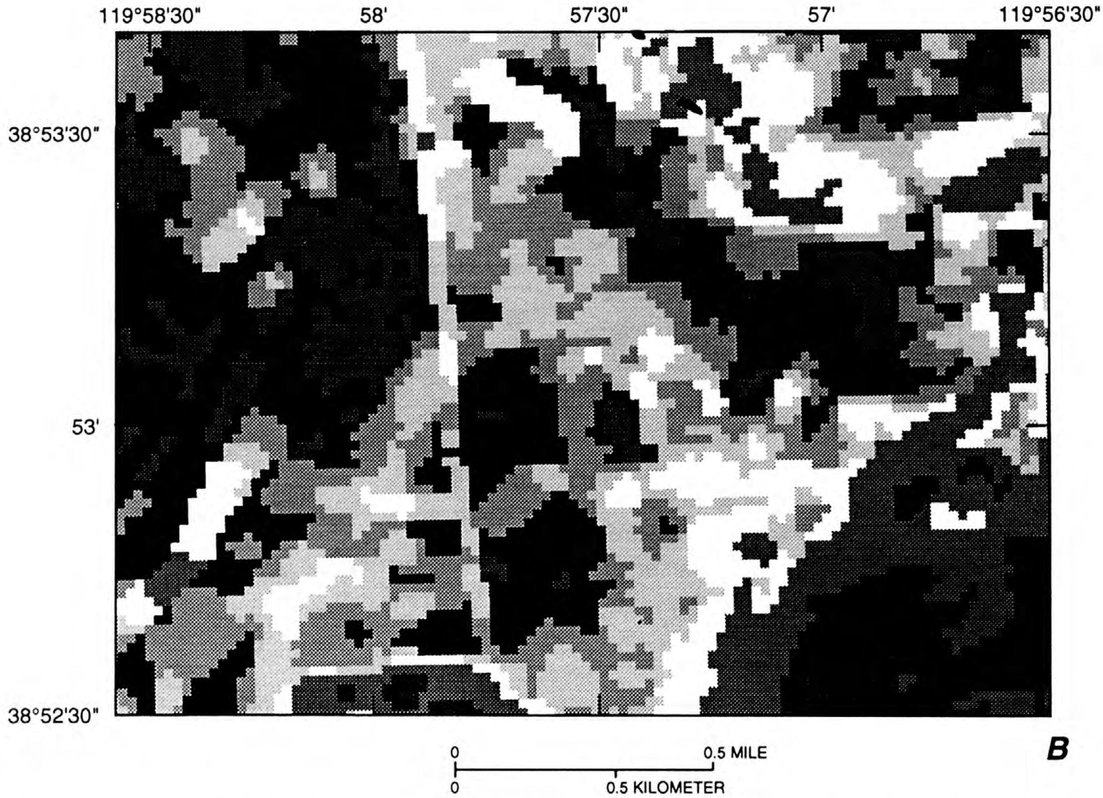


Figure 6. Example plots of spatial data bases derived from Digital Line Graph and Digital Elevation Model files. Plots cover part of South Lake Tahoe map quadrangle and represent same geographic area as portrayed in figures 3 and 5. *A*, Road and channel data bases from transportation and hydrography Digital Line Graph files. Thicker lines represent streams, and thinner lines, roads. *B*, Slope data base from Digital Elevation Model files. Shade patterns indicate slope categories.

Planimetric-Base Features

The DLG files were converted into coverages by using ARC/INFO software. The coverages COUNTY and STATE_LINE were derived from the DLG boundaries files. The coverages CHANNEL, TAHOE_LAKE, and WATERBODY were derived from the DLG hydrography file. The coverage PLSS was derived from the DLG Public Land Survey System files.

For each layer, 16 individual coverages, 1 for each map quadrangle, were appended into a single basinwide coverage. When discrepancies were found between coverage arcs on adjacent coverages, the arcs were connected using the predefined set of rules described in the section titled "Editing Digital Spatial Data."

Two additional modifications were made to the stream-channel coverage (CHANNEL). First, the coding for the beginning and ending of arcs was adjusted to indicate the true down-gradient direction. Second, arcs were added to connect stream channels across water-body polygons. These connecting arcs create linear continuity, which is useful for hydrologic investigations such as streamflow routing.

Slope and Aspect

Sixteen DEM files were used to generate coverages of aspect and slope for the Lake Tahoe basin, 11 from UTM zone 10 and 5 from UTM zone 11. The DEM is a digital representation of the irregular surface of the Earth. The inclination of a surface at a given point has two components, slope (steepness) and aspect (compass direction).

The DEM data were processed by using raster techniques available through NASA's ELAS system (Beverley and Penton, 1989). ELAS is a 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.

Initial mosaicking of a few DEM files was accomplished in part by using ARC/INFO software. The size of each DEM data file ranged from 473 to 475 rows and 374 to 376 columns. Only DEM files in the same UTM zone were merged and processed together. The mosaicking process was limited to a maximum of four DEM files, in blocks of two wide by two high. Each mosaic then was converted to ARC/INFO's single-variable file (SVF) format structure. This file type then was converted to ELAS file structure.

Once in ELAS format, the files were merged into larger mosaic files. The two UTM zones, 10 and 11, are separated by the 120-degree meridian of longitude. The 11 files for areas west of long 120°W. (UTM zone 10) were mosaicked and processed together. Three of the five files for areas east of long 120°W. (UTM zone 11) were mosaicked and processed together. The Freel Peak map quadrangle is east of long 120°W., but the corresponding DEM file was available only in UTM zone 10 coordinates. Because of this anomaly, the files for the Freel Peak area and the Carson Pass area (south of Freel Peak) could not be mosaicked with files for neighboring areas and were processed separately.

A number of 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. The method uses a three-by-three window around each cell, or elevation value, in the grid, comparing the center cell with its eight neighbors. 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. Slope is calculated on the basis of cell size and the difference in elevation values between the center cell and its neighbor in that steepest direction.

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

Classes for slope were set as follows: 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, >50 to 100 percent, and >100 percent. These ranges were selected in order to satisfy requirements of land-use permitting, modeling, and resources management for the Lake Tahoe basin (Deborah Reed, Washoe County Department of Comprehensive Planning, oral commun., 1992).

Nominal filtering was performed on the raster files of slope and aspect. This filtering technique selectively replaces a cell value with a neighboring cell's value if there are not a minimum number of adjacent cells having the same value. The nominal number of cells, set to three, defines the minimum mapping unit to be 0.27 hectare. This process significantly reduced the number of polygons in the final coverage while changing relatively few cells.

Raster techniques that use a window around a central cell do not compute values along the edges—the top and bottom rows and the left and right columns of the array. These cells simply do not have enough neighbors. Because part of the window does not contain valid data, the resulting value for the central cell is null or undefined. If two such raster files are joined along a common edge, the result is a gap of two cells that contain null data.

The raster files of slope and aspect were transferred to ARC/INFO, in SVF format, for further processing. These files were converted into ARC/INFO coverages. Coverages in UTM zone 10 coordinates were projected into UTM zone 11 coordinates. Once all coverages were in the same map projection, they were appended together and edgematched. After appending, gaps of null data existed along edges where coverages were joined. These gaps were filled in with arcs that enclosed areas of the same class on each side of the gap.

Development of Hydrographic Data

Four coverages (BOUND_BASIN, BOUND_OUTER, BOUND_TRPA, and HYD_BASIN) were derived from overlays drawn on topographic maps. One coverage (MONITOR_SITE) was derived from records of hydrologic-monitoring sites.

Development of Drainage-Basin Boundaries

Drainage divides, which define the boundaries of drainage basins and subbasins, were delineated on mylar overlays of 1:24,000-scale topographic maps. The divides were identified for all subbasins above mapped stream confluences, above stream inflows to water bodies, and above selected hydrologic-monitoring sites. The delineations were based on interpretation of the shape of the mapped topographic contour lines and the location of hydrographic features. The drafted lines were verified by two hydrologists. The contour interval on most of the maps was 40 feet (12 meters). In areas of relatively low gradient, such as the South Lake Tahoe area, the contour interval was 20 feet (6.1 meters).

The drainage-basin boundaries were digitized manually, labeled, and verified by the techniques used for thematic maps as described in the section "Development of Thematic Maps." The HYD_BASIN coverage contains all the drainage-basin boundaries that have been delineated for the Lake Tahoe basin.

Three coverages were developed for the boundary of the Lake Tahoe basin. The BOUND_BASIN coverage contains the drainage-basin boundary for the Lake Tahoe basin above the outflow of Lake Tahoe. To match the TRPA administrative boundary, the BOUND_TRPA coverage was modified from the BOUND_BASIN coverage by replacing part of the drainage-basin boundary with data from the PLSS and COUNTY coverages. These modifications altered the basin boundary to comply with U.S. Public Law 96-551, by which Congress legislated the TRPA's jurisdiction. The BOUND_OUTER coverage contains data for the outer boundary of the Lake Tahoe basin and the administrative boundary of TRPA. The coverage was derived by merging the BOUND_BASIN and BOUND_TRPA coverages and then eliminating internal lines where discrepancies exist.

Development of Hydrologic-Monitoring Sites

Federal, State, and local agencies were contacted regarding hydrologic data collection in the Lake Tahoe basin. Agencies having active hydrologic programs evaluated each of their monitoring sites for data quality and significance. The agencies considered the completeness and duration of record as well as the hydrologic significance of each site, and determined which monitoring sites were to be included in the GIS data base. The USGS used the following criteria: (1) The site has at least 3 years of record, (2) the site has a current or historically important period of record, and (3) the site has a record of continuous measurements for at least part of the period of record. The agencies also evaluated each of the surface-water monitoring sites for inclusion in a list of sites for delineation of drainage divides.

For this study, the five agencies tabulated the following information for each site: site identification number; descriptive title; site elevation; period of record, in calendar years; site type, such as surface water, ground water, or lake; and sampling methods. Site locations were provided either digitally (as latitude/longitude coordinates) or marked on 1:24,000-scale topographic maps.

The site-description lists were entered into a relational data base within ARC/INFO and then were used to generate a GIS coverage of point locations. Sites that were marked on topographic maps were digitized manually. The point locations for surface-water sites were compared to the hydrographic-channel coverage and moved to the nearest line segment for the sampled stream channel. The tabular listing of the monitoring-site locations was updated to reflect these adjustments. These records were verified twice by the data-collection agencies.

DOCUMENTATION OF SPATIAL DATA BASES

Summary information for the thematic layers (geology, hydrologic basins, aspect, slope, land capability, monitoring sites, riparian vegetation, soil, and timber type) developed in the TEGIS project is given in tables 8 through 19. This information includes coverage name, source agency, source-map scale, and a statistical description of the feature attributes. For polygon coverages, the statistical description for each map unit bearing a unique symbol includes the number of noncontiguous occurrences, the basinwide total area and mean area, and the areas of the largest and smallest noncontiguous occurrences. For line coverages, the feature labels correspond to cartographic labels for linear features on the source maps and the statistical summary contains information on the lengths of each feature.

Because map symbols for geology are not consistent among the various source maps, the descriptions of geologic map units include an abbreviated name for the map quadrangle from which they were derived. For further information on the source maps used to compile the digital geologic layer, see table 1 and figure 4.

The accuracy, resolution, and other characteristics of the final coverages depend on both the characteristics of the source data and the processes used for digitizing the data. Information on the data sources and resulting spatial data bases is summarized in table 20.

SUMMARY

Twenty-two spatial data bases were developed for the Lake Tahoe basin as part of the Tahoe Environmental Geographic Information System (TEGIS) project. The data bases were created by using the ARC/INFO vector-based and the ELAS raster-based geographic information systems. The spatial data bases are stored as ARC/INFO coverages, in units of the UTM (zone 11) coordinate system.

The TEGIS spatial data bases were generated from three main sources of geographic information: thematic maps, hydrographic data records, and digital data files. Source data were incorporated by manual digitizing, electronic scanning, or data conversion. Extensive quality-control practices were followed in converting the source information into digital form.

The TEGIS coverages consist of spatial coordinates and attribute data for the following layers:

- Basin boundaries—physical boundary of the basin, TRPA administrative boundary, and the composite outermost of these two boundaries;
- Geology—areal geology and linear geologic features from the TRPA natural-hazards map and from the composite of the largest scale geologic mapping;
- Other thematic data—soil units, timber type, riparian vegetation, and land capability;
- Hydrographic data—drainage-basin boundaries and hydrologic-monitoring sites;
- DLG digital data—State and county boundaries, roads and trails, Public Land Survey System, stream channels and canals, and boundaries of Lake Tahoe and other water bodies; and
- DEM digital data—slope and aspect.

Documentation for and summary information about the spatial data bases include detailed descriptions of all the coverages and brief statistical descriptions of the natural-resources coverages.

REFERENCES CITED

Armin, R.A., and John, D.A., 1983, Geologic map of the Freel Peak 15-minute quadrangle, California and Nevada: U.S. Geological Survey Miscellaneous Investigations Series Map I–1424, scale 1:62,500.

Armin, R.A., John, D.A., and Moore, W.J., 1984, Geologic map of the Markleeville 15-minute quadrangle, Alpine County, California, *with* Quaternary geology, by J.C. Dohrenwend: U.S. Geological Survey Miscellaneous Investigations Series Map I–1474, scale 1:62,500.

Bailey, R.G., 1974, Land-capability classification of the Lake Tahoe basin, California–Nevada—A guide for planning: U.S. Forest Service and Tahoe Regional Planning Agency, 32 p. [available from National Technical Information Service, Springfield, VA 22161 as NTIS Report PB82-163429].

Beverley, A.M., and Penton, P.G., eds., 1989, ELAS, Science and Technology Laboratory Applications Software—Vol. II, User Reference: National Aeronautics and Space Administration, John C. Stennis Space Center, Science and Technology Laboratory Report 183.

Bonham, H.F., Jr., and Burnett, J.L., 1976, Geologic map of the South Lake Tahoe quadrangle, California–Nevada: Nevada Bureau of Mines and Geology Urban Map Series, South Lake Tahoe Folio Map 2Ag, scale 1:24,000.

Burnett, J.L., 1971, Geology of the Lake Tahoe basin: California Geology, v. 24, no. 7, p. 119–127.

Campbell, W.G., and Mortenson, D.C., 1989, Ensuring the quality of geographic information system data—A practical application of quality control: Photogrammetric Engineering and Remote Sensing, v. 55, no. 11, p. 1613–1618.

Cartier, K.D., 1992, Macros for editing geographic information system spatial data bases [abs.], *in* Balthrop, B.H. and Baker, E.G., compilers, U.S. Geological Survey National Computer Technology Meeting—Program and Abstracts, Norfolk, Virginia, May 17-22, 1992: U.S. Geological Survey Open-File Report 92–64, p. 4.

Eisenhuth, H.P., 1968, Index of surface-water records to September 30, 1967—Pt. 10, The Great Basin: U.S. Geological Survey Circular 580, 37 p.

Environmental Systems Research Institute, 1989, ARC/INFO—Users guide: Environmental Systems Research Institute, Redlands, Calif., 7 volumes.

Grose, T.L.T., 1985, Geologic map of the Glenbrook quadrangle, Nevada: Nevada Bureau of Mines and Geology Urban Map Series, Glenbrook Folio Map 2Bg, scale 1:24,000.

-----1986, Geologic map of the Marlette Lake quadrangle, Nevada: Nevada Bureau of Mines and Geology Urban Map Series, Marlette Folio Map 2Cg, scale 1:24,000.

Jorgensen, L.N., Seacer, A.L, and Kaus, S.J., 1978, Hydrologic basins contributing to outflow from Lake Tahoe, California–Nevada: U.S. Geological Survey Hydrologic Investigations Atlas HA–587, scale 1:62,500.

Loomis, A.A., 1981, Geology of the Fallen Leaf Lake quadrangle, El Dorado County, California: California Division of Mines and Geology, scale 1:62,500.

Nebert, D.D., 1989, Review of edgematching procedures for digital cartographic data used in geographic information systems: U.S. Geological Survey Open-File Report 89–579, 12 p.

Rogers, J.H., 1974, Soil survey—Tahoe basin area, California and Nevada: U.S. Soil Conservation Service, 184 p.

Skidmore, A.K., 1989, A comparison of techniques for calculating gradient and aspect from a gridded digital elevation model: International Journal of Geographical Information Systems, v. 3, no. 4, p. 323–334.

Snyder, J.P., 1987, Map projections—A working manual: U.S. Geological Survey Professional Paper 1395, 383 p.

Soller, D.R., Stettner W.R., Lanfear, K.J., and Aitken, D.A., 1990, A user's manual for a method of map scanning and digital editing for thematic map production and data-base construction: U.S. Geological Survey Circular 1054, 38 p.

Thompson, G.A., and White, D.E., 1964, Regional geology of the Steamboat Springs area, Washoe County, Nev.: U.S. Geological Survey Professional Paper 458–A, 52 p.

U.S. Geological Survey, 1986, National mapping program technical instructions—Data users guide 1, Digital Line Graphs from 1:24,000-scale maps: U.S. Geological Survey, 109 p.

-----1987, National mapping program technical instructions—Data users guide 5, Digital Elevation Models: U.S. Geological Survey, 38 p.

TABLES 8–20

Table 8. Summary documentation for spatial data base GEOL_COMP in Tahoe Environmental Geographic Information System

Description of coverage: Composite polygon coverage of geology derived from digital data bases
Storage format: ARC/INFO
Data source: Digitized from eight geologic and related thematic maps (table 1)
Source scales: From 1:24,000 to 1:125,000

[Geologic or other map unit: Geologic symbols, unit descriptions or formation names, and age information are as used by authors of cited references and do not necessarily meet U.S. Geological Survey standards. Geologic map units are listed in alphanumeric order (not chronologically) by map-unit symbol within geologic age groups, which are in order from youngest to oldest. Description: Applies to separate precompilation units if more than one description for given map-unit symbol. Geologic units having no age information and other, nongeologic, units are listed as other map units at end of table. Map-quadrangle names are abbreviated as follows: CLK, Caples Lake, Calif.; CPS, Carson Pass, Calif.; EBY, Emerald Bay, Calif.; ELK, Echo Lake, Calif.; FPK, Freel Peak, Calif.; GBK, Glenbrook, Nev.; HWD, Homewood, Calif.; KBH, Kings Beach, Calif. and Nev.; MBY, Meeks Bay, Calif. and Nev.; MLK, Marlette Lake, Nev.; MPK, Martis Peak, Calif. and Nev.; MRS, Mount Rose, Nev.; PPK, Pyramid Peak, Calif.; RBV, Rockbound Valley, Calif.; SLT, South Lake Tahoe, Calif. and Nev.; TCY, Tahoe City, Calif. Do. or do., ditto; --, not applicable]

Geologic or other map unit		Occurrences					Relevant digitized 1:24,000-scale topographic-map quadrangles
			Area (square meters)				
Symbol	Description	Total number basinwide	Basinwide total	Mean	Minimum	Maximum	
Quaternary units							
Qa	Sand and gravel alluvium[1,2]	20	1,645,802	82,290	11,116	747,781	GBK, MLK.
Qac	Carbonaceous alluvium[1]	4	223,796	55,949	31,277	111,027	GBK.
Qal	Lake and stream sediments, undifferentiated[3]	26	32,821,947	1,262,383	2,509	26,484,126	EBY, ELK, PPK, RBV.
	Lake and stream deposits[4]						MRS.
	Alluvial deposits[5]						SLT.
	Alluvium[6]						CLK, HWD, KBH, MBY, MPK, TCY.
Qb	Beach deposits[5]	14	1,007,589	71,971	87	389,228	SLT.
	Beach sand[1,2]						GBK, MLK.
Qb3	Beach deposits of Tioga age[5]	1	439,236	--	--	--	SLT.
Qbo	Older beach sand[2]	1	111,475	--	--	--	MLK.
Qc	Sand and boulder colluvium[1,2]	25	4,586,091	183,444	11,931	1,085,285	GBK, MLK.
Qf3	Younger alluvial-fan deposits[7]	9	1,601,599	177,955	9,268	514,232	FPK.
	Fluvial deposits of Tioga age[5]						SLT.

Qf5	Fluvial deposits of pre-Tahoe age[5]..................	5	1,986,223	397,245	6,967	1,303,224	SLT.
Qfl1	Flood-plain and lacustrine deposits[5]................	5	4,441,735	888,347	275	3,036,417	Do.
Qfl2	...do...	5	3,379,459	675,892	13,614	1,995,255	Do.
Qfp	Flood-plain deposits[7]..............................	1	577,766	--	--	--	FPK.
Qfy	Younger alluvial-fan deposits[8]......................	1	97,557	--	--	--	CPS.
Qg	Glacial outwash, undifferentiated[5]..................	7	16,126,931	2,303,847	4,535	8,234,586	SLT.
	Glacial outwash[6]..................................						CLK, HWD, KBH, MBY, MPK, TCY.
Qg5	Glacial outwash of pre-Tahoe age[5]...................	4	1,860,554	465,139	96,746	891,863	SLT.
Ql	Lake and stream deposits[4]...........................	24	13,763,610	573,484	4,385	6,052,741	MRS.
	Lacustrine deposits[5]...............................						SLT.
	Older lake beds[6]..................................						CLK, HWD, KBH, MBY, MPK, TCY.
Qlo	Older lake sediments[6]..............................	7	1,319,980	188,569	39,171	740,015	CLK, HWD, KBH, MBY, MPK, TCY.
Qlo+Qg	Older lake/glacial outwash[6].........................	3	7,926,886	2,642,295	348,821	4,091,445	CLK, HWD, KBH, MBY, MPK, TCY.
Qls	Landslide and rockfall deposits[5]....................	8	1,353,053	169,132	6,641	735,602	SLT.
	Landslide debris[1].................................						GBK.
	Landslide, rockfalls, and mudflows[6].................						CLK, HWD, KBH, MBY, MPK, TCY.
Qm	Glacial deposits, undifferentiated[4].................	16	47,350,181	2,959,386	9,589	38,087,520	MRS.
	Glacial moraine and outwash gravels[3]................						EBY, ELK, PPK, RBV.
	Moraine deposits, undivided[7]........................						FPK.
	Glacial till, undifferentiated[5].....................						SLT.
	Glacial-moraine deposits, undivided[8]................						CPS.
	Glacial moraines[6].................................						CLK, HWD, KBH, MBY, MPK, TCY.
Qm1	Older moraine deposits[7]............................	2	2,344,289	1,172,145	494,134	1,850,156	FPK.
	Sherwin Till[4].....................................						MRS.
Qm2	Younger moraine deposits[7]..........................	12	14,670,684	1,222,557	84,627	5,371,886	FPK.
	Tahoe Till[4].......................................						MRS.
Qm3	Tioga Till[4].......................................	10	47,652,504	4,765,250	1,685	35,315,115	MRS.
	Tioga till[5].......................................						SLT.
	Glacial moraine[6]..................................						CLK, HWD, KBH, MBY, MPK, TCY.

Table 8. Summary documentation for spatial data base GEOL_COMP in Tahoe Environmental Geographic Information System—Continued

Geologic or other map unit		Occurrences					Relevant digitized 1:24,000-scale topographic-map quadrangles
			Area (square meters)				
Symbol	Description	Total number basinwide	Basinwide total	Mean	Minimum	Maximum	
	Quaternary units--Continued						
Qm3-4	Glacial moraine[6]	1	218,280	--	--	--	CLK, HWD, KBH, MBY, MPK, TCY.
Qm4	Tahoe till[5]	4	10,866,614	2,716,654	74,290	7,541,526	SLT.
	Glacial moraine[6]						CLK, HWD, KBH, MBY, MPK, TCY.
Qm5	Pre-Tahoe till[5]	4	10,117,191	2,529,298	208,144	6,652,180	SLT.
Qmo	Older glacial-moraine deposits[8]	1	186,955	--	--	--	CPS.
Qoa	Older sandy gravel and gravelly sand alluvium[2]	2	2,307,844	1,153,922	701,753	1,606,091	MLK.
Qogl	Older outwash deposits[7]	4	1,751,442	437,860	79,110	857,325	FPK.
Qpl	Pre-Lake Lahontan deposits[4]	1	2,219,534	--	--	--	MRS.
Qt	Talus[2]	2	135,205	67,603	48,260	86,945	MLK.
Qta	Talus[6]	3	312,249	104,083	70,515	164,092	CLK, HWD, KBH, MBY, MPK, TCY.
Qtli	Lousetown Formation--Intrusion, basaltic andesite and basalt[4]	1	15,778	--	--	--	MRS.
Qv	Undifferentiated volcanic[6]	2	2,512,439	1,256,219	72,297	2,440,141	CLK, HWD, KBH, MBY, MPK, TCY.
Qvb	Basalt[6]	2	213,438	106,719	23,608	189,830	CLK, HWD, KBH, MBY, MPK, TCY.
Qvf	Valley-fill deposits[7]	16	2,533,946	158,372	14,360	1,053,096	FPK.
Qvi	Intrusive volcanic rocks, mainly latite[6]	4	24,879,822	6,219,955	105,469	14,335,075	CLK, HWD, KBH, MBY, MPK, TCY.
	Quaternary and (or) Tertiary units						
QTl	Lousetown Formation[4]	2	270,670	135,335	17,229	253,441	MRS.
QTli	Lousetown Formation--Intrusions[4]	3	48,360	16,120	4,936	22,716	Do.

	Tertiary units						
Ta	Andesite flows and minor breccias[8]	6	191,510	31,918	1,679	126,196	CPS.
Tav	Andesitic volcanic rocks, undivided[7]	5	1,545,144	309,029	29,158	670,575	FPK.
Tb	Basalt[2]	3	9,849	3,283	1,299	4,853	MLK.
Tba	Hornblende andesite flows and minor pyroxene-olivine basalt flows[2].	3	37,345	12,448	4,154	22,076	Do.
Tc	Conglomerate and breccia[2]	4	448,977	112,244	3,369	365,219	Do.
Tgt	Hornblende trachyte[1]	2	4,945,028	2,472,514	4,234	4,940,794	GBK.
Thl	Porphyritic hornblende-sanidine latite[1 2]	7	1,915,763	273,680	4,621	1,235,537	GBK, MLK.
Tia	Intrusive andesite, undivided[8]	2	32,123	16,062	2,057	30,066	CPS.
	Intrusive plug of basaltic andesite[5]						SLT.
Tk	Kate Peak Formation--Lavas, flow breccias, and tuff breccias[4].	11	10,932,881	993,898	13,896	3,418,509	MRS.
Tki	Kate Peak Formation--Intrusive rock[4]	2	51,417	25,708	11,100	40,317	Do.
Tkpa	Kate Peak Formation--Dacite flows[2]	1	11,521	--	--	--	MLK.
Tkpc	Kate Peak Formation--Conglomerate[2]	2	100,395	50,197	32,141	68,254	Do.
Trp	Relief Peak Formation[8]	1	5,636,227	--	--	--	CPS.
Tt	Lenihan Canyon Tuff[2]	4	476,753	119,188	5,591	261,943	MLK.
Tv	Undifferentiated volcanic rocks[6]	2	15,725	7,862	3,164	12,560	CLK, HWD, KBH, MBY, MPK, TCY.
Tva	Dominantly andesite breccias[3]	15	74,298,841	4,953,256	208	23,198,696	EBY, ELK, PPK, RBV.
	Andesite[4 6]						CLK, HWD, KBH, MBY, MPK, TCY.
Tvc	Dominantly epiclastic conglomerate and sandstone[3]	1	224,875	--	--	--	EBY, ELK, PPK, RBV.
Tvp	Pyroclastic rocks[6]	3	6,344,577	2,114,859	103,147	5,987,184	CLK, HWD, KBH, MBY, MPK, TCY.
Twt	Vitric-crystal tuff of White Hill[1]	1	796,664	--	--	--	GBK.

Table 8. Summary documentation for spatial data base GEOL_COMP in Tahoe Environmental Geographic Information System—Continued

Geologic or other map unit		Occurrences					Relevant digitized 1:24,000-scale topographic-map quadrangles
		Total number basinwide	Area (square meters)				
Symbol	Description		Basinwide total	Mean	Minimum	Maximum	
	Mesozoic units, undivided						
Mza	Alaskite[1]	1	167,264	--	--	--	GBK.
Mzag	Seriate aplitic granite to granodiorite[2]	5	5,070,534	1,014,107	57,555	2,718,338	MLK.
Mzgd	Hornblende granodiorite[2]	1	1,660,412	--	--	--	Do.
Mzmc	Metaconglomerate and metasandstone[1]	3	906,338	302,113	75,852	746,539	GBK.
Mzmd	Hornblende diorite of Montreal Canyon[1]	3	1,223,709	407,903	19,500	1,045,377	Do.
Mzms	Metasandstone[1]	1	200,896	--	--	--	Do.
Mzmv	Metamorphosed tuff and flows[1 2]	10	8,948,337	894,834	3,874	6,311,644	GBK, MLK.
Mznm	Biotite monzogranite of North Logan House Creek[1]	1	3,631,046	--	--	--	GBK.
Mzqs	Quartzofeldspathic schist[5]	1	1,037,868	--	--	--	SLT.
Mzsm	Biotite-hornblende monzogranite of Spooner Summit[1 2].	7	36,105,887	5,157,984	4,502	32,134,311	GBK, MLK.
	Cretaceous units						
Kal	Quartz diorite at Azure Lake[3]	1	839,240	--	--	--	EBY, ELK, PPK, RBV.
Kbl	Burnside Lake Adamellite of Parker[7]	1	3,126,646	--	--	--	FPK.
Kbm	Bryan Meadow Granodiorite[3 7]	11	59,469,329	5,406,303	12,428	30,733,403	EBY, ELK, FPK, PPK, RBV.
Kcf	Camper Flat Granodiorite[3]	3	2,854,166	951,389	6,718	2,839,260	EBY, ELK, PPK, RBV.
Kdi	Hornblende-biotite diorite[5]	1	125,007	--	--	--	SLT.
Kdl	Dicks Lake Granodiorite[3]	4	14,885,358	3,721,340	281	14,883,149	EBY, ELK, PPK, RBV.

Kdqm	Hornblende quartz monzonite and monzogranite[1]........	1	10,541,038	--	--	--	GBK.
Kdv	Desolation Valley Granodiorite[3]......................	4	411,534	102,884	3,858	256,503	EBY, ELK, PPK, RBV.
Kef	Noritic anorthosite and related rocks[3]..............	2	1,279,327	639,663	461,386	817,941	Do.
Kel	Echo Lake Granodiorite[3,7]...........................	13	18,472,917	1,420,994	117	4,837,715	EBY, ELK, FPK, PPK, RBV.
Kfp	Freel Peak Granodiorite[7]............................	4	13,873,688	3,468,422	14,988	13,699,088	CPS, FPK.
Kga	Glen Alpine Granodiorite[3]...........................	1	1,975,723	--	--	--	EBY, ELK, PPK, RBV.
Kgl	Quartz diorite of Grass Lake[7].......................	4	988,366	247,092	14,657	631,038	FPK.
Kgr	Granodiorite[5].......................................	10	19,351,180	1,935,118	3,469	19,085,121	SLT.
Kgrc	Granodiorite corestones[5]............................	32	1,897,154	59,286	2,768	1,237,575	Do.
Kgrd	Decomposed granodiorite[5]............................	4	43,362,398	10,840,600	10,985	43,134,338	Do.
Kgrg	Glaciated granodiorite[5].............................	3	579,047	193,016	6,421	362,439	Do.
Kgrm	Mafic granodiorite[5].................................	2	1,723,616	861,808	62,731	1,660,885	Do.
Kkd	Keiths Dome Quartz Monzonite[3].......................	18	14,647,810	813,767	184	14,197,245	EBY, ELK, PPK, RBV.
Kmdg	Miscellaneous diorites and gabbros[3].................	9	4,778,348	530,928	9,044	1,580,490	Do.
Kmg	Miscellaneous granitic rocks[3].......................	9	3,475,808	386,201	9,558	1,410,862	Do.
Kodg	Older diorite and gabbro[3]...........................	12	1,189,919	99,160	225	612,480	Do.
Kpp	Phipps Pass Granodiorite[3]...........................	7	14,551,265	2,078,752	5,752	14,303,061	Do.
Kqd	Quartz diorite and diorite[7].........................	4	881,114	220,279	4,836	664,279	FPK.
Krp	Alaskite at Rubicon Point[3]..........................	1	3,865,202	--	--	--	EBY, ELK, PPK, RBV.
Krv	Rockbound Valley Granodiorite[3]......................	1	8,062,533	--	--	--	EBY, ELK, PPK, RBV.
Kwp	Granodiorite of Waterhouse Peak[7]....................	1	18,707	--	--	--	FPK.
Kwpt	Tonalite west of Waterhouse Peak[7]...................	1	423,764	--	--	--	Do.

Table 8. Summary documentation for spatial data base GEOL_COMP in Tahoe Environmental Geographic Information System—Continued

Geologic or other map unit		Occurrences					Relevant digitized 1:24,000-scale topographic-map quadrangles
		Total number basinwide	Area (square meters)				
Symbol	Description		Basinwide total	Mean	Minimum	Maximum	
	Cretaceous units--Continued						
Kydg	Younger diorite and gabbro[3]	6	1,700,379	283,397	16,445	1,202,139	EBY, ELK, PPK, RBV.
Kzqm	Hornblende-biotite quartz monzodiorite and granodiorite of Zephyr Cove[1].	3	31,866,273	10,622,091	2,478,885	22,949,712	GBK.
	Jurassic and (or) Triassic units						
JTRaf	Basalt and pyroxene andesite flows[3]	8	2,272,111	284,014	14,160	728,839	EBY, ELK, PPK, RBV.
JTRbr	Tuff breccias[3]	15	10,805,696	720,380	6,585	5,415,647	Do.
JTRcgl	Interbedded pebble and cobble conglomerate[3]	6	2,848,079	474,680	9,723	1,428,209	Do.
JTRgm	Pyritic, graphitic mudstones[3]	2	1,938,974	969,487	187,494	1,751,480	Do.
JTRms	Miscellaneous metasedimentary rocks[3]	13	2,378,089	182,930	1,304	1,112,029	Do.
	Metasedimentary rocks[7]						FPK.
JTRs	Tuffs and tuffaceous sandstones[3]	6	3,034,108	505,685	611	1,263,533	EBY, ELK, PPK, RBV.
JTRss	Thin-bedded sandstones and siltstones[3]	4	1,246,870	311,717	34,813	510,200	Do.
	Other map units						
af	Artificial fill[5]	1	270,956	--	--	--	SLT.
ap	Aplite and (minor) pegmatites[3]	32	480,143	15,004	2,512	49,588	EBY, ELK, PPK, RBV.
bd	Basalt dikes in granitic rocks[3]	5	105,858	21,172	7,290	39,683	Do.
di	Intrusive rocks (diorite)[6]	1	4,026	--	--	--	CLK, HWD, KBH, MBY, MPK, TCY.
gd	Granodiorite[4]	6	23,972,976	3,995,496	15,415	11,310,730	MRS.
gr,grd	Granitic rocks[6]	6	28,616,746	4,088,106	44,090	16,734,161	CLK, HWD, KBH, MBY, MPK, TCY.

m	Undifferentiated metamorphic rocks[6]	3	401,962	133,987	33,552	311,388	CLK, HWD, KBH, MBY, MPK, TCY.
md	Mafic dikes in roof remnant[3]	21	400,293	19,062	121	79,576	EBY, ELK, PPK, RBV.
ms	Metasedimentary rocks[6]	2	5,070,549	2,535,275	273,355	4,797,195	CLK, HWD, KBH, MBY, MPK, TCY.
ND	No data[6 9]	5	18,964,293	3,792,859	14,304	17,707,041	CLK, HWD, KBH, MBY, MPK, TCY.
NM	Not mapped[10]	20	1,076,627,616	53,831,381	125	331,769,101	CLK, HWD, KBH, MBY, MPK, TCY.
qu	Quarry[5]	3	23,678	7,893	4,332	13,102	SLT.
WBDY	Water body	389	512,924,631	1,318,572	145	282,936,951	All 16 map quadrangles.

[1]Grose (1985).
[2]Grose (1986).
[3]Loomis (1981).
[4]Thompson and White (1964).
[5]Bonham and Burnett (1976).
[6]Tahoe Regional Planning Agency natural-hazards map (Tahoe Regional Planning Agency, written commun., 1990).
[7]Armin and John (1983).
[8]Armin and others, (1984).
[9]No data shown on source map.
[10]Outside basin boundary.

Table 9. Summary documentation for spatial data base GEOL_COMP_LIN in Tahoe Environmental Geographic Information System

Description of coverage: Composite line coverage of linear geologic features

Storage format: ARC/INFO

Data source: Digitized from eight geologic and related thematic maps (table 1)

Source scales: From 1:24,000 to 1:125,000

[Linear geologic feature: Symbol explanations are as used by authors of cited references and do not necessarily conform to U.S. Geological Survey usage]

Linear geologic feature		Occurrences				
			Length (meters)			
Symbol	Explanation	Total number basinwide	Basinwide total	Mean	Minimum	Maximum
FLT.........	Fault..................	34	26,112	768	6	2,164
FLT-INTRP...	Interpretive fault.....	88	90,005	1,023	27	3,506
FLT-CNCLD...	Concealed fault........	65	112,812	1,736	50	26,797
MOR.........	Moraine crest..........	40	33,265	832	256	3,557
DIKE........	Dike...................	34	4,502	132	67	465
SHEAR.......	Shear zone.............	14	14,709	1,051	45	2,628
CONTACT.....	Gradational contact....	3	7,838	2,613	1,605	3,792

Table 10. Summary documentation for spatial data base GEOL_TRPA in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of geology

Storage format: ARC/INFO

Data source: Digitized from natural-hazards map (Tahoe Regional Planning Agency, written commun., 1990)

Source scale: 1:125,000

[Geologic or other map unit: Geologic symbols and unit descriptions are as used by Tahoe Regional Planning Agency and do not necessarily meet U.S. Geological Survey standards. Geologic map units are listed in alpha-numeric order by map-unit symbol within major groups. Geologic units having no age information and other, geologic, units are listed as other map units at end of table. --, not applicable]

Geologic or other map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
Quaternary units						
Qal	Old lake sediment	14	7,572,532	540,895	8,722	3,776,621
Qg	Glacial outwash, undifferentiated	14	30,940,481	2,210,034	781	11,109,767
Ql	Lake deposits	25	26,707,392	1,068,296	630	6,052,740
Qlo	Old lake deposits	64	15,452,762	241,449	5,868	5,016,079
Qlo,Qg	Older lake/glacial outwash	3	7,926,886	2,642,295	348,821	4,091,445
Qls	Landslide deposits	18	2,403,021	133,501	23,076	735,602
Qm	Glacial moraine, undifferentiated	12	992,632	82,719	11,385	226,038
Qm1	Glacial moraine--Youngest	1	520,632	--	--	--
Qm2	Glacial moraine	2	2,777,927	1,388,964	2,707	2,775,220
Qm3	...do	29	82,942,699	2,860,093	1,685	35,315,115
Qm3-4	...do	1	218,280	--	--	--
Qm4	...do	9	38,178,862	4,242,096	74,290	15,037,865
Qm5	Glacial moraine--Oldest	4	18,671,380	4,667,845	928,447	14,222,725
Qta	Talus	8	1,851,572	231,446	7,261	1,450,886
Qv	Volcanics, undifferentiated	2	2,512,439	1,256,219	72,297	2,440,141
Qvb	Basalt	2	213,438	106,719	23,608	189,830
Qvi	Intrusive volcanic rocks, mainly latite	7	25,156,557	3,593,794	14,746	14,335,075
Tertiary units						
Tv	Volcanics, undifferentiated	6	5,120,271	853,379	12,560	4,732,904
Tva	Dominantly andesite breccia	23	94,492,699	4,108,378	15,932	27,330,965
Tvp	Pyroclastic	3	6,344,577	2,114,859	103,147	5,987,184
Other map units						
di	Diorite	15	7,153,972	476,931	9,716	1,591,922
gr	Granite	82	120,948,181	1,474,978	2,097	25,465,406
grd	...do	22	260,201,527	11,827,342	6,397	189,238,881
ISLA	Islands	37	35,677	964	117	6,018
m	Metamorphic, undifferentiated	8	7,366,343	920,793	2,716	5,275,681
ms	Metasediments	14	15,573,020	1,112,359	6,093	4,797,195
mv	Metavolcanic rocks	9	14,804,631	1,644,959	9,185	14,354,541
ND	No data[1]	9	19,815,244	2,201,694	14,304	17,707,041
NM	Not mapped[2]	1	28,892	--	--	--
WBDY	Water body	380	512,933,391	1,349,825	144	498,108,062

[1]No data shown on source map.

[2]Outside basin boundary.

Table 11. Summary documentation for spatial data base GEOL_TRPA_LIN in Tahoe Environmental Geographic Information System

Description of coverage: Line coverage of linear geologic features

Storage format: ARC/INFO

Data source: Digitized from natural-hazards map (Tahoe Regional Planning Agency, written commun., 1990)

Source scale: 1:125,000

[Linear geologic feature: Symbol explanations are as used by Tahoe Regional Planning Agency and do not necessarily conform to U.S. Geological Survey usage]

Linear geologic feature		Occurrences				
		Total number basinwide	Length (meters)			
Symbol	Explanation		Basinwide total	Mean	Minimum	Maximum
FLT.........	Fault..................	19	22,617	1,190	69	6,277
FLT-INTRP...	Interpretive fault.....	44	50,657	1,151	27	5,459
FLT-CNCLD...	Concealed fault........	29	98,135	3,384	55	26,797

Table 12. Summary documentation for spatial data base HYD_BASIN in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of hydrography and hydrologic features

Storage format: ARC/INFO

Data source: Digitized from hydrologic-basin boundaries delineated on U.S. Geological Survey topographic maps

Source scale: 1:24,000

[Hydrographic map unit or site: Symbols (except 0) and descriptions were derived from Jorgensen and others (1978). Intervening area, area tributary to Lake Tahoe and lying between mouths of streams. --, not applicable]

Hydrographic map unit or site		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
0	Area between Truckee River at Tahoe City and map unit 1.	1	9,769	--	--	--
1	Area between Truckee River and site 2	1	385,069	--	--	--
2	Lake Tahoe tributary at mouth at Tahoe City	2	2,781,289	1,390,644	44,656	2,736,633
3	Intervening area	1	886,740	--	--	--
4	Burton Creek at mouth	5	13,946,183	2,789,237	2,191,650	3,836,372
5	Intervening area	1	239,217	--	--	--
6	Unnamed creek at mouth near Lake Forest	1	2,622,498	--	--	--
7	Intervening area	1	37,462	--	--	--
8	Unnamed creek at mouth at Lake Forest	1	1,811,852	--	--	--
9	Intervening area	1	1,891,556	--	--	--
10	Dollar Creek at mouth	2	2,826,858	1,413,429	50,409	2,776,449
11	Intervening area	1	166,639	--	--	--
12	Unnamed creek at mouth near Cedar Flat	1	1,476,061	--	--	--
13	Intervening area	1	3,081,525	--	--	--
14	Watson Creek at mouth	3	6,036,852	2,012,284	193,971	5,139,813
15	Intervening area	1	247,590	--	--	--
16	Unnamed creek at mouth near Carnelian Bay	1	2,344,491	--	--	--
17	Intervening area	1	1,259,100	--	--	--
18	Carnelian Canyon creek at mouth	3	7,768,466	2,589,489	1,205,750	5,148,840
19	Intervening area	1	3,529,574	--	--	--
20	Snow Creek at mouth	10	12,078,962	1,207,896	1,376	3,459,723
21	Intervening area	1	236,492	--	--	--
22	Griff Creek at mouth	4	11,537,021	2,884,255	221,779	7,417,905
23	Intervening area	1	480,499	--	--	--
24	Baldy Creek at mouth	1	1,076,563	--	--	--
25	Intervening area	1	4,922,738	--	--	--
26	Unnamed creek at mouth near Crystal Bay	3	1,727,025	575,675	20,914	1,016,798
27	First Creek at mouth	4	2,791,718	697,929	1,661	2,601,434
28	Intervening area	1	1,236,740	--	--	--
29	Second Creek at mouth	3	3,550,849	1,183,616	66,380	3,379,620
30	Intervening area	3	2,340,591	780,197	188,391	1,411,192
31	Wood Creek at mouth near Crystal Bay	5	5,101,967	1,020,393	20,274	2,597,929
32	Intervening area	1	1,024,112	--	--	--
33	Third Creek at mouth	15	15,675,063	1,045,004	28,707	2,676,455
34	Incline Creek at mouth	25	17,369,623	694,785	4,235	1,838,869
35	Intervening area	1	635,884	--	--	--
36	Mill Creek at mouth	1	5,060,227	--	--	--
37	Intervening area	1	595,417	--	--	--
38	Tunnel Creek at mouth	1	3,281,549	--	--	--
39	Intervening area	1	551,068	--	--	--
40	Unnamed creek at mouth near Sand Harbor	3	2,284,765	761,588	413,425	1,176,169
41	Intervening area	1	5,568,144	--	--	--
42	Marlette Creek at mouth	10	12,809,162	1,280,916	762	5,354,534
43	Intervening area	5	1,980,453	396,091	53,286	690,478
44	Secret Harbor Creek at mouth	7	5,177,744	739,678	108,027	1,559,512
45	Intervening area	1	195,756	--	--	--
46	Bliss Creek at mouth	1	1,414,683	--	--	--
47	Intervening area	5	3,518,675	703,735	217,529	1,835,487
48	Slaughterhouse Canyon creek at mouth	11	16,584,637	1,507,694	146,169	6,201,678
49	Intervening area	1	2,408,396	--	--	--

Table 12. Summary documentation for spatial data base HYD_BASIN in Tahoe Environmental Geographic Information System—Continued

Hydrographic map unit or site		Occurrences				
			Area (square meters)			
Symbol	Description	Total number basinwide	Basinwide total	Mean	Minimum	Maximum
50	Glenbrook Creek at mouth	14	10,626,565	759,040	13,990	2,204,202
51	Intervening area	1	2,411,463	--	--	--
52	North Logan House Creek at mouth	1	2,826,803	--	--	--
53	Intervening area	1	49,491	--	--	--
54	Logan House Creek at mouth	4	5,581,766	1,395,441	13,168	3,962,708
55	Intervening area	3	1,735,583	578,528	330,570	762,588
56	Unnamed creek at mouth near Lincoln Park	3	1,487,531	495,844	21,234	870,919
57	Intervening area	1	861,196	--	--	--
58	Lincoln Creek at mouth	5	6,620,495	1,324,099	496,631	3,018,819
59	Intervening area	1	2,034,558	--	--	--
60	Unnamed Creek at mouth near District Courthouse	7	6,779,051	968,436	144,511	1,798,863
61	Intervening area	1	529,360	--	--	--
62	Unnamed Creek at mouth near Zephyr Cove	2	4,330,743	2,165,372	3,984	4,326,759
63	Intervening area	1	869,890	--	--	--
64	McFaul Creek at mouth	10	9,336,004	933,600	22,569	1,550,562
65	Intervening area	1	832,155	--	--	--
66	Burke Creek at mouth	11	12,039,298	1,094,482	46,855	2,539,124
67	Intervening area	1	225,823	--	--	--
68	Edgewood Creek at mouth	22	17,217,447	782,611	4,360	2,894,461
69	Intervening area	1	7,832,937	--	--	--
70	Bijou Creek at mouth	1	5,781,452	--	--	--
71	Intervening area	1	1,562,083	--	--	--
72	Trout Creek at mouth	87	106,901,062	1,228,748	3,701	4,636,897
73	Upper Truckee River at mouth	93	146,555,346	1,575,864	1,716	8,250,373
74	Intervening area	1	10,729,767	--	--	--
75	Taylor Creek at mouth	31	47,689,639	1,538,375	11,722	11,351,339
76	Tallac Creek at mouth	9	11,605,322	1,289,480	312,340	2,385,502
77	Intervening area	1	260,715	--	--	--
78	Cascade Creek at mouth	9	12,220,634	1,357,848	144,122	3,183,076
79	Intervening area	1	2,835,157	--	--	--
80	Eagle Creek at mouth	12	17,063,067	1,421,922	235,248	4,118,417
81	Intervening area	3	6,141,737	2,047,246	184,126	5,446,238
82	Rubicon Creek at mouth	9	7,397,695	821,966	38,154	1,676,386
83	Intervening area	1	71,638	--	--	--
84	Lake Tahoe tributary at mouth at Paradise Flat	3	1,611,756	537,252	180,908	973,737
85	Intervening area	1	1,185,848	--	--	--
86	Lonely Gulch creek at mouth	1	2,785,877	--	--	--
87	Intervening area	1	16,182	--	--	--
88	Lake Tahoe tributary at mouth near Meeks Bay	2	2,300,253	1,150,126	590,621	1,709,632
89	Intervening area	1	787,440	--	--	--
90	Meeks Creek at mouth	20	21,392,012	1,069,601	14,155	4,418,083
91	Intervening area	1	288,669	--	--	--
92	Unnamed creek at mouth near Meeks Bay	1	702,373	--	--	--
93	Intervening area	1	312,859	--	--	--
94	General Creek at mouth	8	19,776,237	2,472,030	297,359	7,512,099
95	Intervening area	1	3,605,243	--	--	--
96	McKinney Creek at mouth	5	12,530,349	2,506,070	1,147,849	5,782,019
97	Intervening area	1	298,406	--	--	--
98	Quail Creek at mouth	2	3,718,510	1,859,255	12,570	3,705,940
99	Intervening area	1	410,134	--	--	--
100	Homewood Canyon creek at mouth	1	2,726,802	--	--	--
101	Intervening area	1	620,233	--	--	--
102	Madden Creek at mouth	5	5,297,392	1,059,478	5,456	1,941,554
103	Intervening area	1	2,108,965	--	--	--
104	Blackwood Creek at mouth	18	28,901,117	1,605,618	6,826	3,970,266
105	Intervening area	1	4,672,657	--	--	--
106	Ward Creek at mouth	13	25,290,838	1,945,449	71,707	5,338,441
107	Intervening area	1	4,319,447	--	--	--
108	Lake Tahoe (surface area only)	1	498,108,095	--	--	--
109	Lake Tahoe basin at lake outlet	601	1,311,378,392	2,182,683	762	498,108,095

Table 13. Summary documentation for spatial data base LAND_ASPECT in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of land aspect

Storage format: ARC/INFO

Data source: Derived from U.S. Geological Survey Digital Elevation Model computer files

Source resolution: 30 by 30 meters

Land-aspect map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
0	Level	4,106	630,350,723	153,519	<1	498,108,075
1	North	559	8,337,992	14,916	<1	1,380,690
2	Northeast	3,236	81,917,868	25,314	<1	1,649,189
3	East	3,021	95,306,746	31,548	<1	2,271,319
4	Southeast	3,109	103,969,010	33,441	<1	2,313,061
5	South	2,764	101,169,657	36,602	<1	4,908,139
6	Southwest	2,728	84,453,074	30,958	<1	2,088,365
7	West	2,951	85,663,363	29,029	2	1,997,659
8	Northwest	3,313	120,872,256	36,484	<1	6,005,375

Table 14. Summary documentation for spatial data base LAND_SLOPE in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of land slope

Storage format: ARC/INFO

Data source: Derived from U.S. Geological Survey Digital Elevation Model computer files

Source resolution: 30 by 30 meters

Land-slope map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
0	0-percent slope (level land)	845	514,142,460	608,453	<1	498,108,059
1	>0- to 2-percent slope	577	8,308,492	14,399	<1	1,366,626
2	>2- to 5-percent slope	1,286	54,292,355	42,218	1	10,324,264
3	>5- to 10-percent slope	2,841	89,464,903	31,491	<1	5,130,046
4	>10- to 15-percent slope	4,759	60,373,814	12,686	1	473,400
5	>15- to 20-percent slope	5,981	83,787,331	14,009	<1	740,616
6	>20- to 30-percent slope	5,663	149,924,518	26,474	3	1,961,937
7	>30- to 50-percent slope	2,755	233,438,814	84,733	<1	24,036,455
8	>50- to 100-percent slope	1,795	136,048,440	75,793	2	17,127,553

Table 15. Summary documentation for spatial data base LAND_CAP in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of land capability (based on Bailey, 1974)

Storage format: ARC/INFO

Data source: Derived from SOIL coverage (table 18)

Source scale: 1:24,000

[do., ditto; --, not applicable]

Land-capability map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
1a	High-hazard lands...........	128	298,340,933	2,330,789	15,450	149,890,244
1b	...do.......................	167	42,015,992	251,593	3,223	20,200,895
1c	...do.......................	220	223,463,508	1,015,743	432	86,465,536
2	...do.......................	129	42,992,984	333,279	12,941	3,697,263
3	Moderate-hazard lands.......	129	54,321,738	421,099	18,480	6,055,268
4	...do.......................	105	30,868,517	293,986	14,943	3,216,385
5	Low-hazard lands............	106	72,478,823	683,762	14,174	14,566,318
6	...do.......................	72	36,430,047	505,973	20,861	6,815,395
7	...do.......................	20	13,624,826	681,241	28,723	3,561,517
ND	No data.....................	1	84,016	--	--	--
WB	Water body..................	376	512,969,887	1,364,282	144	498,518,930

Table 16. Summary documentation for spatial data base MONITOR_SITE in Tahoe Environmental Geographic Information System

Description of coverage: Point coverage

Storage format: ARC/INFO

Data source: Derived from monitoring-site locations marked on 1:24,000-scale topographic maps by Lahontan Water Quality Control Board, Nevada Department of Environmental Protection, U.S. Forest Service, U.S. Geological Survey, and U.S. Soil Conservation Service

Source scale: 1:24,000

[GIS, geographic information system. SNOTEL, U.S. Soil Conservation Service snowpack-telemetry site]

GIS attribute label for type of site	Hydrographic-monitoring site: Description	Hydrographic-monitoring site: Total number basinwide
Lahontan Water Quality Control Board sites		
GW	Ground-water-monitoring station	4
SW	Surface-water-monitoring station	4
Nevada Department of Environmental Protection sites		
GW	Ground-water-monitoring station	12
SW	Surface-water-monitoring station	12
U.S. Forest Service sites		
LK	Lake-monitoring station	9
SP	Spring-monitoring station	3
SW	Surface-water-monitoring station	47
U.S. Geological Survey sites		
GW	Ground-water-monitoring station	30
SW	Surface-water-monitoring station	73
QW	Water-quality-monitoring station	63
LK	Lake-monitoring station	3
U.S. Soil Conservation Service sites		
P	Precipitation-monitoring station	8
S	Snow-course site	8
SP	Spring-monitoring station	20
T	SNOTEL station	8

Table 17. Summary documentation for spatial data base RIPARIAN_VEG in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of riparian vegetation

Storage format: ARC/INFO

Data source: Digitized from U.S. Forest Service riparian-vegetation maps

Source scale: 1:24,000

[--, not applicable]

Riparian-vegetation map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
1	Coniferous riparian................	1,845	27,413,550	14,298	49	505,427
2	Deciduous riparian.................	2,103	18,592,777	8,576	499	216,928
3	Deciduous/coniferous riparian......	1,168	12,476,827	10,611	686	153,755
4	Wet meadow.........................	486	8,045,592	15,663	327	986,980
5	Moist meadow.......................	460	6,729,732	12,658	128	445,731
6	Nonriparian........................	172	3,486,357	19,435	780	723,719
7	Water..............................	68	1,649,531	21,119	806	375,405
8	No data (no label on source map)...	1	10,773	--	--	--
9	Mixed unit (multiple labels on source map).	4	38,640	6,440	2,973	25,323

Table 18. Summary documentation for spatial data base SOIL in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of soil types

Storage format: ARC/INFO

Data source: Digitized from U.S. Soil Conservation Service soil survey (Rogers, 1974)

Source scale: 1:24,000

[Except for ISLA and WBDY, symbols and descriptions for soil map units are as used by Rogers (1974) and do not necessarily conform to U.S. Geological Survey nomenclature standards. --, not applicable]

Soil or other map unit		Occurrences				
			Area (square meters)			
Symbol	Description	Total number basinwide	Basinwide total	Mean	Minimum	Maximum
Be	Beaches	10	1,218,335	121,834	15,987	402,786
CaD	Cagwin—Rock outcrop complex, 5- to 15-percent slope	44	9,045,353	205,576	14,943	1,499,938
CaE	Cagwin—Rock outcrop complex, 15- to 30-percent slope	101	34,091,781	337,542	8,543	2,954,853
CaF	Cagwin—Rock outcrop complex, 30- to 50-percent slope	67	62,892,845	938,699	29,772	13,735,058
Co	Celio gravelly loamy coarse sand	7	5,525,791	789,399	15,318	4,344,123
EbC	Elmira gravelly loamy coarse sand, 0- to 9-percent slope	10	1,495,364	149,536	71,217	361,960
EbE	Elmira gravelly loamy coarse sand, 9- to 30-percent slope	7	2,969,559	424,223	44,458	1,728,816
EcE	Elmira stony loamy coarse sand, 9- to 30-percent slope	5	1,560,136	312,027	141,791	460,794
EfB	Elmira—Gefo loamy coarse sands, 0- to 5-percent slope	20	13,624,826	681,241	28,723	3,561,517
Ev	Elmira loamy coarse sand, wet variant	37	9,113,008	246,298	13,103	3,004,640
Fd	Fill land	4	1,518,353	379,588	844	1,451,441
FuD	Fugawee very stony sandy loam, 2- to 15-percent slope	18	5,306,104	294,784	9,973	1,364,941
FuE	Fugawee very stony sandy loam, 15- to 30-percent slope	4	1,111,941	277,985	40,188	564,590
GeC	Gefo gravelly loamy coarse sand, 2- to 9-percent slope	17	3,754,811	220,871	41,008	555,601
GeD	Gefo gravelly loamy coarse sand, 9- to 20-percent slope	4	904,319	226,080	106,619	508,949
Gr	Gravelly alluvial land	57	7,215,385	126,586	3,223	1,073,126
GsF	Graylock extremely stony loamy coarse sand, 30- to 50-percent slope	7	9,631,117	1,375,874	82,650	2,731,589

Table 18. Summary documentation for spatial data base SOIL in Tahoe Environmental Geographic Information System—Continued

Soil or other map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Description		Basinwide total	Mean	Minimum	Maximum
IgB	Inville gravelly coarse sandy loam, 0- to 5-percent slope......................	3	1,110,754	370,251	102,506	530,664
IsC	Inville stony coarse sandy loam, 2- to 9-percent slope.........................	1	6,426,085	--	--	--
IsD	Inville stony coarse sandy loam, 9- to 15-percent slope........................	4	2,214,477	553,619	90,663	1,424,494
IsE	Inville stony coarse sandy loam, 15- to 30-percent slope.......................	1	1,036,999	--	--	--
ISLA	Island..	34	25,323	745	117	3,891
JaC	Jabu coarse sandy loam, 0- to 9-percent slope..................................	29	6,860,450	236,567	41,860	900,456
JaD	Jabu coarse sandy loam, 9- to 20-percent slope.................................	12	4,925,147	410,429	25,792	2,276,784
JbD	Jabu coarse sandy loam, seeped, 2- to 15-percent slope.........................	1	1,384,803	--	--	--
JeB	Jabu coarse sandy loam shallow variant, 0- to 5-percent slope..................	7	2,209,052	315,579	60,246	771,961
JeD	Jabu coarse sandy loam shallow variant, 5- to 15-percent slope.................	2	1,300,682	650,341	132,391	1,168,291
JgC	Jabu sandy loam, moderately fine subsoil variant, 0- to 9-percent slope.........	7	3,125,924	446,561	31,578	815,754
JhC	Jabu stony sandy loam, moderately fine subsoil variant, 2- to 9-percent slope...	13	5,052,587	388,661	42,653	2,149,938
JtD	Jorge—Tahoma cobbly sandy loams, 2- to 15-percent slope........................	7	1,109,534	158,505	30,455	635,290
JwD	Jorge—Tahoma very stony sandy loams, 2- to 15-percent slope....................	33	12,596,126	381,701	20,861	2,346,186
JwE	Jorge—Tahoma very stony sandy loams, 15- to 30-percent slope...................	46	13,137,674	285,602	16,648	3,216,385
JwF	Jorge—Tahoma very stony sandy loams, 30- to 50-percent slope...................	30	8,901,203	296,707	26,702	3,697,263
Lo	Loamy alluvial land...	61	10,955,352	179,596	12,951	3,142,624
Mh	Marsh...	50	6,469,767	129,395	1,270	1,025,093
MkB	Meeks gravelly loamy coarse sand, 0- to 5-percent slope........................	15	2,268,064	151,204	11,599	1,309,879
MkD	Meeks gravelly loamy coarse sand, 5- to 15-percent slope.......................	2	1,010,842	505,421	171,107	839,735
MmB	Meeks stony loamy coarse sand, 0- to 5-percent slope...........................	5	3,208,852	641,770	39,496	1,589,883
MsD	Meeks very stony loamy coarse sand, 5- to 15-percent slope.....................	23	7,629,230	331,706	59,995	2,382,862
MsE	Meeks very stony loamy coarse sand, 15- to 30-percent slope....................	28	10,902,543	389,377	42,104	1,745,231
MsG	Meeks very stony loamy coarse sand, 30- to 60-percent slope....................	15	11,214,244	747,616	23,327	2,455,899
MtE	Meeks extremely stony loamy coarse sand, 15- to 30-percent slope...............	22	15,161,109	689,141	61,305	4,816,176
MtG	Meeks extremely stony loamy coarse sand, 30- to 60-percent slope...............	31	13,232,325	426,849	12,392	1,827,980
MxE	Meiss cobbly loam, 9- to 30-percent slope......................................	17	3,008,023	176,943	29,043	664,718
MxF	Meiss cobbly loam, 30- to 50-percent slope.....................................	40	17,440,759	436,019	20,309	7,918,927

NM	Not mapped	68	2,084,763	30,658	2,148	443,823
Px	Pits and dumps	22	1,190,600	54,118	8,353	159,282
Ra	Rock land	169	97,144,124	574,817	432	13,853,773
RcF	Rock outcrop—Cagwin complex, 30- to 50-percent slope	24	18,745,885	781,079	98,772	2,335,263
RcG	Rock outcrop—Cagwin complex, 50- to 70-percent slope	16	10,020,058	626,254	36,683	5,091,307
RtF	Rock outcrop—Toem complex, 30- to 50-percent slope	130	40,338,814	310,299	15,450	3,762,676
RtG	Rock outcrop—Toem complex, 50- to 70-percent slope	22	19,629,196	892,236	61,512	5,237,385
Rx	Rock outcrop and rubble land	123	90,777,001	738,024	3,353	45,821,422
ShE	Shakespeare gravelly loam, 9- to 30-percent slope	2	4,976,299	2,488,149	170,653	4,805,646
SkF	Shakespeare stony loam, 30- to 50-percent slope	7	1,119,853	159,979	77,932	375,818
Sm	Stony colluvial land	51	13,921,962	272,980	10,454	1,946,629
TaD	Tahoma stony sandy loam, 2- to 15-percent slope	20	6,132,431	306,622	25,791	1,259,376
TbD	Tahoma very stony sandy loam, 2- to 15-percent slope	12	4,915,697	409,641	72,809	1,290,723
TcB	Tallac gravelly coarse sandy loam seeped, 0- to 5-percent slope	13	11,053,492	850,269	72,222	5,043,014
TcC	Tallac gravelly coarse sandy loam seeped, 5- to 9-percent slope	15	9,886,252	659,083	58,612	4,144,000
TdD	Tallac stony coarse sandy loam, 5- to 15-percent slope	20	10,925,744	546,287	34,157	5,029,730
TeE	Tallac very stony coarse sandy loam, 15- to 30-percent slope	28	12,916,468	461,302	18,480	1,850,218
TeG	Tallac very stony coarse sandy loam, 30- to 60-percent slope	17	8,246,059	485,062	74,737	3,145,692
TkC	Tallac very stony coarse sandy loam seeped, 2- to 9-percent slope	9	5,417,774	601,975	39,496	2,475,361
TmE	Tallac gravelly coarse sandy loam, shallow variant, 9- to 30-percent slope	7	3,341,777	477,397	102,528	2,112,006
TmF	Tallac gravelly coarse sandy loam, shallow variant, 30- to 50-percent slope	7	3,133,210	447,601	39,724	1,612,790
TrE	Toem—Rock outcrop complex, 9- to 30-percent slope	17	3,313,749	194,926	20,224	658,038
TrF	Toem—Rock outcrop complex, 30- to 50-percent slope	28	20,157,104	719,897	50,209	8,365,166
UmD	Umpa very stony sandy loam, 5- to 15-percent slope	24	6,053,772	252,241	14,174	2,358,955
UmE	Umpa very stony sandy loam, 15- to 30-percent slope	45	12,883,920	286,309	26,132	1,344,139
UmF	Umpa very stony sandy loam, 30- to 50-percent slope	35	24,096,314	688,466	24,411	3,197,559
WaE	Waca cobbly coarse sandy loam, 9- to 30-percent slope	17	7,930,471	466,498	114,057	1,907,904
WaF	Waca cobbly coarse sandy loam, 30- to 50-percent slope	11	2,959,357	269,032	54,071	781,754
WcE	Waca—Rock outcrop complex, 9- to 30-percent slope	10	3,228,233	322,823	39,202	1,207,493
WcF	Waca—Rock outcrop complex, 30- to 50-percent slope	23	15,229,075	662,134	34,041	5,134,020
WBDY	Water body	381	513,030,465	1,346,537	145	498,098,695

Table 19. Summary documentation for spatial data base TIMBER_TYPE in Tahoe Environmental Geographic Information System

Description of coverage: Polygon coverage of timber classes

Storage format: ARC/INFO

Data source: Digitized from U.S. Forest Service timber-type maps

Source scale: 1:24,000

[Timber-type map unit: Except for ISLA and WBDY, symbols are those used on U.S. Forest Service timber-type maps (Joseph Oden, written commun., 1992); see table 2 for explanation of alphanumeric symbols and for more detailed classification basis. do., ditto; --, not applicable]

Timber-type map unit		Occurrences				
Symbol	Main classification basis	Total number basinwide	Area (square meters) Basinwide total	Mean	Minimum	Maximum
	Woody-vegetation areas					
HA	Aspen	56	7,230,894	129,123	6,252	478,131
HX	Miscellaneous hardwoods	10	670,455	67,045	23,817	157,873
LP1G	Lodgepole pine	1	64,857	--	--	--
LP1N	...do	1	61,701	--	--	--
LP2G	...do	35	4,670,037	133,430	14,010	636,370
LP2N	...do	62	8,252,609	133,107	6,723	679,102
LP2P	...do	70	9,900,315	141,433	11,245	1,066,961
LP2P/SC	...do	1	295,095	--	--	--
LP2P/SR	...do	1	25,289	--	--	--
LP2S	...do	62	11,974,129	193,131	10,349	1,442,100
LP2S/GL	...do	1	122,944	--	--	--
LP2S/NG	...do	3	734,975	244,992	160,163	292,738
LP2S/SC	...do	3	453,533	151,178	126,268	199,555
LP2S/SM	...do	2	313,204	156,602	132,410	180,794
LP3G	...do	54	6,849,451	126,842	19,351	521,283
LP3N	...do	110	18,618,320	169,257	17,499	897,797
LP3P	...do	130	20,139,978	154,923	7,934	1,138,746
LP3P/NG	...do	1	144,765	--	--	--
LP3S	...do	52	8,422,261	161,967	18,064	1,063,003
LP3S/NC	...do	1	72,680	--	--	--
LP3S/NG	...do	4	938,785	234,696	43,472	544,583
LP3S/SC	...do	5	1,052,821	210,564	68,215	361,073
LP3S/SR	...do	6	632,941	105,490	69,957	161,186
LPHA3G	Lodgepole pine and aspen	1	111,987	--	--	--
LPHA3N	...do	1	88,927	--	--	--
LPHA3P	...do	2	264,356	132,178	127,717	136,639
LPHA3S/SR	...do	1	164,656	--	--	--
LPMH2G	Lodgepole pine and mountain hemlock	1	102,933	--	--	--
LPMH2N	...do	3	304,260	101,420	64,270	170,108
LPMH2P	...do	3	229,791	76,597	40,017	126,373
LPMH2S	...do	2	382,063	191,032	92,702	289,361
LPMH3G	...do	5	869,417	173,883	58,048	284,085
LPMH3N	...do	17	1,482,116	87,183	5,791	233,228
LPMH3P	...do	9	991,861	110,207	65,982	197,430
LPPP2N	Lodgepole pine and ponderosa or Jeffrey pine.	1	66,349	--	--	--
LPPP2P	...do	1	256,413	--	--	--
LPPP3G	...do	11	1,598,467	145,315	29,369	314,276
LPPP3N	...do	21	3,542,729	168,701	746	517,148
LPPP3P	...do	5	517,001	103,400	67,695	183,255
LPPP3S	...do	4	688,089	172,022	52,487	309,920
LPRF2N	Lodgepole pine and red fir	1	55,895	--	--	--
LPRF2P	...do	5	1,571,559	314,312	122,223	508,805
LPRF3G	...do	13	2,205,993	169,692	43,085	421,177
LPRF3N	...do	43	6,511,481	151,430	3,546	446,526
LPRF3P	...do	29	6,193,833	213,580	13,995	1,109,435
LPRF3S	...do	8	1,567,098	195,887	102,841	317,624
LPRF3S/SR	...do	1	257,233	--	--	--

Table 19. Summary documentation for spatial data base TIMBER_TYPE in Tahoe Environmental Geographic Information System—Continued

Timber-type map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Main classification basis		Basinwide total	Mean	Minimum	Maximum
		Woody-vegetation areas--Continued				
LPRF4N	Lodgepole pine and red fir................	1	199,957	--	--	--
LPRF4P	...do....................................	1	163,448	--	--	--
LPWF2S	Lodgepole pine and white fir..............	1	324,951	--	--	--
LPWF3G	...do....................................	3	199,434	66,478	41,440	91,319
LPWF3N	...do....................................	11	1,589,509	144,501	47,524	358,600
LPWF3P	...do....................................	1	121,660	--	--	--
LPWP3G	Lodgepole pine and western white pine......	2	451,819	225,910	87,812	364,008
LPWP3N	...do....................................	13	2,319,679	178,437	20,924	510,333
LPWP3P	...do....................................	12	1,827,177	152,265	3,694	621,540
LPWP3S	...do....................................	2	258,565	129,282	54,772	203,792
LPWP3S/SR	...do....................................	1	390,347	--	--	--
LPWP4N	...do....................................	6	1,340,133	223,356	132,729	442,252
LPWP4P	...do....................................	3	534,525	178,175	59,751	250,370
MH1N	Mountain hemlock..........................	1	32,632	--	--	--
MH2N	...do....................................	7	357,824	51,118	24,980	132,983
MH2P	...do....................................	5	342,887	68,577	43,170	114,504
MH2S	...do....................................	1	66,425	--	--	--
MH3G	...do....................................	1	43,881	--	--	--
MH3N	...do....................................	2	106,017	53,008	50,737	55,280
MH3P	...do....................................	2	114,734	57,367	51,799	62,935
MH4N	...do....................................	1	61,655	--	--	--
MHLP2G	Mountain hemlock and lodgepole pine........	1	108,695	--	--	--
MHLP2N	...do....................................	2	195,641	97,820	88,687	106,954
MHLP2P	...do....................................	2	212,525	106,262	55,980	156,545
MHLP3G	...do....................................	1	162,580	--	--	--
MHLP3N	...do....................................	5	418,082	83,616	38,193	173,116
MHLP4N	...do....................................	1	139,755	--	--	--
MHRF3G	Mountain hemlock and red fir..............	1	125,576	--	--	--
MHWP3G	Mountain hemlock and western white pine....	1	83,473	--	--	--
PP1G	Ponderosa or Jeffrey pine.................	1	61,443	--	--	--
PP2G	...do....................................	33	3,949,599	119,685	16,708	472,563
PP2N	...do....................................	46	6,973,394	151,596	30,034	626,799
PP2P	...do....................................	30	4,671,961	155,732	27,394	665,542
PP2P/SM	...do....................................	1	108,148	--	--	--
PP2P/SX	...do....................................	1	119,212	--	--	--
PP2S	...do....................................	9	1,333,150	148,128	34,121	358,813
PP2S/SM	...do....................................	5	1,196,072	239,214	138,270	425,722
PP3G	...do....................................	43	5,211,416	121,196	21,691	572,341
PP3N	...do....................................	74	10,071,967	136,108	23,049	581,667
PP3P	...do....................................	86	17,175,993	199,721	11,366	1,343,665
PP3P/SC	...do....................................	2	1,283,255	641,628	399,216	884,040
PP3P/SM	...do....................................	2	336,040	168,020	65,867	270,172
PP3P/SX	...do....................................	1	361,226	--	--	--
PP3S	...do....................................	51	7,552,739	148,093	19,877	566,000
PP3S/GL	...do....................................	1	190,485	--	--	--
PP3S/SM	...do....................................	8	1,859,132	232,391	73,531	345,869
PP3S/SX	...do....................................	1	549,813	--	--	--
PP4G	...do....................................	10	2,029,146	202,915	47,225	561,756
PP4N	...do....................................	24	3,757,769	156,574	30,315	727,686
PP4P	...do....................................	58	9,670,133	166,726	28,867	521,447
PP4P/SC	...do....................................	3	1,367,597	455,866	137,924	850,460
PP4P/SM	...do....................................	1	592,100	--	--	--
PP4S	...do....................................	24	3,617,976	150,749	51,440	446,367
PP4S/SM	...do....................................	6	780,769	130,128	98,467	169,205
PP4S/SR	...do....................................	1	49,587	--	--	--
PP6G	...do....................................	42	6,033,250	143,649	26,571	442,918
PP7G	...do....................................	2	351,780	175,890	127,895	223,884
PPHA2P	Ponderosa or Jeffrey pine and aspen........	1	142,106	--	--	--
PPHA3N	...do....................................	2	177,737	88,868	86,306	91,431

Table 19. Summary documentation for spatial data base TIMBER_TYPE in Tahoe Environmental Geographic Information System—Continued

Timber-type map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Main classification basis		Basinwide total	Mean	Minimum	Maximum
	Woody-vegetation areas--Continued					
PPLP2G	Ponderosa or Jeffrey pine and lodgepole pine.	1	139,795	--	--	--
PPLP2N	...do	1	49,671	--	--	--
PPLP3G	...do	7	2,048,089	292,584	45,298	647,242
PPLP3N	...do	10	2,047,691	204,769	101,107	470,420
PPLP3P	...do	6	917,522	152,920	57,281	271,671
PPLP3S	...do	2	131,992	65,996	54,895	77,098
PPLP4N	...do	3	212,617	70,872	45,907	116,327
PPRF2S	Ponderosa or Jeffrey pine and red fir	1	595,840	--	--	--
PPRF3N	...do	5	491,852	98,370	76,211	153,739
PPRF3P	...do	12	2,464,131	205,344	92,834	437,694
PPRF3S	...do	4	521,140	130,285	59,674	199,731
PPRF4N	...do	5	1,538,526	307,705	85,570	693,097
PPRF4P	...do	6	1,584,197	264,033	55,925	353,520
PPRF4P/SA	...do	1	80,299	--	--	--
PPRF4S	...do	1	264,831	--	--	--
PPSP3N	Ponderosa or Jeffrey pine and sugar pine	1	176,229	--	--	--
PPSP3P	...do	1	111,602	--	--	--
PPSP4G	...do	1	253,200	--	--	--
PPSP4N	...do	3	497,229	165,743	55,446	255,126
PPWF	Ponderosa or Jeffrey pine and white fir	1	119,078	--	--	--
PPWF2G	...do	26	5,124,028	197,078	27,235	722,797
PPWF2N	...do	16	2,892,599	180,787	38,955	589,095
PPWF2P	...do	10	2,093,712	209,371	41,031	768,467
PPWF2S	...do	4	727,491	181,873	41,071	323,053
PPWF3G	...do	53	9,539,875	179,998	20,754	918,357
PPWF3N	...do	63	12,503,218	198,464	38,526	831,523
PPWF3P	...do	55	9,753,671	177,339	30,295	534,499
PPWF3S	...do	18	2,562,748	142,375	62,574	442,362
PPWF3S/SM	...do	2	786,416	393,208	50,393	736,023
PPWF3S/SX	...do	1	395,804	--	--	--
PPWF4G	...do	24	4,448,003	185,333	51,504	494,398
PPWF4N	...do	55	9,785,882	177,925	2,465	1,064,421
PPWF4P	...do	55	12,821,322	233,115	26,960	859,179
PPWF4P/SM	...do	1	118,937	--	--	--
PPWF4S	...do	8	1,047,619	130,952	85,708	212,558
PPWF5G	...do	1	102,043	--	--	--
PPWP2G	...do	1	110,077	--	--	--
PPWP4N	...do	1	392,493	--	--	--
PPWP4P	...do	2	438,971	219,485	208,470	230,500
RF1N	Red fir	4	201,311	50,328	39,750	62,862
RF1P	...do	2	394,288	197,144	119,093	275,195
RF2G	...do	5	485,003	97,001	37,851	194,340
RF2N	...do	15	1,526,767	101,784	7,357	329,778
RF2P	...do	10	1,719,179	171,918	40,544	433,887
RF2P/SA	...do	1	559,503	--	--	--
RF2P/SM	...do	1	239,230	--	--	--
RF2S	...do	10	1,317,609	131,761	35,136	242,704
RF2S/SA	...do	1	192,732	--	--	--
RF2S/SM	...do	7	1,428,991	204,142	28,679	513,948
RF2S/SR	...do	1	80,669	--	--	--
RF3G	...do	46	5,193,986	112,913	25,331	1,114,808
RF3N	...do	81	9,899,158	122,212	10,896	506,357
RF3P	...do	49	6,110,270	124,699	1,779	487,139
RF3P/SC	...do	1	177,495	--	--	--
RF3P/SM	...do	2	309,684	154,842	112,716	196,968
RF3P/SR	...do	2	247,407	123,703	96,700	150,707
RF3S	...do	18	2,529,189	140,511	20,054	634,229
RF3S/NG	...do	1	144,183	--	--	--
RF3S/SA	...do	1	167,862	--	--	--
RF3S/SB	...do	1	403,897	--	--	--
RF3S/SM	...do	5	543,479	108,696	4,035	238,856
RF3S/SR	...do	4	601,143	150,286	117,124	177,087

Table 19. Summary documentation for spatial data base TIMBER_TYPE in Tahoe Environmental Geographic Information System—Continued

Timber-type map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Main classification basis		Basinwide total	Mean	Minimum	Maximum
Woody-vegetation areas--Continued						
RF4G	Red fir	27	5,802,462	214,906	29,653	718,922
RF4N	...do	42	7,326,148	174,432	28,214	823,668
RF4P	...do	8	1,376,133	172,017	71,563	357,559
RF4P/SR	...do	1	69,628	--	--	--
RF4S	...do	7	1,386,032	198,005	25,844	543,092
RF4S/SR	...do	1	114,862	--	--	--
RF6G	...do	1	51,850	--	--	--
RFLP2N	Red fir and lodgepole pine	1	108,139	--	--	--
RFLP2P	...do	3	703,816	234,605	65,503	401,418
RFLP2S	...do	1	45,129	--	--	--
RFLP3G	...do	10	1,738,006	173,801	73,697	359,292
RFLP3N	...do	28	4,155,485	148,410	49,197	301,305
RFLP3P	...do	16	2,434,206	152,138	3,622	374,412
RFLP4G	...do	1	146,049	--	--	--
RFLP4N	...do	7	1,271,752	181,679	81,428	385,019
RFLP4P	...do	2	611,412	305,706	269,196	342,216
RFLP4S/SR	...do	1	115,633	--	--	--
RFMH2N	Red fir and mountain hemlock	1	97,783	--	--	--
RFMH2P	...do	1	87,033	--	--	--
RFMH2P/SR	...do	1	86,665	--	--	--
RFMH3G	...do	3	582,576	194,192	71,398	365,347
RFMH3N	...do	6	560,376	93,396	42,700	137,639
RFMH3P	...do	2	171,989	85,995	77,620	94,369
RFMH4N	...do	1	119,222	--	--	--
RFPP2N	Red fir and ponderosa or Jeffrey pine	1	174,360	--	--	--
RFPP2P	...do	3	186,464	62,155	58,314	68,934
RFPP2S	...do	1	201,599	--	--	--
RFPP3G	...do	4	832,264	208,066	62,573	460,963
RFPP3N	...do	14	2,352,496	168,035	63,466	420,577
RFPP3P	...do	14	1,914,628	136,759	44,959	297,633
RFPP3P/SC	...do	1	132,391	--	--	--
RFPP3S	...do	5	930,098	186,020	82,095	263,582
RFPP3S/SR	...do	2	487,783	243,892	176,115	311,668
RFPP4G	...do	1	609,645	--	--	--
RFPP4N	...do	17	2,896,422	170,378	39,294	349,346
RFPP4P	...do	10	2,122,773	212,277	16,591	558,667
RFPP4S	...do	4	601,662	150,415	86,214	236,466
RFPP4S/SM	...do	2	345,304	172,652	19,095	326,209
RFWF2G	Red fir and white fir	3	596,835	198,945	183,487	222,421
RFWF2P	...do	1	234,394	--	--	--
RFWF2S	...do	1	208,860	--	--	--
RFWF3G	...do	5	722,089	144,418	82,257	249,213
RFWF3N	...do	12	2,782,321	231,860	74,983	934,404
RFWF3P	...do	9	2,683,047	298,116	20,641	609,841
RFWF3S	...do	2	208,227	104,114	103,136	105,091
RFWF4G	...do	1	124,305	--	--	--
RFWF4N	...do	5	1,209,264	241,853	121,614	426,182
RFWF4P	...do	4	1,093,831	273,458	208,696	352,542
RFWP	Red fir and western white pine	1	248,798	--	--	--
RFWP2P	...do	1	116,448	--	--	--
RFWP3G	...do	3	672,327	224,109	37,972	581,501
RFWP3N	...do	7	1,269,490	181,356	35,189	568,800
RFWP3P	...do	7	948,787	135,541	63,766	232,930
RFWP4G	...do	6	619,440	103,240	25,563	182,003
RFWP4N	...do	12	2,871,781	239,315	57,195	623,984
RFWP4P	...do	5	790,184	158,037	121,860	193,458
RFWP4S	...do	2	188,636	94,318	85,758	102,878
SP4S	Sugar pine	1	53,824	--	--	--
SPPP4P	Sugar pine and ponderosa or Jeffrey pine	1	365,772	--	--	--

Table 19. Summary documentation for spatial data base TIMBER_TYPE in Tahoe Environmental Geographic Information System—Continued

Timber-type map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Main classification basis		Basinwide total	Mean	Minimum	Maximum
		Woody-vegetation areas--Continued				
WB	Whitebark pine	25	7,478,558	299,142	2,802	1,833,503
WF1N	White fir	2	130,469	65,234	53,866	76,603
WF1P/NG	...do	1	114,929	--	--	--
WF2G	...do	39	6,459,958	165,640	5,757	678,356
WF2N	...do	39	3,396,598	87,092	22,335	223,427
WF2P	...do	21	2,308,502	109,929	33,620	230,929
WF2P/SM	...do	6	903,437	150,573	88,076	203,662
WF2S	...do	13	1,968,931	151,456	61,692	562,675
WF2S/SA	...do	1	227,355	--	--	--
WF2S/SM	...do	15	3,556,326	237,088	48,383	629,081
WF2S/SR	...do	2	227,429	113,714	69,876	157,553
WF3G	...do	42	4,389,831	104,520	31,479	524,873
WF3N	...do	59	8,188,976	138,796	20,317	471,386
WF3P	...do	43	7,018,200	163,214	6,966	863,616
WF3P/S	...do	1	613,997	--	--	--
WF3P/SM	...do	1	197,993	--	--	--
WF3P/SR	...do	5	657,098	131,420	95,038	238,612
WF3S	...do	13	1,287,234	99,018	24,907	257,058
WF3S/SA	...do	1	227,054	--	--	--
WF3S/SM	...do	8	1,304,829	163,104	72,861	311,638
WF3S/SR	...do	5	681,811	136,362	53,837	273,978
WF4G	...do	5	645,934	129,187	15,653	293,195
WF4N	...do	11	1,639,874	149,079	36,624	289,546
WF4P	...do	2	265,831	132,915	60,400	205,431
WF4P/SR	...do	1	109,897	--	--	--
WF4S	...do	1	488,744	--	--	--
WFHA3N	White fir and aspen	1	106,679	--	--	--
WFLP2N	White fir and lodgepole pine	1	120,592	--	--	--
WFLP3G	...do	3	175,298	58,433	16,794	89,211
WFLP3N	...do	2	248,345	124,173	74,108	174,237
WFLP3P	...do	2	497,999	248,999	116,360	381,639
WFLP3S/SM	...do	1	139,481	--	--	--
WFPP2G	White fir and ponderosa or Jeffrey pine	20	2,453,572	122,679	29,939	437,201
WFPP2N	...do	19	2,472,524	130,133	39,113	291,215
WFPP2P	...do	11	1,364,818	124,074	51,252	245,582
WFPP2P/SM	...do	1	126,868	--	--	--
WFPP2S	...do	1	214,782	--	--	--
WFPP2S/SM	...do	2	1,050,137	525,068	470,935	579,202
WFPP3G	...do	54	11,160,838	206,682	21,562	774,085
WFPP3N	...do	103	17,331,380	168,266	21,656	502,989
WFPP3P	...do	68	11,189,496	164,551	2,272	607,644
WFPP3P/SM	...do	2	564,972	282,486	239,889	325,083
WFPP3S	...do	13	2,098,877	161,452	35,836	323,592
WFPP3S/SM	...do	4	2,114,272	528,568	117,061	1,547,617
WFPP3S/SR	...do	1	79,828	--	--	--
WFPP4G	...do	32	6,161,848	192,558	40,573	887,773
WFPP4N	...do	47	10,899,604	231,906	45,728	1,764,929
WFPP4P	...do	29	5,314,611	183,262	31,707	1,135,551
WFPP4P/SM	...do	1	200,636	--	--	--
WFPP4S	...do	3	436,860	145,620	98,944	189,444
WFPP4S/SM	...do	1	135,390	--	--	--
WFRF2G	White fir and red fir	1	210,717	--	--	--
WFRF2N	...do	2	189,837	94,918	68,222	121,615
WFRF2P	...do	1	49,475	--	--	--
WFRF2S/SM	...do	1	529,161	--	--	--
WFRF3G	...do	3	502,553	167,518	93,100	209,407
WFRF3N	...do	8	1,425,889	178,236	51,936	509,452
WFRF3P	...do	7	1,272,984	181,855	122,088	292,926
WFRF3S	...do	1	260,782	--	--	--
WFRF4N	...do	1	304,868	--	--	--
WFRF4P	...do	1	268,267	--	--	--
WFRF4S	...do	1	343,990	--	--	--

Table 19. Summary documentation for spatial data base TIMBER_TYPE in Tahoe Environmental Geographic Information System—Continued

Timber-type map unit		Occurrences				
		Total number basinwide	Area (square meters)			
Symbol	Main classification basis		Basinwide total	Mean	Minimum	Maximum
	Woody-vegetation areas--Continued					
WFWP4P	White fir and western white pine..........	1	572,744	--	--	--
WP2G	Western white pine........................	1	145,381	--	--	--
WP2P	...do....................................	1	29,010	--	--	--
WP3G	...do....................................	1	29,483	--	--	--
WP3N	...do....................................	2	175,145	87,573	63,677	111,468
WP3P	...do....................................	2	353,622	176,811	105,690	247,932
WP3P/SM	...do....................................	1	219,999	--	--	--
WP3S	...do....................................	4	305,432	76,358	32,624	109,563
WP4N	...do....................................	1	127,202	--	--	--
WP4P	...do....................................	1	198,039	--	--	--
WP4S	...do....................................	1	109,616	--	--	--
WP6G	...do....................................	1	112,464	--	--	--
WPLP3N	Western white pine and lodgepole pine......	1	584,011	--	--	--
WPLP4N	...do....................................	1	69,367	--	--	--
WPMH3N	Western white pine and mountain hemlock....	1	80,618	--	--	--
WPPP2G	Western white pine and ponderosa or Jeffrey pine.	1	66,447	--	--	--
WPPP3G	...do....................................	1	197,861	--	--	--
WPPP3N	...do....................................	2	893,285	446,643	292,400	600,885
WPPP3P	...do....................................	1	56,939	--	--	--
WPRF3G	Western white pine and red fir............	1	277,859	--	--	--
WPRF3N	...do....................................	3	621,579	207,193	53,479	439,919
WPRF3P	...do....................................	1	54,512	--	--	--
WPRF3S	...do....................................	1	129,521	--	--	--
WPRF4N	...do....................................	4	1,113,905	278,476	77,358	620,841
WPRF4P	...do....................................	7	572,405	81,772	20,310	142,280
WPRF4S	...do....................................	1	60,829	--	--	--
	Nonwoody- and shrub-vegetation areas					
GH	Herbaceous cover..........................	3	356,377	118,792	47,091	211,620
GL	Grasses..................................	110	23,213,174	211,029	9,214	3,679,131
NG	Herbs and grasses.........................	1	77,243	--	--	--
SA	Chaparral................................	12	1,719,477	143,290	16,536	832,151
SB	Sagebrush................................	22	9,286,759	422,125	11,088	2,882,759
SC	Shrub (chinquapin)........................	11	1,806,127	164,193	21,481	884,134
SM	Montane (buckbrush, chokecherry, white-thorn.	129	32,445,302	251,514	1,237	1,943,975
SR	Riparian vegetation.......................	118	11,232,966	95,195	9,900	532,268
SX	Miscellaneous shrubs......................	3	287,217	95,739	66,887	147,927
	Nonvegetated or other areas					
ISLA	Island...................................	37	44,283	1,197	117	9,589
NB	Barren, rocky.............................	145	72,851,171	502,422	14,322	33,600,046
ND	Urban development.........................	62	97,910,217	1,579,197	8,034	24,420,156
NM	Not mapped................................	17	1,070,722	62,984	2,919	572,481
WBDY	Water body................................	381	512,924,794	1,346,259	145	498,098,470

Table 20. Detailed documentation for Tahoe

[Coverages listed in alphabetical order by coverage name. For more information on date of data source, see table 5. DEM, ELAS, National Aeronautics and Space Administration's Science and Technology Laboratory Applications Software; GIS, RMS, root-mean-square error, in digitizer inches; TEGIS, Tahoe Environmental Geographic Information System; TRPA, Service; --,

Description of coverage	Data source: Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	Digitizing method
						TEGIS coverage
Line coverage of Lake Tahoe basin boundary.	USGS; basin boundary delineated on topographic maps.	1:24,000	1989	Polyconic	Mylar (excellent condition).	Thematic lines were digitized manually; feature labels were assigned interactively by using ARC/INFO software.
						TEGIS coverage
Line coverage of outer boundary of Lake Tahoe basin and administrative boundary of TRPA. Outer-boundary layer differs from Lake Tahoe basin boundary in vicinity of Tahoe City. This coverage was used as outer limit for digitizing natural-resources layers for TEGIS project.	USGS; basin boundary delineated on topographic maps; TRPA administrative boundary added on basis of congressionally legislated description of TRPA boundary (U.S. Public Law 96-551) and by using TEGIS coverage PLSS.	1:24,000	1989	Polyconic	Mylar (excellent condition) for Lake Tahoe basin and Public Land Survey System DLG files for TRPA boundary.	Thematic lines were digitized manually; feature labels were assigned interactively by using ARC/INFO software.
						TEGIS coverage
Line coverage of TRPA administrative boundary, which corresponds to Lake Tahoe basin boundary with two exceptions: Administrative boundary (1) extends beyond natural-basin boundary in vicinity of Tahoe City and (2) coincides with Alpine County boundary in southeastern part of basin (and thereby excludes Alpine County).	USGS; basin boundary delineated on topographic maps; TRPA administrative boundary added on basis of congressionally legislated description of TRPA boundary (U.S. Public Law 96-551) and by using TEGIS coverage PLSS.	1:24,000	1989	Polyconic	Mylar (excellent condition) for Lake Tahoe basin and Public Land Survey System DLG files for TRPA boundary.	Thematic lines were digitized manually or were derived from DLG Public Land Survey System files; feature labels were assigned interactively by using ARC/INFO software.
						TEGIS coverage
Line coverage of hydrographic channels.	USGS; derived from DLG hydrography files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.

Environmental Geographic Information System coverages

U.S. Geological Survey's Digital Elevation Model; DLG, U.S. Geological Survey's Digital Line Graph; do. or Do., ditto; geographic information system; NASA, National Aeronautics and Space Administration; Res, resolution, in meters; Tahoe Regional Planning Agency; USFS, U.S. Forest Service; USGS, U.S. Geological Survey; SCS, U.S. Soil Conservation not applicable]

Digitizing accuracy	Verification: Spatial data	Verification: Attribute data	GIS data type	Item or field: Names	Item or field: Description	Specifications: Input width (bytes)	Specifications: Output width (bytes)	Specifications: Type
BOUND_BASIN								
RMS range, 0.001-0.003	Two or more verification plots done by USGS.	Two or more verification plots done by USGS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (code: 3, basin boundary).	2	2	Integer.
BOUND_OUTER								
RMS range, 0.001-0.003	Two or more verification plots done by USGS.	Two or more verification plots done by USGS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (code: 3, basin boundary).	2	2	Integer.
BOUND_TRPA								
RMS range, 0.001-0.003	Two or more verification plots done by USGS.	Two or more verification plots done by USGS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (code: 3, basin boundary).	2	2	Integer.
CHANNEL								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Arc	MAJOR1	DLG code	6	6	Integer.
do.	do.	do.	do.	MINOR1	do.	6	6	Do.
do.	do.	do.	do.	MAJOR2	do.	6	6	Do.
do.	do.	do.	do.	MINOR2	do.	6	6	Do.
do.	do.	do.	do.	MAJOR3	do.	6	6	Do.
do.	do.	do.	do.	MINOR3	do.	6	6	Do.
do.	do.	do.	do.	MAJOR4	do.	6	6	Do.
do.	do.	do.	do.	MINOR4	do.	6	6	Do.

Table 20. Detailed documentation for Tahoe Environmental

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Line coverage of hydrographic channels.	USGS; derived from DLG hydrography files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Line coverage of county boundaries (clipped at outer Lake Tahoe basin boundary, as defined by TEGIS coverage BOUND_OUTER).	USGS; derived from DLG boundaries files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
						TEGIS coverage
Polygon coverage of geologic units.	Digitized from composite of eight geologic and related maps (see table 1, fig. 4).	1:125,000 and 1:24,000.	1964-85	Polyconic	Paper composite (good condition) or mylar separates (excellent condition).	Thematic lines were digitized by using electronic scanner except for manual digitizing of TRPA map (table 1); feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Line coverage of geologic linear features.	Digitized from composite of eight geologic and related maps (see table 1, fig. 4).	1:125,000 and 1:24,000.	1964-85	Polyconic	Paper composite (good condition) or mylar separates (excellent condition).	Thematic lines were digitized by using electronic scanner except for manual digitizing of TRPA map (table 1); feature labels were assigned interactively by using ARC/INFO software.

Digitizing accuracy	Verification: Spatial data	Verification: Attribute data	GIS data type	Item or field: Names	Item or field: Description	Specifications: Input width (bytes)	Specifications: Output width (bytes)	Specifications: Type
CHANNEL--Continued								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Arc	LAKE/CHANNEL or ARC-CODE.	General description of linear feature (codes: 1, connecting arc through lake; 2, channel arc).	1	1	Integer.
do.	do.	do.	do.	INSIDE/OUTSIDE or BASIN90.	General description of linear feature (codes: 1, arc inside basin boundary; arc outside basin boundary).	1	1	Do.
do.	do.	do.	do.	MAJOR-MINOR_CODE or M_CODE.	Combination of MAJOR and MINOR codes.	48	48	Character.
COUNTY								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Arc	COUNTY/BUFFER or ARC-CODE.	General description of linear feature (codes: 1, county arc; 2, buffer arc).	2	2	Integer.
GEOL_COMP								
RMS range, 0.001 0.005; Res range, 0.459-3.167	Two or more verification plots, per topographic quadrangle (fig. 4), done by USGS.	Three or more verification plots, per topographic quadrangle (fig. 4), done by USGS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary; 8, fault; 9, geologic contact; 10, edge of map quadrangle).	2	2	Integer.
do.	do.	do.	Polygon	GEOLOGY-UNIT or MAP-UNIT.	Geologic-unit symbol	6	6	Character.
do.	do.	do.	do.	QUAD-ABBREV or QUAD-NAME.	Abbreviated name for 1:24,000-scale topographic quadrangle.	16	16	Character.
do.	do.	do.	do.	WATERBODY or WB-CODE.	Water-body code	6	6	Integer.
GEOL_COMP_LIN								
RMS range, 0.001-0.005; Res range, 0.459-3.167	Two or more verification plots done by USGS.	Three or more verification plots done by USGS.	Arc	FAU/INTR/CONC or FAULT-CODE.	General description of linear feature (codes: 1, fault; 2, inferred fault; 3, concealed fault; 4, moraine crest; 5, dike; 6, shear zone; 7, gradational contact).	1	1	Integer.

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Polygon coverage of geologic units.	Digitized from TRPA natural-hazards map (see table 1).	1:125,000 (recompiled at 1:24,000)	1974	Polyconic	Mylar (good condition except for two warped quadrangles, 1:24,000-scale Emerald Bay and Kings Beach).	Thematic lines were digitized manually; feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Line coverage of geologic linear features.	Digitized from TRPA natural-hazards maps (see table 1).	1:125,000 (recompiled at 1:24,000)	1974	Polyconic	Mylar (good condition except for two warped quadrangles, 1:24,000-scale Emerald Bay and Kings Beach).	Thematic lines were digitized manually; feature labels were assigned interactively by using ARC/INFO software.
						TEGIS coverage
Polygon coverage of hydrologic basins, coded according to Jorgensen and others (1978).	USGS; drainage divides delineated on topographic maps.	1:24,000	1991	Polyconic	Mylar (excellent condition).	Thematic lines were digitized manually; feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Polygon coverage of land-aspect zones.	USGS; derived from DEM files	1:24,000	1955-82 (topographic quadrangle publication dates).	Polyconic	Digital (magnetic tape).	Elevation data from DEM files were converted to elevation zones by using NASA's ELAS raster-format processing system and to vector-format spatial data bases by using ARC/INFO software; then land-aspect polygons for adjacent map quadrangles were appended successively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.

Digitizing accuracy	Verification: Spatial data	Verification: Attribute data	GIS data type	Data structure for attribute tables — Item or field: Names	Description	Specifications: Input width (bytes)	Specifications: Output width (bytes)	Specifications: Type
GEOL_TRPA								
RMS range, 0.001-0.005; Res range, 0.459-3.167	Four or more verification plots done by USGS.	Three or more verification plots done by USGS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary; 8, fault; 9, geologic contact; 10, edge of map quadrangle).	2	2	Integer.
do.	do.	do.	Polygon	GEOLOGY-UNIT or MAP-UNIT.	Geologic-unit symbol	6	6	Character.
do.	do.	do.	do.	WATERBODY or WB-CODE.	Water-body code	6	6	Integer.
GEOL_TRPA_LIN								
RMS range, 0.001-0.005; Res range, 0.459-3.167	Four or more verification plots done by USGS.	Three or more verification plots done by USGS.	Arc	FAU/INTR/CONC or FAULT-CODE.	General description of linear feature (codes: 1, fault; 2, inferred fault; 3, concealed fault; 4, moraine crest; 5, dike; 6, shear zone; 7, gradational contact).	1	1	Integer.
HYD_BASIN								
RMS range, 0.001-0.003; Res range, 0.67-1.634	Three or more verification plots done by USGS.	Three or more verification plots done by USGS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
Do.	do.	do.	Polygon	JORG-1978-BASIN or JORG-BASIN#.	Basin number, according to Jorgensen and others (1978).	5	5	Character.
Do.	do.	do.	Polygon	JORG-BASIN-NAME or JORG-NAME.	Basin name, according to Jorgensen and others (1978).	30	30	Character.
LAND_ASPECT								
Res, 30	One verification plot of vector-format data done by using ARC/INFO software.	--	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
do.	do.	--	Polygon	MAP-UNIT or GRID-CODE.	Aspect code	4	5	Binary.

Table 20. Detailed documentation for Tahoe Environmental

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Polygon coverage of land-aspect zones.	USGS; derived from DEM files	1:24,000	1955-82 (topographic quadrangle publication dates).	Polyconic	Digital (magnetic tape).	Elevation data from DEM files were converted to elevation zones by using NASA's ELAS raster-format processing system and to vector-format spatial data bases by using ARC/INFO software; then land-aspect polygons for adjacent map quadrangles were appended successively by using ARC/INFO software.
						TEGIS coverage
Polygon coverage of land-capability types.	Data from SCS soil-survey maps modified by using Bailey (1974) land-capability classification.	1:24,000	1974	Polyconic	Paper (folded; dry ironed before digitizing).	Thematic lines were digitized by using electronic scanner; feature labels were assigned interactively by using ARC/INFO software; soil units were merged into land-capability types by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Polygon coverage of land-slope zones.	USGS; derived from DEM files	1:24,000	1955-82 (topographic quadrangle publication dates).	Polyconic	Digital (magnetic tape).	Elevation data from DEM files were converted to elevation zones by using NASA's ELAS raster-format processing system and to vector-format spatial data bases by using ARC/INFO software; then land-slope polygons for adjacent map quadrangles were appended successively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.

Digitizing accuracy	Verification: Spatial data	Verification: Attribute data	GIS data type	Item or field: Names	Item or field: Description	Specifications: Input width (bytes)	Specifications: Output width (bytes)	Specifications: Type
LAND_ASPECT--Continued								
Res, 30	One verification plot of vector-format data done by using ARC/INFO software.	--	Polygon	WATERBODY or WB-CODE.	Water-body code	6	6	Integer.
LAND_CAP								
RMS range, 0.001-0.009; Res range, 0.67-5.7	Four linework-verification plots done by USGS and two done by SCS.	Seven verification plots done by USGS and one done by USFS and TRPA.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
do.	do.	do.	Polygon	LAND-CAPABILITY or MAP-UNIT.	Land-capability code	2	2	Character.
do.	do.	do.	do.	WATERBODY or WB-CODE.	Water-body code.	6	6	Integer.
LAND_SLOPE								
Res, 30	One verification plot of vector-format data done by using ARC/INFO software.	--	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
do.	do.	--	Polygon	MAP-UNIT or GRID-CODE.	Slope code	4	5	Binary.
do.	do.	--	do.	WATERBODY or WB-CODE.	Water-body code	6	6	Integer.

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Point coverage of hydrologic-monitoring sites.	Lahontan Water Quality Control Board; Nevada Division of Environmental Protection; USFS; USGS; and SCS. Site locations plotted on topographic maps.	1:24,000	1991	Polyconic	Paper (good condition).	Thematic lines were digitized by using electronic scanner. Scanned locations for surface-water sites were transposed to stream-channel locations and feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Line coverage of Public Land Survey System (clipped at outer Lake Tahoe basin boundary, as defined by TEGIS coverage BOUND_OUTER).	USGS; derived from DLG boundaries files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.

Digitizing accuracy	Verification		GIS data type	Data structure for attribute tables				
				Item or field				
						Specifications		
	Spatial data	Attribute data		Names	Description	Input width (bytes)	Output width (bytes)	Type
MONITOR_SITE								
RMS range, 0.001-0.003	Two verification plots done by USGS and checked by data-collection agency.	Two verifications done by data-collection agency.	Point	STATION-NUM or SITE.	Station number	15	15	Character.
do.	do.	do.	do.	AGENCY-ABBREV or AGENCY.	Monitoring agency	7	7	Character.
do.	do.	do.	do.	STATION-NAME or FULL-NAME.	Station name	53	53	Character.
do.	do.	do.	do.	LONGITUDE-DMS or LONG.	Longitude	13	13	Character.
do.	do.	do.	do.	LATITUDE-DMS or LAT.	Latitude	11	11	Character.
do.	do.	do.	do.	ALTITUDE-FT or ALT.	Elevation	7	7	Numeric.
do.	do.	do.	do.	PERIOD-OF-RECORD or PERIOD.	Period of record, in years.	23	23	Character.
do.	do.	do.	do.	STATION-TYPE or STN-TYPE.	Type of station	8	8	Character.
do.	do.	do.	do.	SAMPLE-PARAMETER or SAMP-PARM.	Sampling parameters	23	23	Character.
do.	do.	do.	do.	QUAD-NAME-ABBREV or QUAD-ABBREV.	Abbreviation of topographic-quadrangle name.	3	3	Character.
do.	do.	do.	do.	SW-GAGE-SITE or GAGE-SITE.	Surface-water gaging sites.	1	1	Character.
do.	do.	do.	do.	SW-DISCHRG-SITE or DISC-SITE.	Surface-water discharge sites.	1	1	Character.
do.	do.	do.	do.	SITE-TO-PLOT or PLOT-SITE.	Long-term site	1	1	Character.
do.	do.	do.	do.	WATERSHED-SITE or WSH-SITE.	Watershed-delineation sites.	1	1	Character.
PLSS								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary; 4, 7, township arc; 8, range arc; 9, arc added to close polygon (where no PLSS arc exists).	2	2	Integer.

Table 20. Detailed documentation for Tahoe Environmental

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Line coverage of Public Land Survey System (clipped at outer Lake Tahoe basin boundary, as defined by TEGIS coverage BOUND_OUTER).	USGS; derived from DLG boundaries files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Polygon coverage of riparian-vegetation zones.	Digitized from USFS riparian-vegetation maps (Joseph Oden, written commun., 1991).	1:24,000	1989	Polyconic	Mylar (six distorted maps had to be re-registered).	Thematic lines were digitized by using electronic scanner; feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Line coverage of roads (clipped at outer Lake Tahoe basin boundary, as defined by TEGIS coverage BOUND_OUTER).	USGS; derived from DLG transportation files and DLG boundaries files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.

Geographic Information System coverages—Continued

Digitizing accuracy	Verification: Spatial data	Verification: Attribute data	GIS data type	Data structure for attribute tables — Item or field: Names	Description	Specifications: Input width (bytes)	Output width (bytes)	Type
PLSS--Continued								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Polygon	MAJOR1	DLG code	6	6	Integer.
do.	do.	do.	Polygon	MINOR1	DLG code	6	6	Integer.
do.	do.	do.	do.	MAJOR2	do.	6	6	Do.
do.	do.	do.	do.	MINOR2	do.	6	6	Do.
do.	do.	do.	do.	MAJOR3	do.	6	6	Do.
do.	do.	do.	do.	MINOR3	do.	6	6	Do.
do.	do.	do.	do.	MAJOR4	do.	6	6	Do.
do.	do.	do.	do.	MINOR4	do.	6	6	Do.
do.	do.	do.	do.	MAJOR-MINOR_CODE or M_CODE.	Combination of MAJOR and MINOR codes.	48	48	Character.
RIPARIAN_VEG								
RMS range, 0.001-0.008; Res range, 0.459-4.595	Two or more verification plots done by USFS.	Three or more verification plots done by USFS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
do.	do.	do.	Polygon	RIPARIAN-UNIT or MAP-UNIT.	Riparian-vegetation code.	2	2	Character.
ROAD								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Arc	MAJOR1	DLG code	6	6	Integer.
do.	do.	do.	do.	MINOR1	do.	6	6	Do.
do.	do.	do.	do.	MAJOR2	do.	6	6	Do.
do.	do.	do.	do.	MINOR2	do.	6	6	Do.
do.	do.	do.	do.	MAJOR3	do.	6	6	Do.
do.	do.	do.	do.	MINOR3	do.	6	6	Do.
do.	do.	do.	do.	MAJOR4	do.	6	6	Do.
do.	do.	do.	do.	MINOR4	do.	6	6	Do.
do.	do.	do.	do.	MAJOR-MINOR_CODE or M_CODE.	Combination of MAJOR and MINOR codes.	48	48	Character.

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Polygon coverage of soil units.	Derived from SCS soil-survey maps.	1:24,000	1974	Polyconic	Paper (folded; dry ironed before digitizing).	Thematic lines from 13 (of 16) topographic quadrangles were digitized by using electronic scanner; Emerald Bay, Homewood, and Meeks Bay quadrangles were digitized manually. Feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Line coverage of Nevada-California boundary (clipped at outer Lake Tahoe basin boundary, as defined by TEGIS coverage BOUND_OUTER).	USGS; derived from DLG boundaries files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
						TEGIS coverage
Polygon coverage of Lake Tahoe.	USGS; derived from DLG hydrography files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
						TEGIS coverage
Polygon coverage of timber types.	Digitized from USFS timber-type maps.	1:24,000	1979	Polyconic	Mylar separates (good to excellent condition).	Thematic lines were digitized by using electronic scanner; feature labels were assigned interactively by using ARC/INFO software.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.

Digitizing accuracy	Verification: Spatial data	Verification: Attribute data	GIS data type	Names	Description	Input width (bytes)	Output width (bytes)	Type
SOIL								
RMS range, 0.001-0.009; Res range, 0.67-5.7	Four linework-verification plots done by USGS and two done by SCS.	Seven verification plots done by USGS and two done by SCS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
do.	do.	do.	Polygon	MAP-UNIT or SOIL-UNIT.	SCS soil-unit symbol	4	4	Character.
do.	do.	do.	do.	WATERBODY or WB-CODE.	Water-body code	6	6	Integer.
STATE_LINE								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files	--	--	--	--	--	--
TAHOE_LAKE								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Polygon	MAJOR1	DLG code	6	6	Integer.
do.	do.	do.	do.	MINOR1	do.	6	6	Do.
do.	do.	do.	do.	MAJOR2	do.	6	6	Do.
do.	do.	do.	do.	MINOR2	do.	6	6	Do.
do.	do.	do.	do.	MAJOR3	do.	6	6	Do.
do.	do.	do.	do.	MINOR3	do.	6	6	Do.
do.	do.	do.	do.	MAJOR4	do.	6	6	Do.
do.	do.	do.	do.	MINOR4	do.	6	6	Do.
do.	do.	do.	do.	MAJOR-MINOR_CODE or M_CODE.	Combination of MAJOR and MINOR codes.	48	48	Character.
TIMBER_TYPE								
RMS range, 0.000-0.006; Res range, 0.28-3.8	Three linework-verification plots done by USGS; one done by USFS; eight done jointly by USGS and USFS.	Two verification plots done by USGS; eight done jointly by USGS and USFS.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (codes: 1, Lake Tahoe boundary; 2, water-body boundary; 3, basin boundary).	2	2	Integer.
do.	do.	do.	Polygon	VEGETATION-UNIT or MAP-UNIT.	USFS vegetation code.	12	12	Character.
do.	do.	do.	do.	WATERBODY or WB-CODE.	Water-body code	6	6	Integer.

Description of coverage	Data source					Digitizing method
	Agency and (or) derivation	Scale	Date	Map projection	Media type and condition, if applicable	
						TEGIS coverage
Polygon coverage of water-body boundaries (excluding Lake Tahoe's).	USGS; derived from DLG hydrography files.	1:24,000	1969-82	Polyconic	Digital	Standard methods for DLG files.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.
Do.	do.	do.	do.	do.	do.	do.

Digitizing accuracy	Verification		Data structure for attribute tables					
				Item or field				
	Spatial data	Attribute data	GIS data type	Names	Description	Specifications		
						Input width (bytes)	Output width (bytes)	Type
WATER_BODY								
Standards for DLG files.	According to digitizing standards for DLG files.	According to digitizing standards for DLG files.	Arc	ARC-CODE or LK/WB/BSN.	General description of linear feature (code: 3, basin boundary).	2	2	Integer.
do.	do.	do.	Polygon	MAJOR1	DLG code	6	6	Do.
do.	do.	do.	do.	MINOR1	do.	6	6	Do.
do.	do.	do.	do.	MAJOR2	do.	6	6	Do.
do.	do.	do.	do.	MINOR2	do.	6	6	Do.
do.	do.	do.	do.	MAJOR3	do.	6	6	Do.
do.	do.	do.	do.	MINOR3	do.	6	6	Do.
do.	do.	do.	do.	MAJOR4	do.	6	6	Do.
do.	do.	do.	do.	MINOR4	do.	6	6	Do.
do.	do.	do.	do.	WATERBODY or WB-CODE.	Water-body code	6	6	Do.
do.	do.	do.	do.	MAJOR-MINOR_CODE or M_CODE.	Combination of MAJOR and MINOR codes.	48	48	Character.

GPO 584-141/19070

USGS LIBRARY - RESTON
3 1818 00152852 8

Cartier and others—DEVELOPMENT AND DOCUMENTATION OF SPATIAL DATA BASES, LAKE TAHOE BASIN, CALIF.–NEV.—WRIR 93-4182