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

# QUATERNARY GEOLOGY AND LIQUEFACTION SUSCEPTIBILITY, NAPA, CALIFORNIA 1:100,000 QUADRANGLE: A DIGITAL DATABASE

By

Janet M. Sowers[1], Jay S. Noller[1] and William R. Lettis[1]

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[1]William Lettis & Associates, Inc., 1777 Botelho Dr., Suite 262, Walnut Creek, CA 94596
(510) 256-6070

## INTRODUCTION

This Open-File report consists of a digital geologic map database and associated digital plot files and text files, revised from a hard copy by Sowers and others (1995). This pamphlet serves to introduce and describe the digital data. There are no paper maps included in the Open-File report. The report does include, however, PostScript plot files and Portable Document Format (PDF) plot files containing the images of the geologic map sheet and the liquefaction susceptibility sheet with explanations, as well as the accompanying text describing the geology of the area. For those interested in a paper plot of information contained in the database or in obtaining the PostScript plot files, please see the section entitled "For Those Who Aren't Familiar With Digital Geologic Map Databases" below. This digital map database, compiled from previously published data, and new mapping by the authors, represents the general distribution of surficial deposits in the Napa region. Together with the accompanying text file (na_geo.txt or na_geo.pdf), it provides current information on Quaternary geology and liquefaction susceptibility of the Napa, California, 1:100,000 quadrangle. The database delineates map units that are identified by general age and lithology following the stratigraphic nomenclature of the U.S. Geological Survey. The scale of the source maps limits the spatial resolution (scale) of the database to 1:100,000 or smaller. The content and character of the database, as well as three methods of obtaining the database, are described below.

### For Those Who Aren't Familiar With Digital Geologic Map Databases

For those interested in the Quaternary geology and liquefaction susceptibility of the Napa, California, 1:100,000 quadrangle who do not use an ARC/INFO compatible Geographic Information System (GIS), but would like to obtain the paper maps with explanation, three PostScript plot files and three Portable Document Format (PDF) files containing the map images of much of the data in the digital database, as well as the explanatory text have been included in separate plotfile packages (please see the section "Obtaining Plots from PostScript and Portable Document Format Files").

Those interested who have computer capability can access plot file packages or the digital database package in any of the three ways described below. However, it should be noted that the plot files do require gzip and tar utilities to access the files. Therefore additional software may be required to use the plot files (please see section "Tar Files").

For those without computer capability, you can obtain the plot file through our plot-on-demand service for map files (please see the section "Obtaining plot from USGS Open-File Services) or from an outside vendor (please see the section "Obtaining Plots from an Outside Vendor").

## DIGITAL OPEN-FILE CONTENTS

This open-file report consists of three digital packages. The first is the Postscript plot file package consisting of two PostScript plot files of the maps and a PostScript file of the explanatory text. The second digital package is the Portable Document Format plot file package containing the same files mentioned above, but in PDF format. A third digital database package consists of the geologic map database itself, and the supporting data, including base map, map explanation, geologic description, and references .

## POSTSCRIPT PLOTFILE PACKAGE

The PostScript plot file package contains the images described here (see below for more information on Postscript plot files):

| | |
|---|---|
| na_plate1.ps | A PostScript plotable file containing an image of the Quaternary geologic map with base map and key of the Napa, California, 1:100,000 quadrangle. |
| na_plate2.ps | A Postscript plotable file containing an image of the liquefaction susceptibility map with base map and key of the Napa, California, 1:100,000 quadrangle. |
| na_geo.ps | A Portable Document Format file of a report containing detailed unit descriptions and geological information, plus sources of data and references cited. |

## PDF PLOTFILE PACKAGE

The PDF plot file package contains the images described here (see below for more information on PDF plot files):

| | |
|---|---|
| na_plate1.pdf | A Portable Document Format plotable file containing an image of the Quaternary geologic map with base map and key of the Napa, California, 1:100,000 quadrangle. |
| na_plate2.pdf | A Portable Document Format plotable file containing an image of the liquefaction susceptibility map with base map and key of the Napa, California, 1:100,000 quadrangle. |
| na_geo.pdf | A Portable Document Format file of a report containing detailed unit descriptions and geological information, plus sources of data and references cited. |

## DIGITAL DATABASE PACKAGE

The digital database package includes a geologic map database file for the Napa, California, 1:100,000 quadrangle. The digital maps, or coverages, along with their associated INFO directory have been converted to uncompressed ARC/INFO export files. ARC export files promote ease of data handling, and are usable by some Geographic Information Systems in addition to ARC/INFO (see below for a discussion of working with export files). The ARC export files and the associated ARC/INFO coverages and directories, as well as the additional digital material included in the database package, are described below:

| ARC/INFO export file | Resultant Coverage | Description of Coverage |
|---|---|---|
| na-geol.e00 | na-geol | Depositional contacts, unit labels, and liquefaction susceptibility |
| na-hist.e00 | na-hist | Historical liquefaction events. |
| na-index.e00 | na-index_um | Topographic contours base map (from 1:100,000 scale originals). |
| na-drain.e00 | na-drain_um | Drainage base map (from 1:100,000 scale originals). |

| | | |
|---|---|---|
| na-cult.e00 | na-cult_um | Cultural and map boundary base map. |

ASCII text files, including explanatory text, Postscript, and Portable Document Format files of formatted versions of the explanatory text, and an ARC Macro Language file for conversion of ARC export files into ARC coverages:

| | |
|---|---|
| na_geo.pdf | A Portable Document Format file of a report containing detailed unit descriptions and geological information, plus sources of data and references cited. |
| na_geo.ps | A PostScript Format version of na_geo.pdf |
| na_geo.txt | A text-only file containing an unformatted version of na_geo.pdf |
| na_db.pdf | A Portable Document Format file of the data base description (this report). |
| na_db.ps | A PostScript format version of na_db.pdf |
| na_db.txt | A text-only file containing an unformatted version of na_db.pdf |
| import.aml | ASCII text file in ARC Macro Language to convert ARC export files to ARC coverages in ARC/INFO. |

The following supporting directory is not included in the database package, but is produced in the process of reconverting the export files into ARC coverages:

| | |
|---|---|
| info/ | INFO directory containing files supporting the databases. This directory is not included in the database release, but is created in the process of converting the export files into ARC coverages. |

## Tar Files

The three data packages are stored in tar (UNIX Tape Archive) files. A tar utility is required to extract the database from the tar file. This utility is included in most UNIX systems, and can be obtained free of charge via the Internet from Internet Literacy's Common Internet File Formats Webpage (http://www.matisse.net/files/formats.html). The tar files have been compressed, and may be uncompressed with gzip, which is available free of charge via the Internet from the gzip Home Page (http://w3.teaser.fr/~jlgailly/gzip), and via links from the USGS Public Domain Software page (http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/public.html). When the tar file is uncompressed and the data is extracted from the tar file, a directory is produced that contains the data in the package as described above. The specifics of the tar files are listed below.

| Name of compressed tar file | Size of compressed tar file (uncompressed) | Directory produced when extracted from tar file | Data package contained |
|---|---|---|---|
| na_ps.tar.gz | 16.8 (48.7) MB | /na_ps | PostScript plotfile package |
| na_pdf.tar.gz | 10.2 (10.2) MB | /na_pdf | PDF plotfile package |
| na_data.tar.gz | 14.8 (52.6) MB | /na_data | digital database package |

## PostScript Plot Files

For those interested in the Quaternary Geology and Liquefaction Susceptibility, Napa, California, 1:100,000 quadrangle who do not use an ARC/INFO compatible GIS system, but would like to obtain the paper map with explanation, we have included a separate data package (na_ps.tar.gz) with three PostScript plot files containing the geologic description and discussion. The plot files can be used to create a color plot of the Quaternary geologic map (na-plate1.ps), the Liquefaction Susceptibility map (na-plate2.ps), as well as the geologic description and discussion pamphlet (na_geo.ps). These plot files are available in any of the three ways described below, including the World Wide Web pages. However, the plot files are stored as gzip tar files requiring gzip and tar utilities to access the file.

The PostScript images of plates 1 and 2 are 42 inches wide by 29 inches high, so it requires a large plotter to produce paper copies at the intended scale. In addition to size constraints, some plotters, such as those with continual paper feed from a roll, are oriented with the long axis in the vertical direction, so the PostScript image will have to be rotated 90 degrees to fit entirely onto the page. Some plotters and plotter drivers, as well as many graphics software packages, can perform this rotation. The geologic description and discussion is on 8.5 by 11 inch pages. Because this release is primarily a digital database, the plot files (and plots derived therefrom) have not been edited to conform to U.S. Geological Survey standards. Small units have not been labeled with leaders and in some instances map features or annotation may overlap. Sample plots by the authors have proven to be quite legible and useful, however. The PostScript plotfiles for maps were produced by the ‘postscript’ command with compression set to zero in ARC/INFO version 7.0.4. The PostScript plotfiles for pamphlets were produced in Microsoft Word 6.0 using the Destination PostScript File option from the Print command.

## Portable Document Format Plot Files

We have also included a separate data package (na_pdf.tar.gz) with three Portable Document Format(PDF) plot files containing the geologic description and discussion. It contains a color plot of the Quaternary geologic map (na-plate1.pdf), the Liquefaction Susceptibility map (na-plate2.pdf) and the geologic description and discussion (na_geo.pdf). As with the Postscript files, the plot files are stored as gzip tar files requiring gzip and tar utilities to access the file.

Adobe Acrobat PDF files are similar to PostScript plot files in that they contain all the information needed to produce a paper copy of a map or pamphlet and they are platform independent. Their principal advantage is that they require less memory to store and are therefore quicker to download from the Internet. In addition, PDF files allow for printing of portions of a map image on a printer smaller than that required to print the entire map without the purchase of expensive additional software. All PDF files in this report have been created from PostScript plot files using Adobe Acrobat Distiller. In test plots we have found that paper maps created with PDF files contain almost all the detail of maps created with PostScript plot files. We would, however, recommend that those users with the capability to print the large PostScript plot files use them in preference to the PDF files.

To use PDF files, the user must get and install a copy of Adobe Acrobat Reader. This software is available free from the Adobe website (http://www.adobe.com). Please follow the instructions given at the website to download and install this software. Once installed, the Acrobat Reader software contains an on-line manual and tutorial.

There are two ways to use Acrobat Reader in conjunction with the Internet. One is to use the PDF reader plug-in with your Internet browser. This allows for interactive viewing of PDF file images within your browser. This is a very handy way to quickly look at PDF files without downloading them to your hard disk. The second way is to download the PDF file to your local hard disk, and then view the file with Acrobat Reader.

We strongly recommend that large map images be handled by downloading to your hard disk, because viewing them within an Internet browser tends to be very slow.

To print a smaller portion of a PDF map image using Acrobat Reader, it is necessary to cut out the portion desired using Acrobat Reader and the standard cut and paste tools for your platform, and then to paste the portion of the image into a file generated by another software program that can handle images. Most word processors (such as Microsoft Word) will suffice. The new file can then be printed. Image conversion in the cut and paste process, as well as changes in the scale of the map image, may result in loss of image quality. However, test plots have proven adequate.

## Database Format

The databases in this report were compiled in ARC/INFO, a commercial Geographic Information System (Environmental Systems Research Institute, Redlands, California), with version 3.0 of the menu interface ALACARTE (Fitzgibbon and Wentworth, 1991, Fitzgibbon, 1991, Wentworth and Fitzgibbon, 1991). The files are in either GRID (ARC/INFO raster data) format or COVERAGE (ARC/INFO vector data) format. Coverages are stored in uncompressed ARC export format (ARC/INFO version 7.x). ARC/INFO export files (files with the .e00 extension) can be converted into ARC/INFO coverages in ARC/INFO (see below) and can be read by some other Geographic Information Systems, such as MapInfo via ArcLink and ESRI's ArcView (version 1.0 for Windows 3.1 to 3.11 is available for free from ESRI's web site: http://www.esri.com). The digital compilation was done in version 7.0.4 of ARC/INFO with version 3.0 of the menu interface ALACARTE (Fitzgibbon and Wentworth, 1991, Fitzgibbon, 1991, Wentworth and Fitzgibbon, 1991).

## OBTAINING THE DIGITAL DATA AND PLOTFILE PACKAGES

The digital database and plotfile packages can be obtained in any of three ways:

a. From the Western Region Geologic Information Web Page.
b. Anonymous ftp over the Internet
c. Sending a tape with request

### To obtain tar files of database or plotfile packages from the USGS web pages:

The U.S. Geological Survey now supports a set of graphical pages on the World Wide Web. Digital publications (including this one) can be accessed via these pages. The location of the main Web page for the entire USGS is

http://www.usgs.gov

The Web server for digital publications from the Western Region is

http://wrgis.wr.usgs.gov

Go to

http://wrgis.wr.usgs.gov/open-file/of98-460 to access this publication. Besides providing easy access to the entire digital database, the Western Region Web page also affords easy access to the PostScript and PDF plot files for those who do not use digital databases.

**To obtain tar files of database or plotfile packages by ftp:**

The files in these reports are stored on the U.S. Geological Survey Western Region FTP server. The Internet ftp address of this server is:

ftp://wrgis.wr.usgs.gov

The user should log in with the user name ‘anonymous’ and then input their e-mail address as the password. This will give the user access to all the publications available via ftp from this server.

The files in this report are stored in the subdirectory:

pub/open-file/of98-460

**To obtain tar files of database or plotfile packages on tape:**

Database files, PostScript plotfiles, and related files can be obtained by sending a tape with request and return address to:

Napa Quaternary Geology and Liquefaction
Susceptibility 1:100,000 quadrangle PostScript Plotfile
c/o Database Coordinator
U.S. Geological Survey
345 Middlefield Road, M/S 975
Menlo Park, CA 94025

Do not omit any part of this address!

NOTE: Be sure to include with your request the exact names, as listed above, of the tar files you require. An Open-File Report number is not sufficient, unless you are requesting both the database package and plotfile package for the report.

The compressed tar file will be returned on the tape. The acceptable tape types are:

2.3 or 5.0 GB, 8 mm Exabyte tape.

## Obtaining plots from USGS Open-File Services

NOTE: As of this writing, plot-on-demand is not available from USGS. It is anticipated later in 1998.

U.S. Geological Survey is planning to provide a plot-on-demand service for map files, such as those described in this report, through Open-File Services. In order to obtain plots, contact Open-File Services at:

USGS Information Services

Box 25286
Denver Federal Center
Denver, CO 80225-0046

(303) 202-4200
1-800-USA-MAPS

FAX: (303) 202-4695

e-mail: infoservices@usgs.gov

Be sure to include with your request the Open-File Report number and the exact names, as listed in the Database Contents section above, of the plotfiles you require. An Open-File Report number and its letter alone may not be sufficient, unless you are requesting plots of all the plotfiles for that report.

## Obtaining Plots from an Outside Vendor

Those interested in Preliminary Geologic Map of the Napa 1:100,000 Quadrangle, but who use neither a computer nor the Internet, can still obtain the information. We will provide the PostScript or Portable Document Format plot files on digital tape (details below) for use by commercial vendors who can make large-format plots. Send a blank tape with request and return address to:

> Napa Quaternary Geology and Liquefaction
> Susceptibility 1:100,000 quadrangle PostScript Plotfiles
> c/o Database Coordinator
> U.S. Geological Survey
> 345 Middlefield Road, M/S 975
> Menlo Park, CA 94025

Do not omit any part of this address!

The compressed tar file will be returned on the tape. The acceptable tape type is:

> 2.3 or 5.0 GB, 8 mm Exabyte tape.

Make sure your vendor is capable of reading this tape type and PostScript or Portable Document Format plot files. Important information regarding tape file format is included in the sections " "Tar Files," "PostScript Plot Files", and "PDF Plot Files" above, so be certain to provide a copy of this document to your vendor.

## Converting ARC export files

ARC export files are converted to ARC coverages using the ARC command IMPORT with the option COVER. In order to ease conversion and to maintain naming conventions, we have included an ASCII text file in ARC Macro Language that will convert all of the export files in the database into coverages and create the associated INFO directory. From the ARC command line type:

Arc: &run import.aml

ARC export files can also be read by some other Geographic Information Systems. Please consult your GIS documentation to see if you can use ARC export files and the procedure to import them.

## ADDITIONAL INFORMATION

### Digital Compilation

The geologic map information was digitized from stable original of the geologic map at 1:100,000 scale. The author manuscripts (pencil on mylar) were scanned using a Altek monochrome scanner with a resolution of 800 dots per inch. The scanned images were vectorized and transformed from scanner coordinates to projection coordinates with digital tics placed by hand at map corners. The scanned lines were edited interactively by hand using ALACARTE, color boundaries were tagged as appropriate, and scanning artifacts visible at 1:100,000 were removed.

### Base Maps

Base Map layers were prepared from scale-stable printing negatives of the U.S. Geological Survey Napa, California 1:100,000 topographic maps, which have a 50 meter contour interval. Scanned and vectorized images were transformed from scanner coordinates to projection coordinates with digital tics placed by hand at map corners. The images were then trimmed interactively by hand using ALACARTE to conform to the area of the geologic coverages, and the four portions were combined. Small mismatches at the boundaries caused by slight differences in the original scans remain in the three base map coverages. These base map layers are digital images but no information other than location is attached to the lines. The base maps are provided for reference only.

### Faults and Landslides

This map is intended to be of general use to engineers and land-use planners. However, its small scale does not provide sufficient detail for site development purposes. In addition, this map does not take the place of fault-rupture hazard zones designated by the California State Geologist (Hart and Bryant, 1997). Similarly, the database cannot be used to identify or delineate landslides in the region. For a depiction of landslide distribution, see Nilsen and others (1979).

### Spatial Resolution

Uses of this digital geologic map should not violate the spatial resolution of the data. Although the digital form of the data removes the constraint imposed by the scale of a paper map, the detail and accuracy inherent in map scale are also present in the digital data. The fact that this database was edited at a scale of 1:100,000 means that higher resolution information is not present in the dataset. Plotting at scales larger than 1:100,000 will not yield greater real detail, although it may reveal fine-scale irregularities below the intended resolution of the database. The base map layers also have a resolution of 1:100,000 and are provided for reference only.

## DATABASE SPECIFICS

The map databases consist of ARC coverages and supporting INFO files, which are stored in a Universal Transverse Mercator (California coordinate system) projection (Table 1).

**Table 1 -** *Map Projection*

| | |
|---|---|
| PROJECTION UNIVERSAL TRANSVERSE MERCATOR | |
| UNITS METERS | -on the ground |
| ZONE 10 | UTM zone 10 |
| PARAMETERS | |
| END | |

The content of the geologic database can be described in terms of the lines, points, and the areas that compose the map. Descriptions of the database fields use the terms explained in Table 2.

**Table 2 -** *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, I-ASCII integer, C-ASCII character string |
| N. DEC. | number of decimal places maintained for floating point numbers |

LINES -

The lines (arcs) for na-geol are recorded as strings of vectors and are described in the arc attribute table (Table 3). They define the boundaries of the map units, the boundaries of open bodies of water, faults, and the map boundaries. These distinctions, including the geologic identities of the unit boundaries, are recorded in the LTYPE field according to the line types listed in Table 4.

**Table 3 -** *Content of the Arc Attribute Tables*

| 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 |
| <coverage># | 4 | 5 | B | - | unique internal control number |
| <coverage>-ID | 4 | 5 | B | - | unique identification number |
| LTYPE | 35 | 35 | C | - | line type (see Table 4) |
| SEL | 1 | 1 | I | - | user defined field used to save a selected set |
| SYMB | 3 | 3 | I | - | user defined field used to save symbol assignments (such as color) |

**Table 4 -** *Line Types Recorded in the LTYPE Field*

contact, certain
water boundary, certain
map boundary, certain

The geologic line types are ALACARTE line types that correlate with the geologic line symbols in the ALACARTE line set GEOL61.LIN according to the ALACARTE lines lookup table (GEOL61.LUT).

AREAS -

Map units and liquefaction susceptibility (polygons) for na-geol are described in the polygon attribute table (Table 5). The identities of the map units from compilation sources are recorded in the PTYPE field by map label (Table 6). Map units are described more fully in the accompanying text file na_geo.txt or na_geo.pdf. The identities of the liquefaction susceptibility units are recorded in the LIQ field by susceptibility label (table 7). Note that ARC/INFO coverages cannot contain both point and polygon information, so only coverages with polygon information will have a polygon attribute table, and these coverages will not have a point attribute table.

**Table 5 -** *Content of the Polygon Attribute Tables*

| 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 |
| <coverage># | 4 | 5 | B | - | unique internal control number |
| <coverage>-ID | 4 | 5 | B | - | unique identification number |
| PTYPE | 35 | 35 | C | - | unit label |
| SEL | 1 | 1 | I | - | user defined field used to save a selected set |
| SYMB | 3 | 3 | I | - | user defined field used to save symbol assignments (such as color) |
| LIQ | 8 | 8 | C | | liquefaction susceptibility |

**Table 6 -** *Map Units*
(See na_geo.txt or na_geo.pdf for descriptions of units)

| | | |
|---|---|---|
| | Qht | Qpt |
| af | Qhf | Qpf |
| Qhbm/af | Qha | Qpa |
| Qhbm | Qs | Qpmt |
| Qhay | Qb | Qoa |
| Qhay/Qhb | Qt | Qomt |
| Qhb | Qf | w |
| Qhs | Qa | br |