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

DIGITAL COMPILATION OF "PRELIMINARY MAP OF LANDSLIDE DEPOSITS IN SANTA CRUZ COUNTY, CALIFORNIA, BY COOPER-CLARK AND ASSOCIATES, 1975": A DIGITAL MAP DATABASE

by
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with a preface by
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ABSTRACT

A 1:62,500-scale black-and-white map identifying some 2,000 landslides of various types in Santa Cruz County, California, has been converted to a digital-map database that can be acquired from the U.S. Geological Survey over the Internet or on magnetic tape.

PREFACE

The effort toward a landslide inventory of Santa Cruz County began about 1972 when Walter Monasch, then Planning Director for the county, saw a landslide inventory and other hazard maps prepared for San Mateo County as part of a pilot program underway by the U.S. Geologic Survey (USGS) for the nine counties surrounding San Francisco Bay. He asked if the USGS would prepare similar maps for his county so that he could respond to a new State of California requirement that geologic hazards be considered in the seismic safety element of the general plan for all cities and counties. When informed that the USGS did not have the manpower to comply with his request, he asked if the USGS would supervise the work of consultants to prepare a landslide inventory, a fault map, and a map showing areas that might liquefy during an earthquake– providing that the County fund this project. The USGS agreed to find the consultants to do the work. N. Timothy Hall was engaged to prepare the fault map, William Dupré the liquefaction map, and Cooper-Clark and Associates the landslide inventory. Earl E. Brabb was assigned by the USGS to monitor the work. All of the finished maps were added to the seismic safety element of the general plan adopted by the Santa Cruz County Board of Supervisors on August 26, 1975.

The formal citation for the landslide map is: Cooper-Clark and Associates, 1975, Preliminary map of landslide deposits in Santa Cruz County, CA, Planning Department, 1 sheet, map scale 1:62,500.

Although the information in this database has not been updated or amended beyond that in Cooper-Clark and Associates (1975), it is being released in digital form because it is the only systematic landslide-inventory that exists for Santa Cruz County. Users are cautioned that these 25- to 30-year-old data have shortcomings in addition to the several caveats cited in the original map text. Information on the slope-failure hazard is incomplete. Landslides occurring in the County after 1970 (date of the latest airphotos used in the 1975 compilation), particularly during the severe winters of 1982 (15 fatalities; Cotton, 1982), 1983, and 1998, are not recorded here.

The January 3-5, 1982, storm alone triggered hundreds of debris flows across the County (Ellen and others, 1997), and scores of landslides of various types occurred during the 1997-98 El Niño causing $9.3 million in damages (Schuster and others, 1998). A few post-1970 maps at medium scale are listed below; detailed mapping by private consultants is not cited. Finally, many locations in Santa Cruz County that might be susceptible to slope-failure are indicated in a recent terrain-based mathematical model that predicts source areas for debris flows (Ellen and others, 1997).

This report is organized as three parts. The first reproduces verbatim the entire explanatory text printed on the 1975 Cooper-Clark source map. Part II describes compilation of the Cooper-Clark map as a digital database and the conventions adopted in encoding its landslide information in a geographic information system (GIS). The final section describes details of the digital-map database, its constituent data files, and their computer formats. It further lists the steps required to obtain the contents of the landslide-map database from USGS.

RECENT REFERENCES

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I.
THE SOURCE MAP

This section is repeated verbatim from the 1975 map by Cooper-Clark and Associates

INTRODUCTION

PURPOSE AND METHOD

Knowledge of the distribution and type of landslides present in a region is one of the kinds of geologic information necessary for more effective land-use planning. This map provides such information. It is a preliminary map of known and suspected landslides prepared by stereoscopic analyses of high and intermediate level aerial photographs. Although prepared and published without the benefit of field checking for accuracy and completeness, this map is useful because it has quickly provided needed landslide information for immediate use in making land-use decisions.

DEFINITION OF TERMS

Landsliding is commonly defined as the "downward and outward movement of slope-forming materials composed of natural rock, soils, artificial fills or combinations of these materials" (General Reference No. 1). This map shows landslides that have occurred only in natural materials. However, the works of man have very likely contributed to the development of at least some of the landslides shown.

Landslides are often classified according to the type of materials involved and the type of movement which occurs. On this basis, the principal types of landslides are: (1) falls, (2) slides, and (3) flows (see Figures 1 and 2). Combinations of these basic types are classified as "complex" landslides.

Landslides may also be classified according to age, which is suggestive of their level of activity. On this basis, landslides can be tentatively classified as: (1) ancient (static), (2) old (dormant), or (3) young (active or recently active). Dormant landslides are not presently active, but may reactivate under existing natural slope conditions. In contrast, static landslides require a gross disturbance of their slope environment before they will be reactivated. Examples of gross disturbances are: substantial ground shaking generated by an earthquake, inappropriate grading in a critical portion of the slide, and extensive, prolonged saturation of the slide mass.

Classifications which evaluate the certainty of landslide existence provide a reliability rating which is often useful, particularly when landslide identification is based upon aerial photographic analyses without an opportunity to field check the accuracy of interpretations. A three-part classification is often used, based on the confidence the investigator has in his interpretations. The following reliability rating classification is commonly used: (1) <u>definite</u> landslide, (2) <u>probable</u> landslide and (3) <u>questionable</u> landslide.

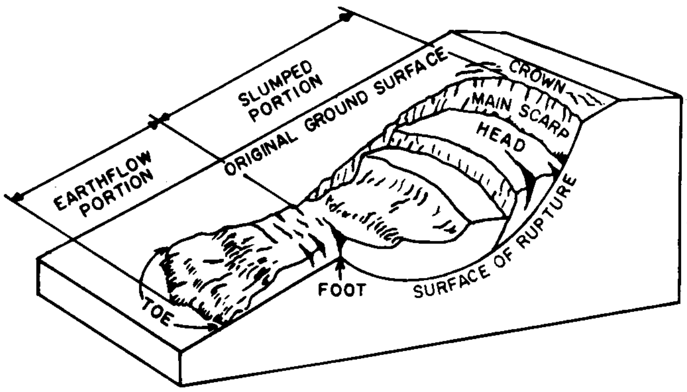

Figure 1. General morphology of recently active landslides

SUMMARY OF LANDSLIDE CAUSES

Included among the major inter-related factors and processes which contribute to landsliding are:

1. Unfavorable geologic structure
2. Weakened or unconsolidated soil and rock
3. High annual rainfall
4. High groundwater levels
5. Steeply-inclined slopes and irregular topography
6. Deep weathering
7. High rates of differential erosion
8. Seismic ground shaking
9. Activities of man

The activities of man which can initiate landsliding or reactivate dormant or static landslides include the following:

1. Inappropriate or poorly engineered cuts and fills.
2. Deflection or blockage of surface or subsurface drainage.
3. Gross removal of protective vegetative cover.
4. Increase in soil and rock moisture through prolonged or excessive outside domestic water usage or extensive use of septic tanks and leach fields.
5. Insufficient maintenance or repair of improvements such as culverts, storm drains, gutters, etc.

LANDSLIDE CONDITIONS IN SANTA CRUZ COUNTY

DISTRIBUTION

Widespread landslide conditions exist in Santa Cruz County. The most intense conditions occur in the mountainous areas in the northern and eastern parts of the County. There is substantially less landslide development in the more gently sloping areas in the south and west parts of the County.

LANDSLIDE TYPES

Landslides in Santa Cruz County vary widely in dimension, age, type of movement and type of material.

Most landslides appear to have moved as slumps, earthflows, or as a combination of these movements. (see Figures 1 and 2). In the latter situation, movement initially occurs as a slump. Following slumping, movement continues, producing an earthflow, often extending a long distance downslope from the original slump (see Figure 1).

Other types of landslide movement which appear to have occurred are block glides, debris avalanches, rockfalls and sand flows.

Landslides, which vary in maximum surface dimension from a few feet upwards to a few hundred feet, are present throughout most portions of the County. In addition, there are numerous, remarkably large landslides in the mountainous portions of the County. The surface dimensions of these large landslides range from slightly less than 1000 feet to over 8000 feet. Depths are estimated to range from 100 to possibly 400 feet. Several of the larger landslides are located along the San Andreas Rift Zone, strongly suggesting a correlation between intense ground shaking and massive landslide development. In many cases, smaller slides have developed upon the surfaces of the large landslides.

The largest landslides appear to be the oldest. The age range for the origin of these landslides is probably several hundreds to several thousands of years. Movements may have occurred intermittently since time of origin.

TYPE OF MOVEMENT	TYPE OF MATERIAL			
	BEDROCK		SOILS	
FALLS	ROCKFALL		SOILFALL	
SLIDES — FEW UNITS	ROTATIONAL SLUMP	PLANAR BLOCK GLIDE	PLANAR BLOCK GLIDE	ROTATIONAL BLOCK SLUMP
SLIDES — MANY UNITS		ROCKSLIDE	DEBRIS SLIDE	FAILURE BY LATERAL SPREADING
	ALL UNCONSOLIDATED			
	ROCK FRAGMENTS	SAND OR SILT	MIXED	MOSTLY PLASTIC
FLOWS — DRY	ROCK FRAGMENT FLOW	SAND RUN; LOESS FLOW		
FLOWS		RAPID EARTHFLOW	DEBRIS AVALANCHE	SLOW EARTHFLOW
FLOWS — WET		SAND OR SILT FLOW	DEBRIS FLOW	MUDFLOW
COMPLEX	COMBINATIONS OF MATERIALS OR TYPE OF MOVEMENT			

Figure 2. Classification of landslides After: Varnes, D.J. 1958, Landslide types and process, In Eckel, E.B., ed., Landslide and engineering practice: Highway Research Board Spec. Rep. 29, NAS- NRC 544, Washington, D.C.,p. 20-47.

LANDSLIDE ACTIVITY AND RATES OF MOVEMENT

Most landslides observed in the aerial photographs do not appear to be grossly active. However, observations for slide activity in aerial photographs can be deceptive. For example, a large, old landslide which appears dormant or static may have an annual average rate of movement that amounts to a few inches. This movement would not be sufficient to show surface distress observable in aerial photographs. Therefore, when the activity of a slide is important, detailed geologic investigations, including subsurface exploration, should be undertaken for activity determination.

Recently active landslides in the County which can be identified in aerial photographs are those which have undergone rapid movement (those labeled R on the map see map symbols below). These are classified as debris avalanches, or debris flows (see Figure 2). They leave a well-defined, readily discernible slide track, or scar from which the slide debris was rapidly evacuated. Slides of this type have developed on steep canyon walls. Movement appears to have involved only surficial materials or possibly highly weathered bedrock. They are relatively long and narrow. The length of the slides and steepness of slopes suggest very rapid movement and a fluid condition of the slide material. Because these slides generally occur without forewarning, and move with rapidity, they impose a risk to life not normally associated with slower moving slides such as earthflows and slumps.

MAP PREPARATION

METHOD

Landslides were identified solely by the stereoscopic examination of vertical black and white aerial photographs. Both intermediate and high-level photographs were used. Difficult and complex areas were reviewed by two and in some cases, three interpreters using both high and intermediate-level photographs to develop the best opinion of existing landslide conditions.

AERIAL PHOTO SCALES AND FLIGHT DATES

The following aerial photographs were used in map preparation:

1. U.S. Soil Conservation Service
   Scale: 1:20,000
   Flight Date: 1963
2. U.S. Geological Survey
   Scale: 1:30,000
   Flight Date: 1967 ,68
3. U.S. Geological Survey
   Scale: 1 :80,000
   Flight Date: 1970

REGIONAL GEOLOGY

Regional geologic maps (Brabb, 1970; Clark, 1966, 1970a, 1970b; and Farrington, 1974) were reviewed to supplement interpretations.

MAP RELIABILITY

Numerous factors affect the reliability of interpreting landslides from aerial photographs. These include:

1. Scale of maps and photography
2. Date(s) of photography
3. Degree and extent of forest cover
4. Age and activity of landslides
5. Degree and extent of urbanization
6. Problems of interpretation
7. Skill and experience in aerial photo interpretation

SCALES OF MAP AND PHOTOGRAPHY

Most landslide deposits less than about 50 feet in maximum dimension are not shown because they are too small to be identified on the photographs used (1963, 1 " = 1670').

DATES OF PHOTOGRAPHY

Most of the landslide deposits shown on this map were interpreted from aerial photographs taken in 1963 and in 1970. Supplemental interpretations were also made from photographs taken in 1967 and 1968. In some areas within the county, particularly in the Santa Cruz-Rio Del Mar, Felton-Boulder Creek and Scotts Valley areas, pre-1963 urbanization may have obscured some landslides. These landslides would not be identifiable. Also, some small landslides may have formed since 1963 which would not be visible in the higher-level 1970 photographs. Such slides would also not be delineated. However, since urban areas represent a small percentage of the total County area and since most slides formed prior to 1963, the map reliability is not substantially affected by photography dates.

FOREST COVER

The degree and extent of forest cover significantly affects the reliability of landslide interpretations. This is particularly the case with smaller (less than 50 feet in maximum dimension), older landslides whose landform is obscured by dense forest cover. Approximately 75 percent of the County is mantled by moderate to dense forest cover. This condition is reflected on the landslide map by a relatively large percentage of landslides which are classified as being "questionable" (see map symbols below).

AGE AND ACTIVITY OF LANDSLIDES

Recently active, well-defined landslides with surface dimensions greater than 50 feet are usually discernible in aerial photographs of the scale used in this investigation. Older, inactive or slowly moving landslides, which are deeply eroded and obscured by forest cover are more difficult to observe unless they have very large dimensions. This condition is also reflected on the landslide map by a relatively large percentage of landslides which are classified as being questionable.

PROBLEMS OF INTERPRETATION

Mapping of landslide deposits by photo interpretation presents a number of difficult problems, some of which can only be resolved through extensive field checking. Problems that are especially difficult include: (1) the distinction of terrace-shaped slump deposits from alluvial terrace deposits adjacent to stream courses; (2) the recognition of landslide deposit boundaries that have been modified by natural processes and are no longer well-defined– whereas the upslope boundary is commonly defined by an easily recognized scarp, the toe or downslope boundary is often poorly defined and difficult to locate exactly; (3) the recognition of unslid masses of bedrock surrounded by landslide deposits; (4) the distinction of irregular or hummocky topography caused by variations in the erosional resistance of bedrock from that caused by landslide activity; and (5) the distinction between steep arcuate scarps at the upper slope caused by differential erosion of relatively resistant, generally flat-lying beds from similar scarps caused by landslide movement.

SKILL AND EXPERIENCE IN INTERPRETATION

Reliability of interpretations can be affected by the skill and experience of the aerial photo interpreters. Interpretations for this map were made by personnel with 5 to 10 years of aerial photo interpretation experience. The map, therefore, reflects the current state-of-the-art regarding interpretation of landforms of landslide origin from aerial photographs.

IMPROVING MAP RELIABILITY

The reliability of this landslide map can be improved by integrating it with other landslide data. Such data would be from site specific studies conducted by consultant firms, landslide repair records from public works agencies, subregional landslide maps prepared by students and/or faculty of Bay Area universities, and by field checking the map for accuracy and completeness.

MAP USE AND LIMITATIONS

USE

This map is primarily intended for advance planning purposes. It provides an early indication of possible slope stability problems associated with areas which may be subject to various types of proposed improvements. The map can also be used to make relative comparisons between alternative sites for feasibility purposes and for the scoping of needed sites specific stability investigations. It can also be used as a basis for developing requirements for predevelopment investigations which must be met as a requisite to development.

When this map is used in conjunction with available Countywide geologic and slope maps, it is possible to analyze and evaluate the susceptibility of various areas within the County with respect to <u>future</u> landslide development. Such evaluations should only be undertaken by qualified geotechnical personnel.

LIMITATIONS

This map is intended for <u>regional</u> landuse evaluations and decisions. It is not intended for detailed slope stability evaluations of individual sites. Such information must be developed during detailed site specific engineering and geologic studies.

This map is no more detailed than the aerial photographs and maps used. For this reason, small localized slides may be present which are not shown on the maps and some larger slides may not be shown because they are obscured by dense forest cover.

GENERAL REFERENCES ON LANDSLIDE DEPOSITS

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Brabb, E.E., and Pampeyan, E.H., 1972, Preliminary map of landslide deposits in San Mateo County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF344, scale 1 :62,500 (Basic Data Contribution no. 42).

Clark, J.C., 1966, Tertiary stratigraphy of the Felton-Santa Cruz area, Santa Cruz Mountains, California: Stanford University, unpublished Ph.D. thesis, 184 p.

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II.
DIGITAL COMPILATION

INTRODUCTION

The landslide deposit database was compiled using version 7.1.1 of ARC/INFO, a commercial geographic information system, or GIS (Environmental Systems Research Institute [ESRI], Redlands, California) on a UNIX computer using the menu interface ALACARTE (versions 1 through 3.1: Fitzgibbon and Wentworth, 1991; Fitzgibbon, 1991; Wentworth and Fitzgibbon, 1991).

The digital compilation was derived from linework inked directly by the authors on 17 USGS mylar greenline 7.5-minute (1:24,000-scale) quadrangle maps that cover Santa Cruz County. The inked linework for each source map was scanned (800 dots per inch), converted from raster to vector form, imported into ARC/INFO, and hand edited and combined into a single digital file. Small adjustments were made to fit lines across quadrangle boundaries, but larger misfits were retained. The base map for the landslide data includes topography, drainage, and culture at a scale of 1:125,000. These base layers were derived from USGS Bay Region Topographic Sheets (Aitken 1997).

The boundary of Santa Cruz County was added to the database to delineate the area of detailed mapping inside the county, This county line was derived from Wentworth 1997. Any landslides mapped outside the county boundary were deleted and are not included in this map database. The 17 constituent USGS quadrangles are: Mindego Hill, Cupertino, Franklin Point, Big Basin, Castle Rock Ridge, Los Gatos, Año Nuevo, Davenport, Felton, Laurel, Loma Prieta, Mount Madonna, Santa Cruz, Soquel, Watsonville West, Watsonville East, and Chittenden. The Moss Landing quadrangle was omitted from the database because the authors did not map any landslide deposits within its boundary.

LANDSLIDE-DEPOSIT UNITS

The spatial database uses two different symbols to represents landslide deposits in two separate data layers. All landslides larger than 500 feet in maximum dimension are delineated by polygons enclosing their approximate boundaries. Each landslide with a maximum dimension of 50 to 500 feet is represented in the database by a point, which is printed as an arrow on the landslide deposit map and can be plotted from the Postscript and PDF plotfiles included with the database. This arrow points in the direction of downslope movement and is centered over the point representing the location of the deposit. Although the smaller landslides range in size from 50 to 500 feet, the arrow symbol for each of these slides is the same size and measures about 180 feet . The primary landslide identifier is a character string in the field PTYPE (polygon type) in the large landslide data layer and PTTYPE (point type) in the small landslide data layer.

Because landslides in this database were identified via analysis of aerial photographs without an opportunity to field check the resulting map, the values in the PTYPE and PTTYPE fields classify the degree of confidence the author has in his interpretations. The values for this field range from Definite to Questionable. In both the Postscript and PDF plot files, large landslide polygons are color coded according to this classification, and the small landslides have these classifications printed at the head of each arrow as annotation.

Table 1. General PTYPE and PTTYPE Categories

Descriptions of landslide categories are modified from the Cooper-Clark Landslide Map Explanation.

D	- definite landslide deposit
P	- probable landslide deposit
?	- questionable landslide deposit
<no value>	- landslide without any attribute
R	- a modifier added to one of the above values for landslide features that strongly suggest a rapid rate (several feet per second to over 100 feet per second) of landslide movement.

SPATIAL RESOLUTION

Uses of this digital map should not violate the spatial resolution of the data. Although the digital form of the data removes the physical constraint imposed by the scale of a paper map, the detail and accuracy inherent in map scale are also present in the digital data. Because this database was compiled from maps at a scale of 1:24,000, higher-resolution information is not present. Enlargement of the database to scales larger than 1:24,000 will not yield greater real detail, although it may reveal fine-scale irregularities below the intended resolution of the database. Similarly, where this database is used in combination with other data of higher resolution, the resolution of the combined output will be limited by the lower resolution of this data.

SPECIFICS OF THE LANDSLIDE-DEPOSIT DATABASE

The landslide-deposit spatial database itself consists of various data layers each with the naming convention pf-extn. The abbreviation <pf> represents the quadrangle prefix, and the abbreviation <extn> is a data layer extension (suffix). The various data layers are described in Table 2 below. The map layer is stored in UTM projection (zone 10) (see Table 3), and projection files are included to convert between that and the state plane projection. Digital tics define a 7.5 minute grid of latitude and longitude (see 7.5 MINUTE QUADRANGLE GRID, below). The contents of the map database are described in terms of the lines, areas, and points that compose it. The terms in Table 4 describe the database fields.

Table 2. Data Layers

DATA LAYER NAME	DESCRIPTION
pf-slid_um	polygons for large landslides, fault scarps, map boundaries, coastal water boundary, county boundary
pf-smls_um	point features for small landslides. There is no cu-smls_um layer.
pf-anno_um	annotation showing landslide type on large landslides, arrow showing downslope movement on large landslides. The cu-anno_um layer does not contain downslope movement arrows.

Table 3. Map Projection

projection	UTM (universal transverse mercator)
units	meters
zone	10
datum	NAD27
spheriod	CLARKE 1866

Table 4. Field Definition Terms

ITEM NAME	name of the database field (item)
WIDTH	maximum number of digits or characters stored
OUTPUT	output width
TYPE	B- binary integer, F- binary floating point number, N- ASCII floating point number, I- ASCII integer, C- ASCII character string
N.DEC	number of decimal places maintained for floating point numbers

Lines - Database lines (arcs) are recorded as strings of vectors with characteristics that are described in the arc attribute table (see Table 5). In the pf-slid_um map layer they define the boundaries of the landslide units, topographic escarpments, the boundary of the coastline, the map and internal sheet boundaries, scratch boundaries, and the boundary of Santa Cruz County. In the pf-anno_um layer they define the arrows showing downslope movement of large landslides. These distinctions are recorded in the LTYPE database field according to the line types listed in Table 6. Please note that the lines representing topographic escarpments have endpoints that are dangling (i.e. they do not complete an enclosed polygon) and will be displayed as errors with the node errors option in ARC INFO.

Table 5. Content of the Arc Attribute Table
(PF-SLID.AAT & PF-ANNO.AAT PF = quadrangle prefix)

ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	
FNODE#	4	5	B		starting node of arc (from node)
TNODE#	4	5	B	-	ending node of arc (to node)
LPOLY#	4	5	B		polygon to the left of the arc
RPOLY#	4	5	B	-	polygon to the right of the arc
LENGTH	4	12	F	3	length of arc in meters
PF-SLID#	4	5	B	-	unique internal control number
PF-SLID-ID	4	5	B	-	unique identification number
LTYPE	35	35	C	-	line type

Table 6. Line Types Recorded in the LTYPE Field
The line types are ALACARTE style types that correlate with geologic line symbols in the ALACARTE line set GEOLOGY.LIN according to the ALACARTE lines lookup table GEOLINE.LUT.

LINE TYPE	DESCRIPTION
contact, certain	arcs delineating large landslide polygons
topographic escarpment	inferred main scarp on large landslides
arrow, certain	arrow showing downslope movement on large landslides
county boundary	Santa Cruz County boundary
scratch boundary	questionable boundary added during digital compilation
map boundary	quadrangle and sheet boundary
water boundary	water boundary on the coastline

Areas - Large landslide units (maximum dimension greater than 500 feet) are recorded as vector polygons with characteristics that are described in the polygon attribute table (see Table 7). The primary unit identifier is PTYPE.

Table 7. Content of the Polygon Attribute Table
(PF-SLID.PAT PF = quadrangle prefix)

ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	
AREA	4	12	F	3	area of polygon in square meters
PERIMETER	4	12	F	3	length of perimeter in meters
PF-SLID#	4	5	B	-	unique internal control number
PF-SLID-ID	4	5	B	-	unique identification number
PTYPE	35	35	C	-	landslide category

Points - Small landslide units (maximum dimension 50 to 500 feet) are recorded as point features in ARC/INFO. These point features are plotted as arrows showing the direction of downslope movement and are centered over the location of the slide. Although the slides range in length from 50 to 500 feet, all arrows have the same length of approximately 180 feet when plotted. In both the Postscript and PDF plot files, the value for PTTYPE is printed as an annotation at the head of each landslide arrow.

Table 8. Content of the Point Attribute Table
(PF-SMLS.PAT PF = quadrangle prefix)

ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	
AREA	4	12	F	3	area of polygon in square meters
PERIMETER	4	12	F	3	length of perimeter in meters
PF-SMLS#	4	5	B	-	unique internal control number
PF-SLID-ID	4	5	B	-	unique identification number
PTTYPE	35	35	C	-	landslide category
STRIKE	3	3	I	-	direction of downslope movement in degrees

REFERENCES CITED

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III.
THE DIGITAL DATABASE

INTRODUCTION

This report consists of a digital map database, a digital map image derived from it entitled "Preliminary Map of Landslide Deposits in Santa Cruz County, California: A Digital Map Database", and supporting files. The map is at a scale of 1:62,500. The report is stored as several digital files, for the spatial data both ARC export (uncompressed) and ARCVIEW shape formats, and for the map image both Postscript and PDF formats. The exported ARC coverages lie in UTM zone 10 projection and the shape versions are coded in decimal degrees. This pamphlet, which only describes the content and character of the digital map database, is included as postscript. PDF, and ASCII text files and is also available on paper as USGS Open-File Report 98-792. A plotted copy of the map can be ordered from a USGS Earth Science Information Center or by phone at 1-800-USMAPS. Any or all of the digital files can be obtained over the Internet or by magnetic tape copy, as described at the end of this section.

The full versatility of the spatial database is realized by importing the ARC export files into ARC/INFO or an equivalent GIS. Other GIS packages, including MapInfo and ARCVIEW, can use either the ARC export or shape files. The Postscript map image can be used for viewing or plotting in computer systems with sufficient capacity, and the considerably smaller PDF image file can be viewed or plotted in full or in part from Adobe ACROBAT software running on Macintosh, PC, or UNIX platforms.

DATABASE CONTENTS

The nine sets of digital files comprising the database, are encoded in more than one format. The names of the files are unique designators based on the report identifier, of98-792, followed by part numbers (i.e. 3 through 6 below) and an extension indicating file type. Some of the files have been bundled using the tar (UNIX Tape Archive) utility (.tar extension). All of the larger files have been compressed with the gzip utility, indicated by the .gz extension. The files and their identities are as follows:

1. Revision List: A list of the parts of the report and at what version number of the report each was last revised (if at all) followed by a chronologic list that describes any revisions (see REVISIONS, below).

   of98-792revs_1a.txt   ASCII file

2. Open File Text: The open-file pamphlet (this text), which describes the database and how to obtain it.

of98-792_2a.txt	ASCII file
of98-792_2b.ps	Postscript file
of98-792_2c.pdf	PDF file

3. Database for Large Landslide Deposits: ARC export coverages for each quadrangle containing both lines and polygons. Import aml will name these coverages pf-slid_um. (pf is the quadrangle prefix)

FILE NAME	QUADRANGLE NAME
of98-792_3a.e00.gz	Mindego Hill
of98-792_3b.e00.gz	Cupertino
of98-792_3c.e00.gz	Franklin Point
of98-792_3d.e00.gz	Big Basin
of98-792_3e.e00.gz	Castle Rock Ridge
of98-792_3f.e00.gz	Los Gatos
of98-792_3g.e00.gz	Año Nuevo
of98-792_3h.e00.gz	Davenport
of98-792_3i.e00.gz	Felton
of98-792_3j.e00.gz	Laurel
of98-792_3k.e00.gz	Loma Prieta
of98-792_3l.e00.gz	Mount Madonna
of98-792_3m.e00.gz	Santa Cruz
of98-792_3n.e00.gz	Soquel
of98-792_3o.e00.gz	Watsonville West
of98-792_3p.e00.gz	Watsonville East
of98-792_3q.e00.gz	Chittenden

4. Database for Annotation on Large Landslides and Downslope Movement Arrows: ARC export coverages for each quadrangle containing the annotation layer, which consists of annotation on the large landslide polygons and arcs representing the arrows on large landslide polygons. Import aml will name these coverages pf-anno_um.

FILE NAME	QUADRANGLE NAME
of98-792_4a.e00.gz	Mindego Hill
of98-792_4b.e00.gz	Cupertino
of98-792_4c.e00.gz	Franklin Point
of98-792_4d.e00.gz	Big Basin
of98-792_4e.e00.gz	Castle Rock Ridge
of98-792_4f.e00.gz	Los Gatos
of98-792_4g.e00.gz	Año Nuevo
of98-792_4h.e00.gz	Davenport
of98-792_4i.e00.gz	Felton
of98-792_4j.e00.gz	Laurel

of98-792_4k.e00.gz	Loma Prieta
of98-792_4l.e00.gz	Mount Madonna
of98-792_4m.e00.gz	Santa Cruz
of98-792_4n.e00.gz	Soquel
of98-792_4o.e00.gz	Watsonville West
of98-792_4p.e00.gz	Watsonville East
of98-792_4q.e00.gz	Chittenden

5. Database for Small Landslide Deposit: ARC export coverage for each quadrangle containing points. Import aml will name these coverages pf-smls_um.

FILE NAME	QUADRANGLE NAME
of98-792_5a.e00.gz	Mindego Hill
	(no Cupertino layer)
of98-792_5c.e00.gz	Franklin Point
of98-792_5d.e00.gz	Big Basin
of98-792_5e.e00.gz	Castle Rock Ridge
of98-792_5f.e00.gz	Los Gatos
of98-792_5g.e00.gz	Año Nuevo
of98-792_5h.e00.gz	Davenport
of98-792_5i.e00.gz	Felton
of98-792_5j.e00.gz	Laurel
of98-792_5k.e00.gz	Loma Prieta
of98-792_5l.e00.gz	Mount Madonna
of98-792_5m.e00.gz	Santa Cruz
of98-792_5n.e00.gz	Soquel
of98-792_5o.e00.gz	Watsonville West
of98-792_5p.e00.gz	Watsonville East
of98-792_5q.e00.gz	Chittenden

6. Line and polygon ARCVIEW shape files bundled as one tar file. When opened, the tar file yields:

- line files	pf-arc.dbf,	pf-arc.shp,	and pf-arc.shx
- polygon files	pf-poly.dbf,	pf-poly.shp,	and pf-poly.shx
-line files	pf-anno.dbf,	pf-anno.shp,	and pf-anno.shx
-point files	pf-smls.dbf,	pf-smls.shp,	and pf-smls.shx

Note: The annotation in the pf-anno_um data layer is not included in this format because ARCVIEW shape files do not support annotation. of98-792_6b.tar.gs does not contain pf-anno or pf-smls data layers.

FILE NAME	QUADRANGLE NAME
of98-792_6a.tar.gz	Mindego Hill
of98-792_6b.tar.gz	Cupertino
of98-792_6c.tar.gz	Franklin Point
of98-792_6d.tar.gz	Big Basin
of98-792_6e.tar.gz	Castle Rock Ridge
of98-792_6f.tar.gz	Los Gatos
of98-792_6g.tar.gz	Año Nuevo
of98-792_6h.tar.gz	Davenport
of98-792_6i.tar.gz	Felton
of98-792_6j.tar.gz	Laurel
of98-792_6k.tar.gz	Loma Prieta
of98-792_6l.tar.gz	Mount Madonna
of98-792_6m.tar.gz	Santa Cruz
of98-792_6n.tar.gz	Soquel
of98-792_6o.tar.gz	Watsonville West
of98-792_6p.tar.gz	Watsonville East
of98-792_6q.tar.gz	Chittenden

7. Supporting files for ARC/INFO use, bundled as one tar file. When opened, the tar file yields:
   - utm2sp.prj and sp2utm.prj: These are projection files to convert between the UTM zone 10 projection of the database and state plane projection.
   - import.aml: This is an ASCII script written in Arc Macro Language for converting the ARC export files into usable coverages and INFO files that are assigned standard names (see IMPORTING THE ARC EXPORT FILES).

   of98-792_7a.tar

8. Quadrangle Index Database: The data files representing lines and polygons of the quadrangle index (ARC export and ARCVIEW shape format). The ARC version also includes quadrangle names as annotation.

   of98-792_8a.e00.gz ARC export coverage containing lines, polygons, and annotation. Import.aml will name this coverage cc-index_um.

   of98-792_8b.tar.gz Line and polygon ARCVIEW shape files bundled as one tar file. When opened, the tar file yields:

- line files	grdlns.dbf,	grdlns.shp,	and grdlns.shx
- polygon files	grdpys.dbf,	grdpys.shp,	and grdpys.shx

9. Plot File for the Map: Landslide Deposits in Santa Cruz County which measures 50 by 36 inches when plotted.

of98-792_9a.ps.gz	Postscript file (27 MB compressed to 5.8 MB)
of98-792_9b.pdf	PDF file (7.8 MB)

REVISIONS

Changes to any parts of the report (the numbered items described above and listed in the revision list of98-792revs_a.txt) may be made in the future if needed. These could involve, for example, fixing files that don't work, correcting or adding landslide details, or adding new file formats or other components. Major revision of the basic landslide information would result in a new report.

The report begins at version 1.00. Any revisions will be noted in the revision list and will result in the recording of a new version number for the report. Small changes will be indicated by decimal increments and larger changes by integer increments in the version number. Revisions will be announced and maintained on the Web page for this report on the Western Region Geologic Information Server (see next section).

OBTAINING THE DATA FILES

The database may be obtained in three ways.

1. The simplest way to obtain the database is to download it over the World Wide Web from the USGS Western Region Geologic Information Server:

http://wrgis.wr.usgs.gov

From the main page, click on 'Geologic map databases' under the heading 'Data On-line'; next click on 'California'. Scroll down to the listing for this database (Open File Report 98-792) and click on the Open-File button, which takes you to the page for this publication. You can also go directly to that final page at:

http://wrgis.wr.usgs.gov/open-file/of98-792

On this page, the several parts of the report in their different file types are separately available. Set your Web browser to save to a local disk and click on the appropriate links to download the desired files.

2. To download the files from the Internet via anonymous ftp:

ftp wrgis.wr.usgs.gov	- make ftp connection with the USGS computer wrgis.
Name: anonymous	- enter "anonymous" as your user name.

Password: [your address] - enter your own email address as password.
pub/open-file/of98-792 -the subdirectory in which the files from this report are stored

3. To obtain files from the database on magnetic tape, send a blank tape with your request specifying the desired files and your return address to:

San Francisco Bay Geologic Materials Database
c/o Database Coordinator
U.S. Geological Survey
345 Middlefield Road MS 975
Menlo Park, CA 94025

The specified files bundled in a compressed tar file will be returned to you on the tape. The acceptable tape types are: 2.3 or 5.0 GB, 8 mm Exabyte tape

OPENING THE DATABASE FILES

Some of the files are packaged as tar files, and the larger files containing the databases and images have been compressed with gzip. Thus gzip is required to uncompress the files, and a tar utility is required to open the tar files. The necessary utilities are available on-line:

Compressed Gzip Files

Files compressed with gzip (those with a .gz extension) can be uncompressed with gzip. The gzip utility converts the compressed file name.gz to its uncompressed equivalent name. The compressed file is replaced by the uncompressed file. This utility is free of charge over the Internet at:

http://w3.teaser.fr/~jlgailly/gzip

Tar Files (UNIX Tape Archive)

To extract the contents of a tar file, first uncompress it with gzip if the extension is .tar.gz. Once the tar extension is exposed, extract the contents with a tar utility. This utility is included in most UNIX systems. Tar utilities for PC and Macintosh can be obtained free of charge via the Internet from Internet Literacy's Common Internet File Formats Web Page:

http://www.matisse.net/files/formats.htm

WinZip

This commercial package runs on PCs and can deal with both gzip and tar files. An evaluation copy of WinZip for Windows 3.1, 95 and NT can be downloaded from:

http://www.winzip.com/winzip/:

IMPORTING THE ARC EXPORT FILES

The ARC export files (__.e00) can be converted to ARC/INFO vector maps (coverages) and INFO files by running the import.aml that is included in the database. This will import the export files and assign standard names (see below). Run import.aml from the ARC prompt in the directory containing the export files:

ARC: &run import.aml - run import.aml

Note that the arc coverages and separate INFO files will be given standard names:

of98-792_3a.e00 through of98-792_3q.e00	(Large Landslide Deposit Database)	is named	pf-slid_um
of98-792_4a.e00 through of98-792_4q.e00	(Large Landslide Arrows Database)	is named	pf-anno_um
of98-792_5a.e00 through of98-792_5q.e00	(Small Landslide Deposit Database)	is named	pf-smls_um
of98-792_8a.e00.gz	(Quadrangle Index Database)	is named	cc-index_um