GL01246

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

August 16, 1984

MEMORANDUM

TO: Walter Arabasz

FROM: Mike Wright

SUBJECT: Recommendations for Regional and Urban Earthquake Hazards Evaluation Work Plan -- Wasatch Front, Utah

Herewith a few comments, observations and recommendations pertaining to the captioned program plan.

1. Geodetic Studies. Even with the enthusiasm shown at the meetings for precise surveying, I feel that the potential contribution of such work may be understated. With the work of Arabasz, that shows strike-slip components on certain faults in central Utah that were previously believed to be normal faults, and with the confirmation of this seismic evidence through field geology by Anderson, the need for precise horizontal surveys to supplement the leveling surveys is evident. It seems to me that documentation of extent of east-west extension along with vertical motions could help distinguish among various potential models of deformation in the Basin and Range. North-south relative strains would be valuable in visualizing possible strike slip on the N-S faults that predominate.

It also seems to me that precise surveying as a means of measuring current strain rates has the potential for contributing in a relatively short time, and additional information might even be available before 1986. Certainly with vertical rates of 4 mm/year, surveys could be repeated in a 5-10 year time frame with expectation of valuable information. The same should be true for horizontal surveys.

The surveying should not be restricted to merely releveling the Spanish Fork profile, as was implied at our meeting. I believe that we should consider spending on the order of $250K on establishing precise horizontal and vertical networks for at least 5 carefully selected locations along the Wasatch Front. Networks should extend far enough east of the Wasatch Fault itself to detect movement on the more seismically active faults, as shown by your seismic occurrence data. These networks would provide very valuable data in the years to come as they are resurveyed. There is no other way to obtain this kind of information.

2. Subsurface Studies. As I recommended at the meeting, I believe that an interdisclipinary group should be identified to help determine subsurface configuration and conditions, not only of the faults, but of the rocks between the major faults. Integrated interpretation of interdisciplinary data would be the strategy for this group. I believe that at least the following disciplines can contribute to such an effort:

   (a) Structural Studies. Geologic mapping and structural studies should be part of the effort funded by this program. We actually know little about the structure of the area of interest. For example, the Wasatch Fault itself is a complex structure not all of whose many strands have been identified either in the alluvial areas or in bedrock.

(b) Microseismic Studies. Detailed microseismic studies have the potential of mapping active fault planes at depth in selected areas.

(c) Reflection Seismic Surveys. The value of this technique has been well demonstrated.

(d) Gravity Studies. The start made by Zobach on this work should be encouraged. We should look seriously at upgrading the gravity data base.

(e) Magnetic Studies. I know from looking at detailed magnetic surveys at Kennecott that such data is rich in pertinent details--fault boundaries to bodies, subsurface configuration, etc. I recommend that consideration be given to flying detailed aeromagnetic surveys over selected portions of the Wasatch Front, since publically available data may not be of the quality needed. This is relatively inexpensive.

(f) Electrical Studies. The MT method has great potential to contribute to knowledge of subsurface structure using modern modeling techniques. Dipole-dipole resistivity surveys would be needed for shallow control on the MT interpretations. Funding such work should be considered.

My second basic recommendation in the area of subsurface studies is that a workshop be convened to help define the current state of knowledge, availability of data and to make recommendations for studies that have the best chance of contributing substantially to the picture. This workshop should include representatives from industry as well as the USGS, UGMS and academic circles. A great deal of data exists in oil company files, some of which could undoubtedly be broken loose. Oil companies would have motivation

to participate in and contribute to such a workshop, and perhaps provide some funding support.

I believe a one and one-half day workshop along the following lines would work well:

Day 1. 30-minute invited presentations on

1. Overview of the Basin and Range and Wasatch Front in Utah
2. Structural geology of area
3. Styles of faulting in the area
4. Seismicity of area
5. Subsurface structure as indicated by seismic data (reflection, etc.)
6. Subsurface structure as indicated by gravity and magnetic data
7. Subsurface structure as indicated by electrical data
8. Implications of heat flow studies on structure of area

Day 2.

1. Separate working groups on potential contribution of each discipline to subsurface understanding
2. Plenary session to integrate results

STATE OF UTAH
DIVISION OF COMPREHENSIVE EMERGENCY MANAGEMENT
DEPARTMENT OF PUBLIC SAFETY
1543 SUNNYSIDE AVENUE
P.O. BOX 8100, SALT LAKE CITY, UTAH 84108
TELEPHONE (801) 533-5271

SCOTT M. MATHESON
Governor

LARRY E. LUNNEN
Commissioner

LORAYNE TEMPEST
Director

MIKE

June 28, 1984

Mr. Dale Green, Electronics Engineer
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Mr. Green:

Please accept the sincere appreciation of the Division of Comprehensive Emergency Management and staff for the efforts you put forth concerning the earth movement monitoring efforts during Fall 1983 through Spring 1984. The monitoring of the Rudd Creek and Reynolds Gulch slides, have "paid off" in alerting residents of impending danger.

We have been impressed with the efficiency and cooperation that you have shown to us. Again, may we say thank you.

Sincerely,

Robert L. Kistner
Disaster Recovery Manager

RLK/vab
0562C

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DIVISION OF COMPREHENSIVE EMERGENCY MANAGEMENT
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SCOTT M. MATHESON
Governor

LARRY E. LUNNEN
Commissioner

LORAYNE TEMPEST
Director

June 28, 1984

Mr. Steve Olsen, Electronics Technician
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Mr. Olsen:

Please accept the sincere appreciation of the Division of Comprehensive Emergency Management and staff for the efforts you put forth concerning the earth movement monitoring efforts during Fall 1983 through Spring 1984. The monitoring of the Rudd Creek and Reynolds Gulch slides, have "paid off" in alerting residents of impending danger.

We have been impressed with the efficiency and cooperation that you have shown to us. Again, may we say thank you.

Sincerely,

Robert L. Kistner
Disaster Recovery Manager

RLK/vab
0562C

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

In Reply Refer To:
Mail Stop 905

JUN 22 1984

Dr. Duncan Foley
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way Suite A
Salt Lake City, Utah 84108

Subject: Workshop on "Evaluation of Regional and Urban Earthquake Hazards and Risk in Utah," August 14-16th, 1984, Salt Lake City, Utah

Dear Dr. Foley:

On behalf of the Steering Committee for the subject workshop, I am inviting you to participate in the workshop on "Evaluation of Regional and Urban Earthquake Hazards and Risk in Utah," which the U.S. Geological Survey (USGS), the Federal Emergency Management Agency, the Utah Geological and Mineral Survey, the University of Utah, and the Utah Division of Comprehensive Emergency Management are cosponsoring. The workshop will begin at 8:00 a.m. on Tuesday, August 14th and end on Thursday, August 16th. The State Capitol Building (Room 301) will be the headquarters for the workshop.

The workshop may be somewhat different from others you have attended in the past so we would like to share our objectives and concepts with you which are as follows:

1) Assess the present state-of-knowledge of earthquake hazards in Utah including scientific, engineering, and societal-preparedness componets.

2) Determine what additional scientific, engineering, and societal-response information is needed to implement an earthquake-loss-reduction program in Utah.

3) Create action plans to implement an earthquake-loss-reduction program.

The workshop will be attended by some 125-150 invited participants, selected for their preeminence in each specialized field of knowledge to be discussed and for their capability to set goals, identify problems, and reach solutions in earthquake preparedness and mitigation. A special effort will be made to involve people who can influence public policy about earthquake hazards.

The program will be organized to achieve an effective exchange of information through use of individual speakers, panels, and small discussion groups. A copy of the preliminary program is enclosed to give you an idea of what we hope to accomplish at this workshop.

Following the workshop, the proceedings will be published as an USGS Open-File Report. The summary of the workshop discussions will be contained in the proceedings as well as papers presented at the workshop.

Please let us know by July 30, if you will be able to participate in this workshop by returning the enclosed registration form so that we can finalize our planning efforts.

A block of rooms at group rates has been set aside for this workshop at the Hotel Utah. Please make your own accommodations by returning the enclosed hotel registration form prior to July 30.

We are looking forward to an exciting and productive meeting.

Very truly yours,

Walter Hays

Walter W. Hays
Deputy for Research Applications
Office of Earthquakes, Volcanoes and
Engineering

Enclosures

P.S. SPECIAL INVITATION

Following the main workshop, a special session will be convened at 1:30 p.m. Thursday, at the Hotel Utah (p. 7 of the enclosed program). This session is for about fifty key planners and decisionmakers who have a long-time interest or pressing need to have scientific information translated, transferred, and effectively used to reduce hazards.

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TELEPHONE 801-524-3422

August 1, 1985

MEMORANDUM

TO: Dennis Nielson/Mike Wright

FROM: Duncan Foley

SUBJECT: Earthquake Workshop

On Monday afternoon, at 4:30 pm, I found out that CEM, USGS, UGMS, and FEMA were running a two-day workshop on earthquake and landslide hazards along the Wasatch Front. Ralph Findlay of CEM invited me to attend, and I sat in on the two morning sessions.

The main benefit in my attending the workshop was the contact I had with Gary Johnson, FEMA-DC. Jerry Olson, FEMA Denver, was also attending. We discussed the earthquake-induced avalanche proposal. Gary felt that he didn't have the money to fund such a study in his budget, but that it may be worth submitting anyway. He wasn't sure that anyone in FEMA would fund the study (he didn't say absolutely no, however) but avalanche awareness in D.C. is growing, and submitting this proposal now may ease the way for future funding. I will talk with Gary after Labor Day, when he returns from vacation, to find out who the proposal will be addressed to, etc. Sue and I plan to have a revised draft well before then.

The workshop was directed toward planners, but I only attended the more technical sessions. Walt Hays started by conducting a laboratory in the calculation of earthquake effects on buildings. It left many planners (and the FEMA representatives) confused. Jeff Keaton, Loren Anderson, and Les Youd discussed liquefaction, and gave a good presentation on Wasatch Front hazards. David Schwartz, who is now with the USGS, but until this year was with Woodward-Clyde, summarized the behavior of the Wasatch Fault. The USGS is about to release an open-file map of the Salt Lake segment at 1:24,000. No faults in bedrock are shown on the map. I didn't have the chance to ask him about bedrock as he wasn't around the second day.

The second morning was directed toward landslides. Russ Campbell gave a general talk on landslide hazards. Martin McCann gave a very interesting discussion of impacts the failure of Pineview Dam would have on Ogden (5,000-8,000 killed, much area with 100% destruction). Wes Dewsnup discussed the multihazard program in Ogden.

I have attached a copy of the meeting agenda.

Duncan

DF/jp

attachment

D. Foley

UTAH GEOLOGICAL AND MINERAL SURVEY (UGMS),
UTAH DIVISION OF COMPREHENSIVE EMERGENCY MANAGEMENT (CEM),
FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA),
AND U.S. GEOLOGICAL SURVEY (USGS)

WORKSHOP ON EARTHQUAKE AND LANDSLIDE HAZARDS IN THE WASATCH FRONT REGION OF UTAH

Sheraton Hotel
Salt Lake City, Utah
July 30 - August 1, 1985

TUESDAY, JULY 30, 1985

8:00 a.m. REGISTRATION

MODERATOR: Don Mabey, Utah Geological and Mineral Survey

8:30 WELCOME: Lorayne Tempest, Director, Utah Division of Comprehensive Emergency Management

WORKSHOP TOPIC 1: OVERVIEW OF EARTHQUAKE HAZARDS MAPPING - GROUND SHAKING

Objective: To arrive at a consensus statement of the users' needs for maps and the depictions needed on the maps to show useful potential ground shaking hazards.

Review of methods, map formats, scales, potential applications of technology, status of current efforts, and plans for the future. Lead into discussion which will bring out the following:
---Walter W. Hays, USGS

1. Areas of quadrangles in Northern Utah or Wasatch Fault Region which need to be mapped.

2. Desired scales.

3. Details of information to be depicted.

9:30 WORKSHOP TOPIC 2: OVERVIEW OF EARTHQUAKE HAZARDS MAPPING - LIQUEFACTION

Objective: To arrive at a consensus statement of the users' needs for maps and the depictions showing potential liquefaction hazards.

Review of methods, map formats, scales, potential applications of technology, status of current efforts, and plans for future products. Lead into discussion which will bring out the following:
---Jeffrey R. Keaton, Dames and Moore
---Loren R. Anderson, Utah State University

1. Details of information to be depicted.

2. Included on same map series with other earthquake hazards or mapped separately as single series?

10:30 BREAK

11:00 WORKSHOP TOPIC 3: OVERVIEW OF EARTHQUAKE HAZARDS MAPPING - FAULTING

Objective: To arrive at a consensus statement of the users' needs for maps and the depictions needed on the maps to show potential faulting hazards in sufficient locational detail.

Review of methods, map formats, scales, potential applications of technology, status of current mapping efforts, and plans for future products or research needs. Lead into discussion which will bring out the following:
---David Schwartz, USGS

1. Details of information to be depicted.

2. Included on same map series with other earthquake hazards or depicted separately on single series?

12:00 LUNCH

1:30 P.M. WORKSHOP TOPIC 4: APPLICATION OF TECHNICAL INFORMATION AND IMPLEMENTABLE USES BY LOCAL PLANNERS

MODERATOR: Ralph Findlay, Utah Division of Comprehensive Emergency Management

Objective: Assist local planners in their day by day and master planning implementations of hazard reduction information. Provide them with information on how to apply the information at local levels to achieve mitigation results. Simplify in lay terms.

1. Review of subdivision/community considerations in land use planning and seismic risk reduction. Use example of application in California.
   ---Robert D. Brown, Jr., USGS
   ---Kenneth Topping, San Bernadino, California

2. How to apply site specific ground shaking, liquefaction, and fault/tectonic deformation information to reduce risks to people, critical facilities, and lifelines.

   Discussion Leaders
   ---William Kockelman, USGS
   ---Robert D. Brown, USGS
   ---George Mader, William Spangle and Associates

---Morris Johnson, University of Utah

a. Master Planning
b. Zoning
c. Building codes
d. Site development
e. In lay terms--how to use hazard maps and hazard depiction problems.
f. How to get hazards information more available.

3:00 BREAK

3:30 REACTION OF RESOURCE TEAM AND DISUCSSION

The Resource Team will wear their "user hats" as they participate in the discussion.

---CEM representatives
---UGMS representatives
---Arabasz, University of Utah
---Anderson, Utah State University
---Keaton, Dames and Moore
---Barnes, Salt Lake City Planning Commission
---Geis, American-Institute of Architects
---Olson, Johnson, FEMA
---Campbell, Hays, Gori, Schwartz, Kockelman, and Brown, USGS

5:00 ADJOURN

WEDNESDAY, JULY 31, 1985

MODERATOR: Ralph Findlay, Utah Division of Comprehensive Emergency Management

8:30 A.M. WORKSHOP TOPIC 5: LANDSLIDES AND MUDFLOWS HAZARDS MAPPING

Discussion of landslides and mudflows hazards mapping. Methods, map formats, scales, status of mapping efforts, plans for future, ways to depict the threats, and research needs. Lead into user oriented treatment of the problem.
---Russ Campbell, USGS

9:30 BREAK

10:00 WORKSHOP TOPIC 6: EARTHQUAKE HAZARDS AND RISKS IN THE CONTEXT OF A MULTIHAZARDS SCENARIO.

1. "Summary of the Utah Multihazards Mitigation Project Consequence Analysis."
---Martin W. McCann, Jr., Jack R. Benjamin Associates, Inc., and Stanford University

2. The Project Manager will summarize the current project products and results: "Demographic Analysis" prepared by Project Manager; "Economic Impact Analysis" prepared by University of Utah Bureau of Business and Economic Research; "Risk Assessment of Pineview Dam" by Bureau of Reclamation; "Consequence Analysis" by Jack R. Benjamin Associates, Inc.; "Critical Facilities and Lifelines Analysis" with atlas of maps by the Project Manager and Dames and Moore; near term mitigation actions initiated; and "Long Term Multihazards Mitigation Plan" being prepared for adoption and implementation.
   ---Wesley G. Dewsnup, Multihazards Mitigation Project Manager

11:30 REACTION OF RESOURCE TEAM AND DISCUSSION

---UGMS representatives
---Hughes, Hughes Engineers
---Keaton, Dames and Moore
---Arabasz, University of Utah
---Ward, Structural Facilities, Inc.
---Anderson, Utah State University
---Youd, Brigham Young University
---Reaveley, Reaveley Engineers and Associates
---Olson and Johnson, FEMA
---Hays, Campbell, Gori, Kockelman, Alexander, Jessen, USGS
---Taylor, Bureau of Reclamation

12:00 LUNCH

1:30 P.M. REACTION OF RESOURCE TEAM AND DISCUSSION (CONTINUED)

WORKSHOP TOPIC 7: DEVELOPMENT OF USER ORIENTED PRODUCTS

2:30 Panel discussion and conclusions on the following:

1. Who will use the earthquake hazards and landslide hazards map products?

2. How and for what purpose will they be used?

3. What are the deficiencies or constraints which inhibit or limit current hazards map usages?

4. Is desired information currently accessible? Or what are the problems of lack of accessibility?

5. To what extent are tools (map products) available for accomplishing:

   a) Land use planning and regulation? b) Engineering design?
   c) Building costs? d) Disaster response?

Panelists:

---William Kockelman, USGS
---Robert D. Brown, USGS
---Morris Johnson, University of Utah

3:30 BREAK

4:00 REACTION OF RESOURCE TEAM AND DISCUSSION

5:00 ADJOURN

THURSDAY, AUGUST 1, 1985

8:30 FIELD TRIPS IN THE SALT LAKE CITY AREA

1. For city and county planners to see the Thistle landslide, fault scarps, and other geologic features. The field trip will take about 8 hours.
---Campbell, USGS and Bruce Kalister, UGMS

FRIDAY AND SATURDAY, AUGUST 2-3, 1985, SHERATON HOTEL

Optional attendance at a workshop on designing for earthquakes sponsored by American Institute of Architects, Sheraton Hotel, Salt Lake City, Utah. Experts in geology and seismology, city planning (George Mader), and architecture (Chris Arnold) will be presenting information. A 1/2 day field trip to see buildings in Salt Lake City is planned for August 3.

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

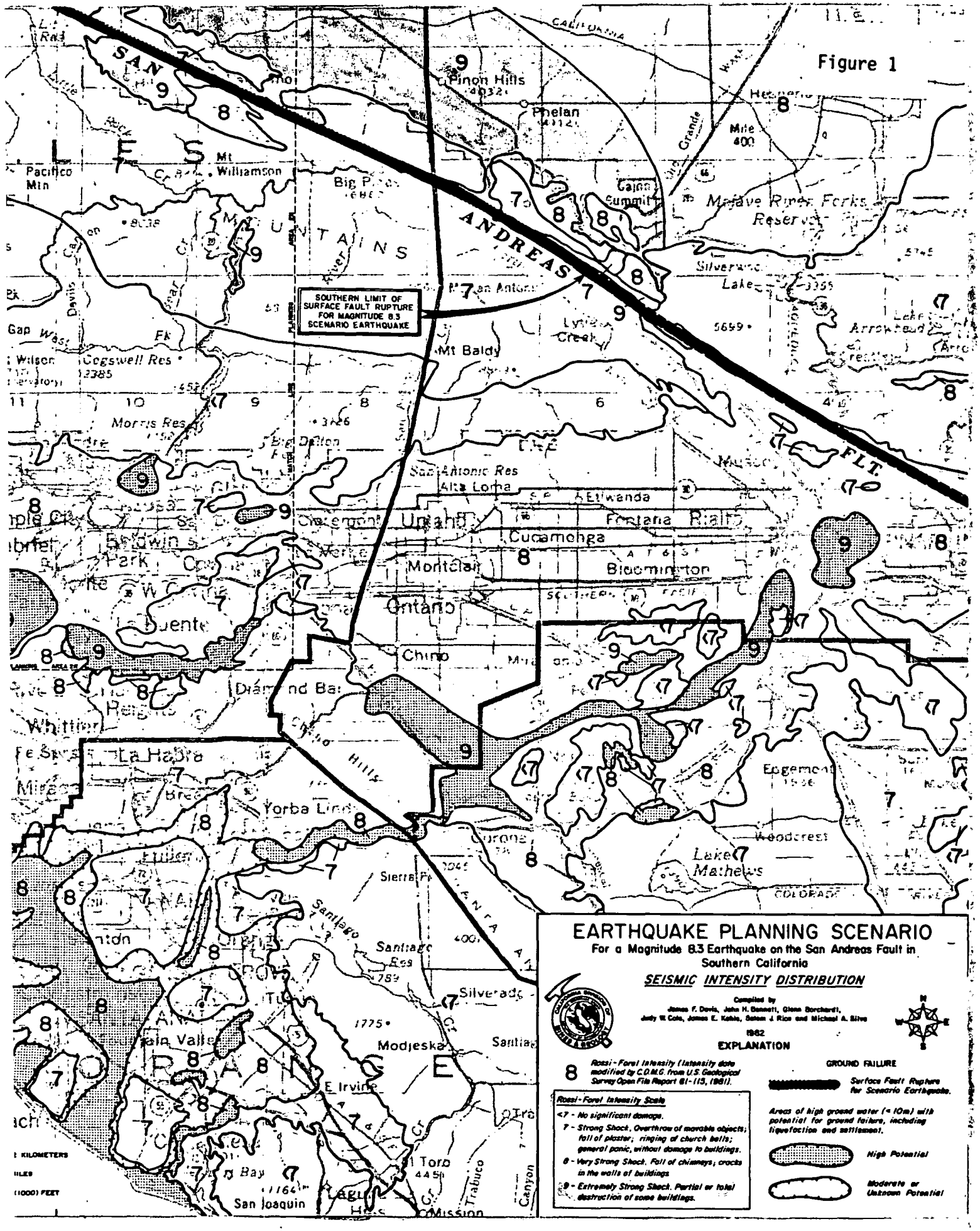
Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1



EARTHQUAKE PLANNING SCENARIO

For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California

SEISMIC INTENSITY DISTRIBUTION

Compiled by

James F. Davis, John H. Bennett, Glenn Borchardt, Judy W. Cole, James E. Kahle, Susan J. Rice and Michael A. Silva

1982

EXPLANATION

8 — *Rossi-Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-113, 1981).*

Rossi-Forel Intensity Scale

- *<7 - No significant damage.*
- *7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.*
- *8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.*
- *9 - Extremely Strong Shock. Partial or total destruction of some buildings.*

GROUND FAILURE

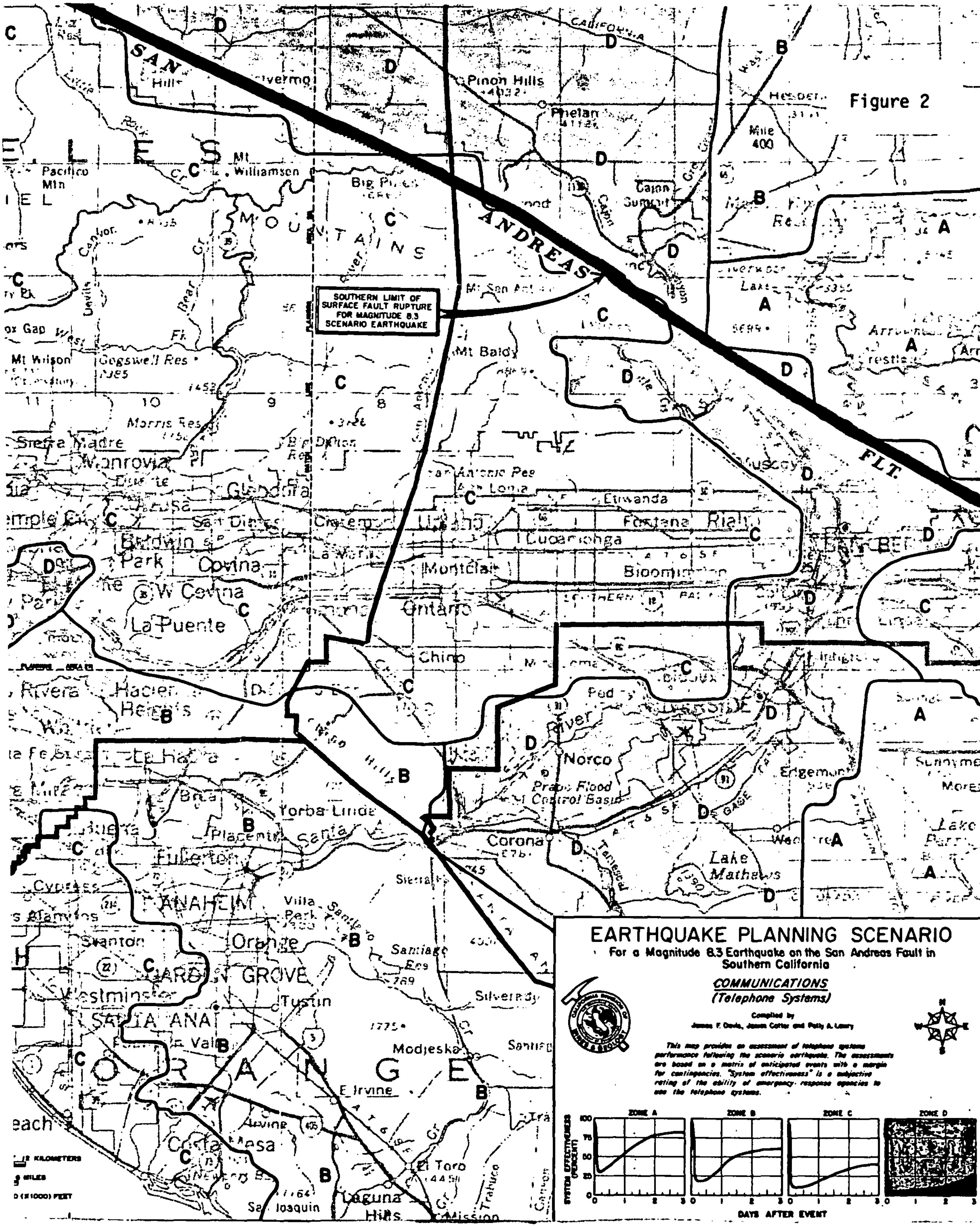
Surface Fault Rupture for Scenario Earthquake.

Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.

High Potential

Moderate or Unknown Potential

Figure 2



SAN ANDREAS FLT.
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
MOUNTAINS
Pinon Hills
Phelan
Mt Williamson
Big Pines
Cajon Summit
Mt Baldy
Mt Wilson
Cogswell Res
Morris Res
Sierra Madre
Monrovia
Glendora
Azusa
Temple City
Baldwin Park
Covina
W Covina
La Puente
La Verne
Claremont
Upland
Montclair
Ontario
Cucamonga
Etiwanda
Fontana
Rialto
Bloomington
Chino
Norco
Corona
Prado Flood Control Basin
Edgemont
Lake Mathews
Hacienda Heights
La Habra
Brea
Yorba Linda
Placentia
Fullerton
Cypress
ANAHEIM
Villa Park
Orange
Stanton
GARDEN GROVE
Westminster
Tustin
SANTA ANA
Silverado
Modjeska
O R A N G E
E Irvine
Irvine
Costa Mesa
El Toro
Laguna Hills
San Joaquin
Mission
Trabuco
Santiago Res
Sunnymead
Moreno
Lake Perris
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
100
75
50
25
0
0 1 2 3
DAYS AFTER EVENT
N
S
E
W

1.

Figure 6

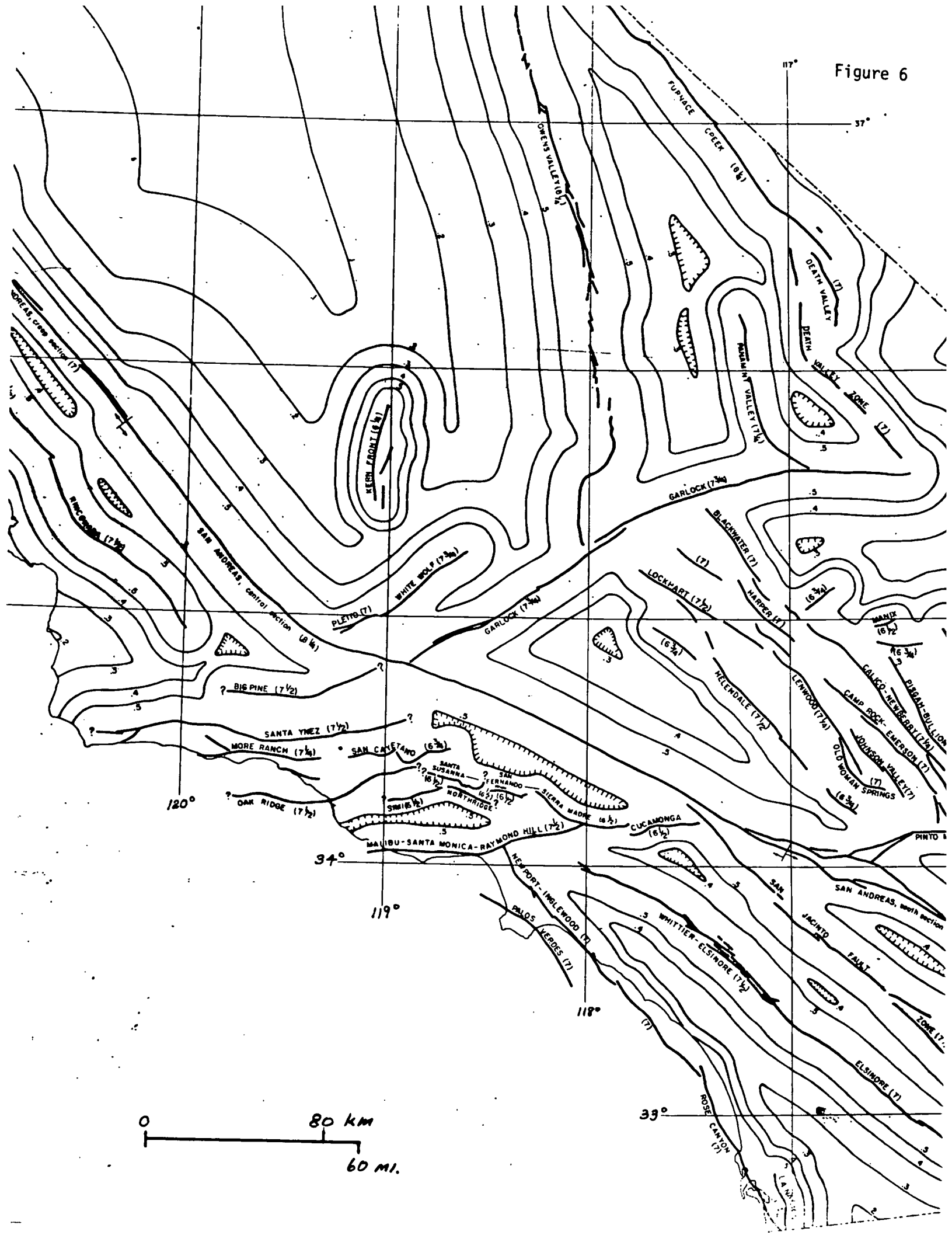
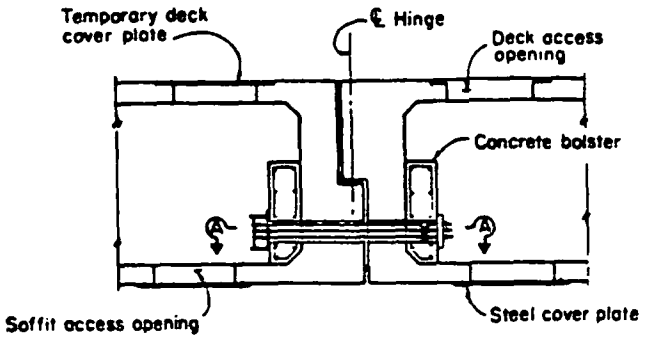
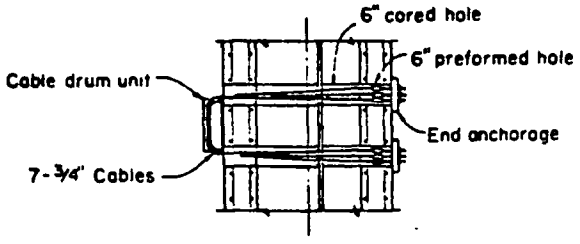

117°
37°
FURNACE CREEK (8½)
OWENS VALLEY (8½)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7½)
KERN CANYON (8½)
GARLOCK (7¾)
BLACKWATER (7)
LOCKHART (7½)
HARPER (7)
(6¾)
MANIX (6½)
(6¾)
PISGAH-BULLION
CALICO-NEWBERRY (7½)
CAMP ROCK-EMERSON (7)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS (7)
(6¾)
HELENDALE (7½)
LENWOOD (7½)
SAN ANDREAS, central section (8½)
PLEITO (7)
WHITE WOLF (7¾)
GARLOCK (7¾)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7½)
SAN CAYETANO (6¾)
SANTA SUSANNA (6½)
SAN FERNANDO (6½)
NORTHRIDGE (6½)
SIERRA MADRE (6½)
OAK RIDGE (7½)
SIMI (6½)
CUCAMONGA (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
PINTO
120°
34°
119°
NEWPORT-INGLEWOOD (7)
PALOS VERDES (7)
SAN ANDREAS, south section
JACINTO FAULT ZONE (7)
WHITTIER-ELSINORE (7½)
ELSINORE (7)
118°
39°
ROSE CANYON (7)
0
80 km
60 mi.

Figure 7

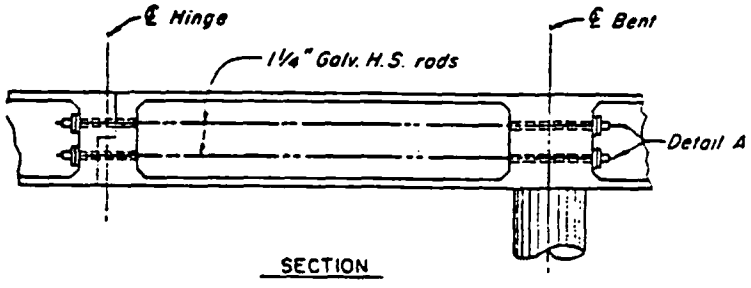


SECTION THRU HINGE

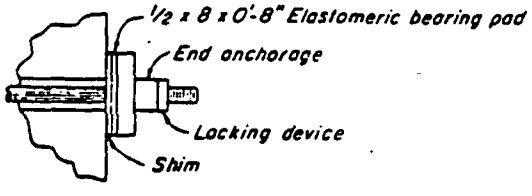


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

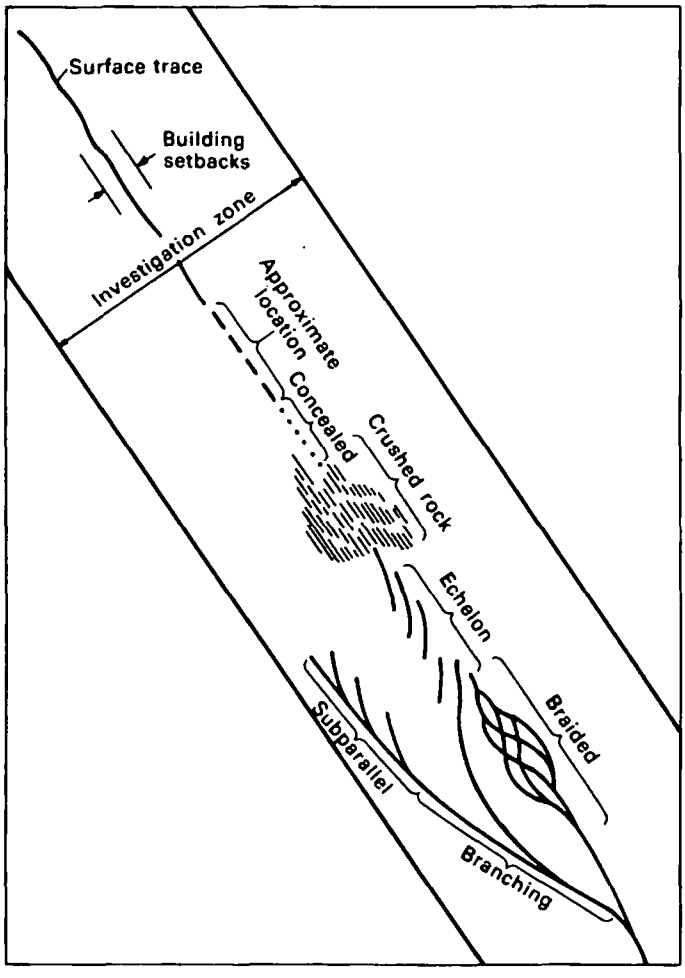


Figure 8. -- Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

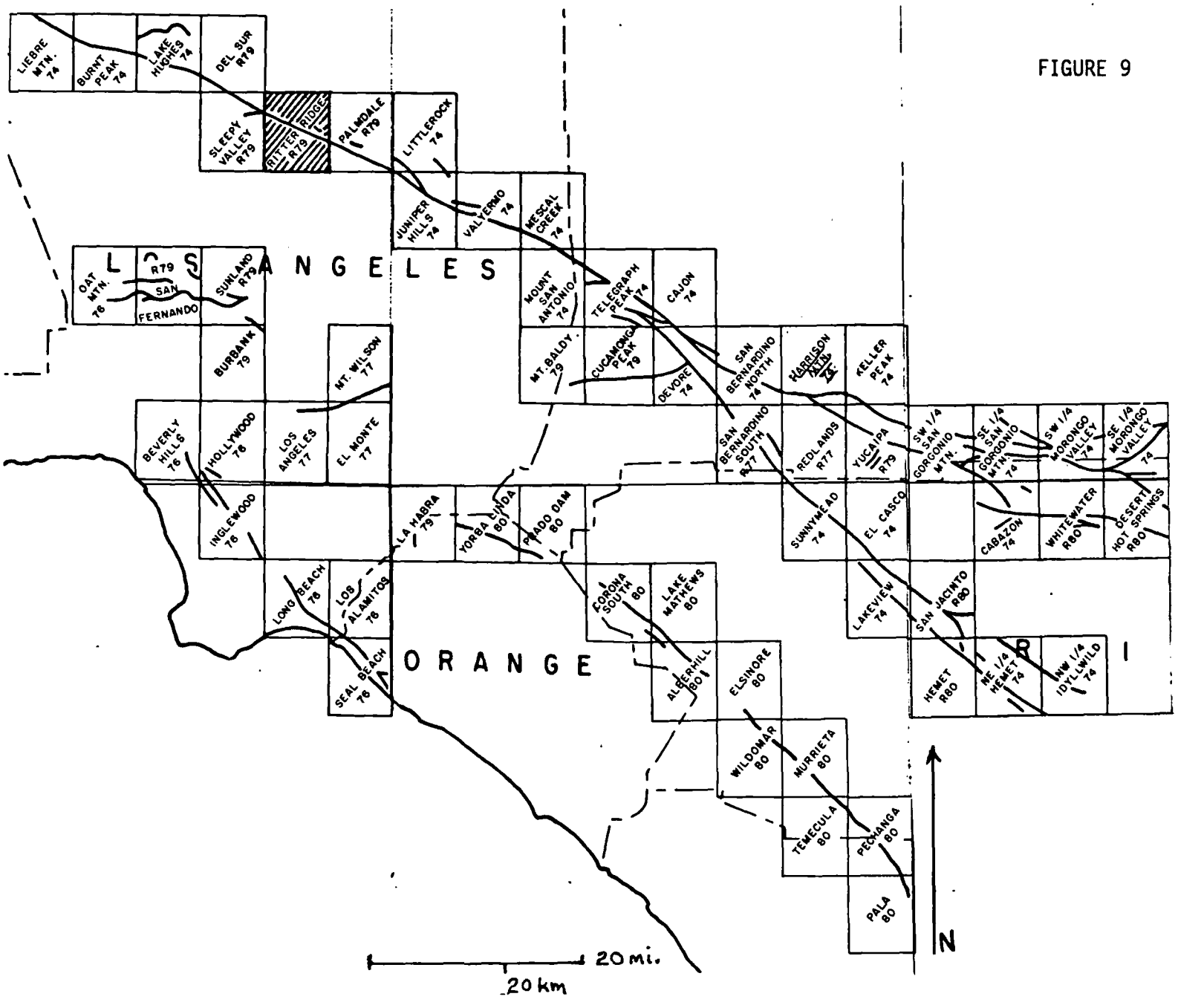


Figure 9. — Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.

Figure 10

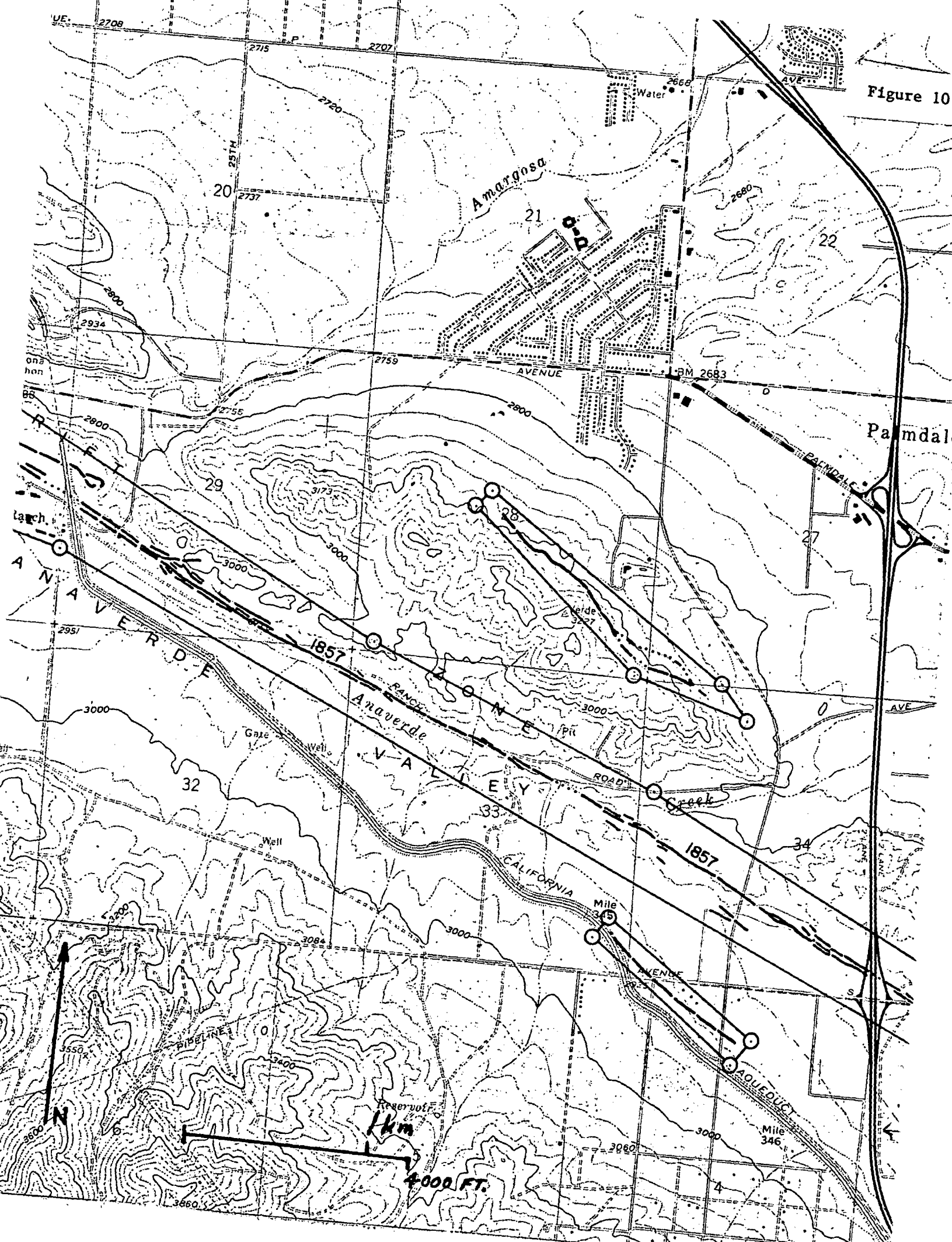

2708
2715
2707
2720
25TH
20
2737
Amargosa
21
22
2680
2934
2759
AVENUE
BM 2683
2755
2800
Palmdal
PALMDALE
29
28
27
3173
3000
Verde
3227
2951
1857
RANCHO
Anaverde
VALLEY
Gate
Well
Pit
ROAD
Creek
32
33
34
Well
CALIFORNIA
Mile
345
3084
AVENUE
PIPELINE
3550
3400
Reservoir
AQUEDUCT
Mile
346
3060
3600
3860
4
N
1km
4000 FT.

FIGURE 11

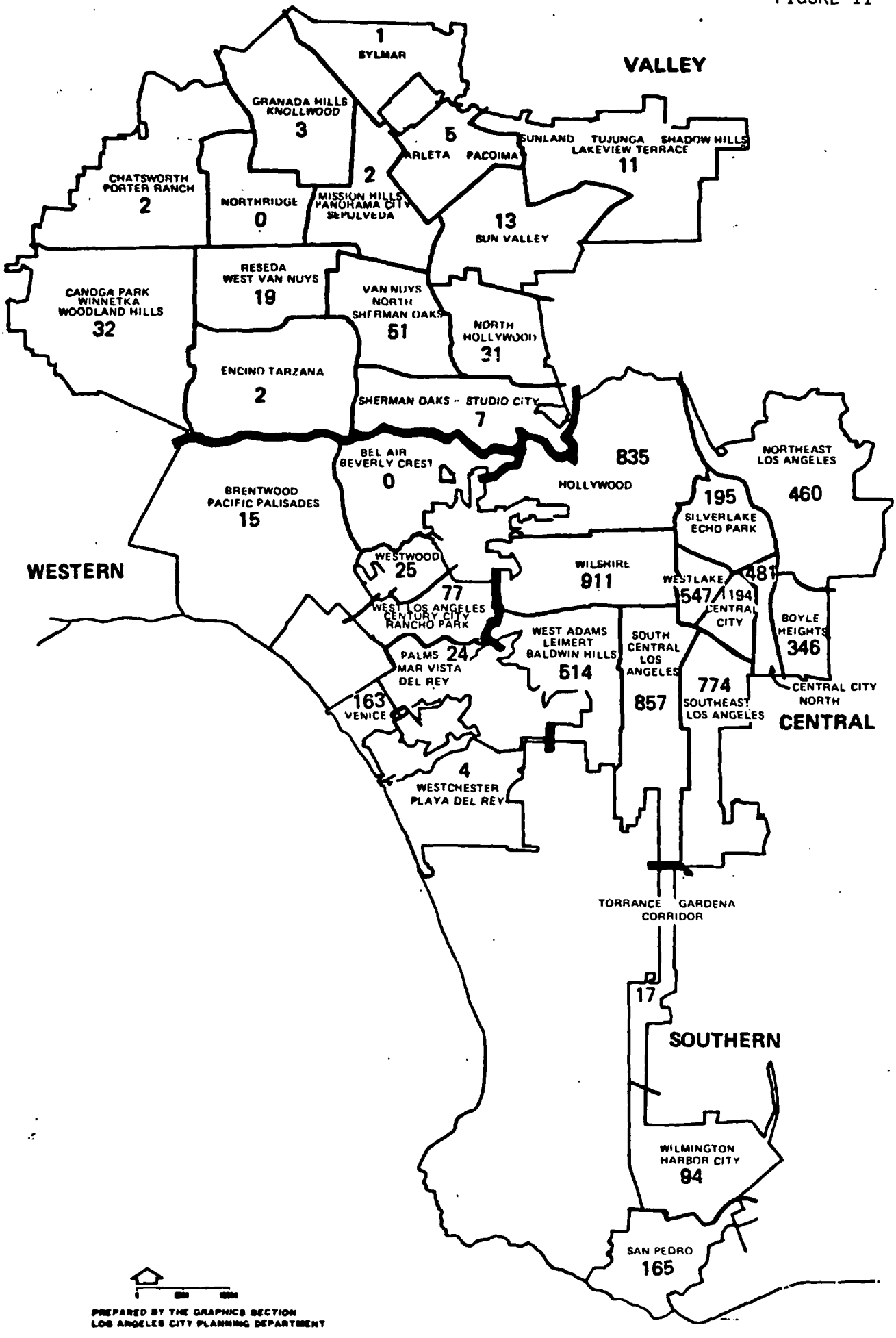

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND TUJUNGA SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
2
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
WILSHIRE
911
WESTLAKE
547
481
194
CENTRAL
CITY
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
BOYLE
HEIGHTS
346
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
PALMS
MAR VISTA
DEL REY
24
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE GARDENA
CORRIDOR
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective dafe of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story-family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

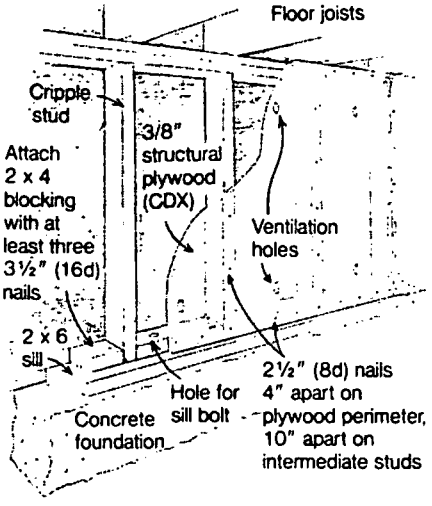
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

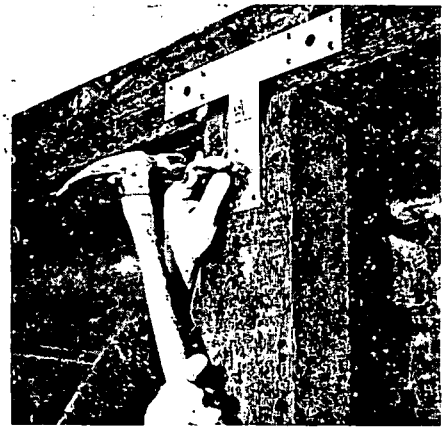
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

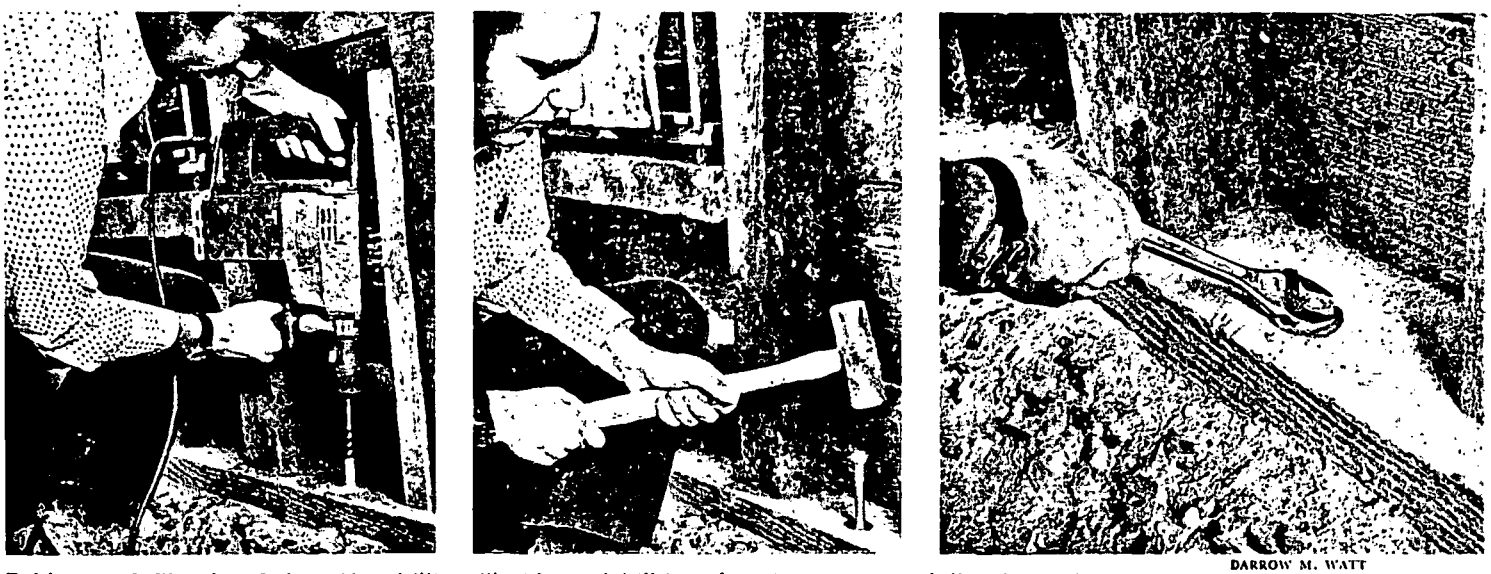
Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad



DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse." Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage. For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

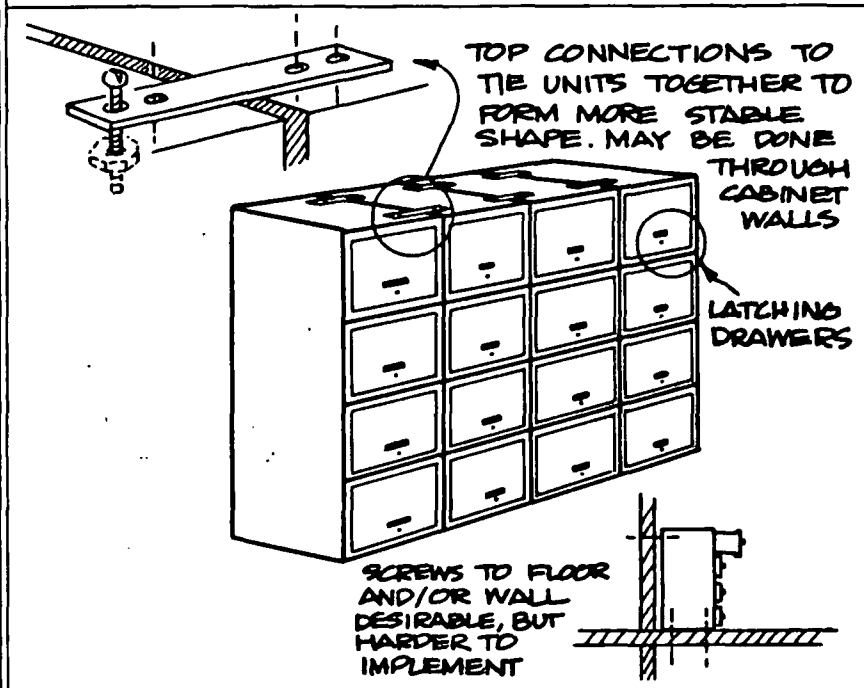
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

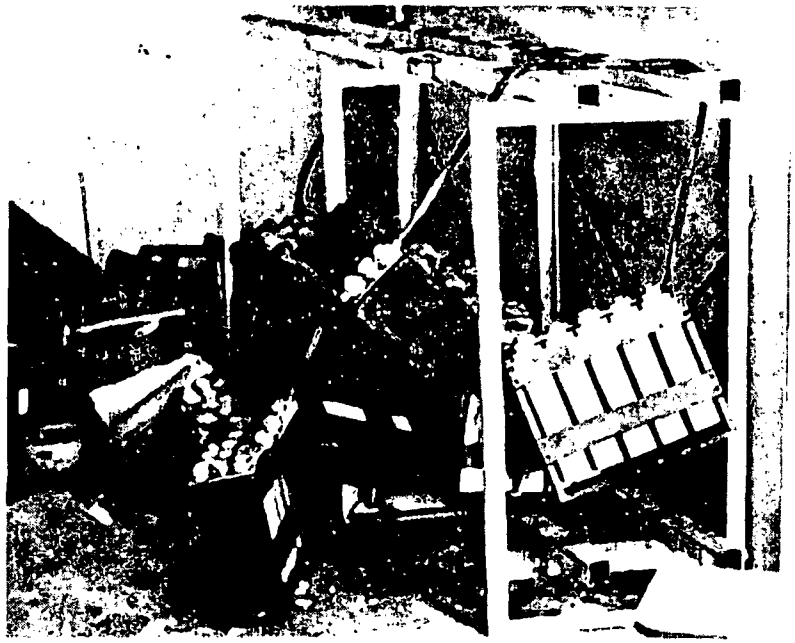
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

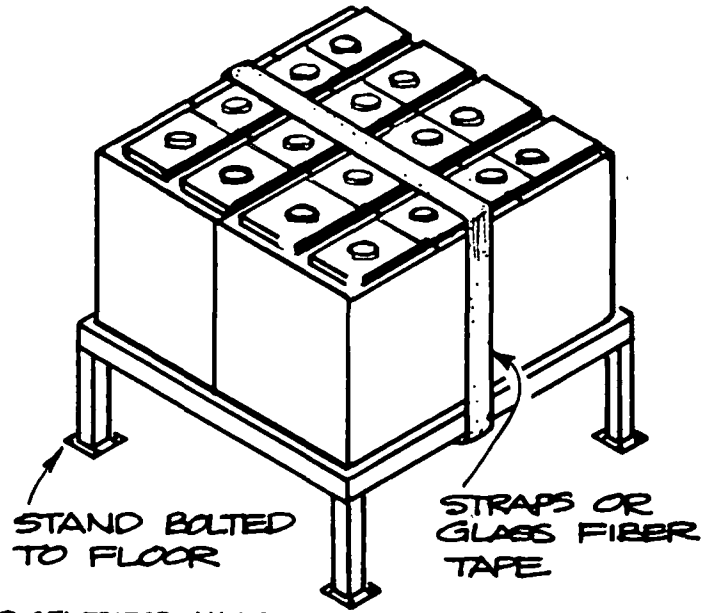
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING - AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

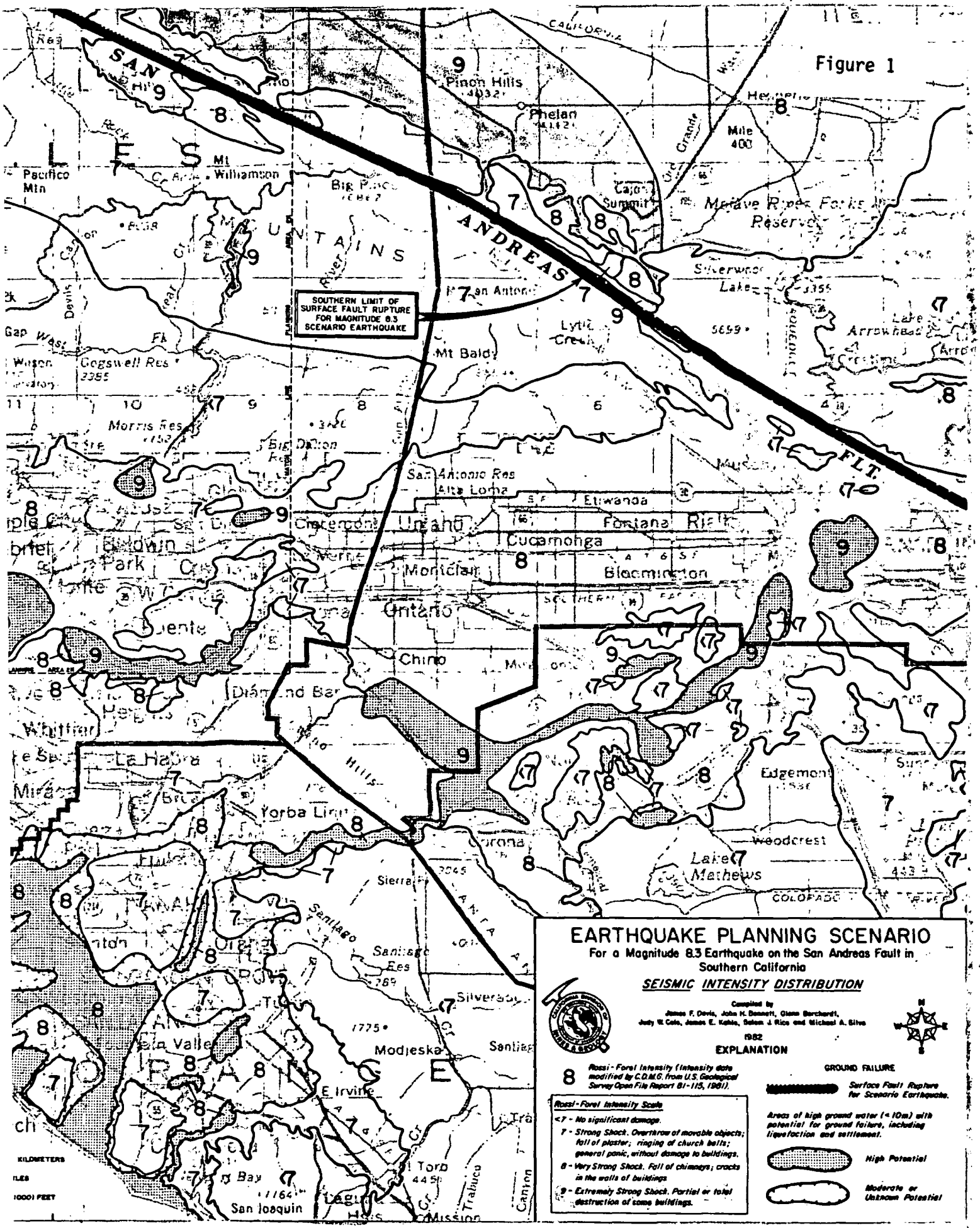
Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1



EARTHQUAKE PLANNING SCENARIO

For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California

SEISMIC INTENSITY DISTRIBUTION

Compiled by

James F. Davis, John H. Bennett, Diane Borchardt, Judy W. Cole, James E. Kahle, Salem J. Rice and Michael A. Silva

1982

EXPLANATION

8 — *Rossi-Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).*

Rossi-Forel Intensity Scale

- *<7 - No significant damage.*
- *7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.*
- *8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.*
- *9 - Extremely Strong Shock. Partial or total destruction of some buildings.*

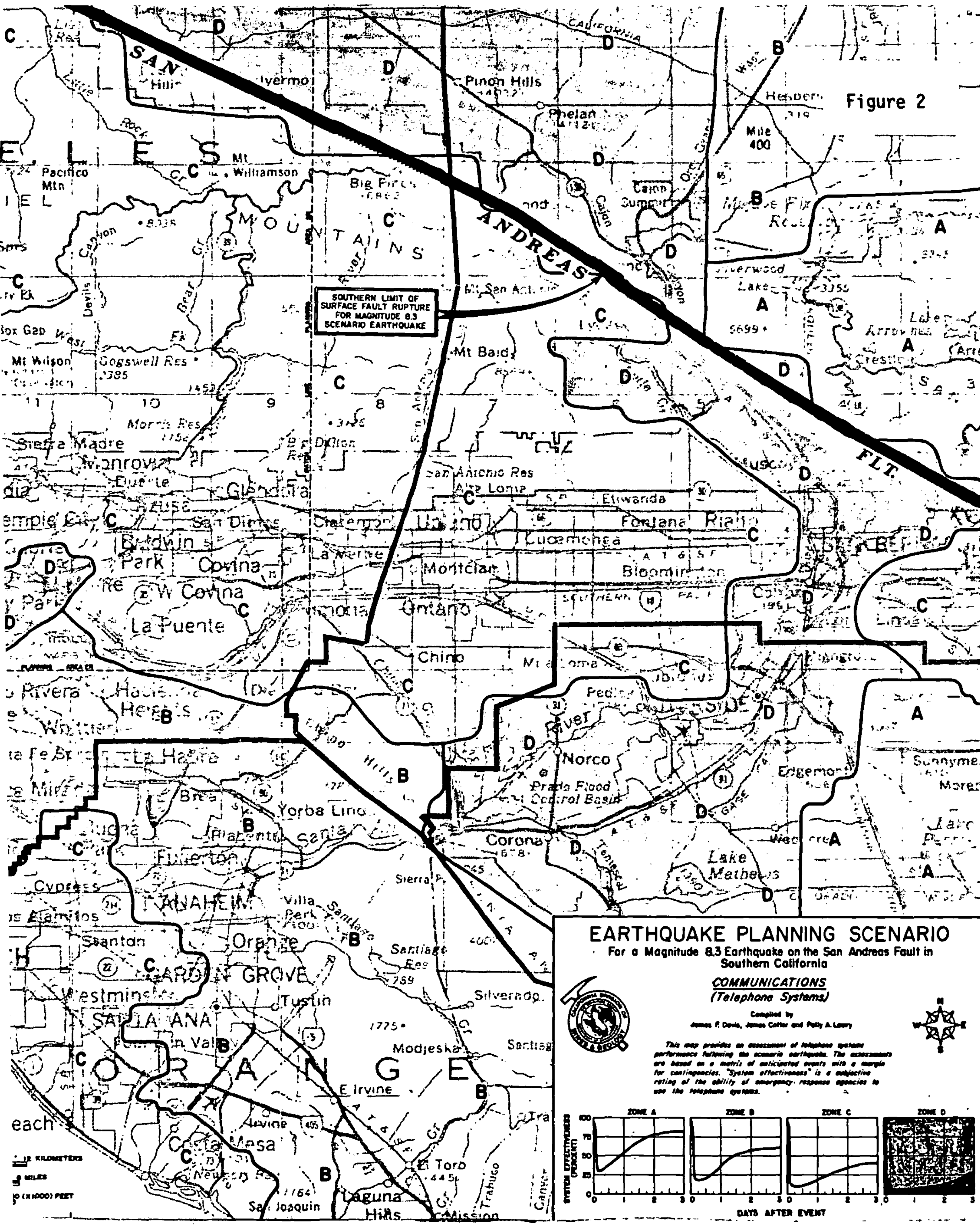
GROUND FAILURE

Surface Fault Rupture for Scenario Earthquake.

Areas of high ground water (<10m) with potential for ground failure, including liquefaction and settlement.

High Potential

Moderate or Unknown Potential



SAN ANDREAS FLT.
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
MOUNTAINS
Pinon Hills
Phelan
Mile 400
Cajon Summit
Big Pines
Mt Williamson
Pacifico Mtn
Mt Wilson
Cogswell Res
Mt Baldy
Morris Res
Sierra Madre
San Antonio Res
Alta Loma
Etiwanda
Fontana
Rialto
Cucamonga
San Dimas
Claremont
La Verne
Upland
Montclair
Bloomington
Baldwin Park
Covina
W Covina
La Puente
Ontario
Chino
Norco
Prado Flood Control Basin
Corona
Lake Mathews
Edgemont
Sunnymead
La Habra
Brea
Yorba Linda
Placentia
Fullerton
Cypress
ANAHEIM
Villa Park
Orange
Santiago Res
Silverado
GARDEN GROVE
Westminster
Tustin
SANTA ANA
Modjeska
ORANGE
E Irvine
Irvine
Costa Mesa
El Toro
Laguna Hills
Mission
San Joaquin
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
James F. Davis, James Coffer and Polly A. Lowry
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT

Figure 2

Figure 6

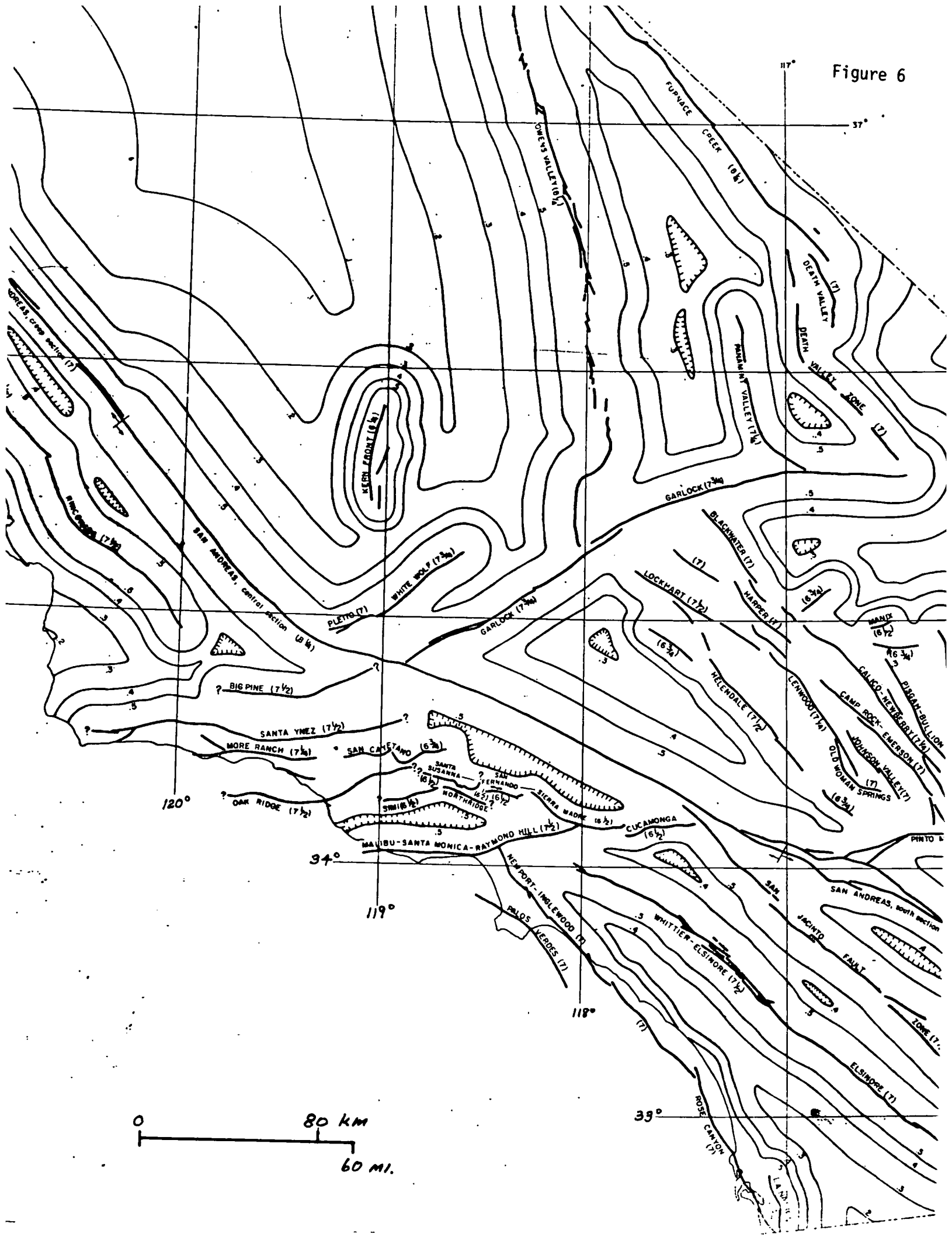
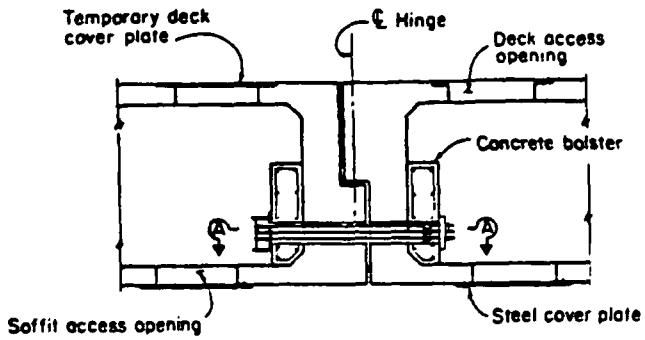
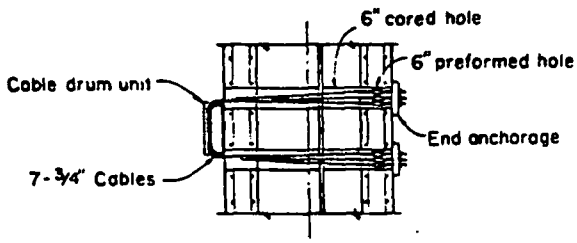

117°
37°
120°
119°
118°
34°
39°
FURNACE CREEK (8½)
OWENS VALLEY (7)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7½)
KERN FRONT (8½)
GARLOCK (7½)
BLACKWATER (7)
LOCKHART (7½)
HARPER (7)
HELENDALE (7½)
LENWOOD (7½)
CALICO-NEWBERRY (7½)
CAMP ROCK-EMERSON (7)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS (7)
PISGAH-BULLION
SAN ANDREAS, central section (8½)
SAN ANDREAS, Coachella section (7)
WHITE WOLF (7½)
PLEITO (7)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7½)
SAN CAYETANO (6¾)
SANTA SUSANNA (6½)
SAN FERNANDO (6½)
NORTHRIDGE (6½)
SIMI (6½)
OAK RIDGE (7½)
SIERRA MADRE (6½)
CUCAMONGA (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
NEWPORT-INGLEWOOD (7)
PALOS VERDES (7)
SAN ANDREAS, south section
SAN JACINTO FAULT ZONE (7)
WHITTIER-ELSINORE (7½)
ELSINORE (7)
ROSE CANYON (7)
0
80 km
60 mi.

Figure 7

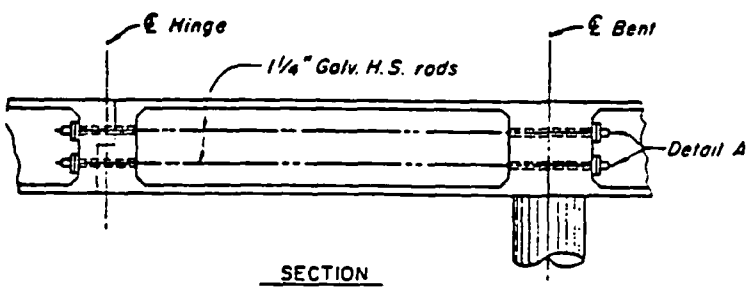


SECTION THRU HINGE

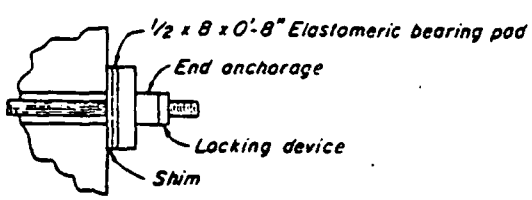


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

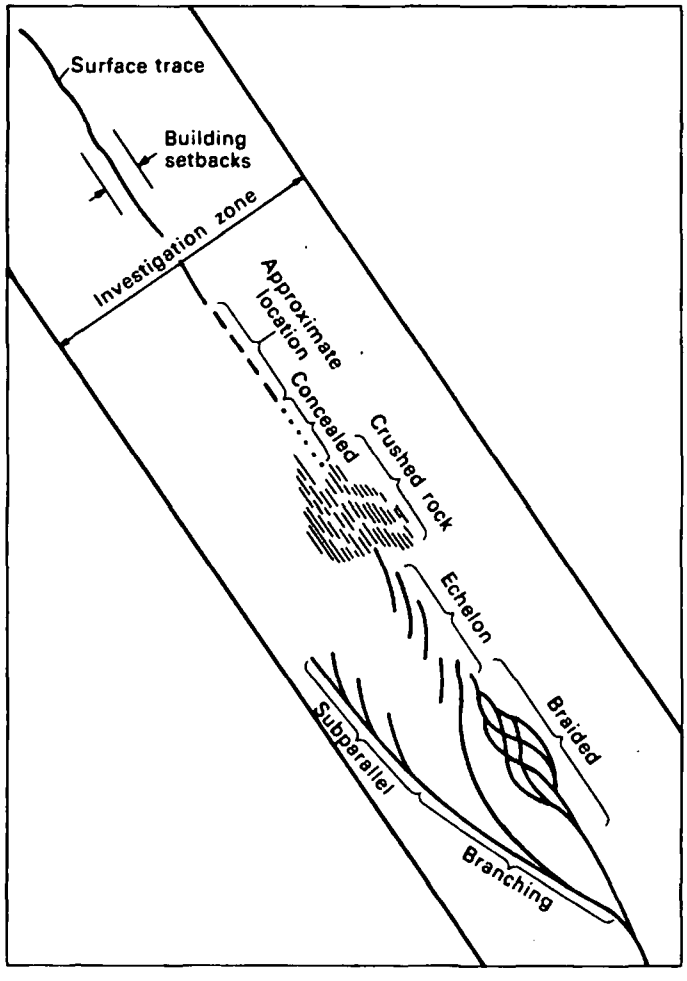


Figure 8. -- Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

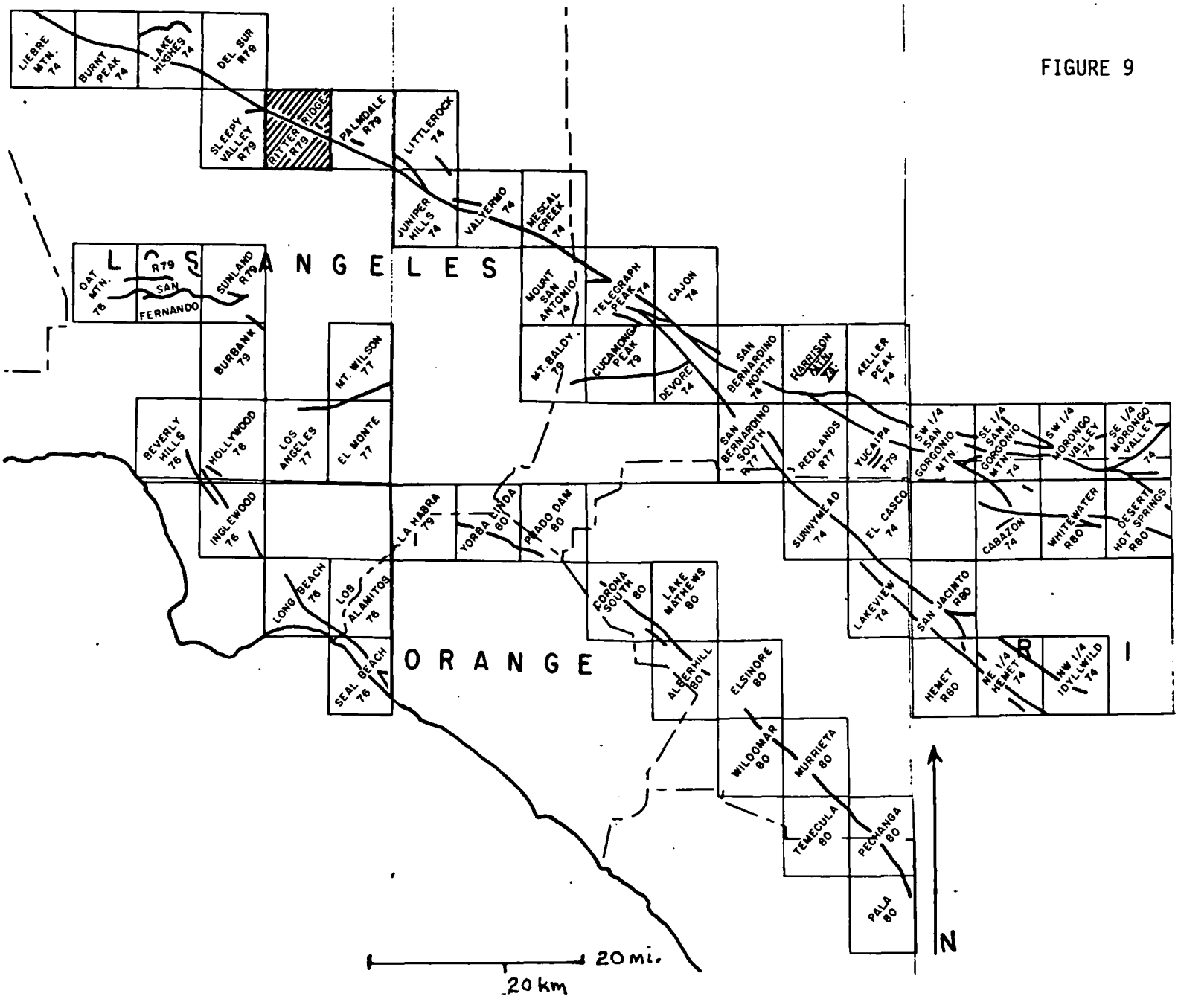


Figure 9. -- Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.

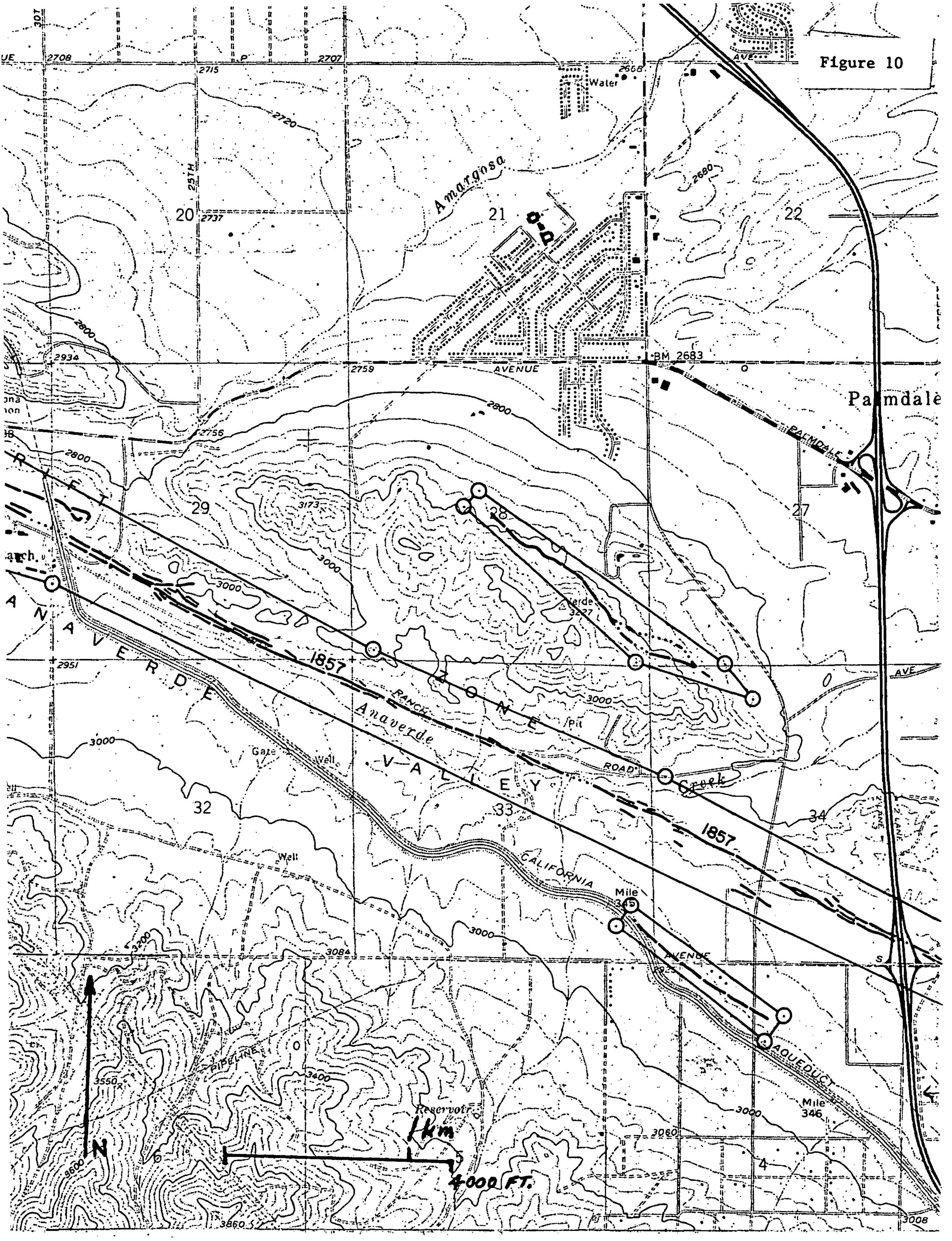

Amargosa
Palmdale
BM 2683
AVENUE
PALMDALE
RIFT
ZONE
ANAVERDE
VALLEY
Anaverde
Creek
RANCH
ROAD
1857
1857
CALIFORNIA
AQUEDUCT
Mile 345
Mile 346
PIPELINE
Reservoir
Gate
Well
Well
Pit
Water
N
1 km
4000 FT.

Figure 10

FIGURE 11

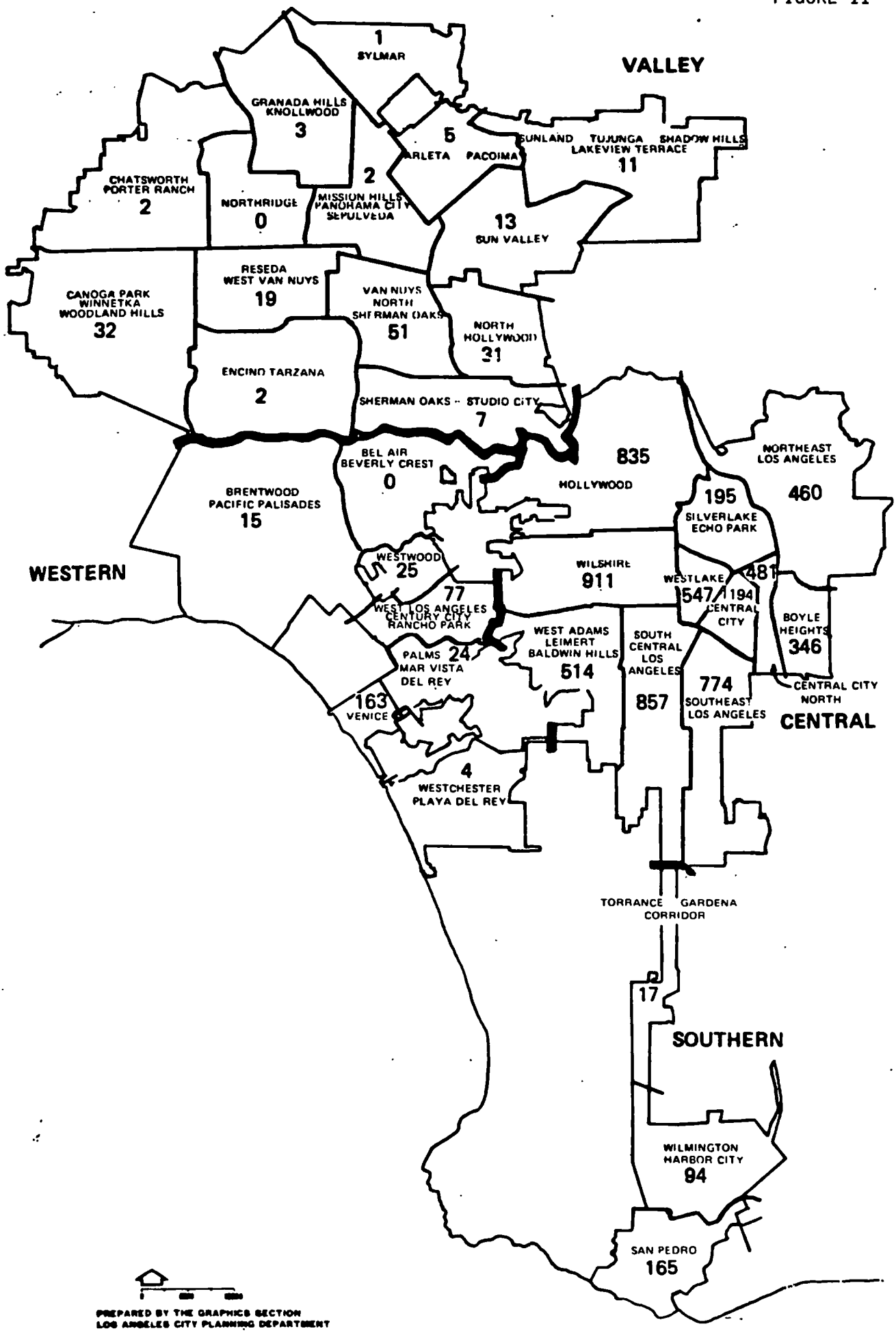

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND
TUJUNGA
SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
2
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
WILSHIRE
911
WESTLAKE
547
194
CENTRAL
CITY
481
BOYLE
HEIGHTS
346
PALMS
24
MAR VISTA
DEL REY
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE
CORRIDOR
GARDENA
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story-family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.

2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

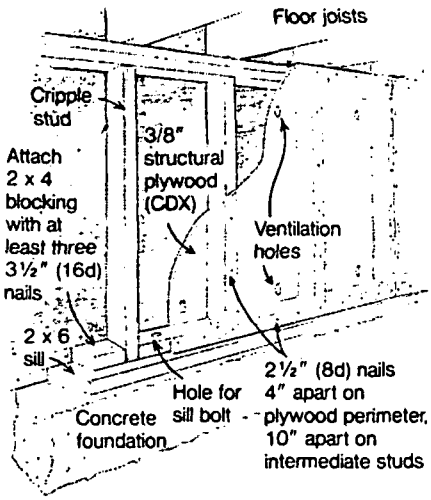
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

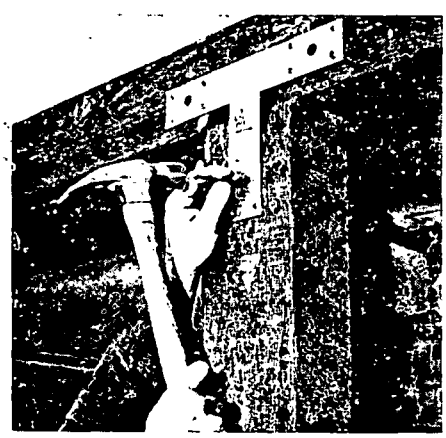
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad

DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse."

Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage.

For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

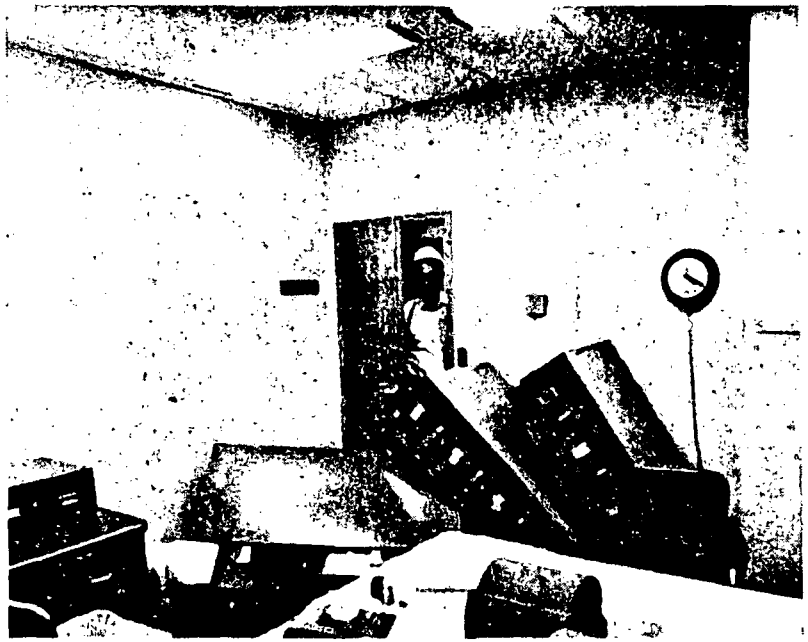
How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

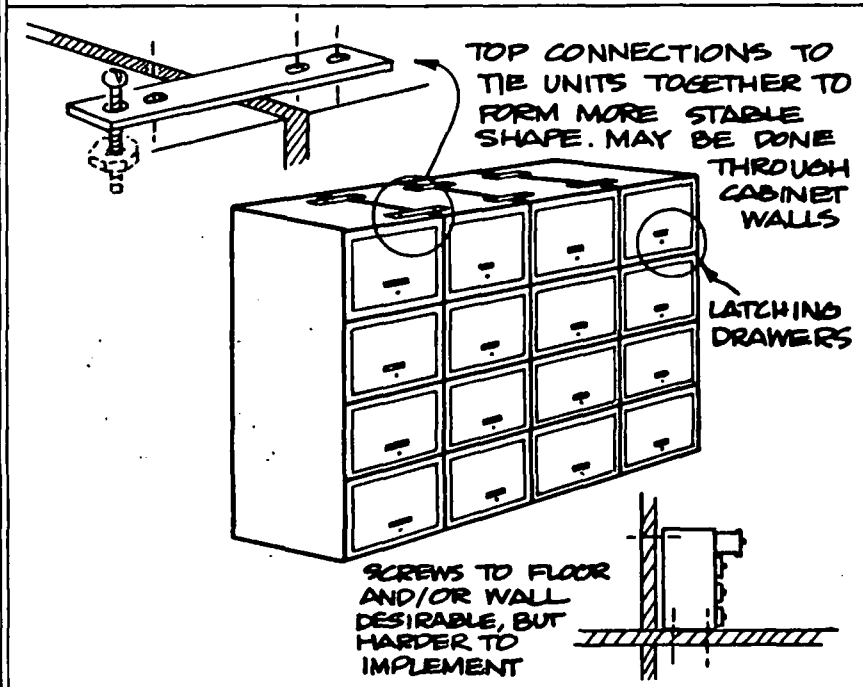
TALL FILE CABINETS

DAMAGE EXAMPLE



earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

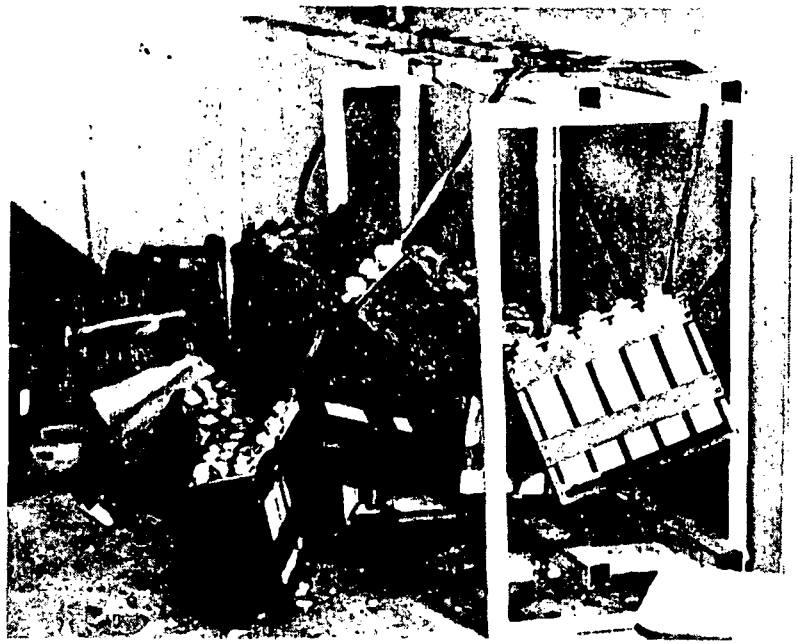
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

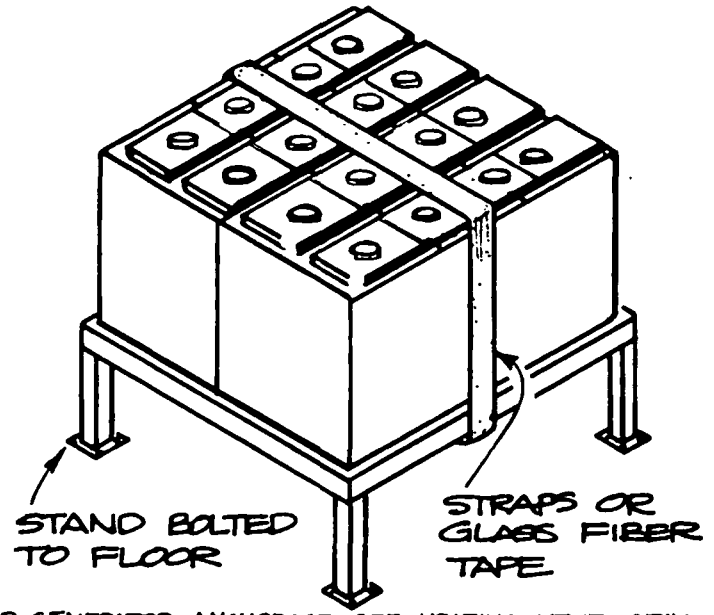
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING-AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

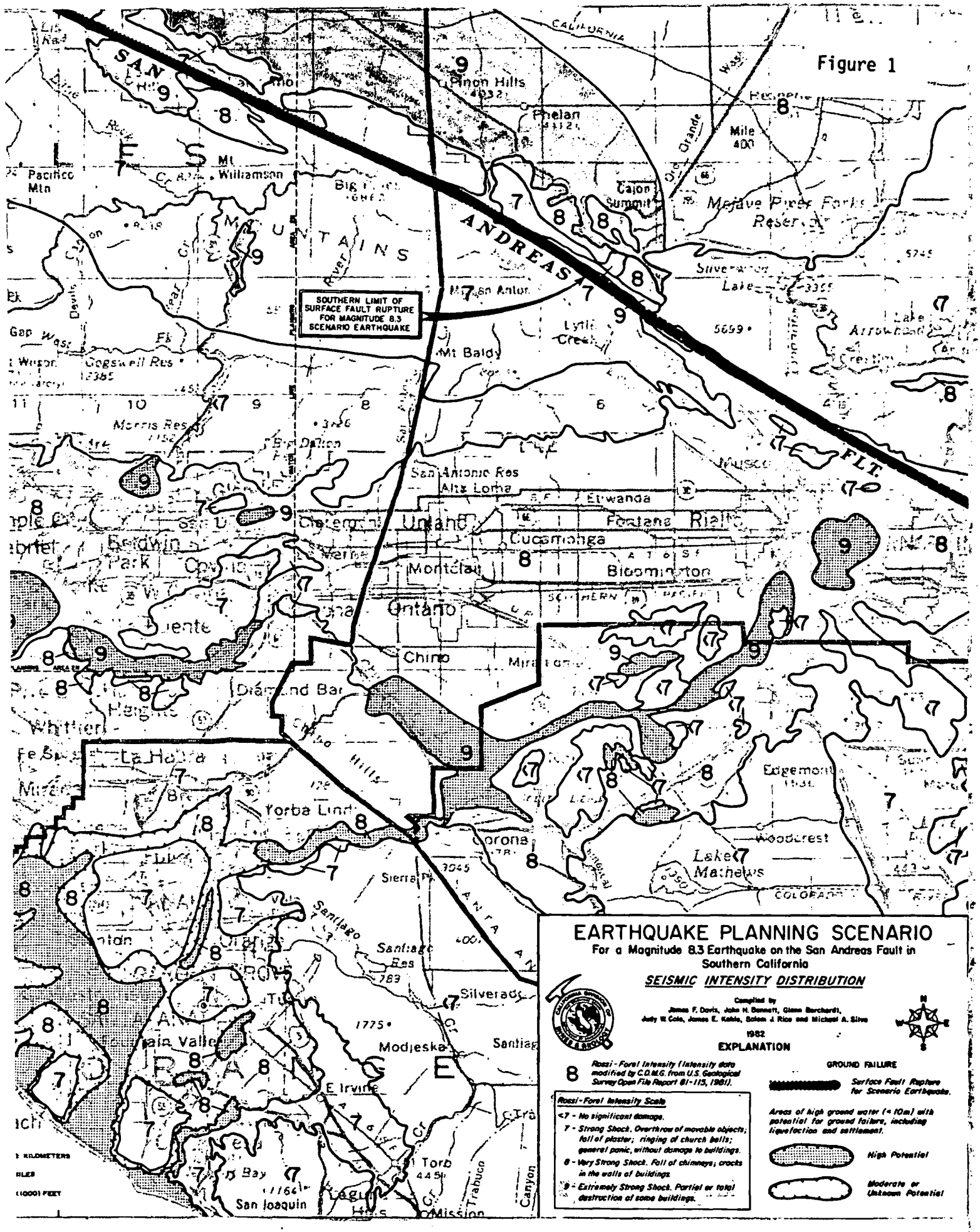
Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1



EARTHQUAKE PLANNING SCENARIO

For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California

SEISMIC INTENSITY DISTRIBUTION

Compiled by
James F. Davis, John H. Bennett, Glenn Borchardt, Judy W. Cole, James E. Kahle, Salem J. Rice and Michael A. Silva

1982

EXPLANATION

8 — *Rossi-Forel Intensity (Intensity data modified by C.G.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).*

Rossi-Forel Intensity Scale

- *<7 - No significant damage.*
- *7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.*
- *8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.*
- *9 - Extremely Strong Shock. Partial or total destruction of some buildings.*

GROUND FAILURE

Surface Fault Rupture for Scenario Earthquake.

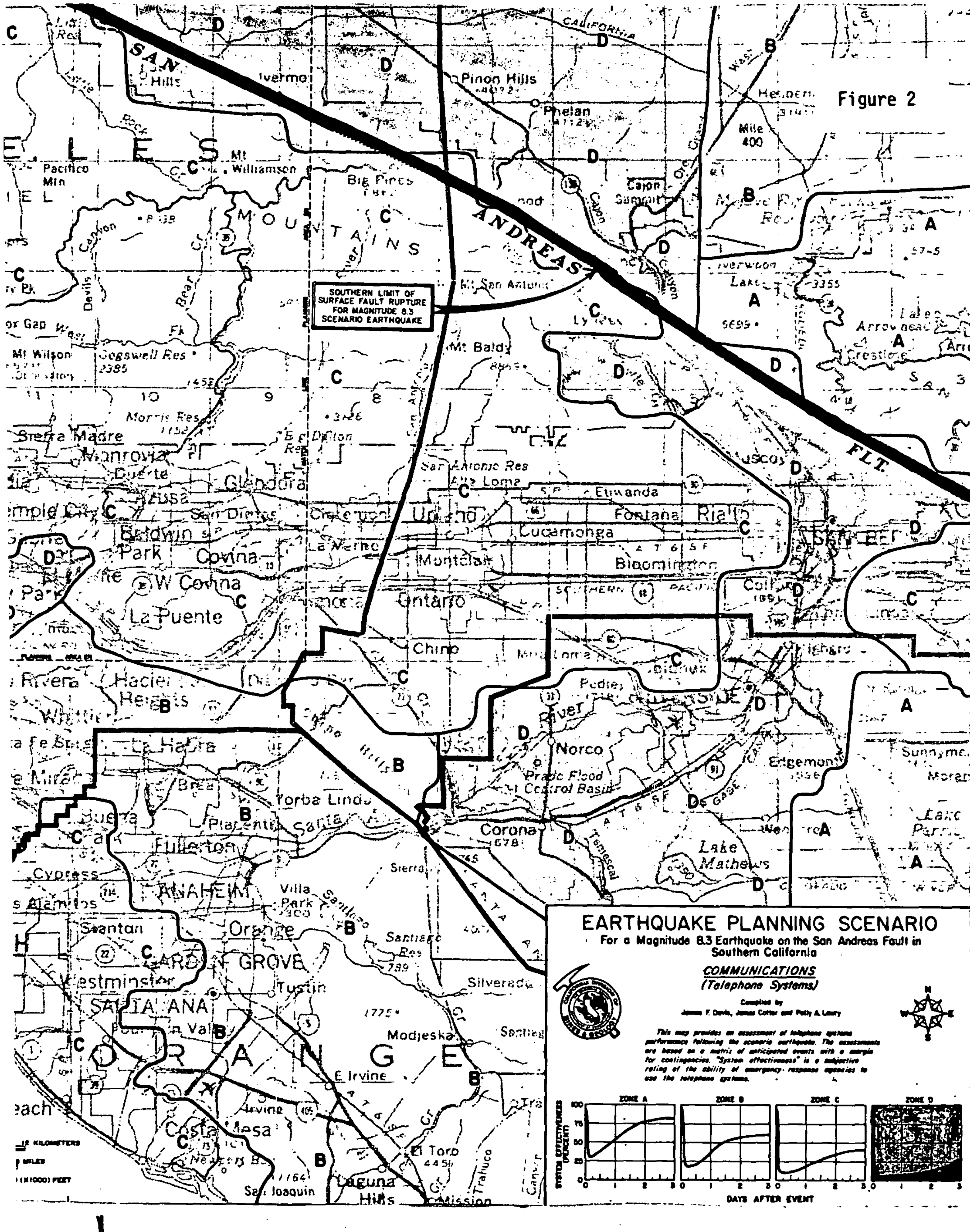
Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.

High Potential

Moderate or Unknown Potential

KILOMETERS
MILES
(1000) FEET

Figure 2


EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
James F. Davis, James Cotter and Patty A. Lowry
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency-response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
MOUNTAINS
ORANGE
Pinon Hills
Phelan
Mt Baldy
Glendora
Azusa
Baldwin Park
Covina
W Covina
La Puente
Upland
Cucamonga
Fontana
Etiwanda
Bloomington
Montclair
Ontario
Chino
Norco
Corona
Lake Mathews
La Habra
Brea
Yorba Linda
Fullerton
Anaheim
Orange
Garden Grove
Westminster
Santa Ana
Tustin
Modjeska
Costa Mesa
El Toro
Laguna Hills
Edgemont

1.

Figure 6

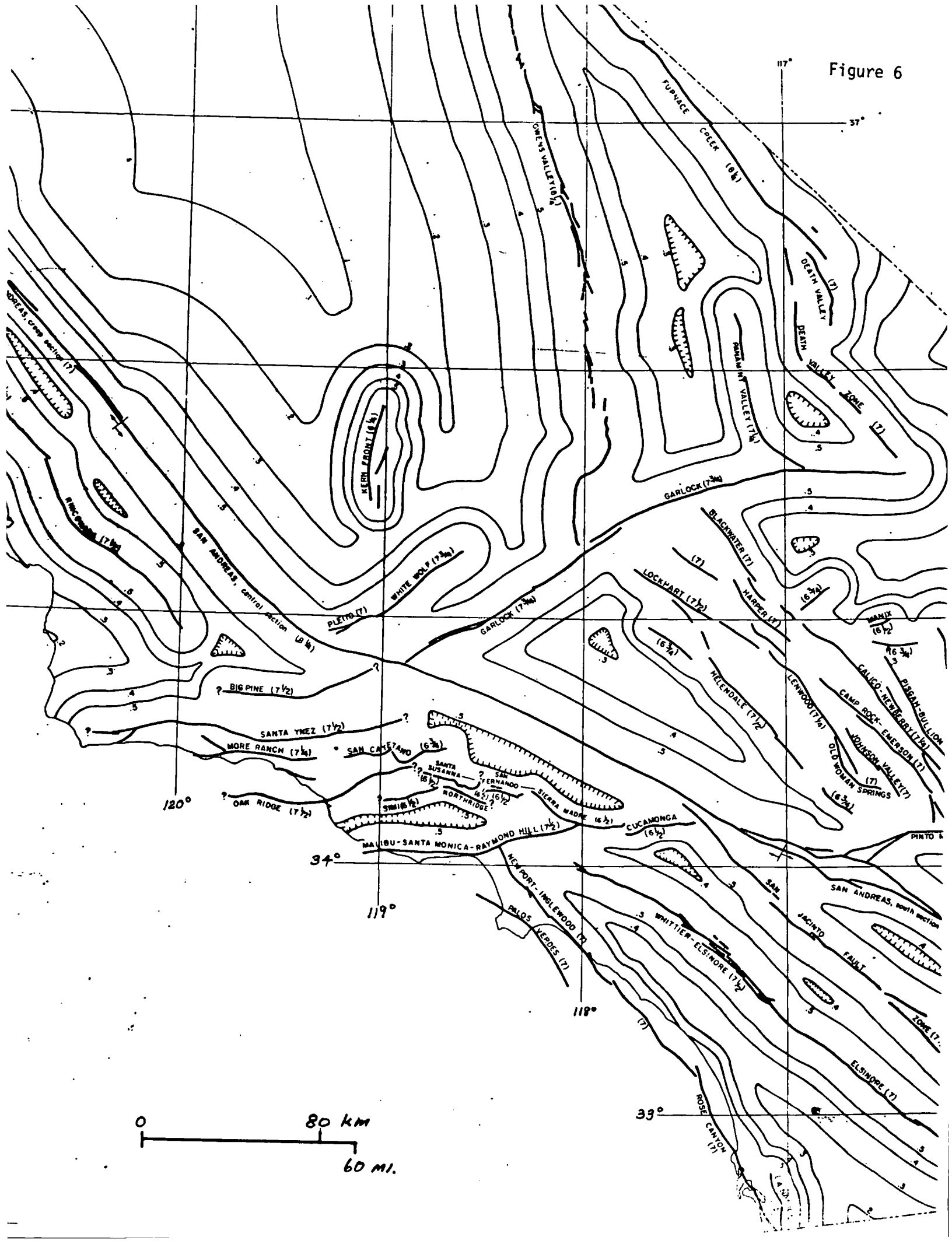
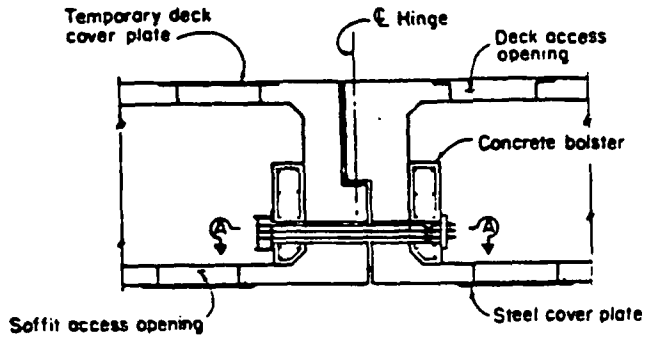
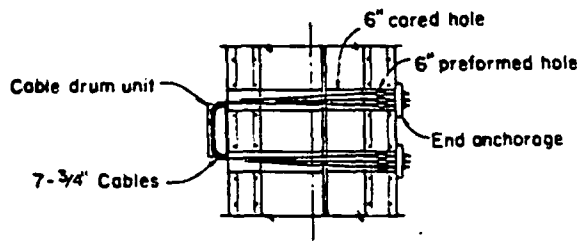

117°
37°
FURNACE CREEK (8½)
OWENS VALLEY (8½)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7½)
KERN FRONT (8½)
GARLOCK (7¾)
BLACKWATER (7)
LOCKHART (7½)
HARPER (?)
(7)
(6¾)
MANIX (6½)
PISGAH-BULLION
CALICO-NEWBERRY (7½)
CAMP ROCK-EMERSON (7½)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS (7)
(6¾)
HELENDALE (7½)
LENWOOD (7½)
PINTO
SAN ANDREAS, south section
JACINTO FAULT ZONE (7)
ELSINORE (7)
WHITTIER-ELSINORE (7½)
NEWPORT-INGLEWOOD (?)
PALOS VERDES (7)
ROSE CANYON (7)
LAGUNA
SAN ANDREAS, central section (8½)
RINCONADA (7¾)
PLEITO (7)
WHITE WOLF (7¾)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7½)
SAN CAYETANO (6¾)
SANTA SUSANNA (6½)
SAN FERNANDO (6½)
NORTHRIDGE (6½)
SIERRA MADRE (6½)
OAK RIDGE (7½)
SIMI (6½)
CUCAMONGA (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
120°
119°
118°
34°
33°
0
80 km
60 mi.

Figure 7

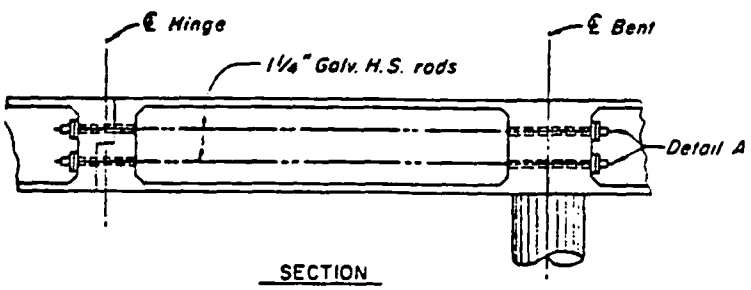


SECTION THRU HINGE

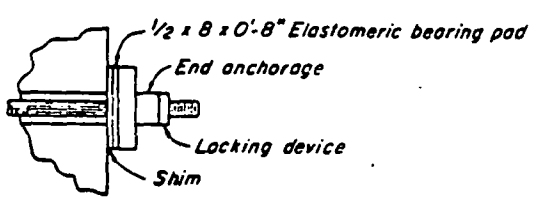


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

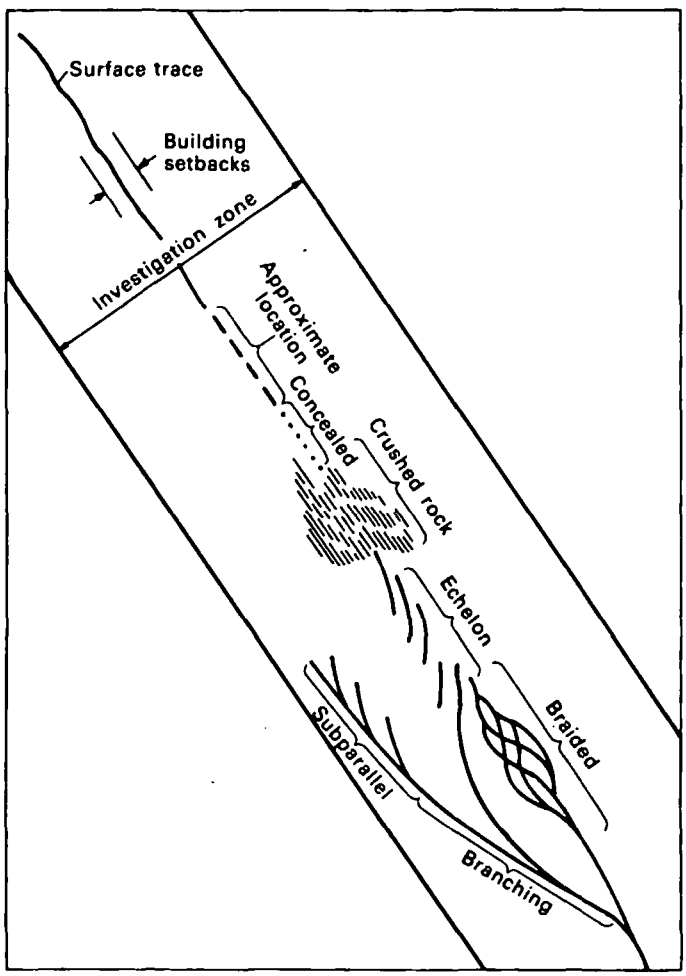


Figure 8. -- Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

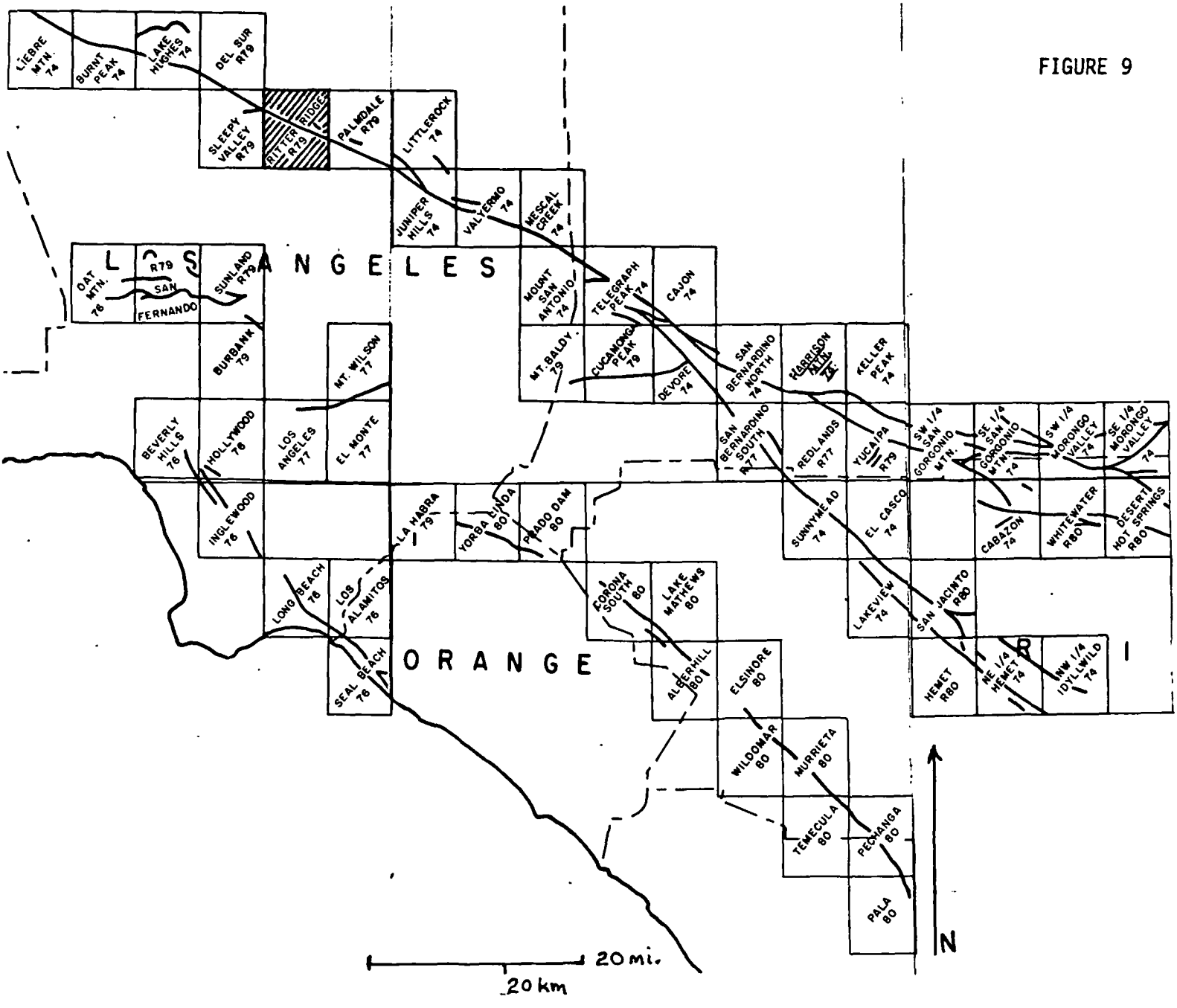


Figure 9. — Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.

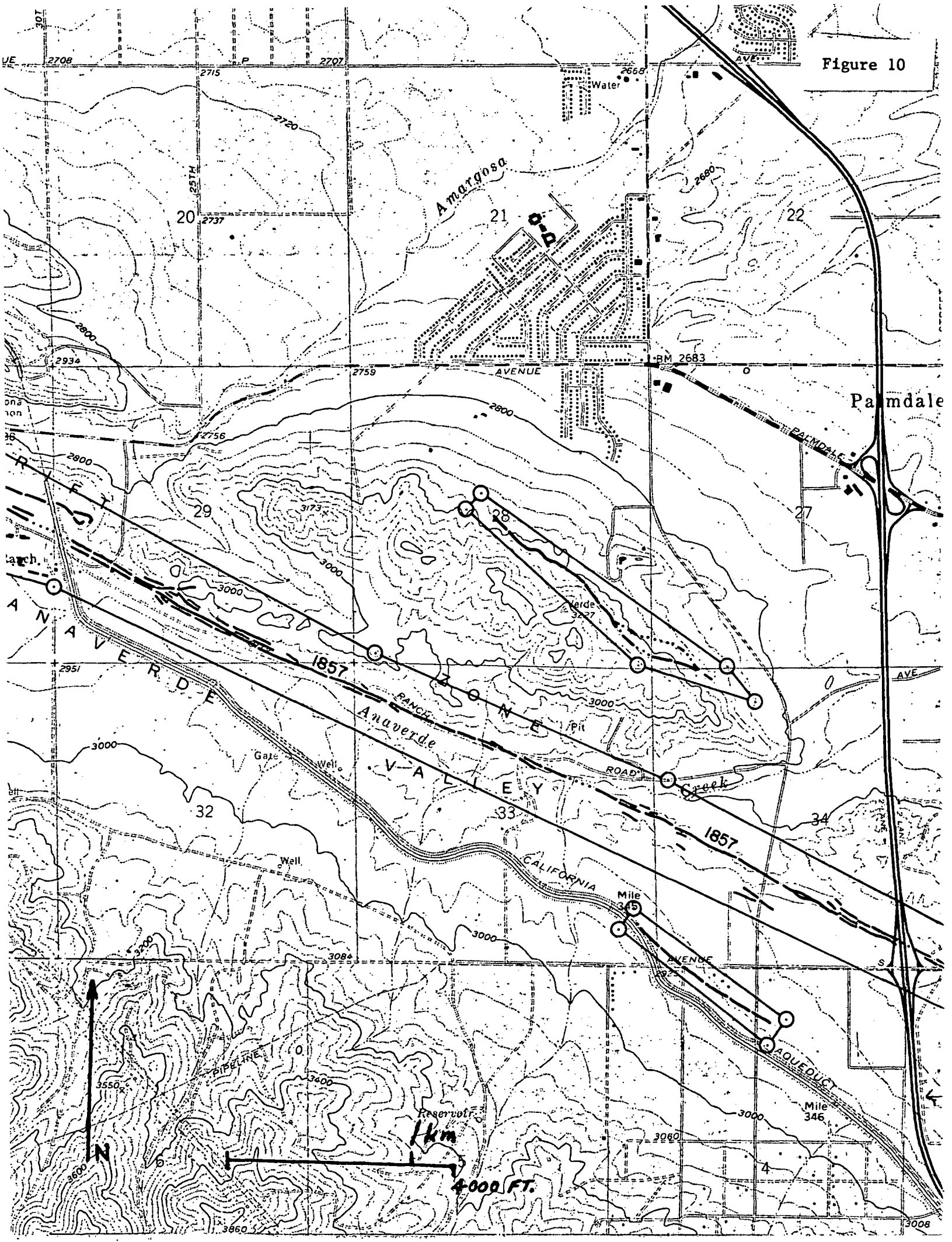


Figure 10
Amargosa
AVENUE
Palmdale
PALMDALE
ANAVERDE VALLEY
1857
RANCH
Anaverde
ROAD
Creek
CALIFORNIA
Mile
AQUEDUCT
PIPELINE
Reservoir
Well
Gate
Pit
Water
BM 2683
1km
4000 FT.
N

FIGURE 11

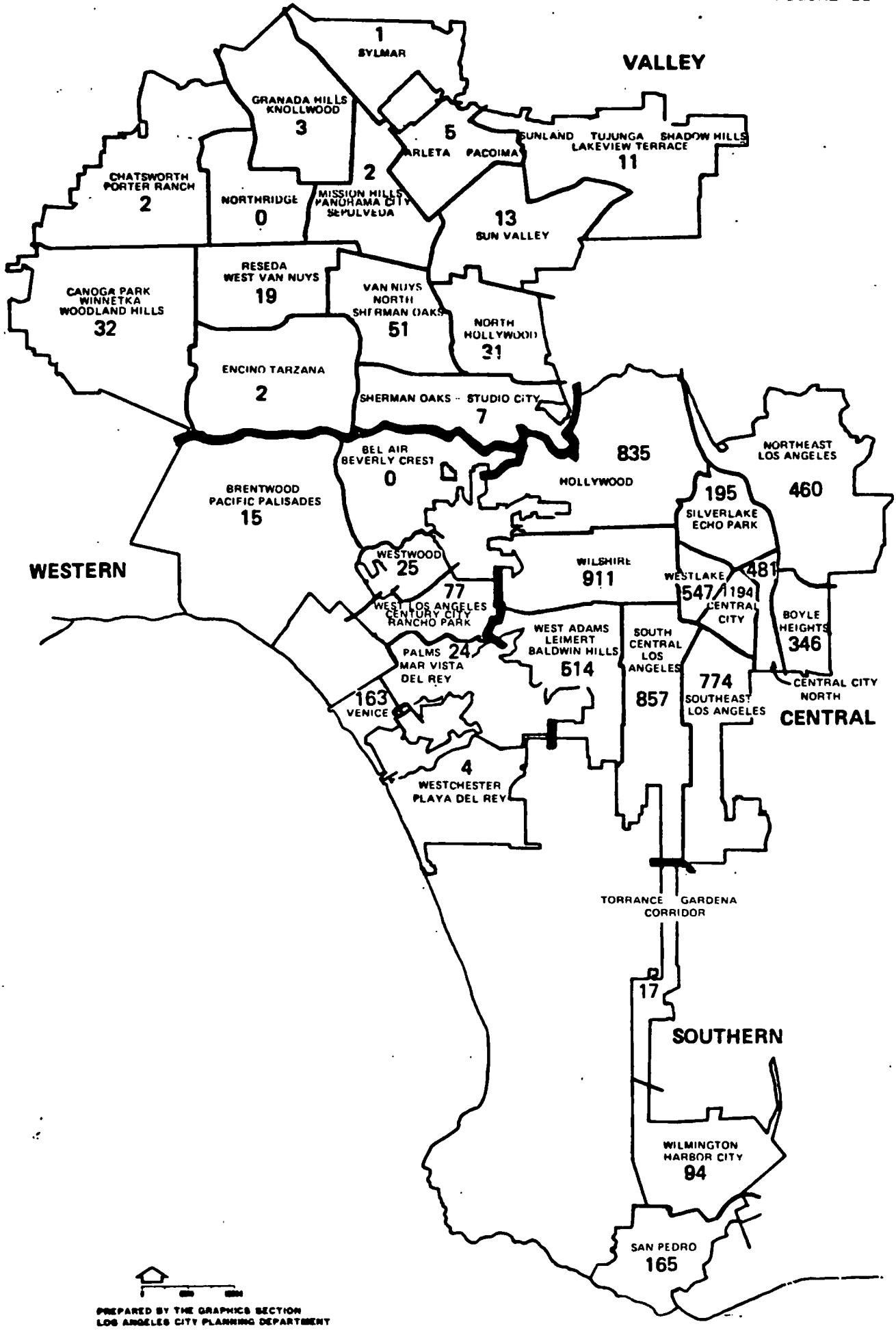

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND
TUJUNGA
SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
2
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
WILSHIRE
911
WESTLAKE
547
194
CENTRAL
CITY
481
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
BOYLE
HEIGHTS
346
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
PALMS
24
MAR VISTA
DEL REY
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE
CORRIDOR
GARDENA
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiilings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

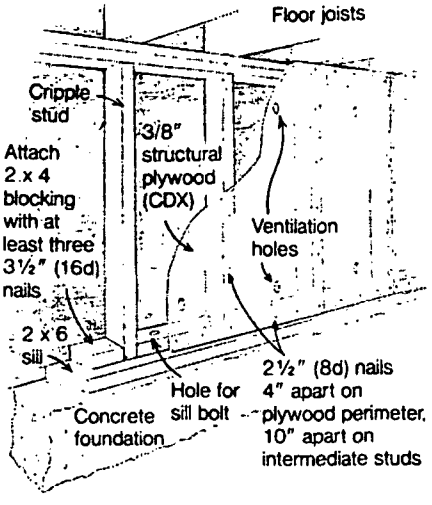
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

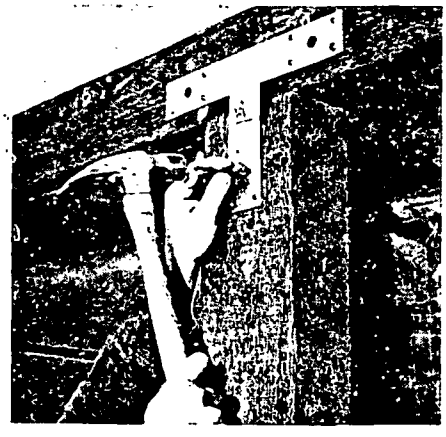
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

tend to perform poorly, suffering severe cracking and often collapse.

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad

DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse."

Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much *shaking your house might suffer in a quake*, let alone how much damage. For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most-common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (*Underwriters define a single earthquake as* any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

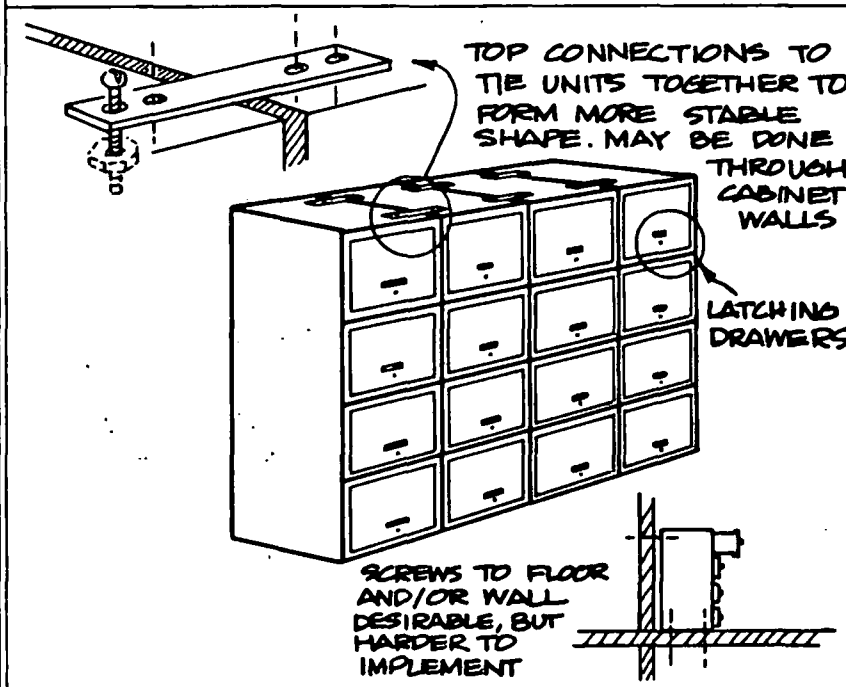
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

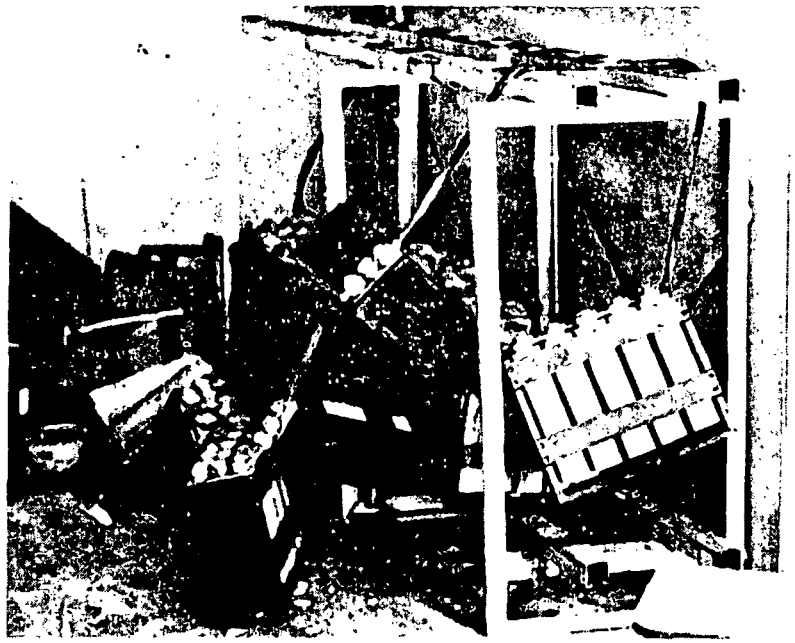
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

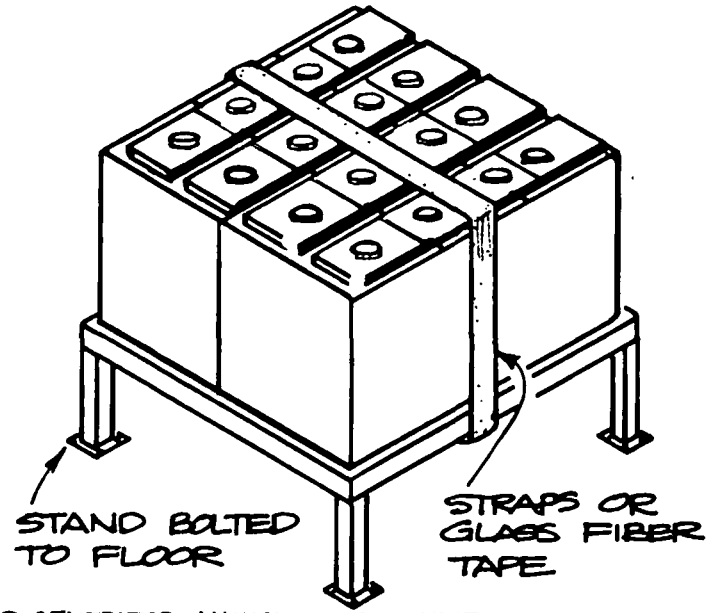
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING-AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1

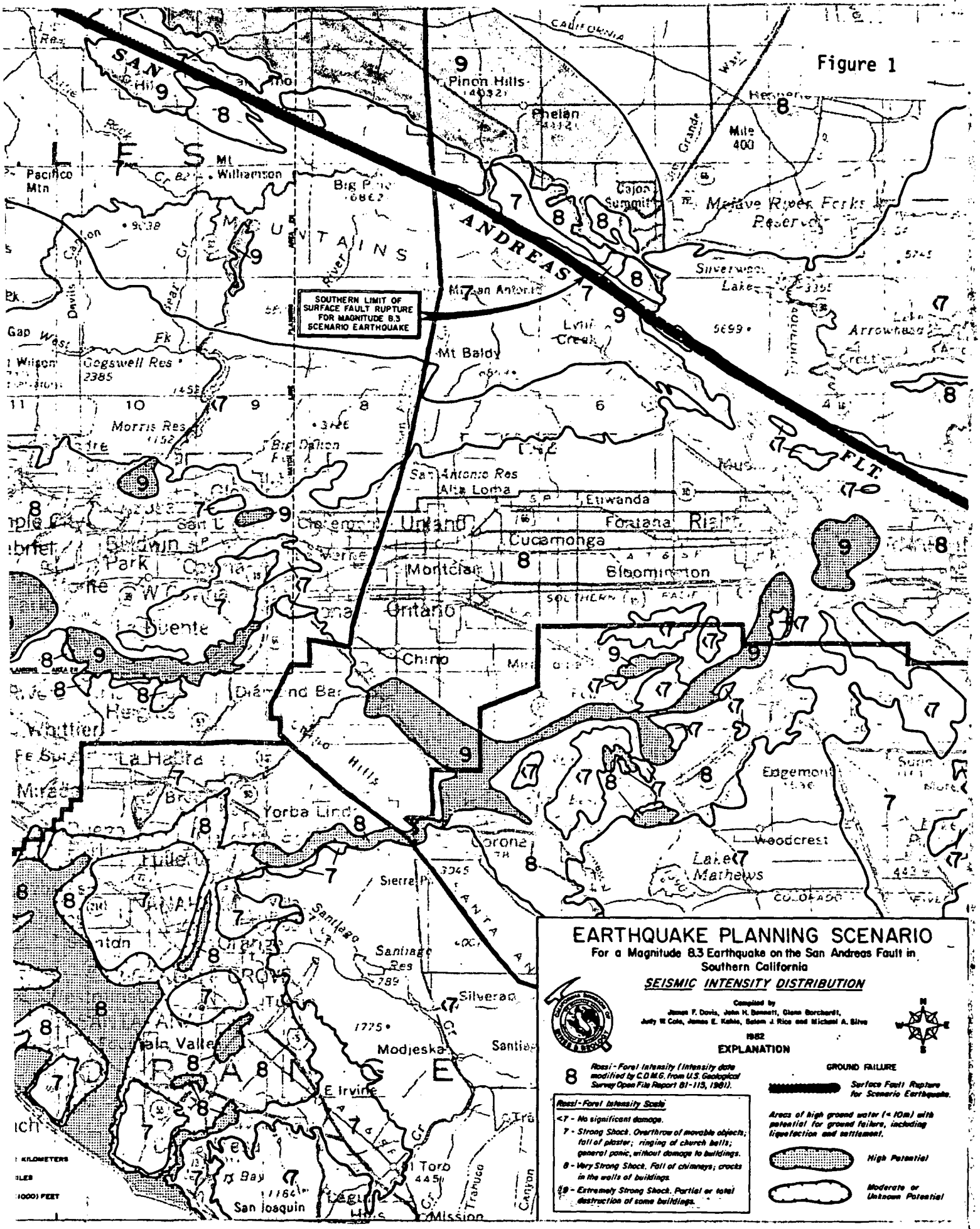
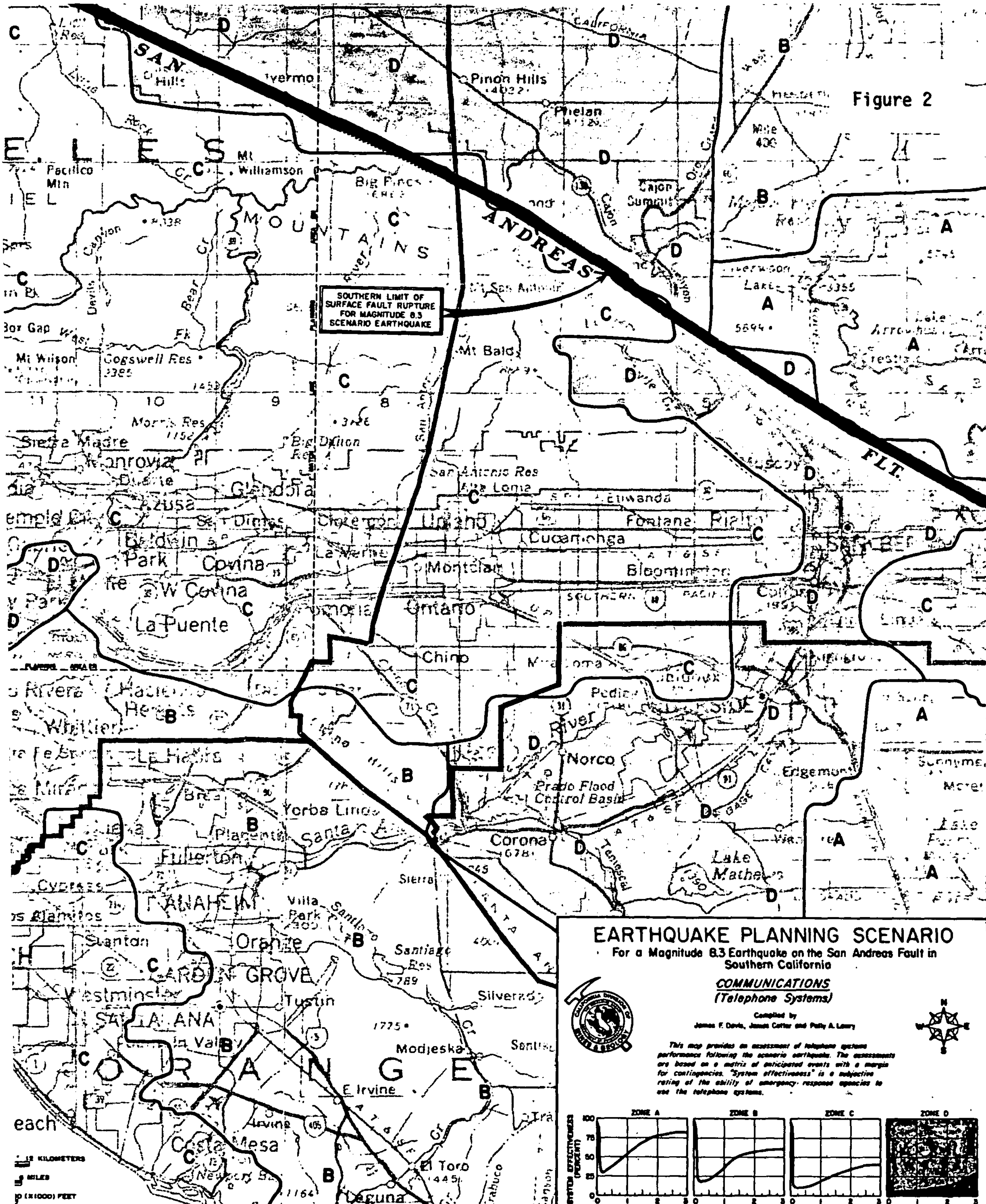

SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
SEISMIC INTENSITY DISTRIBUTION
Compiled by
James F. Davis, John H. Bennett, Glenn Borchardt, Judy W. Cole, James E. Kahle, Selem J. Rice and Michael A. Silva
1982
EXPLANATION
8 Rossi-Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).
Rossi-Forel Intensity Scale
<7 - No significant damage.
7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.
8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.
9 - Extremely Strong Shock. Partial or total destruction of some buildings.
GROUND FAILURE
Surface Fault Rupture for Scenario Earthquake.
Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.
High Potential
Moderate or Unknown Potential

Figure 2


EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency-response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
MOUNTAINS
ORANGE
Pinon Hills
Phelan
Big Pines
Cajon Summit
Mt Baldy
Glendora
Azusa
San Dimas
Claremont
Upland
Fontana
Rialto
Cucamonga
Baldwin Park
Covina
W Covina
La Puente
Montclair
Bloomington
Ontario
Chino
Norco
Corona
Prado Flood Control Basin
Whittier
La Habra
Brea
Yorba Linda
Placentia
Fullerton
Anaheim
Villa Park
Orange
Garden Grove
Westminster
Tustin
Santa Ana
Modjeska
Silverado
E Irvine
Irvine
Costa Mesa
El Toro
Laguna Hills
San Joaquin
Edgemont
Lake Mathews
Monrovia
Sierra Madre
Cogswell Res
Mt Wilson
Mt Williamson
Pacifico Mtn

1.

Figure 6

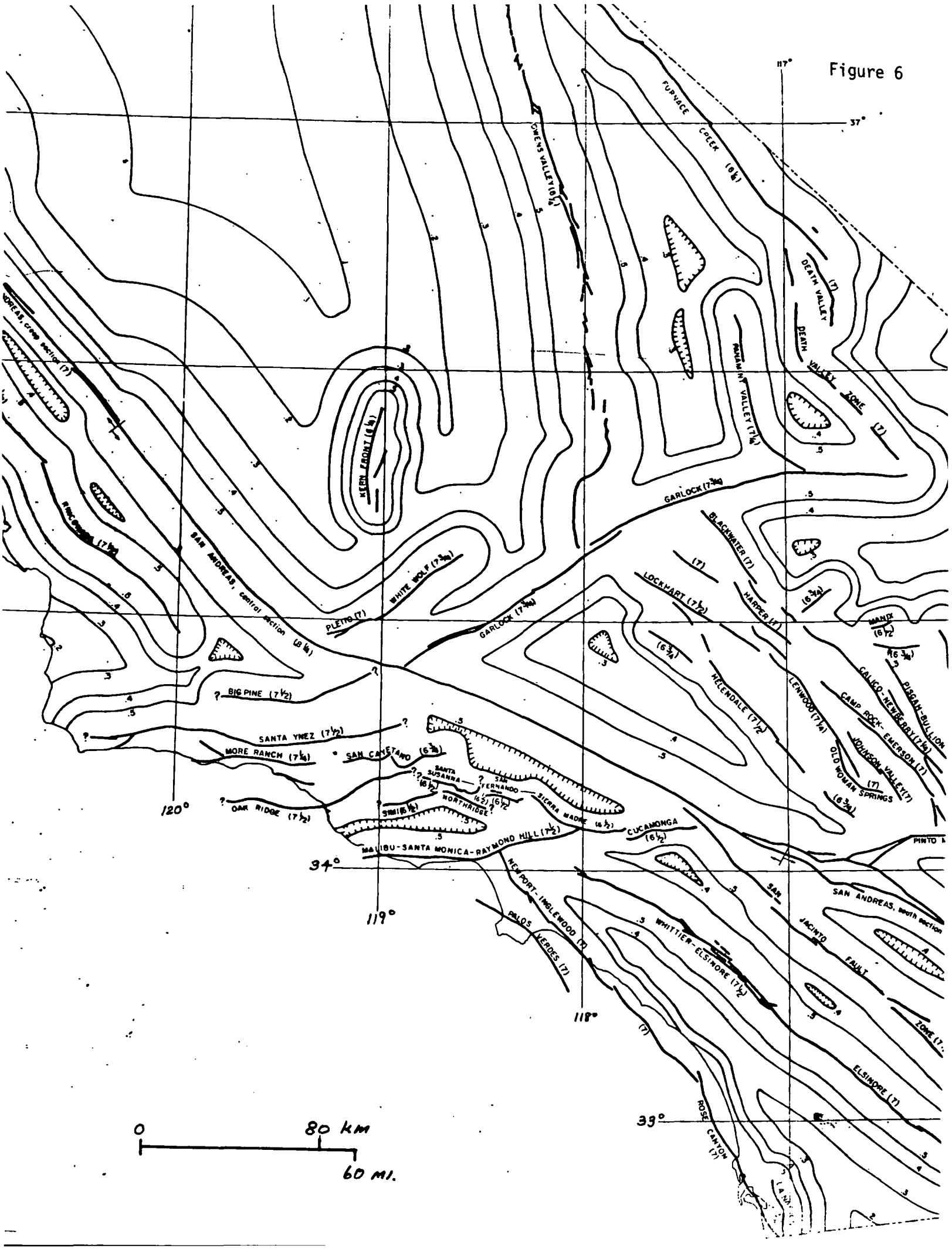
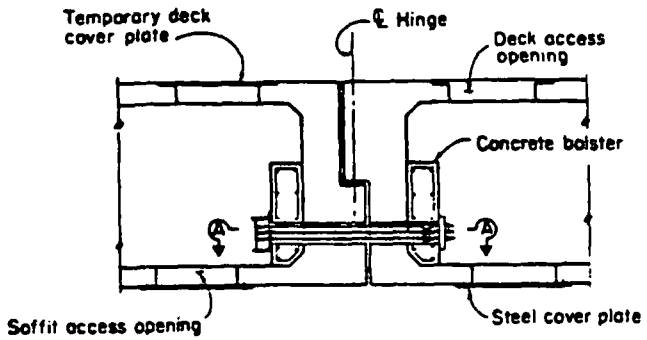
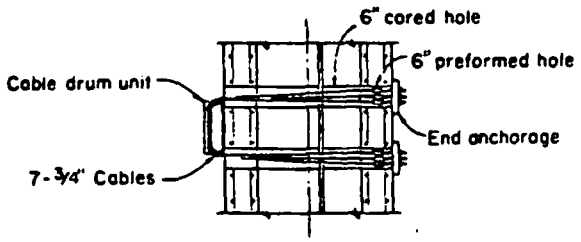

117°
37°
FURNACE CREEK (8½)
OWENS VALLEY (8½)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7½)
KERN FRONT (8½)
GARLOCK (7½)
BLACKWATER (7)
LOCKHART (7½)
HARPER (7)
WHITE WOLF (7½)
PLETYO (7)
SAN ANDREAS, central section (8½)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7½)
SAN CAYETANO (6¾)
SANTA SUSANNA (6½)
SAN FERNANDO (6½)
NORTHRIDGE (6½)
SIERRA MADRE (6½)
OAK RIDGE (7½)
SIMI (6½)
CUCAMONGA (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
NEWPORT-INGLEWOOD (7)
PALOS VERDES (7)
WHITTIER-ELSINORE (7½)
SAN JACINTO FAULT ZONE (7)
ELSINORE (7)
SAN ANDREAS, south section
ROSE CANYON (7)
HELENDALE (7½)
LENWOOD (7½)
OLD WOMAN SPRINGS (7)
JOHNSON VALLEY (7)
CAMP ROCK-EMERSON (7½)
CALICO-NEWBERRY (7½)
PISGAH-BULLION
MANIX (6½)
PINTO
120°
119°
118°
34°
39°
0
80 km
60 mi.

Figure 7

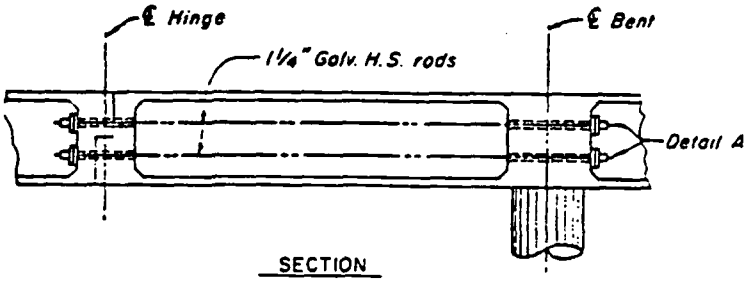


SECTION THRU HINGE

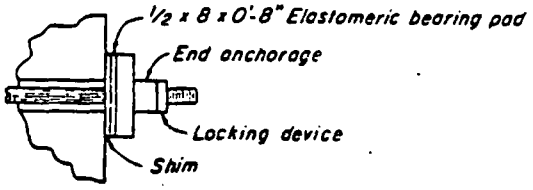


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

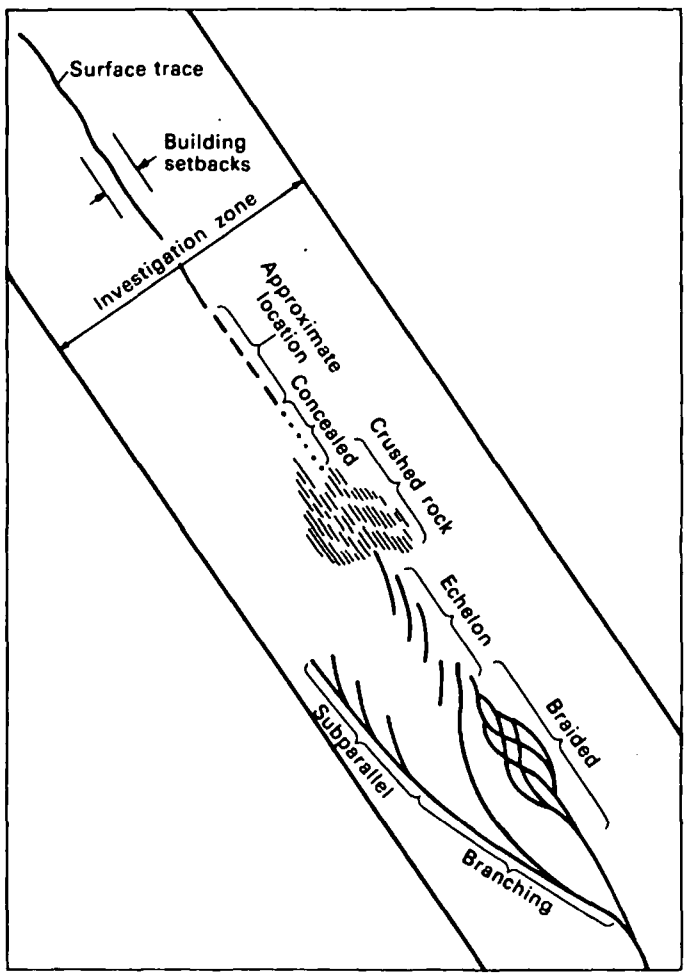


Figure 8. -- Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

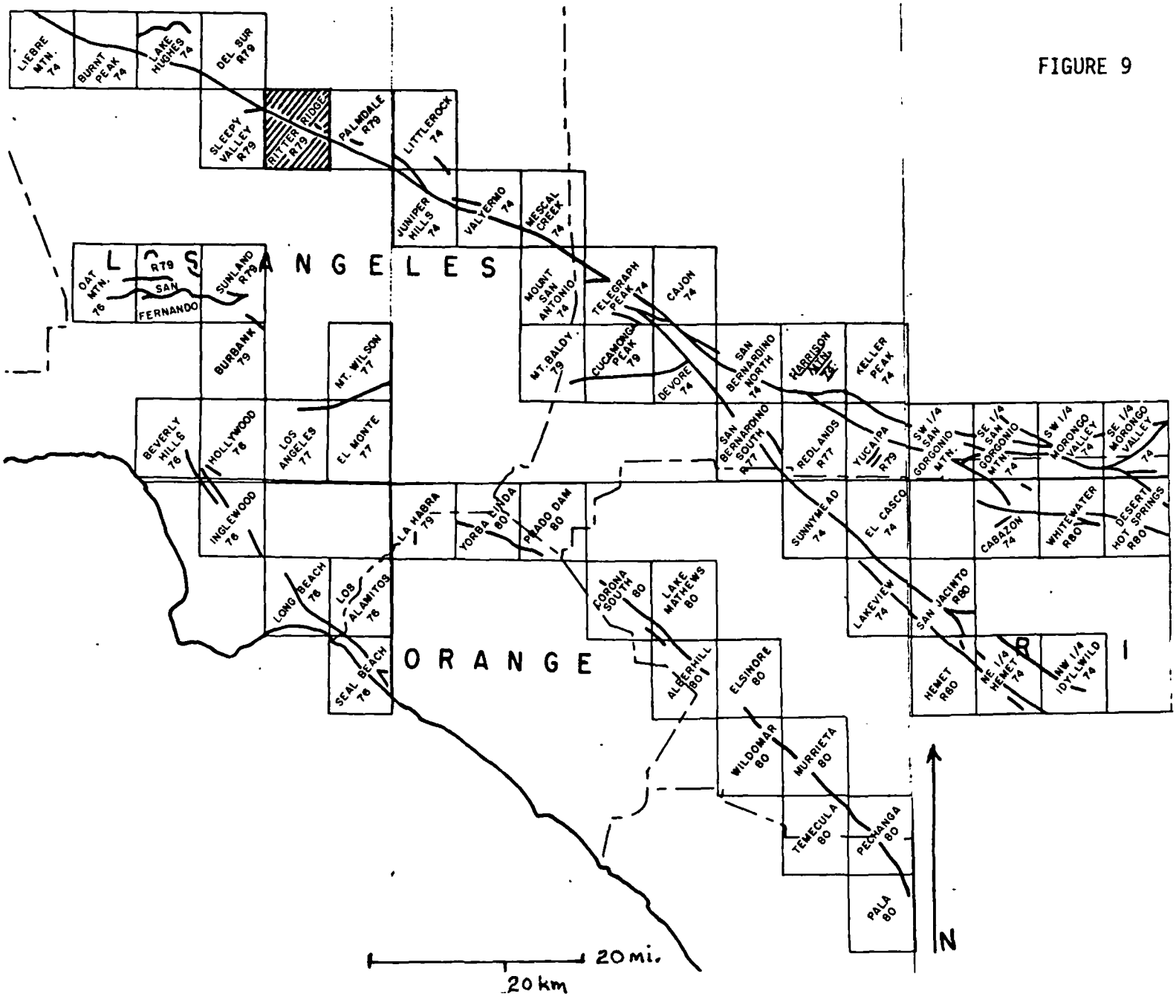


Figure 9. — Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the *Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.*

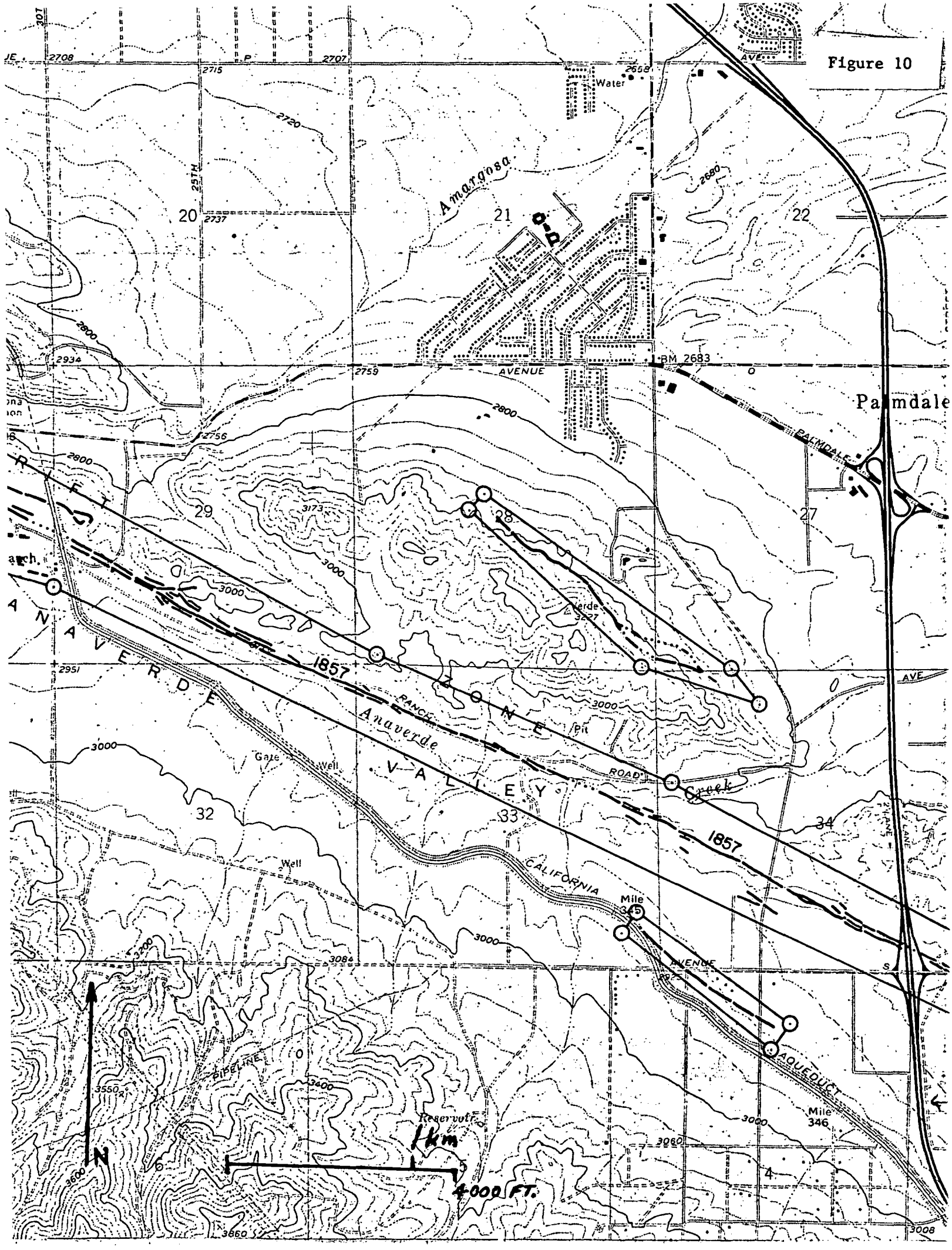


Figure 10
Amargosa
Palmdale
AVENUE
PALMDALE
RANCH
Anaverde
ROAD
Creek
Gate
Well
Pit
Water
CALIFORNIA
AQUEDUCT
PIPELINE
Reservoir
Mile 345
Mile 346
1857
ZONE
VALLEY
ANAVERDE
RIFT
1km
4000 FT.
N

FIGURE 11

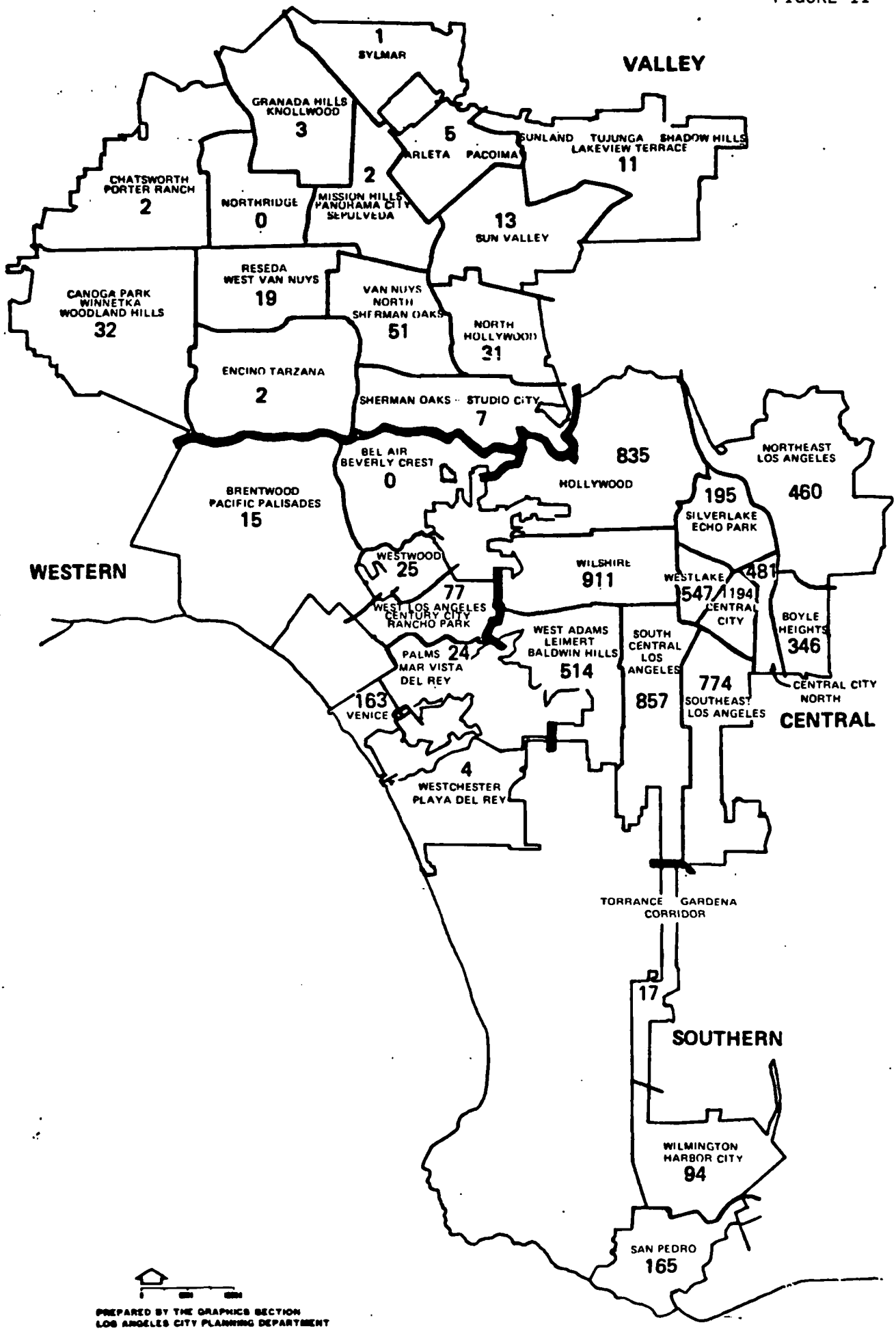

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND
TUJUNGA
SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
2
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
WILSHIRE
911
WESTLAKE
547
481
1194
CENTRAL
CITY
BOYLE
HEIGHTS
346
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
PALMS
MAR VISTA
DEL REY
24
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE
CORRIDOR
GARDENA
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story-family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

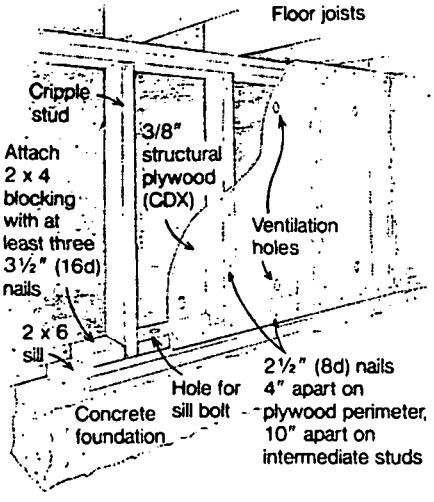
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

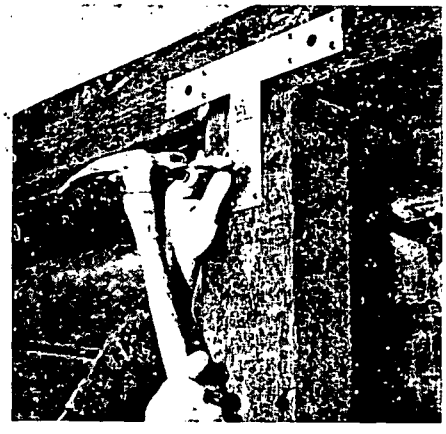
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad

DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse."

Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage.

For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

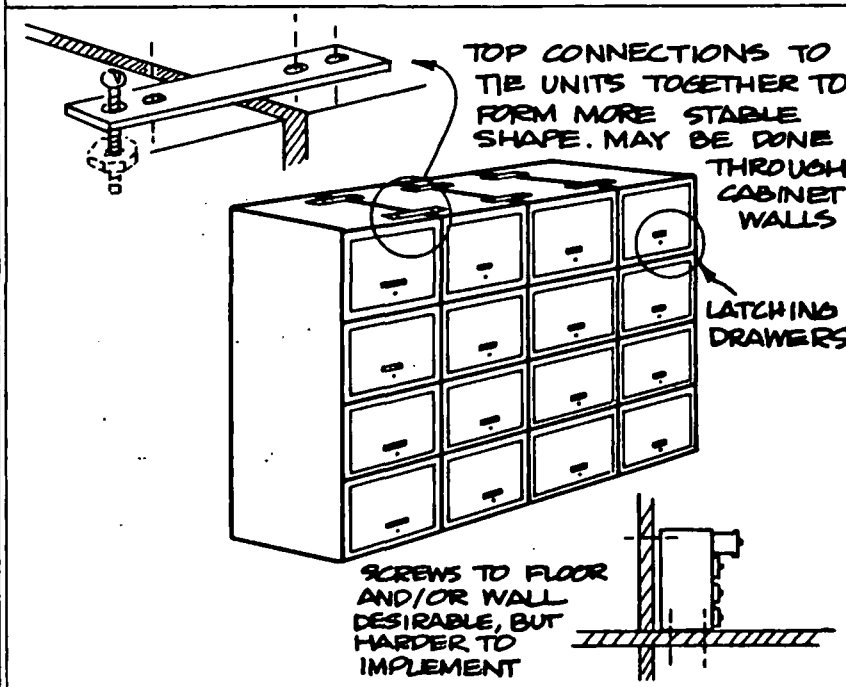
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

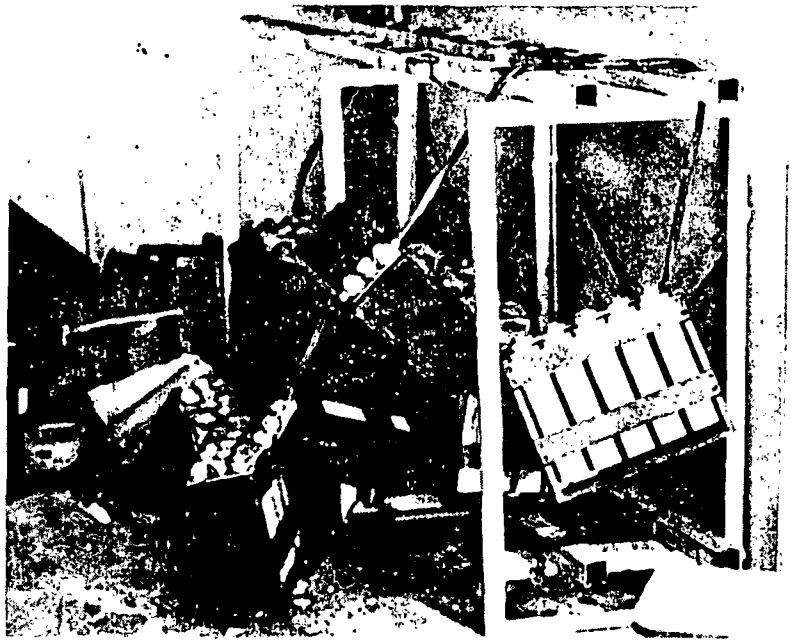
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

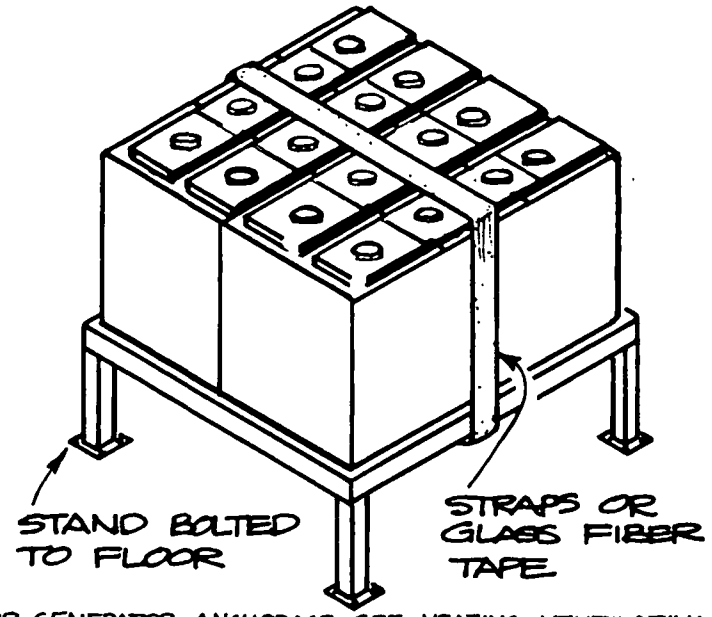
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING - AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1

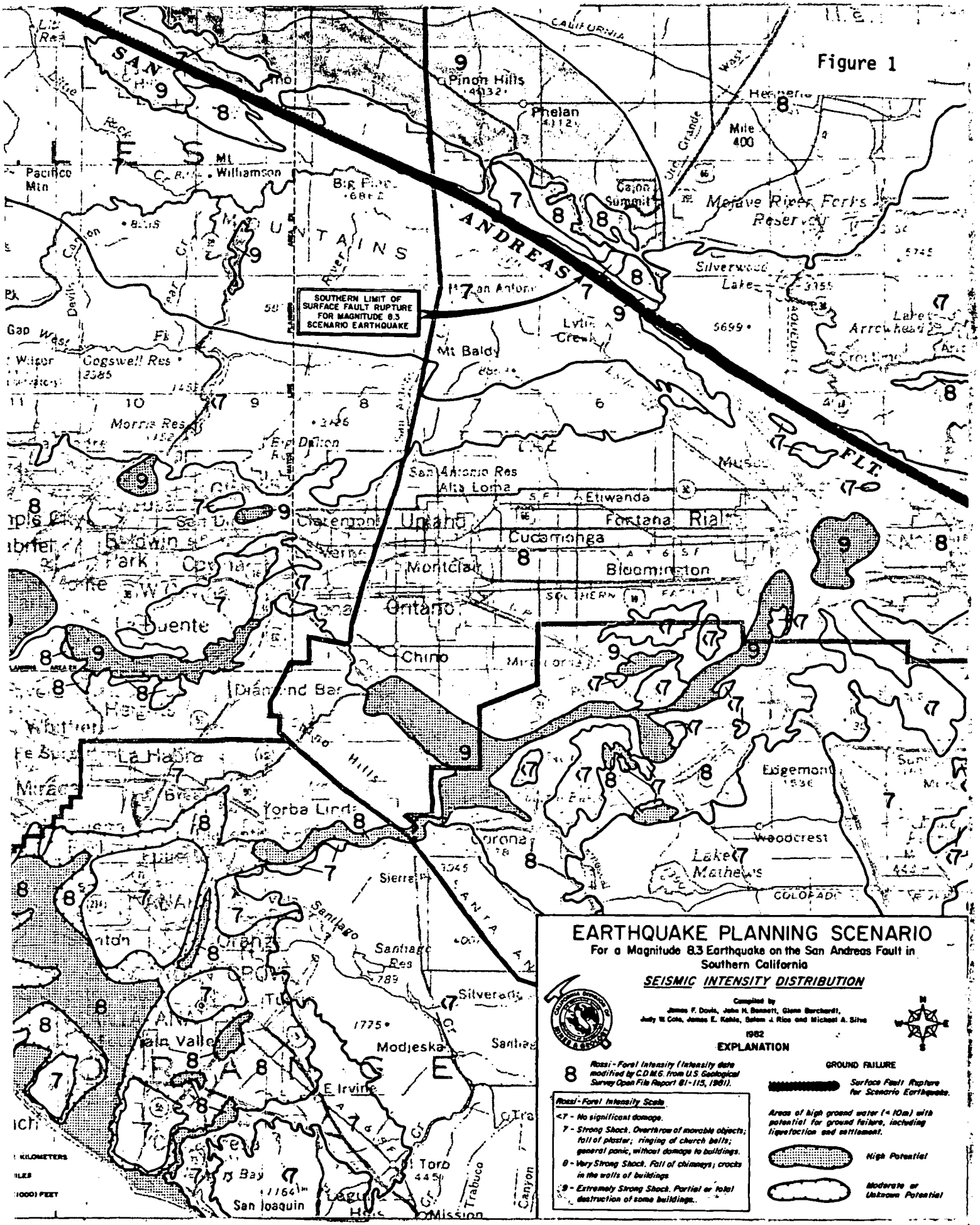
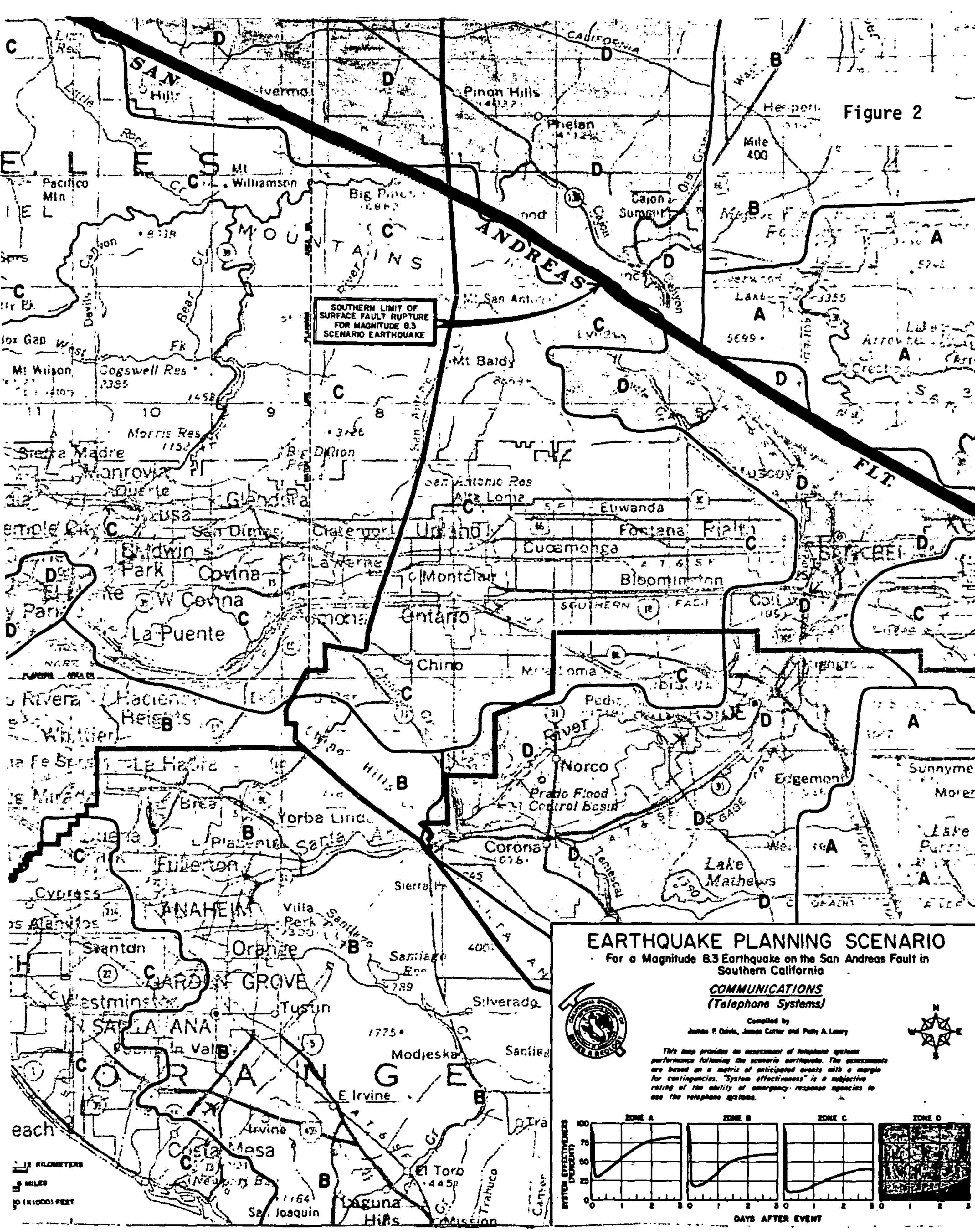

SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
Pinon Hills
Phelan
Pacifico Mtn
Mt Williamson
Cajon Summit
Mojave River Forks Reservoir
Silverwood Lake
Lake Arrowhead
Mt Baldy
Cogswell Res
Morris Res
San Antonio Res
Alta Loma
Etiwanda
Fontana
Rialto
Rancho Cucamonga
Bloomington
Montclair
Ontario
Chino
Chino Hills
La Habra
Yorba Linda
Brea
Edgemont
Woodcrest
Lake Mathews
Corona
Santiago Res
Modjeska
Irvine
Newport Bay
San Joaquin
Mission Viejo
Trabuco Canyon
COLORADO
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
SEISMIC INTENSITY DISTRIBUTION
Compiled by
James F. Davis, John H. Bennett, Glenn Borchardt, Judy W. Cole, James E. Kahle, Salem J. Rice and Michael A. Silva
1982
EXPLANATION
8 Rossi-Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).
Rossi-Forel Intensity Scale
<7 - No significant damage.
7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.
8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.
9 - Extremely Strong Shock. Partial or total destruction of some buildings.
GROUND FAILURE
Surface Fault Rupture for Scenario Earthquake.
Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.
High Potential
Moderate or Unknown Potential

Figure 2


EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
James F. Davis, James Cotter and Polly A. Lowry
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
MOUNTAINS
Pinon Hills
Phelan
Cajon Summit
Mt Baldy
Mt Williamson
Big Pines
Mt Wilson
Cogswell Res
Morris Res
Sierra Madre
Monrovia
Duarte
Glendora
San Dimas
Claremont
Upland
Etiwanda
Fontana
Rialto
Cucamonga
Montclair
Bloomington
Baldwin Park
Covina
W Covina
La Puente
Ontario
Chino
Hacienda Heights
Whittier
La Habra
Brea
Yorba Linda
Placentia
Fullerton
Cypress
ANAHEIM
Villa Park
Orange
GARDEN GROVE
Westminster
Tustin
SANTA ANA
Silverado
Modjeska
E Irvine
Irvine
Costa Mesa
El Toro
Laguna Hills
San Joaquin
Mission
Norco
Prado Flood Control Basin
Corona
Lake Mathews
Edgemont
Sunnymead
O R A N G E
A
B
C
D

1.

Figure 6

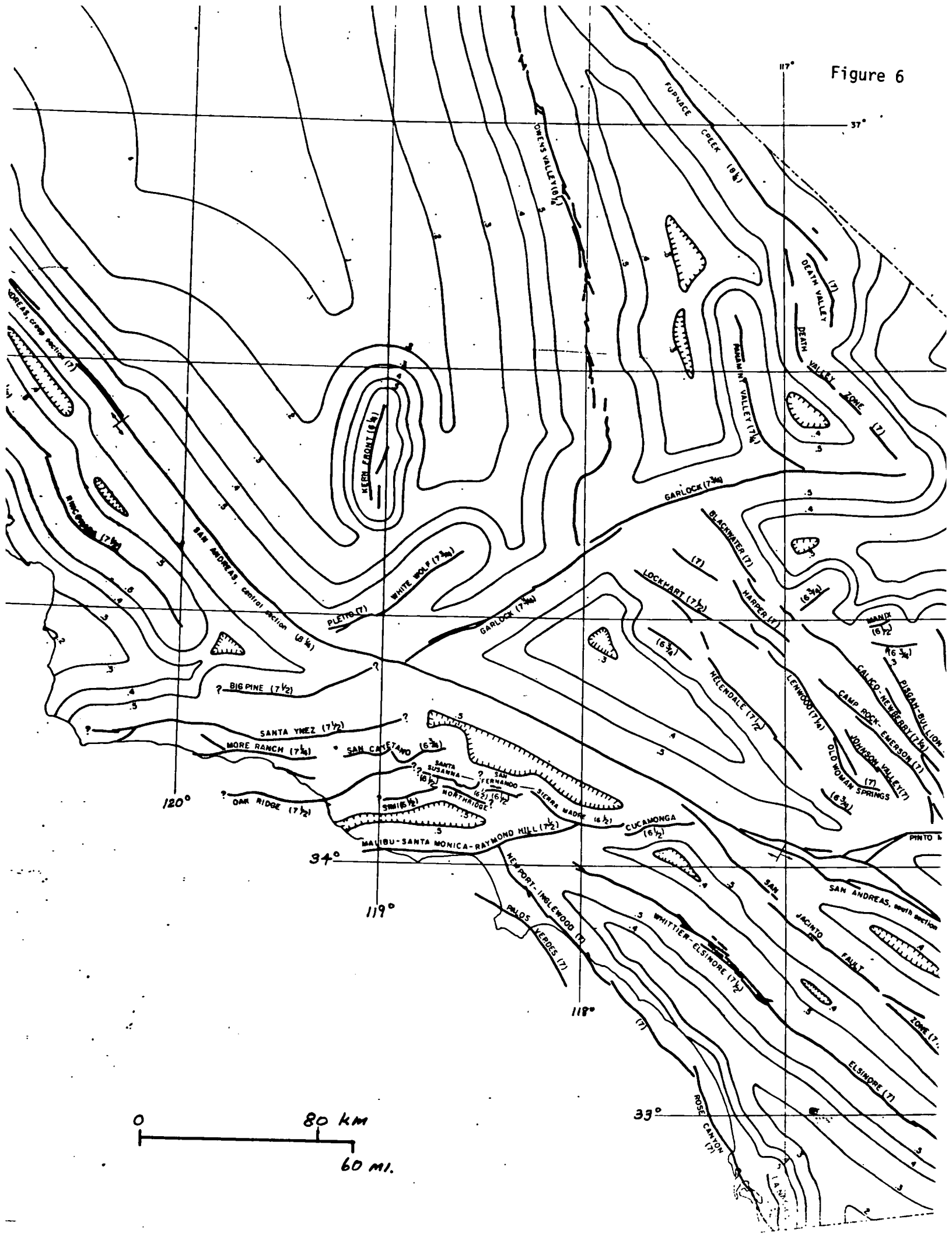
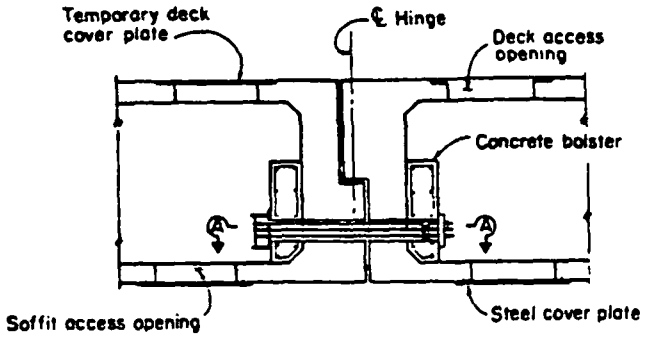
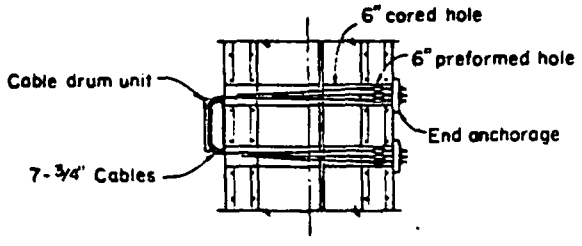

117°
37°
FURNACE CREEK (8½)
OWENS VALLEY (?)
DEATH VALLEY (?)
DEATH VALLEY ZONE (?)
PANAMINT VALLEY (7½)
KERN FRONT (8½)
GARLOCK (7¾)
BLACKWATER (7)
LOCKHART (7½)
HARPER (?)
(7)
(6¾)
MANIX (6½)
SAN ANDREAS, central section (8½)
PLEITO (7)
WHITE WOLF (7¾)
GARLOCK (7¾)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7½)
SAN CAYETANO (6¾)
SANTA SUSANNA (6½)
SAN FERNANDO (6½)
NORTHRIDGE (6½)
SIERRA MADRE (6½)
CUCAMONGA (6½)
OAK RIDGE (7½)
SIMI (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
HELENDALE (7½)
LENWOOD (7½)
CALICO-NEWBERRY (7½)
CAMP ROCK-EMERSON (7)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS (7)
PISGAH-BULLION
PINTO
120°
119°
118°
34°
33°
NEWPORT-INGLEWOOD (?)
PALOS VERDES (?)
WHITTIER-ELSINORE (7½)
SAN JACINTO FAULT ZONE (?)
SAN ANDREAS, south section
ELSINORE (?)
ROSE CANYON (?)
0
80 km
60 mi.

Figure 7

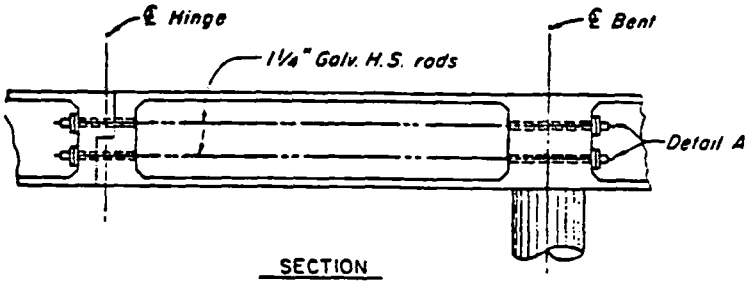


SECTION THRU HINGE

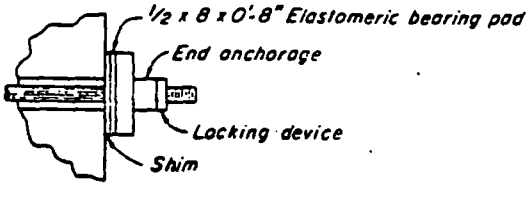


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

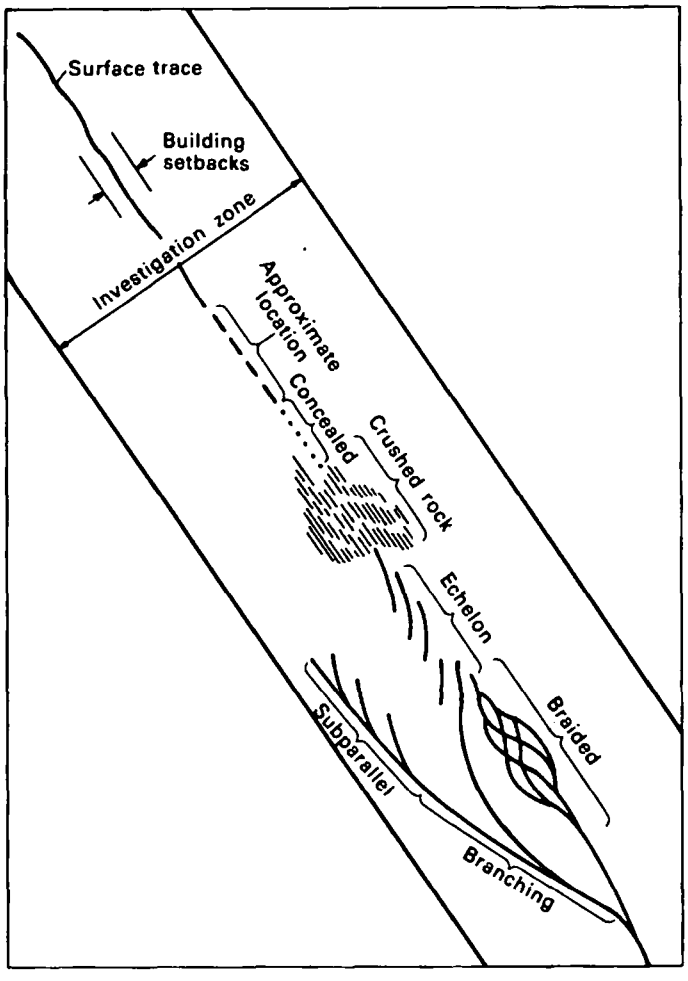


Figure 8. — Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

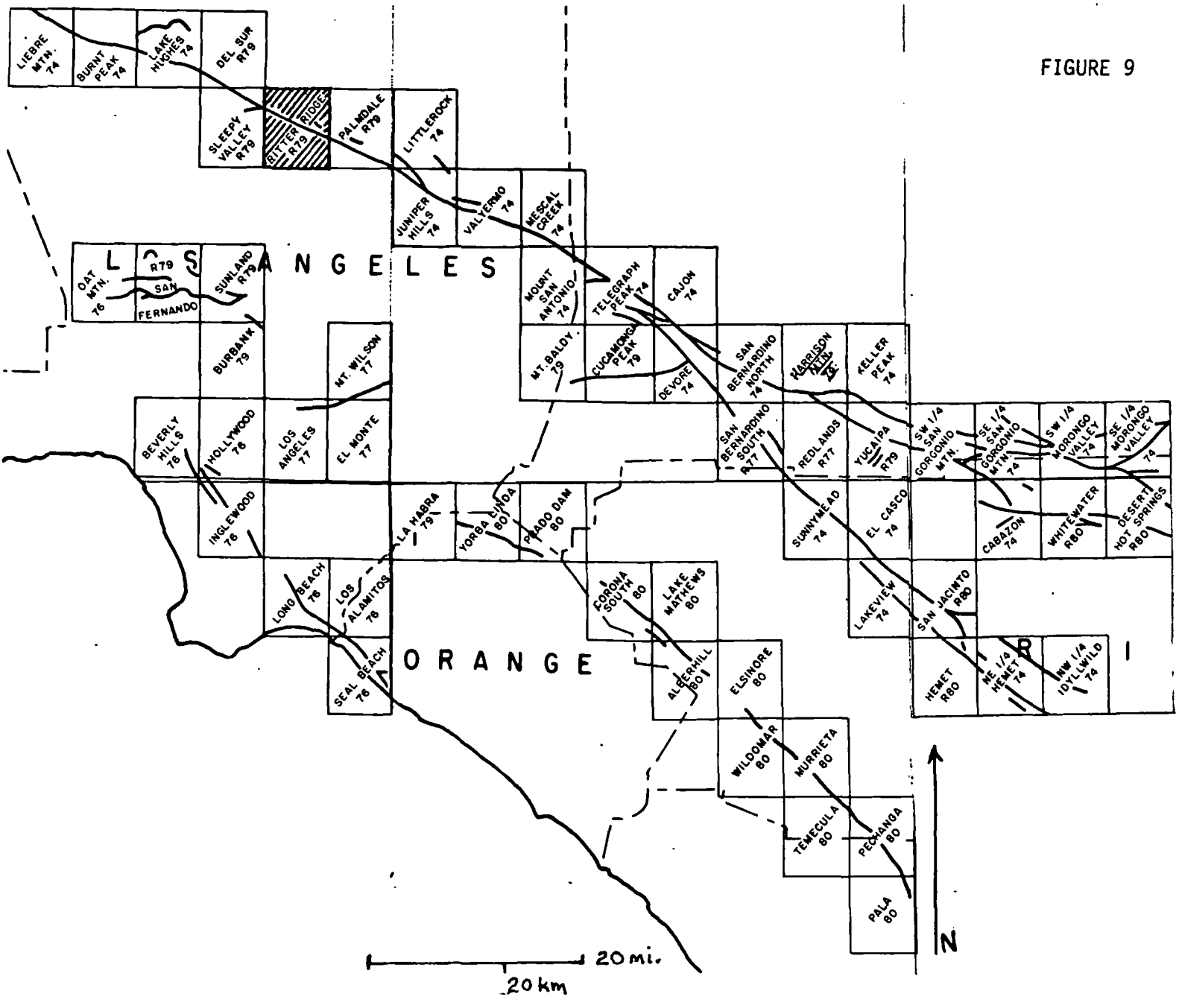


Figure 9. — Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the *Fault Evaluation Program Supervisor, California Division of Mines and Geology*, Room 1009, Ferry Building, San Francisco, CA 94111.

Figure 10

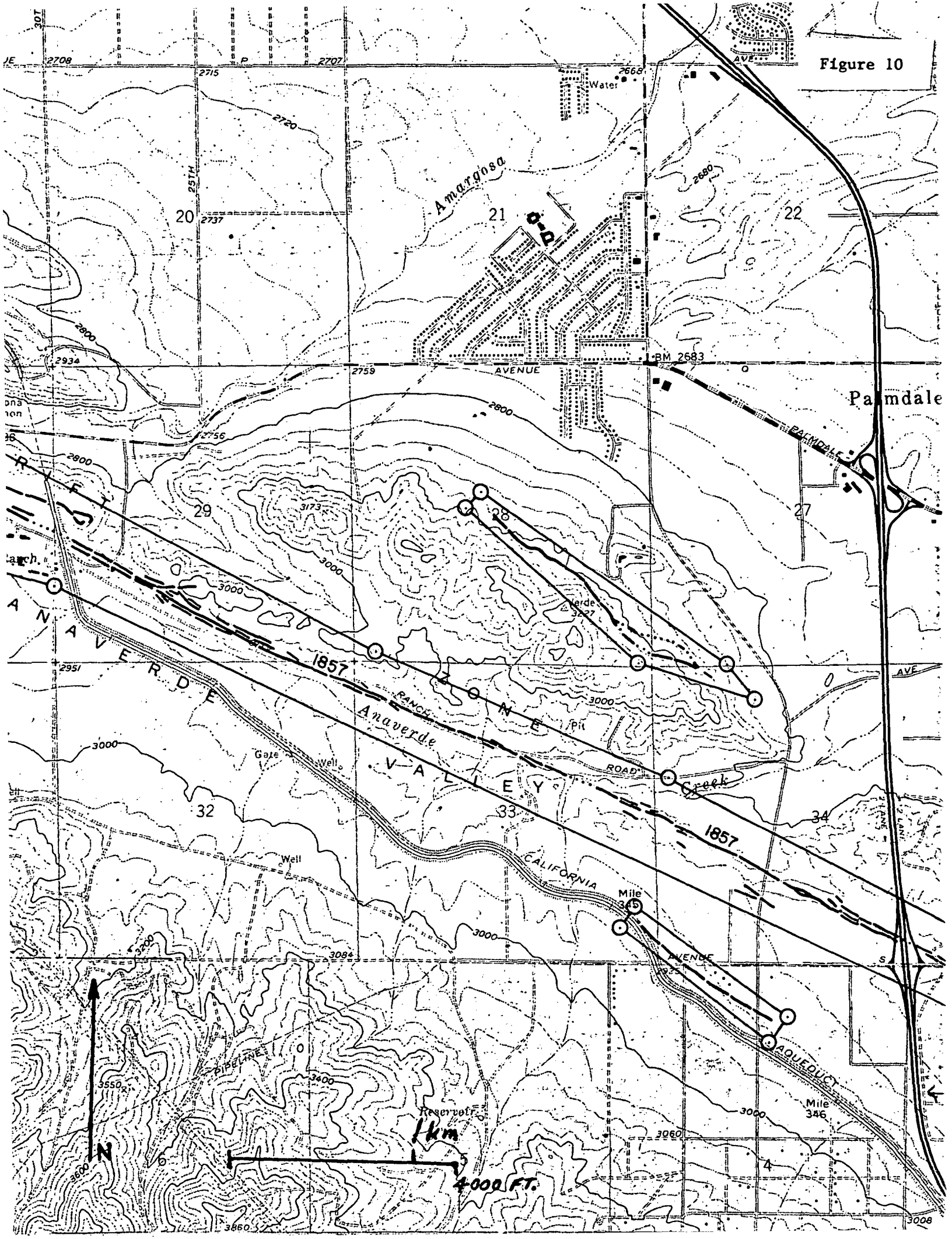

Amargosa
Palmdale
AVENUE
BM 2683
1857
ANAVERDE VALLEY
RANCH
Anaverde
ROAD
Creek
Pit
Gate
Well
CALIFORNIA
AQUEDUCT
PIPELINE
Reservoir
Mile
1km
4000 FT.
N

FIGURE 11

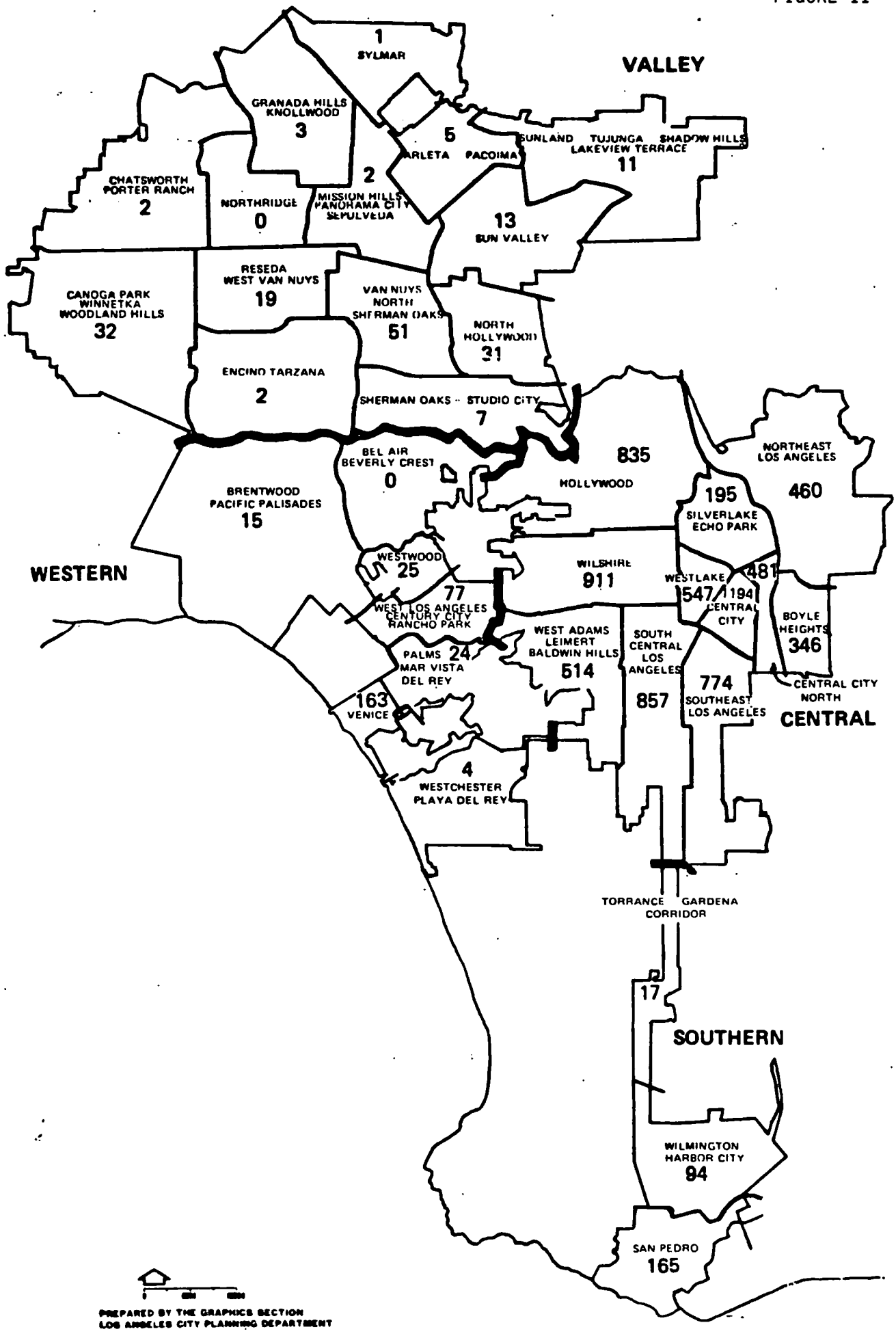

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND TUJUNGA SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
2
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
WILSHIRE
911
WESTLAKE
547
481
1194
CENTRAL
CITY
BOYLE
HEIGHTS
346
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
PALMS
MAR VISTA
DEL REY
24
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE GARDENA
CORRIDOR
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiilngs constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

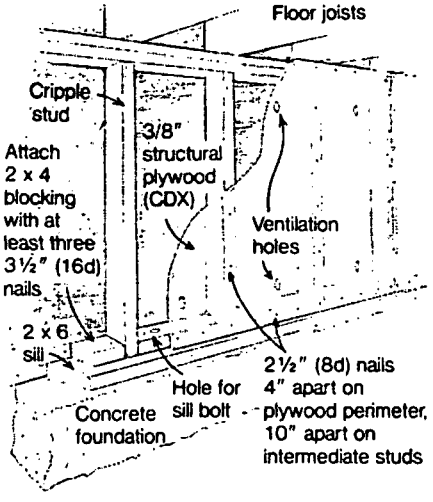
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

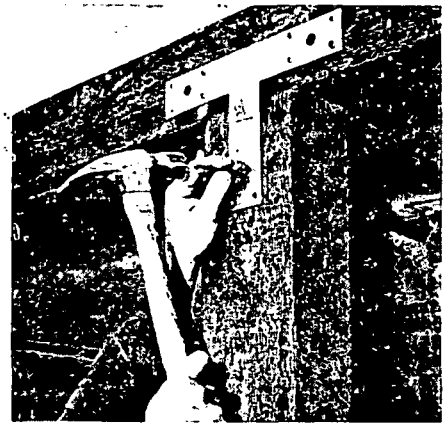
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad



DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse." Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage.

For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

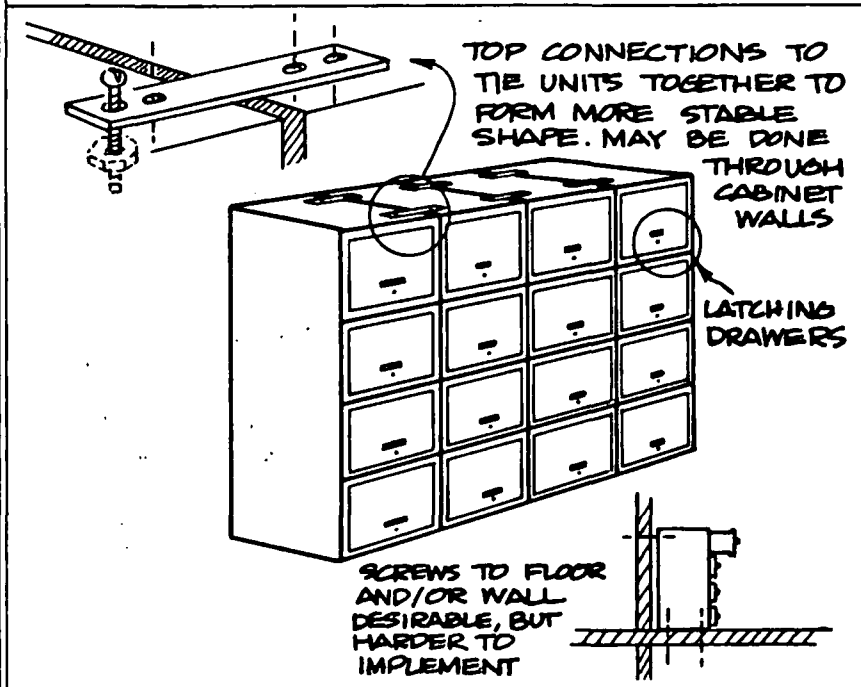
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

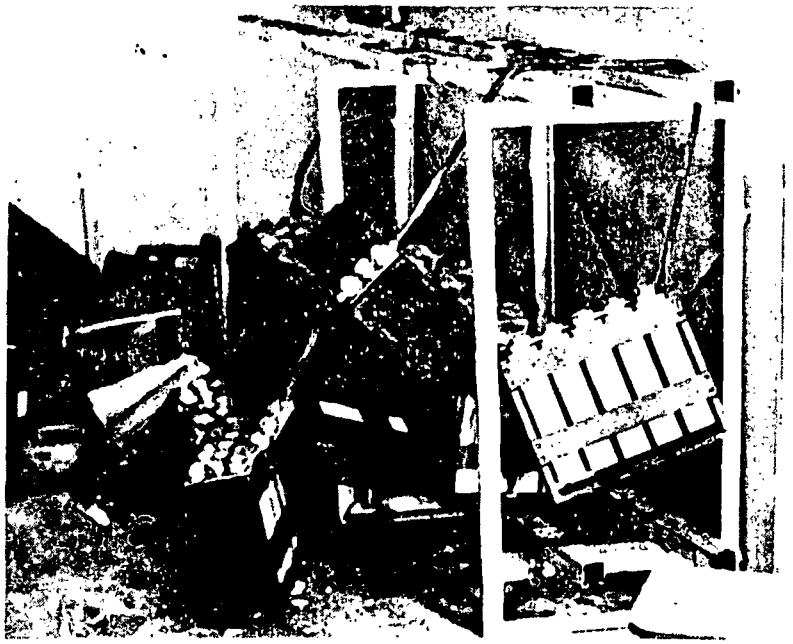
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

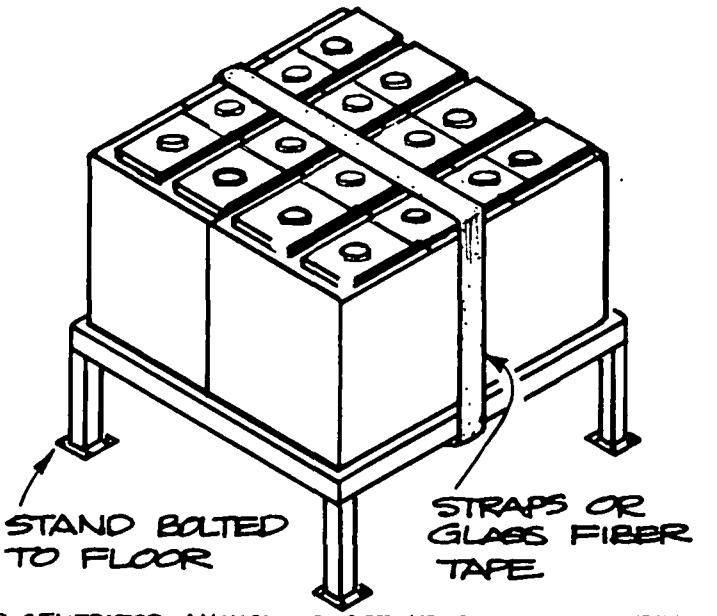
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING-AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

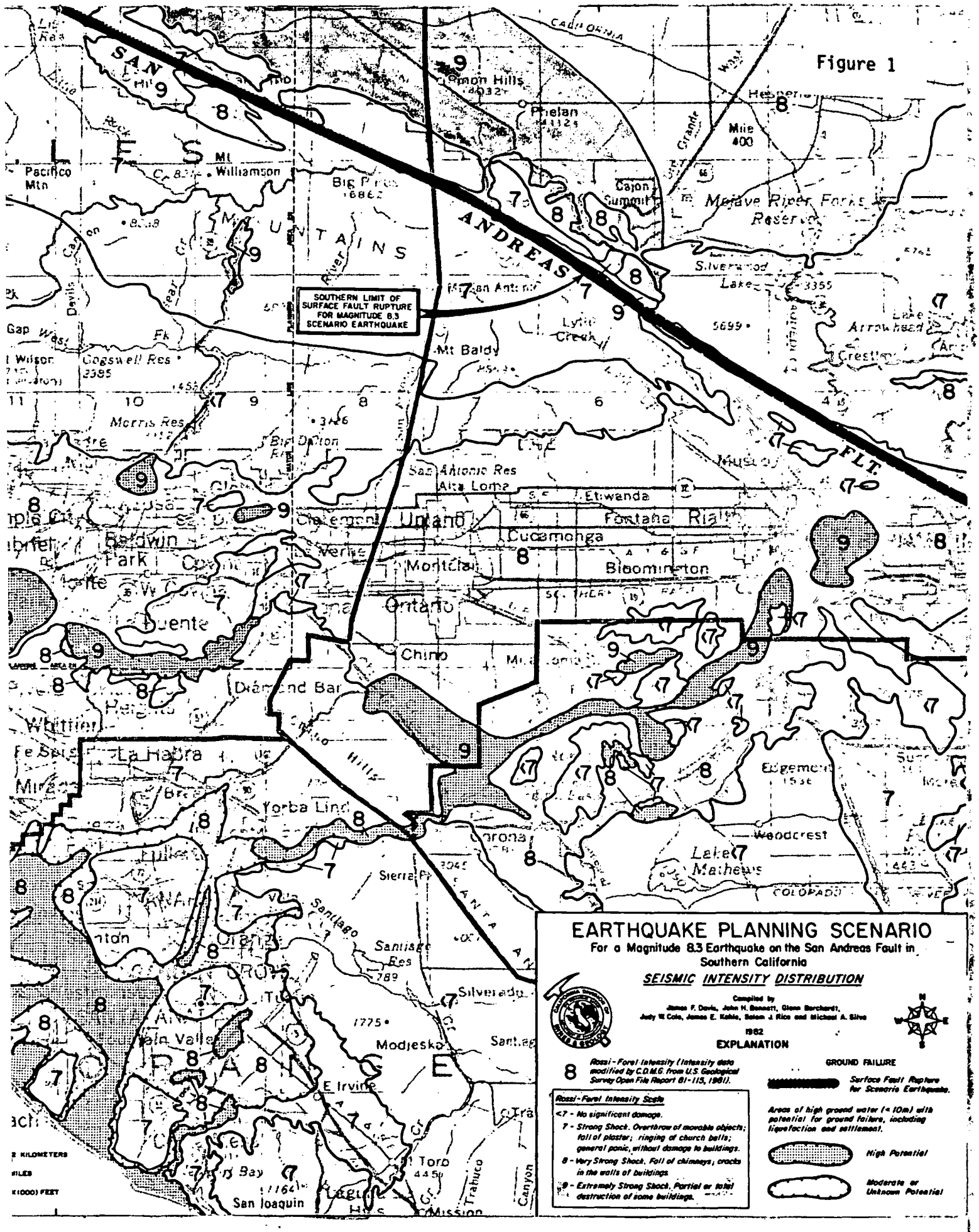
Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1



EARTHQUAKE PLANNING SCENARIO

For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California

SEISMIC INTENSITY DISTRIBUTION

Compiled by
James F. Davis, John H. Bennett, Glenn Borchardt,
Judy W. Cole, James E. Kahle, Salem J. Rice and Michael A. Silva

1982

EXPLANATION

8 — *Rossi-Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).*

GROUND FAILURE

Surface Fault Rupture for Scenario Earthquake.

Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.

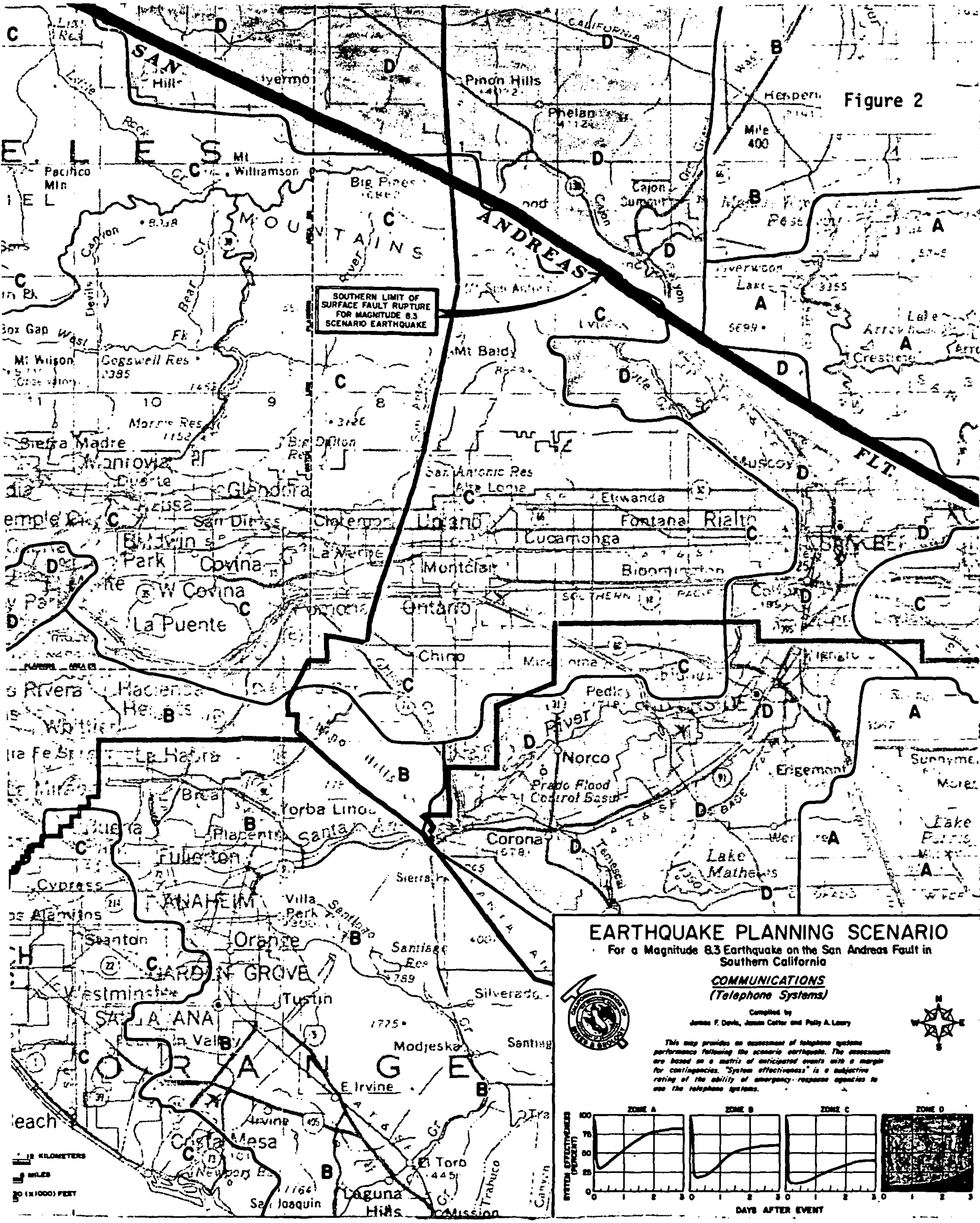
High Potential

Moderate or Unknown Potential

Rossi-Forel Intensity Scale

- *<7 - No significant damage.*
- *7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.*
- *8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.*
- *9 - Extremely Strong Shock. Partial or total destruction of some buildings.*

Figure 2


EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
James F. Davis, James Coffer and Patty A. Lowry
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency-response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
MOUNTAINS
O R A N G E
Pinon Hills
Phelan
Cajon Summit
Mt Baldy
Big Pines
Mt Williamson
Mt Wilson
Cogswell Res
Sierra Madre
Monrovia
Glendora
Azusa
San Dimas
Claremont
Upland
Cucamonga
Etiwanda
Fontana
Rialto
Bloomington
Baldwin Park
Covina
W Covina
La Puente
La Verne
Pomona
Montclair
Ontario
Chino
Hacienda Heights
Whittier
La Habra
Brea
Yorba Linda
Placentia
Fullerton
Anaheim
Cypress
Stanton
Garden Grove
Westminster
Orange
Villa Park
Santa Ana
Tustin
Irvine
E Irvine
Costa Mesa
El Toro
Laguna Hills
Mission
Modjeska
Silverado
Norco
Corona
Prado Flood Control Basin
Pedley
Edgemont
Muscoy
Lake Mathews
Sunnymead
Lake Arrowhead
Crestline
Hesperia
Figure 2

1.

Figure 6

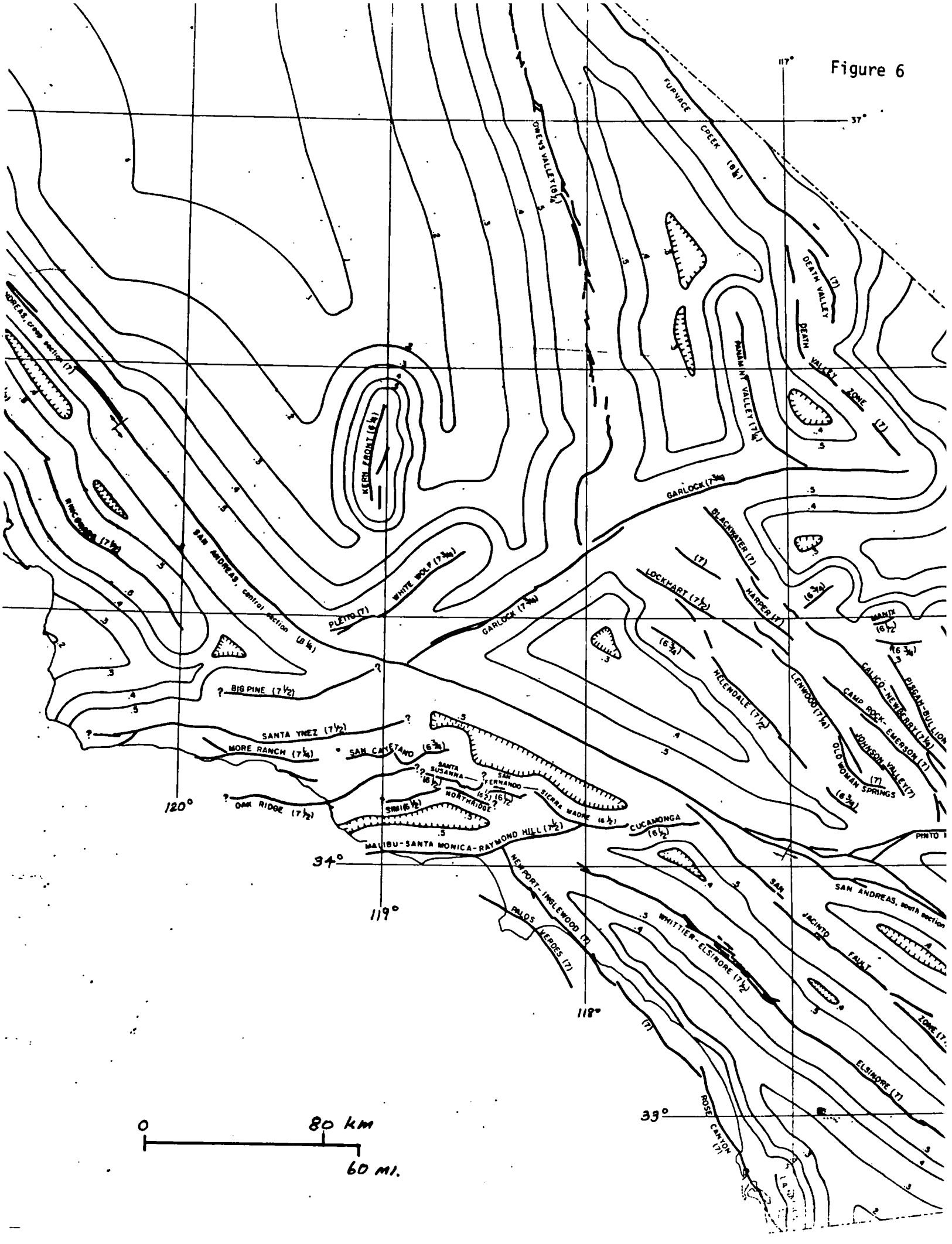
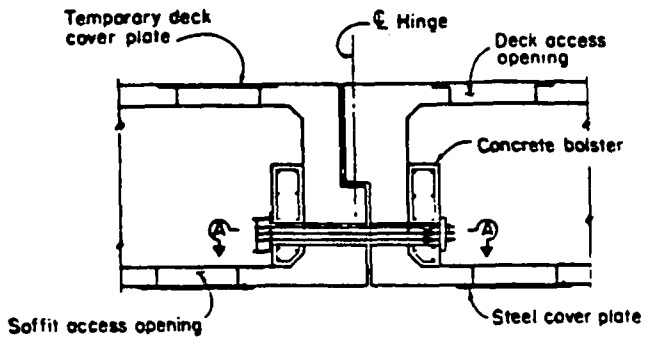
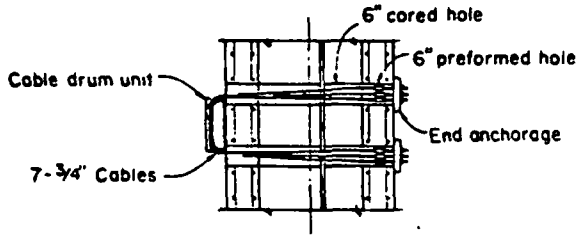

117°
37°
FURNACE CREEK (6¼)
OWENS VALLEY (6¼)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7¼)
KERN FRONT (6¾)
GARLOCK (7¾)
BLACKWATER (7)
LOCKHART (7½)
HARPER (7)
HELENDALE (7½)
LENWOOD (7¼)
CAMP ROCK-EMERSON (7)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS (7)
PINTO
SAN ANDREAS, south section
JACINTO FAULT ZONE (7)
ELSINORE (7)
WHITTIER-ELSINORE (7½)
NEWPORT-INGLEWOOD (?)
PALOS VERDES (7)
ROSE CANYON (7)
SAN ANDREAS, creep section (?)
SAN ANDREAS, central section (6¼)
PLEITO (7)
WHITE WOLF (7¾)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7¼)
SAN CAYETANO (6¾)
SANTA SUSANNA
SAN FERNANDO
NORTHRIDGE
SIERRA MADRE (6½)
CUCAMONGA (6½)
OAK RIDGE (7½)
SIMI (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
120°
119°
118°
34°
33°
0
80 km
60 mi.

Figure 7

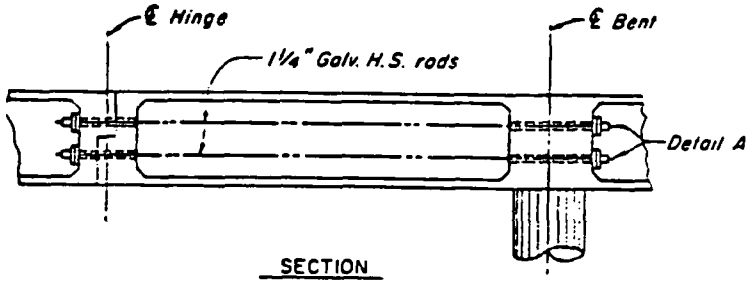


SECTION THRU HINGE

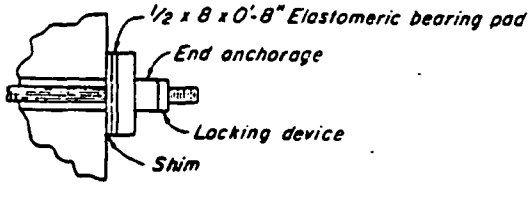


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

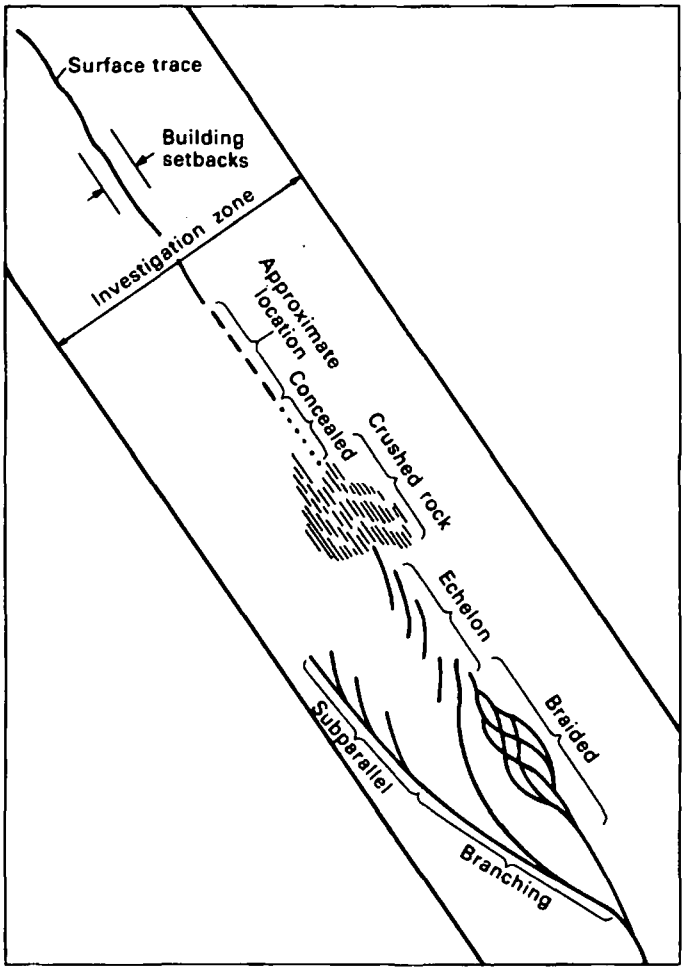


Figure 8. -- Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

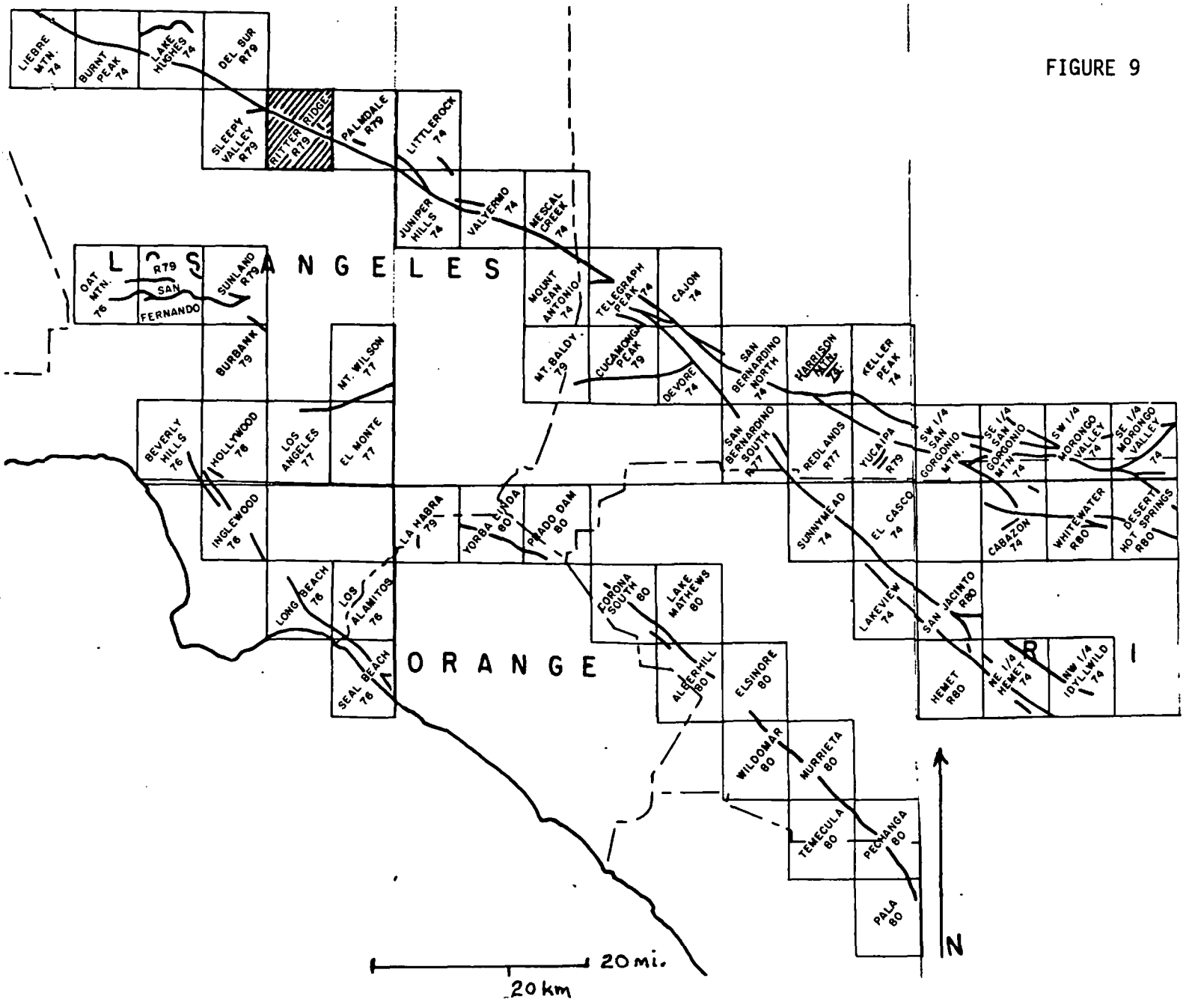


Figure 9. — Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.

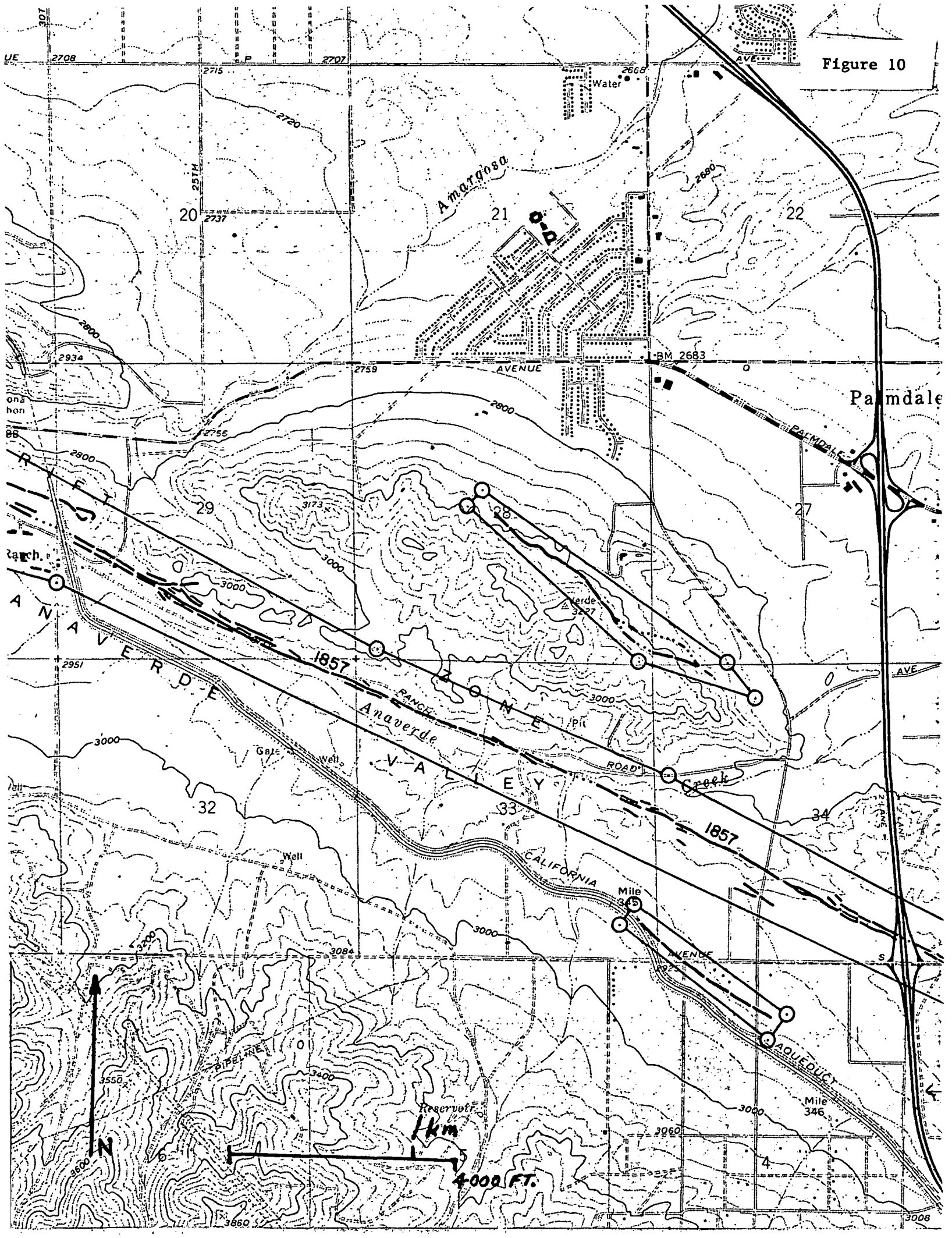


Figure 10
Amargosa
AVENUE
Palmdale
PALMDALE
ANAVERDE
FAULT
ZONE
VALLEY
Anaverde
Creek
1857
RANCH
ROAD
CALIFORNIA
AQUEDUCT
PIPELINE
Reservoir
Well
Gate
Pit
Water
Mile 345
Mile 346
BM 2683
1km
4000 FT.
N

FIGURE 11

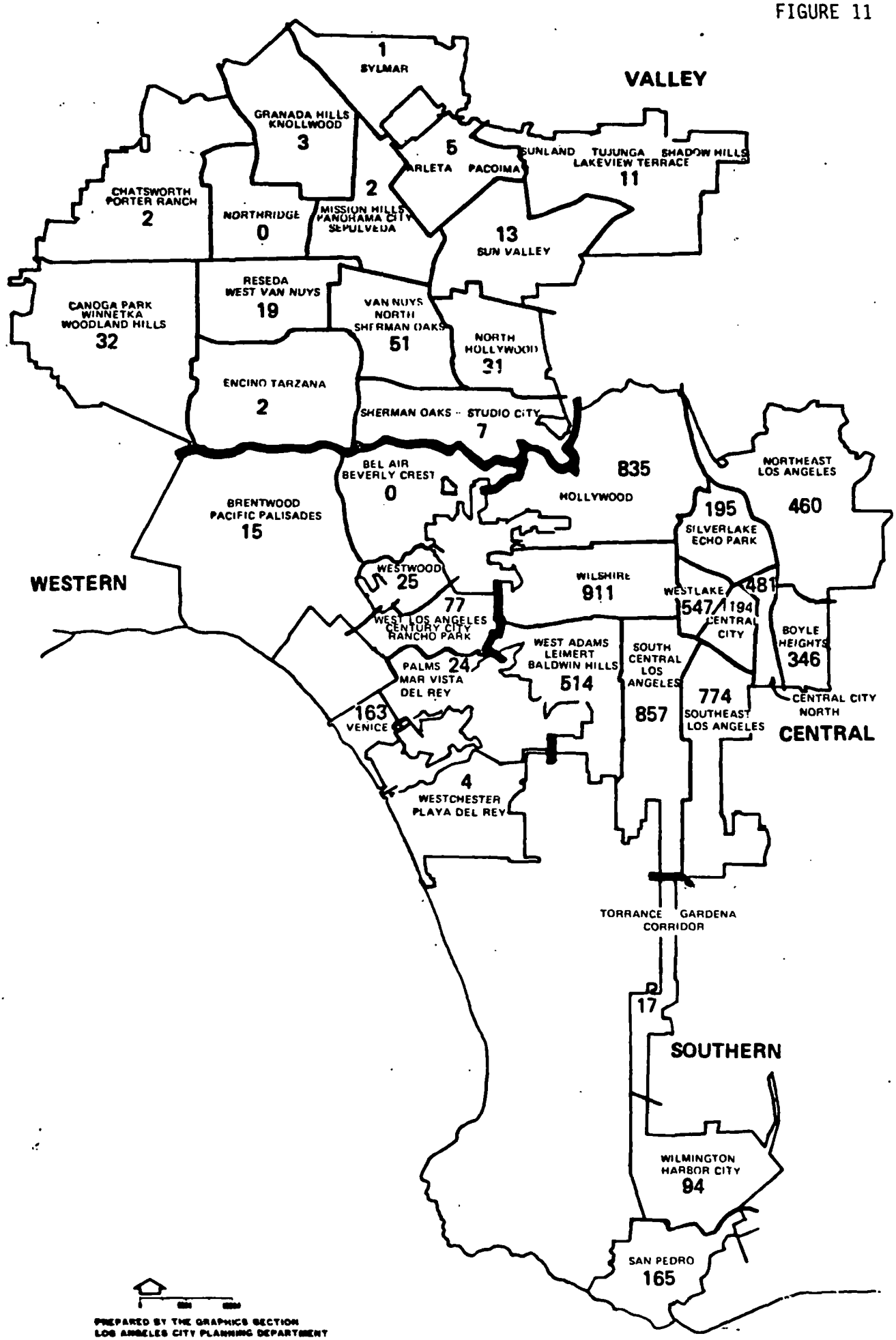

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND
TUJUNGA
SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
2
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
WILSHIRE
911
WESTLAKE
547
481
194
CENTRAL
CITY
BOYLE
HEIGHTS
346
PALMS
24
MAR VISTA
DEL REY
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE
CORRIDOR
GARDENA
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.

2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

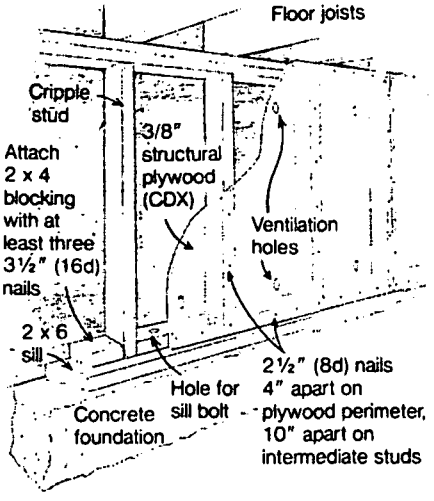
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

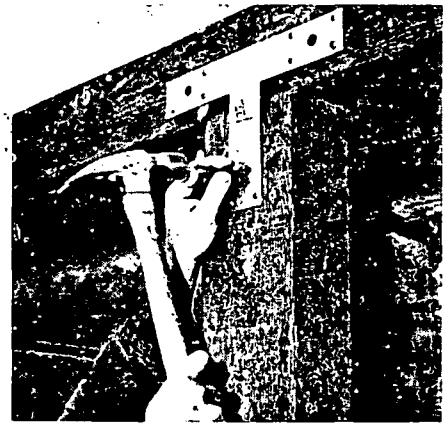
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad

DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse."

Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure.

Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage.

For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had *suffered* quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

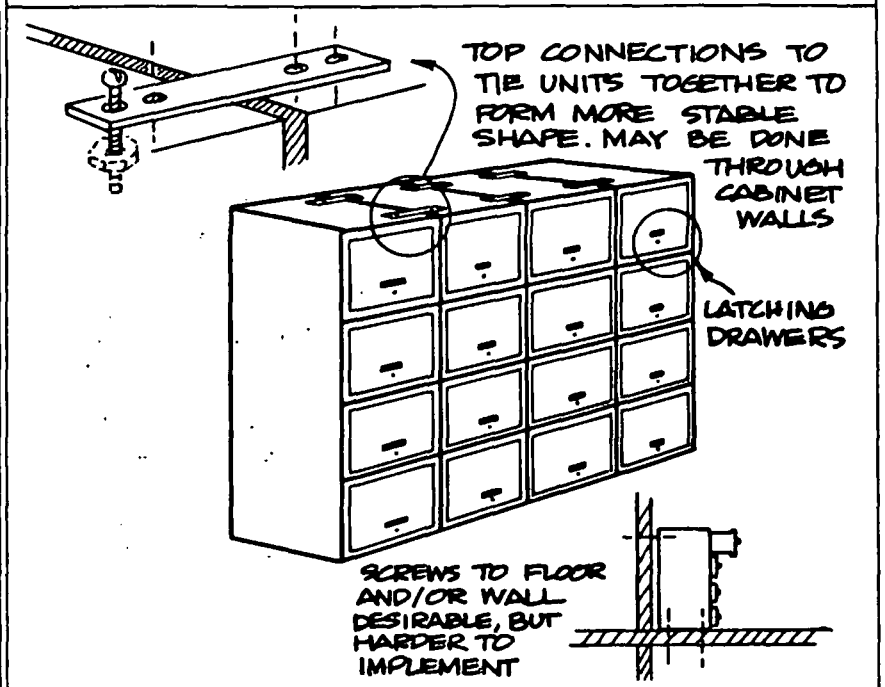
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

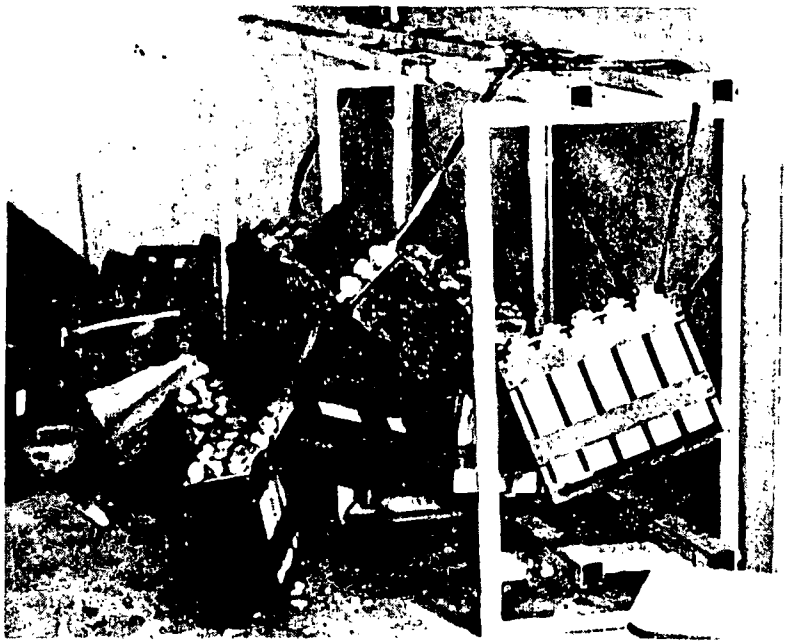
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

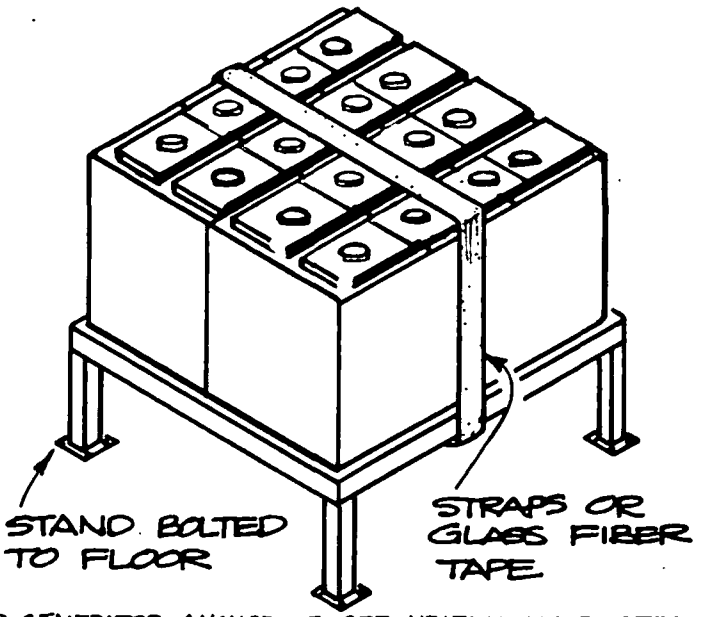
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING-AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

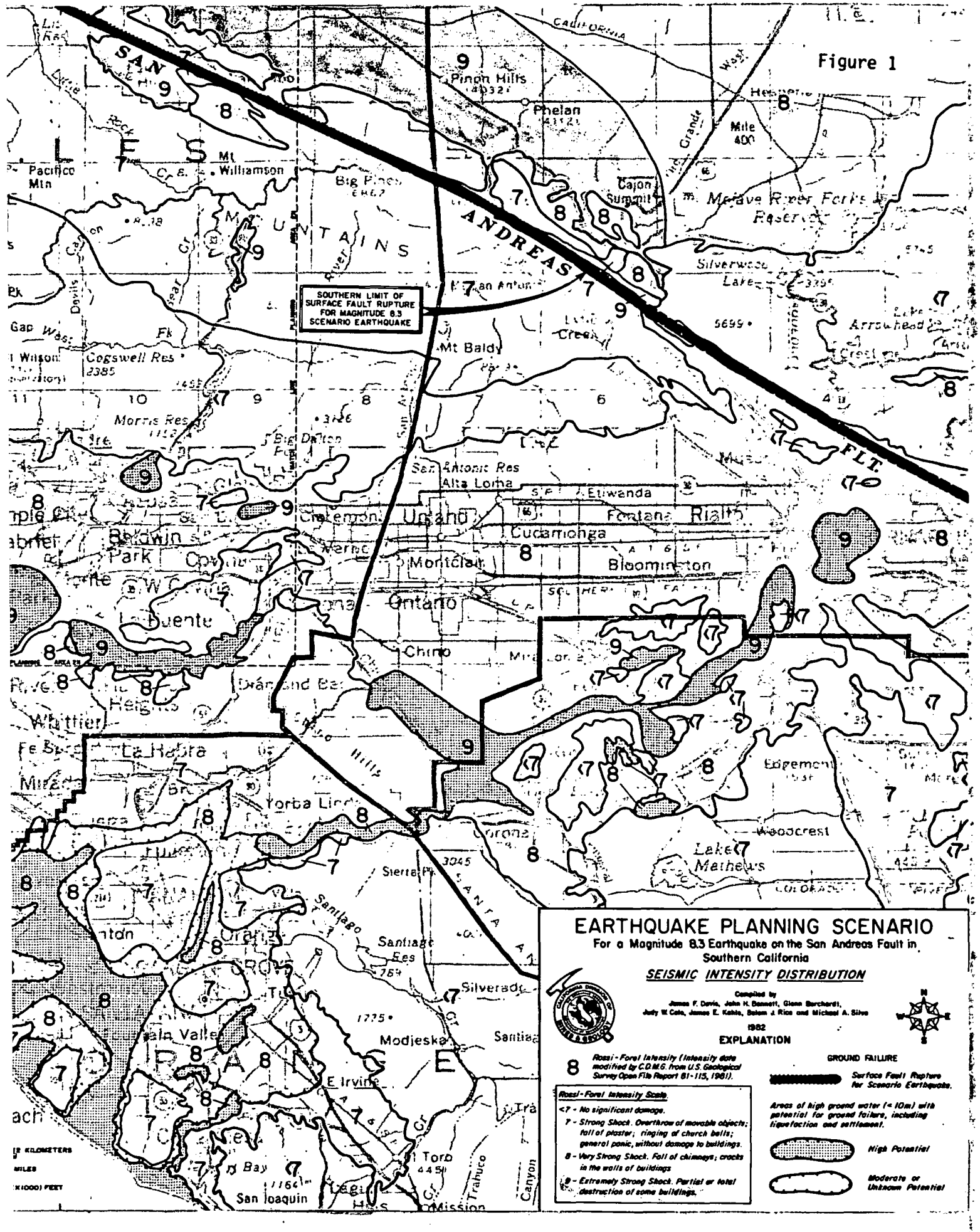
Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1



EARTHQUAKE PLANNING SCENARIO

For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California

SEISMIC INTENSITY DISTRIBUTION

Compiled by
James F. Davis, John H. Bennett, Glenn Borchardt, Judy W. Cole, James E. Kahle, Salem J. Rice and Michael A. Silva

1982

EXPLANATION

8 — *Rossi - Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).*

Rossi - Forel Intensity Scale

- *<7 - No significant damage.*
- *7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.*
- *8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.*
- *9 - Extremely Strong Shock. Partial or total destruction of some buildings.*

GROUND FAILURE

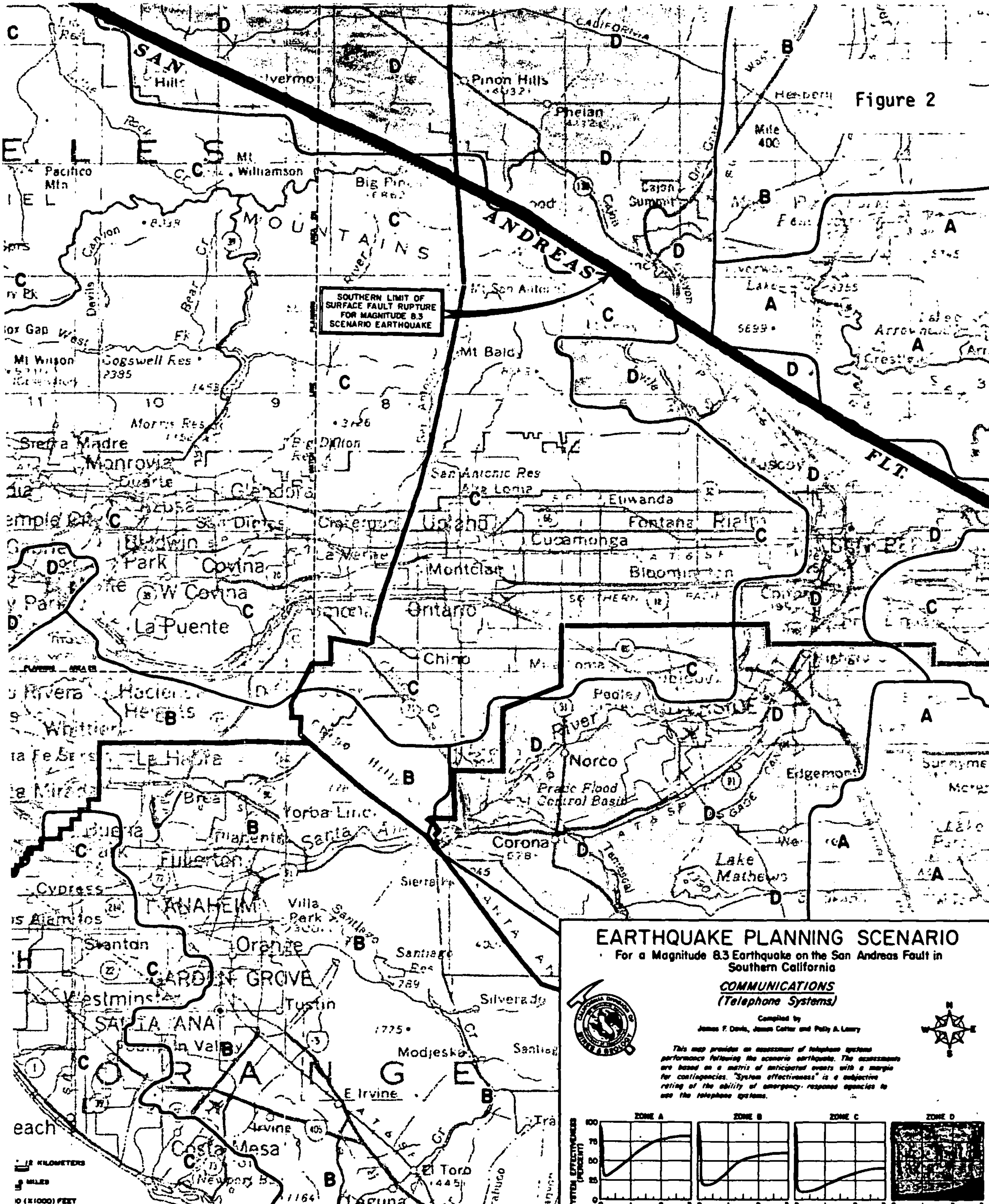
Surface Fault Rupture for Scenario Earthquake.

Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.

High Potential

Moderate or Unknown Potential

Figure 2


EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
James F. Davis, James Cotter and Polly A. Lowry
This map provides an assessment of telephone systems performance following the scenario earthquake. The assessments are based on a matrix of anticipated events with a margin for contingencies. "System effectiveness" is a subjective rating of the ability of emergency-response agencies to use the telephone systems.
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
SAN ANDREAS FLT.
MOUNTAINS
Pinon Hills
Phelan
Cajon Summit
Mt Williamson
Big Pines
Mt San Antonio
Mt Baldy
Mt Wilson
Cogswell Res
Morris Res
Sierra Madre
Monrovia
Duarte
Glendora
Azusa
San Dimas
Claremont
Upland
Etiwanda
Fontana
Rialto
Cucamonga
Baldwin Park
Covina
La Verne
Montclair
Bloomington
W Covina
La Puente
Pomona
Ontario
Chino
Mira Loma
Pedley
Riverside
Norco
Prado Flood Control Basin
Corona
Edgemont
Lake Mathews
Hacienda Heights
Whittier
La Habra
Brea
Yorba Linda
Placentia
Fullerton
Cypress
Anaheim
Los Alamitos
Villa Park
Orange
Stanton
Garden Grove
Westminster
Tustin
Santa Ana
Silverado
Modjeska
E Irvine
Irvine
Costa Mesa
El Toro
Laguna Hills
San Joaquin
Mission
Lake Arrowhead
Crestline
O R A N G E
KILOMETERS
MILES

1.

Figure 6

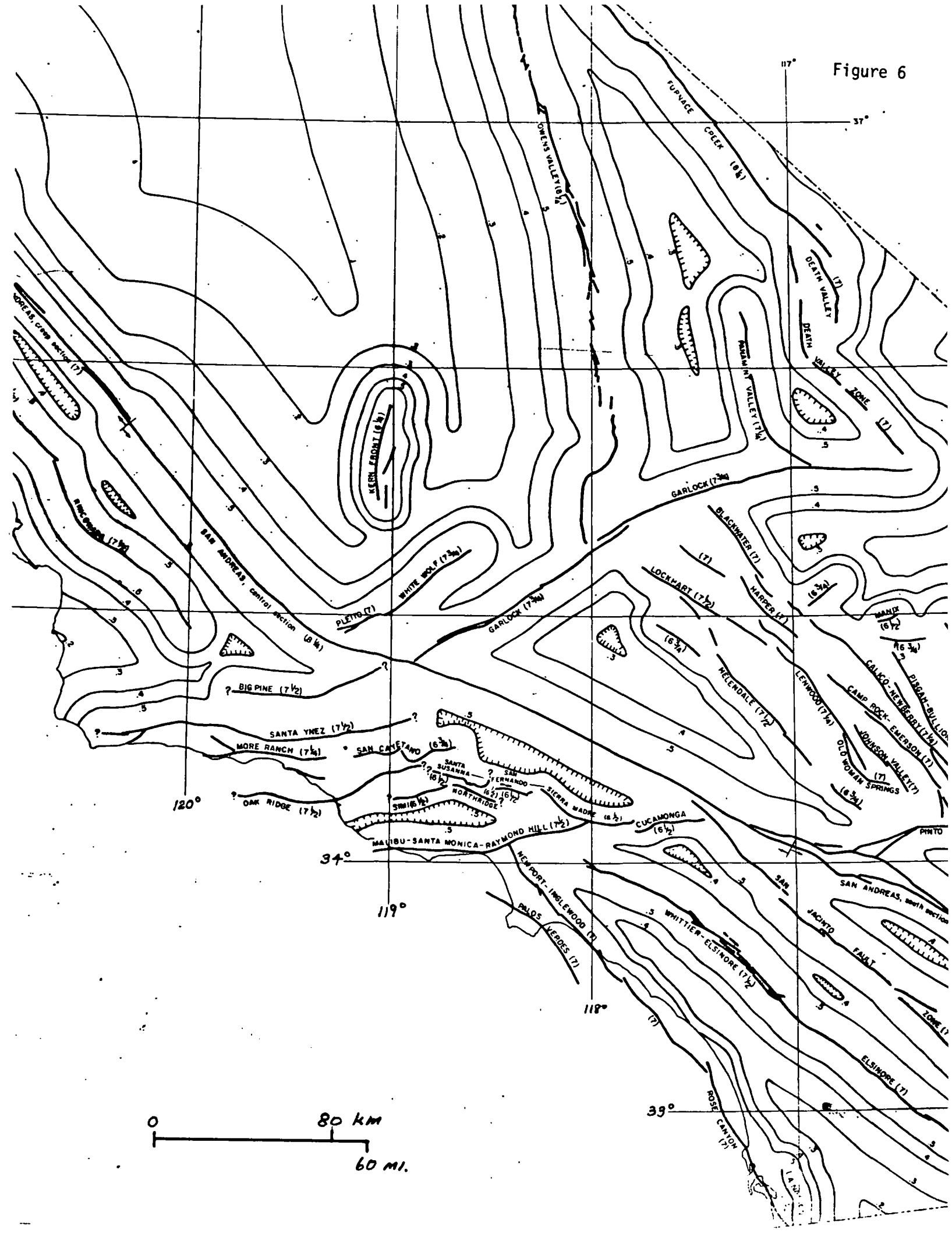
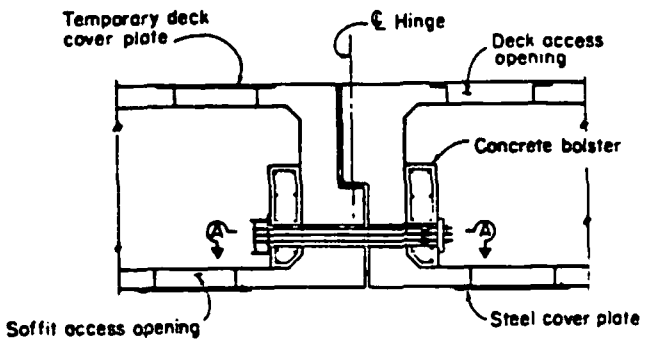
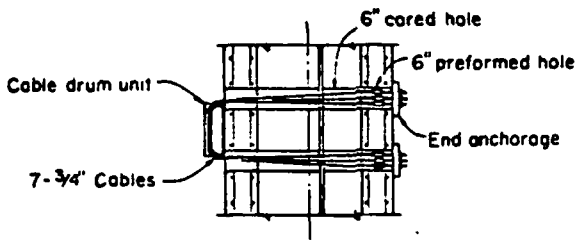

117°
37°
FURNACE CREEK (8½)
OWENS VALLEY (8½)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7½)
KERN FRONT (8½)
GARLOCK (7½)
BLACKWATER (7)
LOCKHART (7½)
HARPER (7)
MANIX (6½)
PINTO
CALICO-NEWBERRY (7½)
CAMP ROCK-EMERSON (7)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS (7)
LENWOOD (7½)
HELENDALE (7½)
SAN ANDREAS, Carrizo section (8½)
WHITE WOLF (7½)
PLEITO (7)
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7½)
SAN CAYETANO (6¾)
SANTA SUSANNA (6½)
SAN FERNANDO (6½)
NORTHRIDGE (6½)
SIERRA MADRE (6½)
OAK RIDGE (7½)
SIMI (6½)
CUCAMONGA (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
NEWPORT-INGLEWOOD (7)
PALOS VERDES (7)
WHITTIER-ELSINORE (7½)
SAN JACINTO FAULT ZONE (7)
ELSINORE (7)
ROSE CANYON (7)
120°
119°
118°
34°
39°
0
80 km
60 mi.

Figure 7

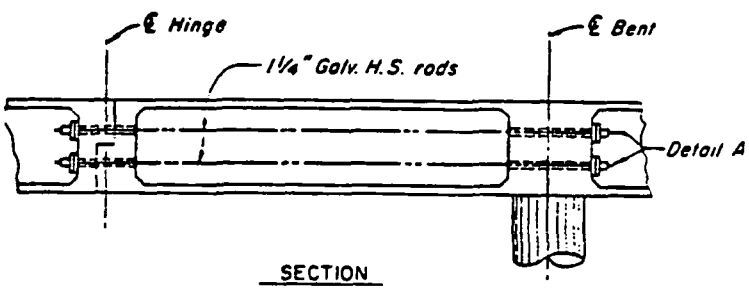


SECTION THRU HINGE

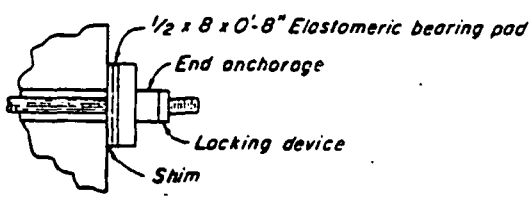


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

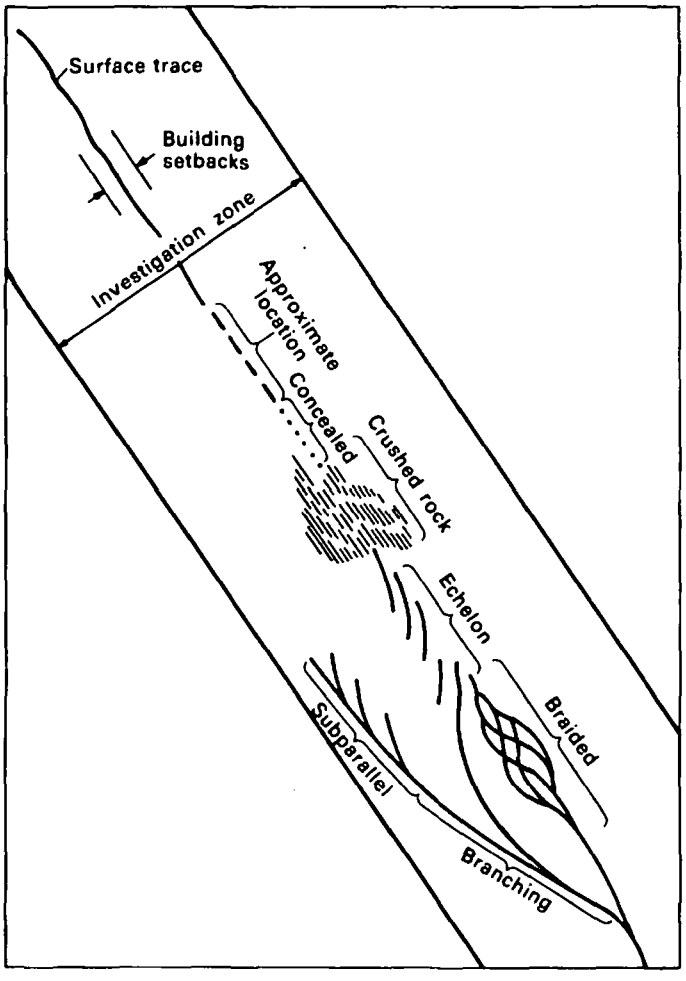


Figure 8. — Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

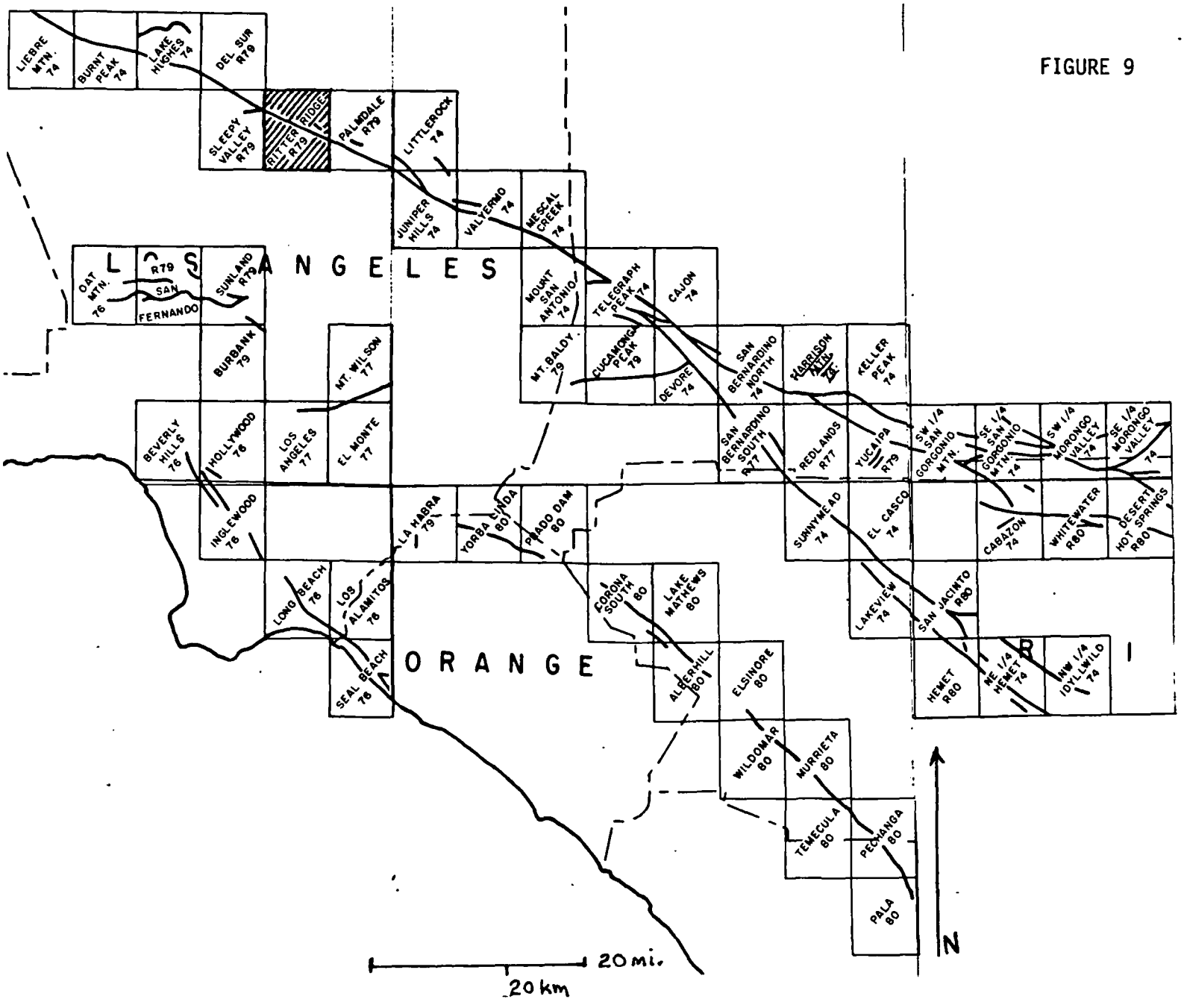
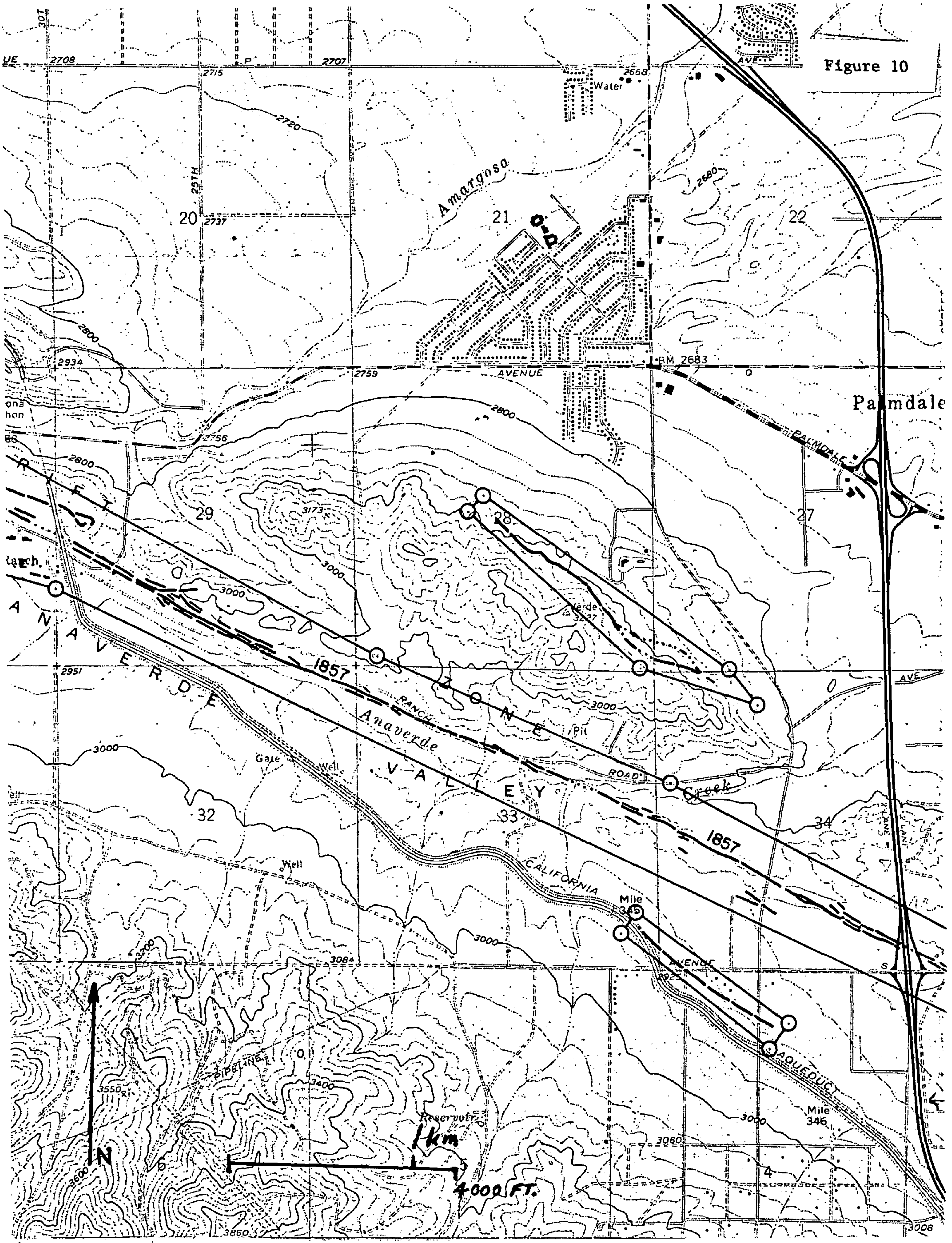


Figure 9. — Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.

Figure 10



Amargosa
Palmdale
AVENUE
PALMDALE
RIFT ZONE
ANAVERDE VALLEY
1857
1857
Anaverde
Creek
RANCH
ROAD
CALIFORNIA
AQUEDUCT
PIPELINE
Water
Well
Gate
Pit
Reservoir
Mile 345
Mile 346
BM 2683
AVE
25TH
20
21
22
27
28
29
32
33
34
4
5
6
1km
4000 FT.
N

FIGURE 11

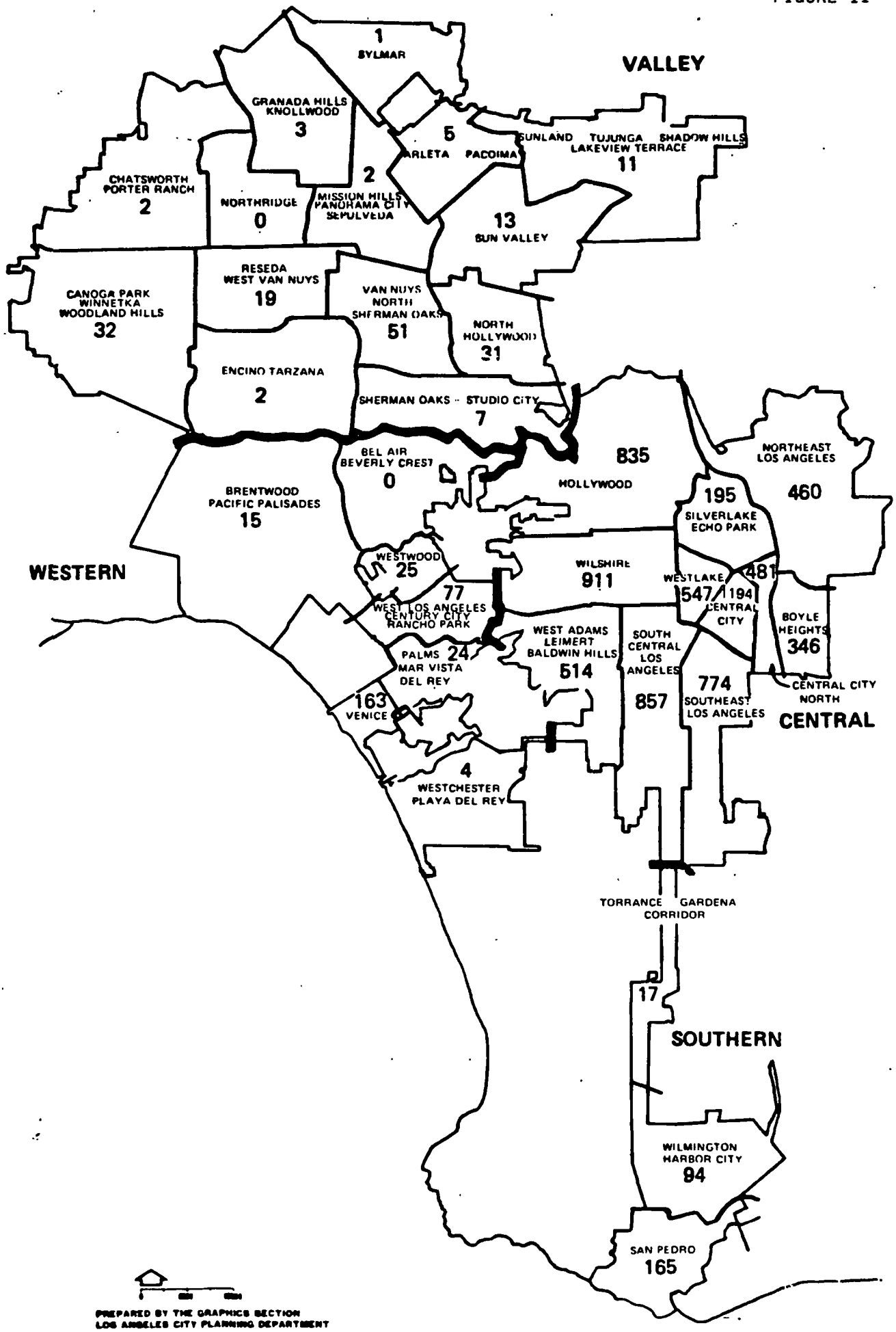

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND
TUJUNGA
SHADOW HILLS
LAKEVIEW TERRACE
11
2
CHATSWORTH
PORTER RANCH
2
NORTHRIDGE
0
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
WILSHIRE
911
WESTLAKE
547
194
CENTRAL
CITY
481
BOYLE
HEIGHTS
346
PALMS
MAR VISTA
DEL REY
24
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE
CORRIDOR
GARDENA
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story-family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	Extension of Time if Wall Anchors are Installed	Minimum Time Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

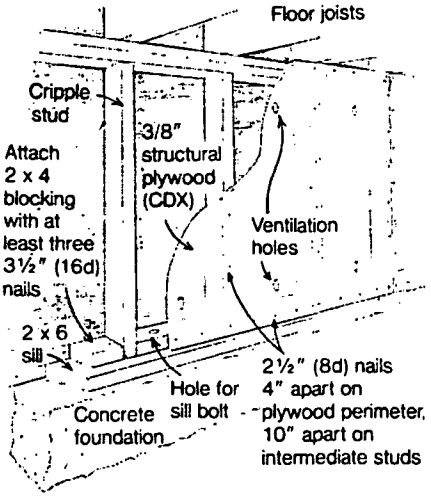
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

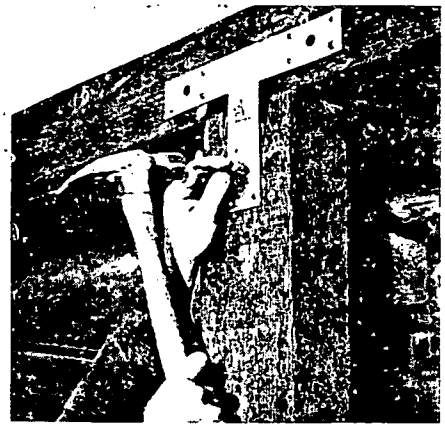
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad

DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse."

Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage.

For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

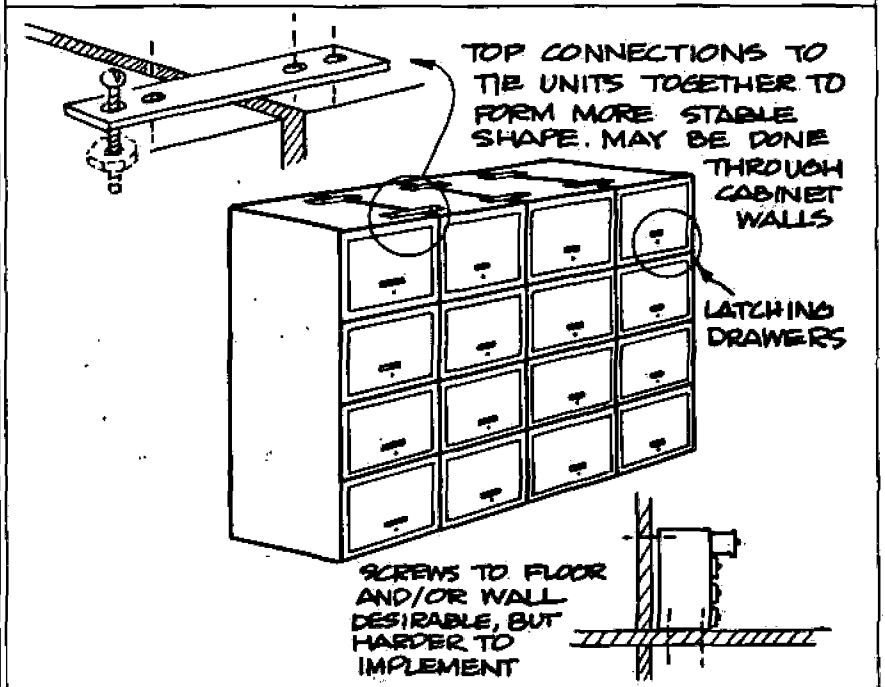
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

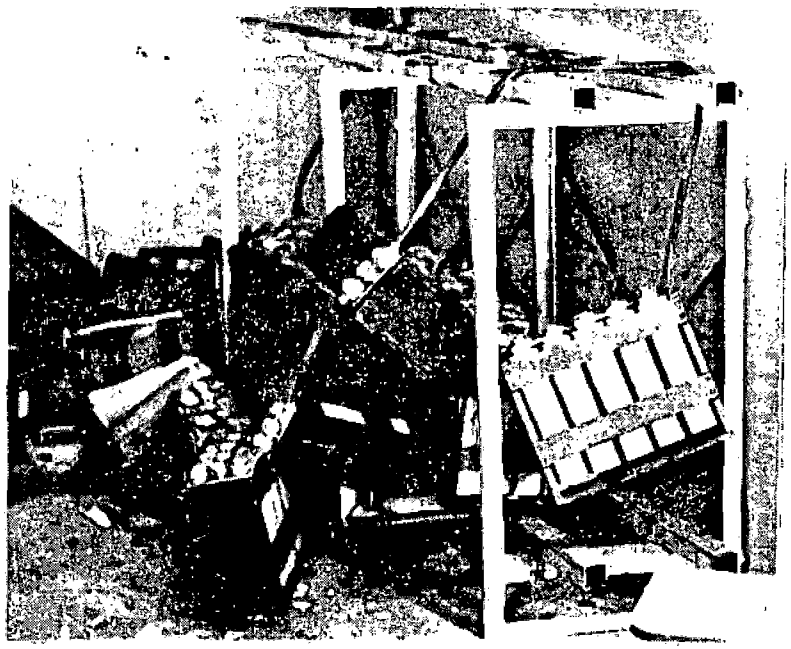
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

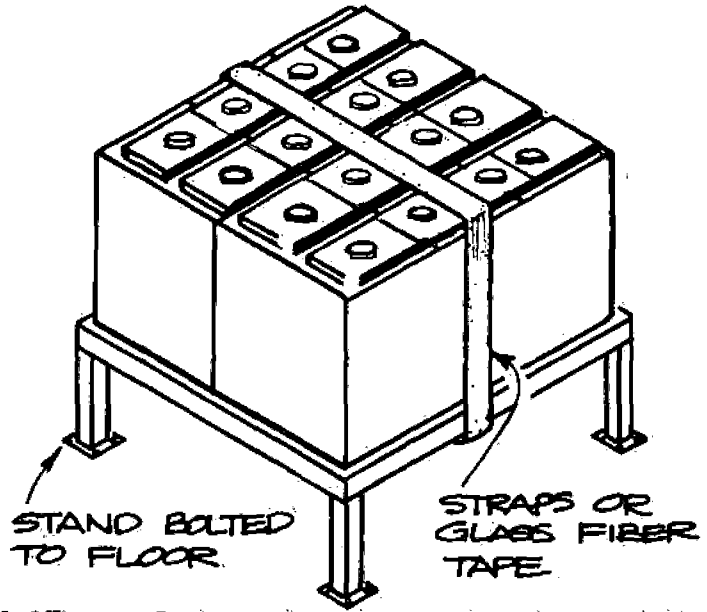
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING-AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

Table

TYPICAL HAZARD-REDUCTION TECHNIQUES

Preparing development studies and plans

Community-facility and utility inventories or plans
Environmental-impact assessments and reports
Land-capability analyses
Land-use and open-space inventories or plans
Public-safety or hazard-reduction plans
Redevelopment or relocation plans (pre- and post-disaster)
Subdivision design or lot layouts
Transportation studies or plans
Vulnerability analyses or risk evaluations

Discouraging new or removing existing development

Acquisition or exchange of hazardous areas
Disclosure of hazards
Nonconforming-use regulations
Policies for extending utility services
Policies for providing community services
Posted warnings of potential hazards
Public information and education
Public records of hazards
Removal of unsafe structures

Providing financial incentives or disincentives

Capital-improvement expenditures
Costs of insurance (non-subsidized)
Federal and state grants, loans, or other subsidies
Legal liability for damage
Policies of private lenders
Post-disaster reinvestments
Real-property appraisal or assessment practices
Special-assessment districts
Tax credits for preserving resource areas

Protecting existing development

Anchoring roofs and other mobiles
Debris-catchment basins and retention structures
Floodproofing, waterproofing, or stormproofing
Flood-control works
Landslide-restraining measures
Mudflow diversions and channels
Rockfall fences, nets, and sheds
Securing building contents and nonstructural components
Slope-stabilization methods

Regulating development

Building and grading ordinances
Building-setback regulations
Detailed investigations in hazard zones
Land-use zoning districts and regulations
Public-nuisance legislation
Rebuilding moratoria
Sanitary ordinances
Special design and construction requirements
Special hazard-reduction zones and regulations
Subdivision ordinances

Designing and building structures

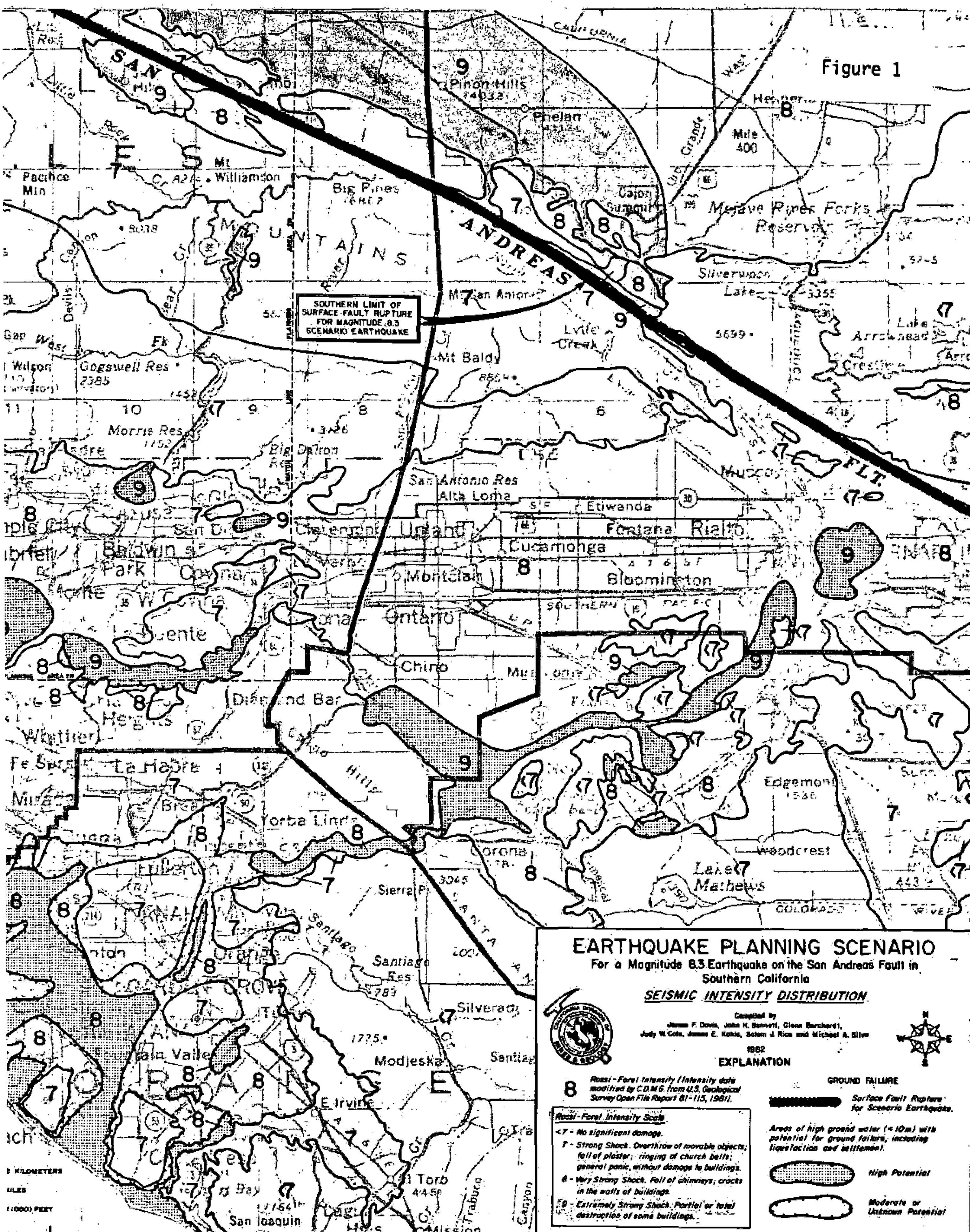
Engineering, geologic, and seismologic studies
Post-disaster repairs, strengthening, or reconstruction
Site-specific investigations
Siting and design of critical facilities
Strengthening, replacement, or repair of hydraulic-fill dams
Strengthening or retrofitting of structures
Testing of structural systems, materials, and connections

Preparing for and responding to disasters

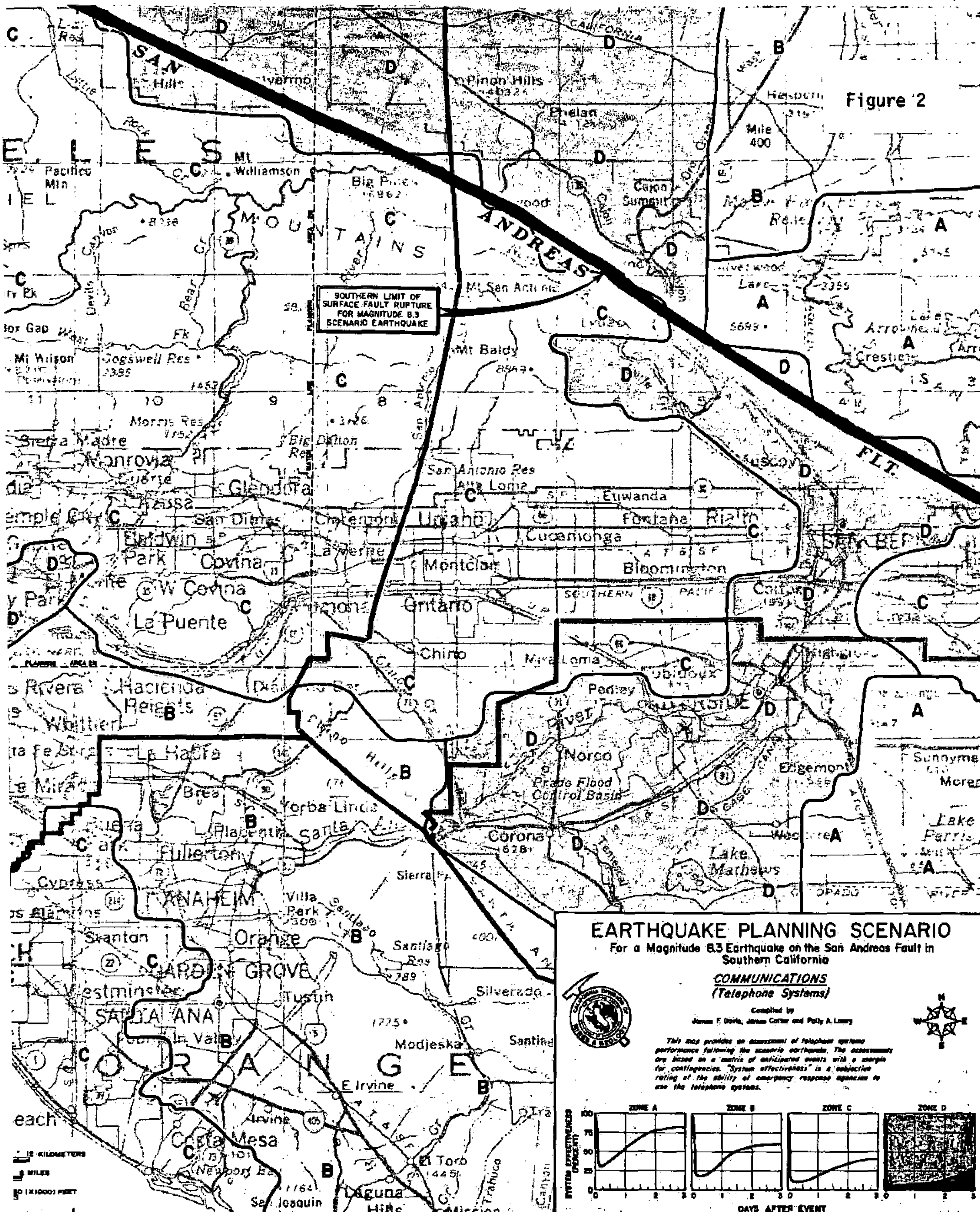
Damage and outage scenarios
Damage inspection, evaluation, and repair procedures
Disaster-preparedness, response, and recovery plans
Emergency-response operations
Evacuation plans
Event-prediction response
Monitoring and warning systems
Post-disaster mitigation reports

WJKockelman:cr January 1985
U.S. Geological Survey, Menlo Park, CA
415/323-8111, ext. 2312

Figure 1

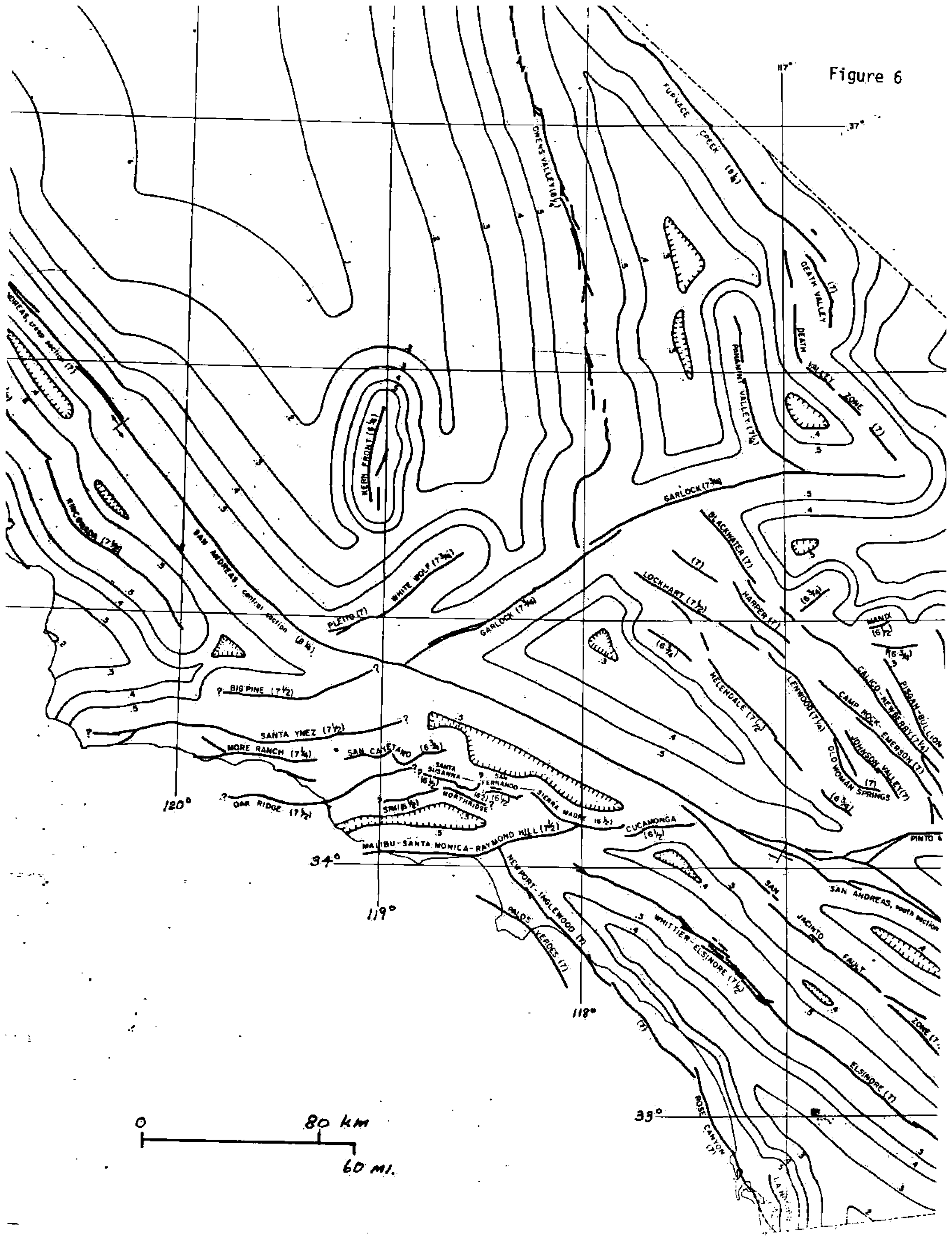


SAN ANDREAS FLT.
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
Pinon Hills
Phelan
Hesperia
Mile 400
Cajon Summit
Mojave River Forks Reservoir
Silverwood Lake
Lake Arrowhead
Crestline
Big Pines
Mt Williamson
Pacifico Mtn
MOUNTAINS
Mt San Antonio
Mt Baldy
Lytle Creek
Cogswell Res
Morris Res
Big Dalton
San Antonio Res
Alta Loma
Etiwanda
Fontana
Rialto
Claremont
Upland
Cucamonga
Baldwin Park
Covina
Montclair
Bloomington
Ontario
La Puente
Chino
Diamond Bar
Whittier
La Habra
Brea
Yorba Linda
Chino Hills
Corona
Edgemont
Woodcrest
Lake Mathews
Fullerton
Sierra
Santiago Res
Orange
Silverado
Modjeska
E Irvine
San Joaquin
Mission
ORANGE
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
SEISMIC INTENSITY DISTRIBUTION
Compiled by
James F. Davis, John H. Bennett, Glenn Borchardt, Judy W. Cole, James E. Kahle, Salem J. Rice and Michael A. Silva
1982
EXPLANATION
8 Rossi-Forel Intensity (Intensity data modified by C.D.M.G. from U.S. Geological Survey Open File Report 81-115, 1981).
Rossi-Forel Intensity Scale
<7 - No significant damage.
7 - Strong Shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.
8 - Very Strong Shock. Fall of chimneys; cracks in the walls of buildings.
9 - Extremely Strong Shock. Partial or total destruction of some buildings.
GROUND FAILURE
Surface Fault Rupture for Scenario Earthquake.
Areas of high ground water (< 10m) with potential for ground failure, including liquefaction and settlement.
High Potential
Moderate or Unknown Potential
N
E
S
W


SAN ANDREAS FLT.
SOUTHERN LIMIT OF SURFACE FAULT RUPTURE FOR MAGNITUDE 8.3 SCENARIO EARTHQUAKE
Pinon Hills
Phelan
Cajon Summit
Big Pines
MOUNTAINS
Mt. Williamson
Pacifico Mtn
Mt Wilson
Cogswell Res
Mt San Antonio
Mt Baldy
San Antonio Res
Alta Loma
Etiwanda
Fontana
Rialto
Cucamonga
Bloomington
Upland
Claremont
Montclair
Ontario
Chino
Mira Loma
Pedley
Norco
Prado Flood Control Basin
Corona
Lake Mathews
Edgemont
Sunnymead
Lake Perris
Sierra Madre
Monrovia
Duarte
Azusa
Glendora
San Dimas
La Verne
Baldwin Park
Covina
W Covina
La Puente
Hacienda Heights
Whittier
La Habra
Brea
Chino Hills
Yorba Linda
Placentia
Fullerton
Anaheim
Cypress
Stanton
Villa Park
Orange
Garden Grove
Westminster
Santa Ana
Tustin
Santiago Res
Silverado
Modjeska
E Irvine
Irvine
Costa Mesa
Newport Beach
El Toro
Laguna Hills
Mission
San Joaquin
ORANGE
A
B
C
D
Figure 2
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
COMMUNICATIONS
(Telephone Systems)
Compiled by
ZONE A
ZONE B
ZONE C
ZONE D
SYSTEM EFFECTIVENESS (PERCENT)
DAYS AFTER EVENT
MILES
KILOMETERS

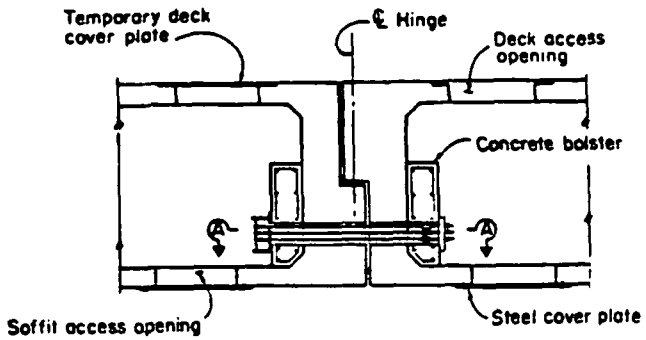
1.

Figure 6

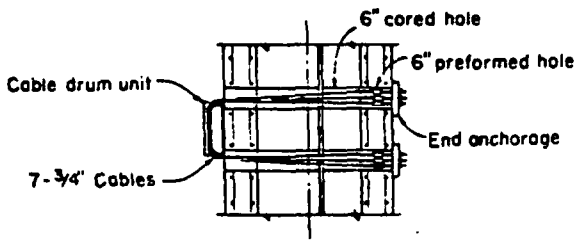


FURNACE CREEK (6¾)
OWENS VALLEY (6½)
DEATH VALLEY (7)
DEATH VALLEY ZONE (7)
PANAMINT VALLEY (7¼)
SAN ANDREAS, creep section (7)
KERN FRONT (6¾)
GARLOCK (7¾)
BLACKWATER (7)
WHITE WOLF (7¾)
RINCONADA (7½)
SAN ANDREAS, central section (8¼)
PLEITO (7)
LOCKHART (7½)
HARPER (7)
MANIX (6½)
HELENDALE (7½)
LENWOOD (7¼)
CALICO-NEWBERRY (7¼)
PISGAH-BULLION
CAMP ROCK-EMERSON (7)
JOHNSON VALLEY (7)
OLD WOMAN SPRINGS
BIG PINE (7½)
SANTA YNEZ (7½)
MORE RANCH (7¼)
SAN CAYETANO (6¾)
SANTA SUSANNA
SAN FERNANDO
NORTHRIDGE
SIERRA MADRE (6½)
OAK RIDGE (7½)
SIMI (6½)
MALIBU-SANTA MONICA-RAYMOND HILL (7½)
CUCAMONGA (6½)
PINTO
SAN ANDREAS, south section
NEWPORT-INGLEWOOD (7)
PALOS VERDES (7)
WHITTIER-ELSINORE (7½)
SAN JACINTO FAULT ZONE
ELSINORE (7)
ROSE CANYON (7)
37°
117°
120°
119°
118°
34°
33°
0
80 km
60 mi.

Figure 7

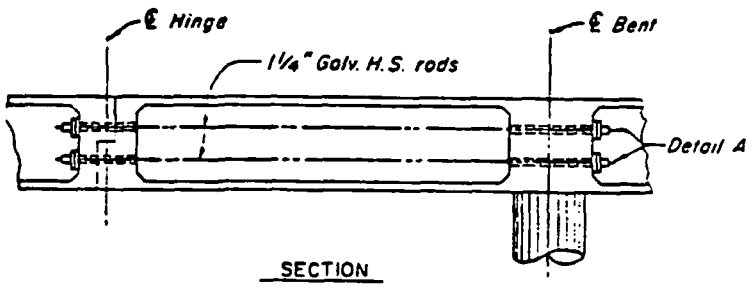


SECTION THRU HINGE

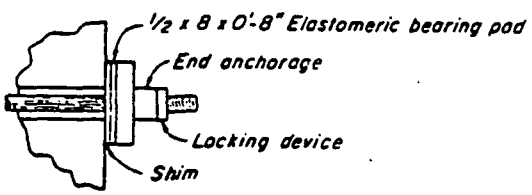


SECTION A-A

(A)



SECTION



DETAIL A

(B)

Figure 8

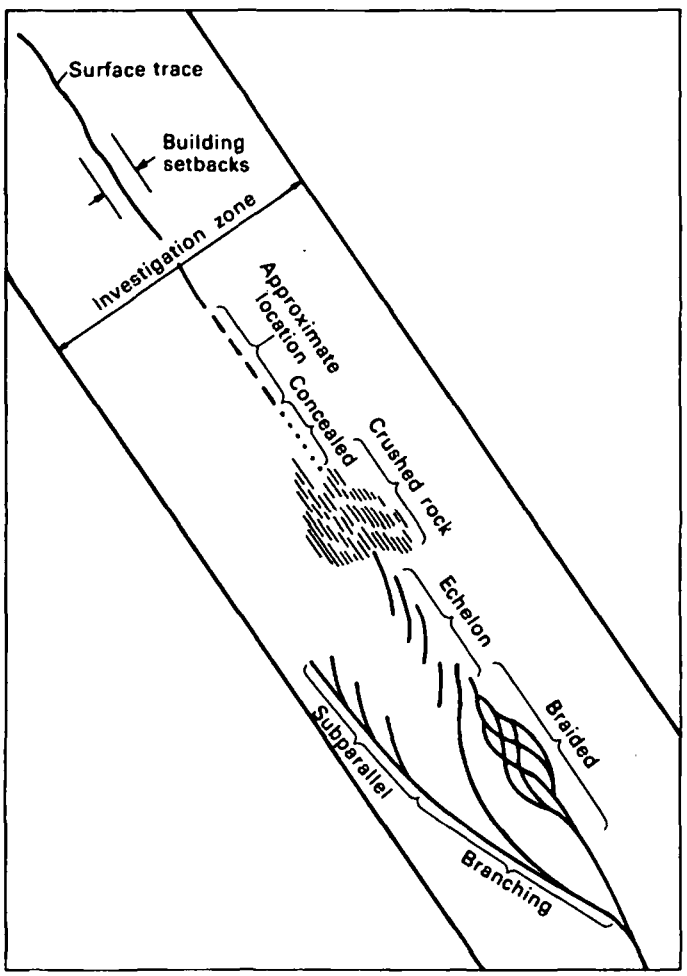


Figure 8. -- Diagram of hypothetical fault traces showing possible complexities of faulting, that demonstrate the necessity for detailed geologic investigations within a broad zone astride a known fault-rupture trace.

FIGURE 9

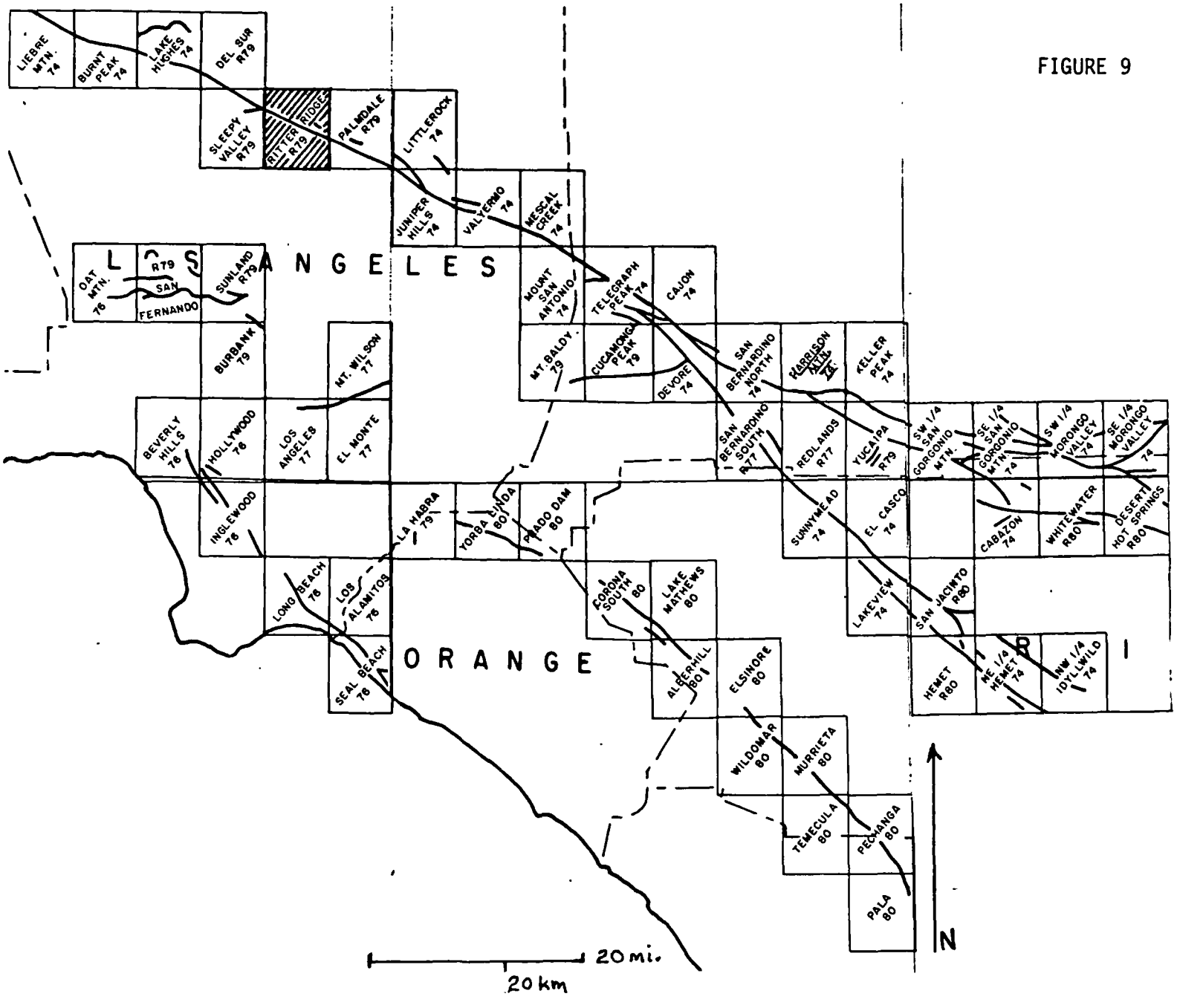


Figure 9. -- Part of the index to the Special Studies Zones maps showing faults zoned for special geologic studies (Hart, 1980). The official name of each quadrangle map and the year issued are indicated. Part of the cross-hatched quadrangle is shown as figure 10. Information about the availability of the maps and their updating can be obtained from the Fault Evaluation Program Supervisor, California Division of Mines and Geology, Room 1009, Ferry Building, San Francisco, CA 94111.

Figure 10

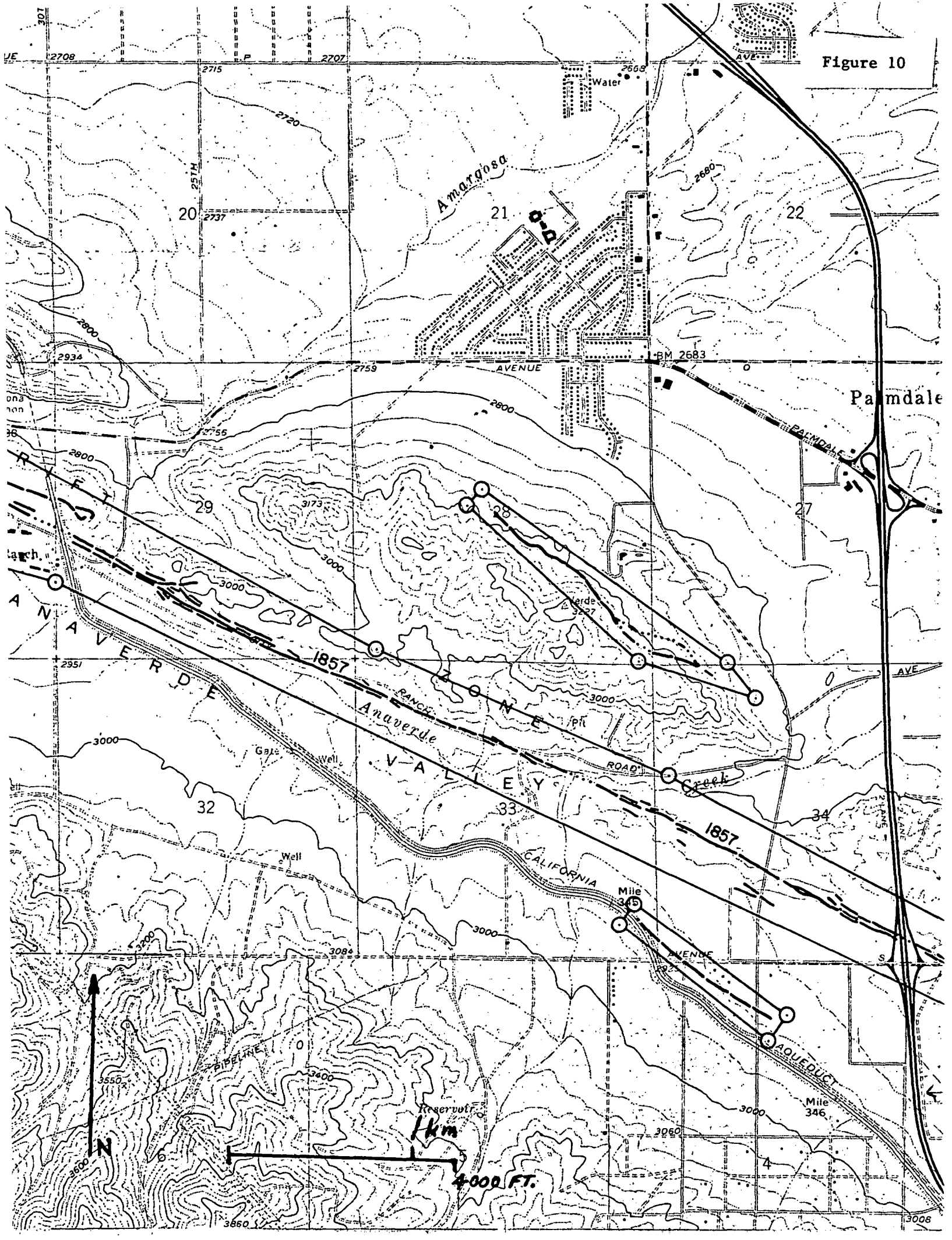

Amargosa
Palmdale
AVENUE
BM 2683
PALMDALE
ANAVERDE VALLEY
1857
RANCH
ROAD
Creek
Anaverde
ZONE
Pit
Gate
Well
CALIFORNIA
Mile
AQUEDUCT
PIPELINE
Reservoir
Water
1km
4000 FT.
N

FIGURE 11

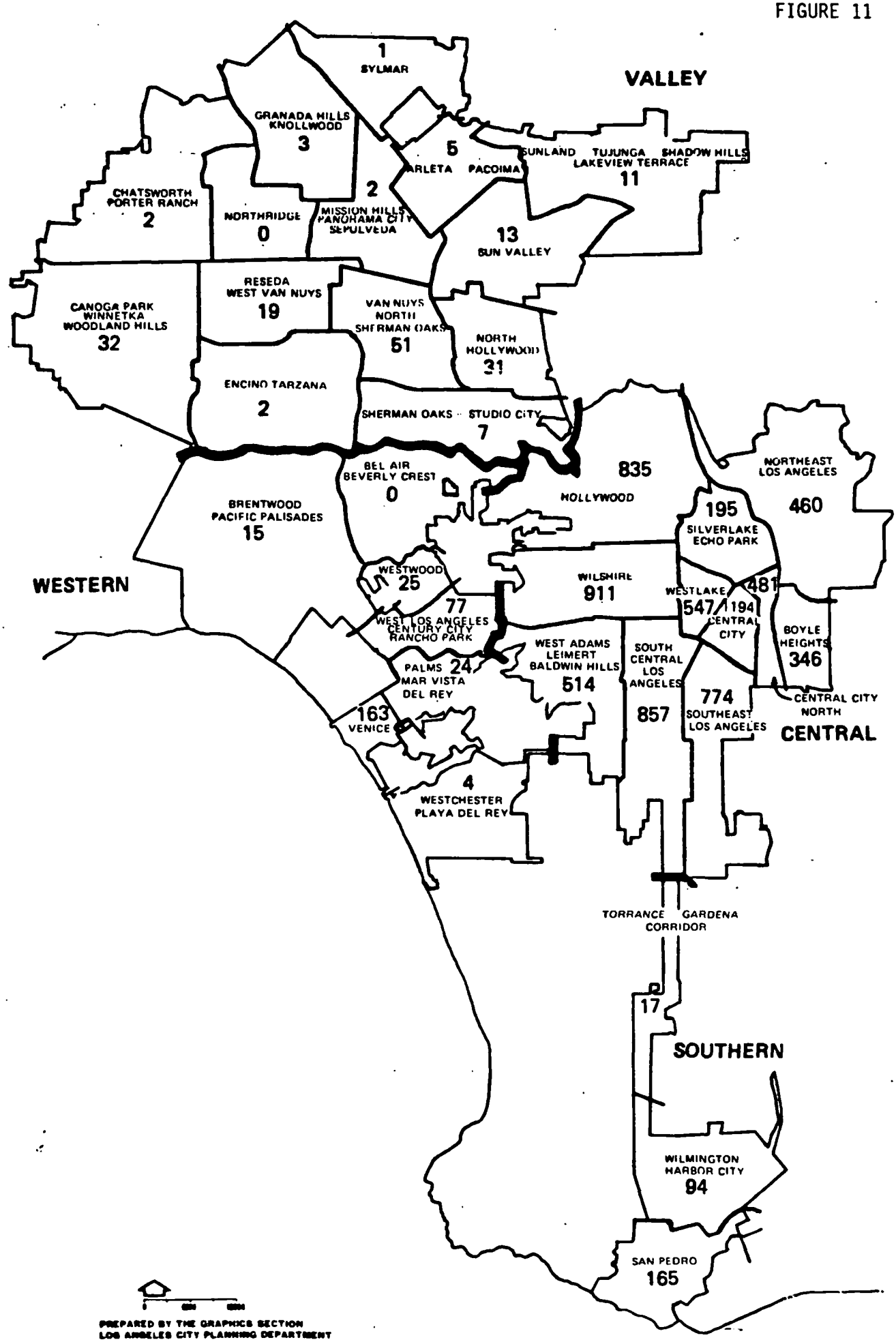

VALLEY
1
SYLMAR
GRANADA HILLS
KNOLLWOOD
3
5
ARLETA
PACOIMA
SUNLAND
TUJUNGA
SHADOW HILLS
LAKEVIEW TERRACE
11
CHATSWORTH
PORTER RANCH
2
2
NORTHRIDGE
0
MISSION HILLS
PANORAMA CITY
SEPULVEDA
13
SUN VALLEY
RESEDA
WEST VAN NUYS
19
CANOGA PARK
WINNETKA
WOODLAND HILLS
32
VAN NUYS
NORTH
SHERMAN OAKS
51
NORTH
HOLLYWOOD
31
ENCINO TARZANA
2
SHERMAN OAKS - STUDIO CITY
7
BEL AIR
BEVERLY CREST
0
835
HOLLYWOOD
NORTHEAST
LOS ANGELES
460
195
SILVERLAKE
ECHO PARK
BRENTWOOD
PACIFIC PALISADES
15
WESTERN
WESTWOOD
25
77
WEST LOS ANGELES
CENTURY CITY
RANCHO PARK
WILSHIRE
911
WESTLAKE
547
194
CENTRAL
CITY
481
BOYLE
HEIGHTS
346
PALMS
24
MAR VISTA
DEL REY
WEST ADAMS
LEIMERT
BALDWIN HILLS
514
SOUTH
CENTRAL
LOS
ANGELES
857
774
SOUTHEAST
LOS ANGELES
CENTRAL CITY
NORTH
CENTRAL
163
VENICE
4
WESTCHESTER
PLAYA DEL REY
TORRANCE
CORRIDOR
GARDENA
17
SOUTHERN
WILMINGTON
HARBOR CITY
94
SAN PEDRO
165
PREPARED BY THE GRAPHICS SECTION
LOS ANGELES CITY PLANNING DEPARTMENT

Figure 12

Ordinance No. 154,807

An ordinance adding Division 68 of Article 1 of Chapter IX of the Los Angeles Municipal Code relative to earthquake hazard reduction in existing buildings.

Section 1. Article 1 of Chapter IX of the Los Angeles Municipal Code is hereby amended to add a Division 68 to read:

DIVISION 68 — EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.6801. PURPOSE:

The purpose of this Division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this Division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This Division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This Division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this Division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this Division.

SEC. 91.6802. SCOPE:

The provisions of this Division shall apply to all buiings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

EXCEPTION: This Division shall not apply to detached one or two story family dwellings and detached apartment houses containing less than five dwelling units and used solely for residential purposes.

SEC. 91.6803. DEFINITIONS:

For purposes of this Division, the applicable definitions in Sections 91.2301 and 91.2305 of this Code and the following shall apply:

Essential Building: Any building housing a hospital or other medical facility having surgery or emergency treatment areas; fire or police stations; municipal government disaster operation and communication centers.

High Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of this Code of 100 occupants or more.

EXCEPTION: A high risk building shall not include the following:

1. Any building having exterior walls braced with masonry crosswalls or wood frame crosswalls spaced less than 40 feet apart in each story.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

Historical Building: Any building designated as an historical building by an appropriate Federal, State or City jurisdiction.

Low Risk Building: Any building, not classified an essential building, having an occupant load as determined by Section 91.3301(d) of less than 20 occupants.

Medium Risk Building: Any building, not classified as a high risk building or an essential building, having an occupant load as determined by Section 91.3301(d) of 20 occupants or more.

Unreinforced Masonry Bearing Wall: A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418(e) of this Code.

SEC. 91.6804. RATING CLASSIFICATIONS:

The rating classifications as exhibited in Table No. 68-A are hereby established and each building within the scope of this Division shall be placed in one such rating classification by the Department. The total occupant load of the entire building as determined by Section 91.3301(d) shall be used to determine the rating classification.

TABLE NO. 68-A
RATING CLASSIFICATIONS

Type of Building	Classification
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

SEC. 91.6805. GENERAL REQUIREMENTS:

The owner of each building within the scope of this Division shall cause a structural analysis to be made of the building by a civil or structural engineer or arthitect licensed by the State of California; and, if the building does not meet the minimum earthquake standards specified in this Division, the owner shall cause it to be structurally altered to conform to such standards; or cause the building to be demolished.

The owner of a building within the scope of this Division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

a. Within 270 days after the service of the order, a structural analysis. Such analysis which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this Division; or

b. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this Division; or

c. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.6808(c); or

d. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in No. Table 68-B. These time limits shall begin to run from the date the order is served in accordance with Section 91.6806(a) and (b).

TABLE NO. 68-B
TIME LIMITS FOR COMPLIANCE

Required Action By Owner	Obtain Building Permit Within	Commence Construction Within	Complete Construction Within
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

*Measured from date of building permit issuance.

Owners electing to comply with Item c of this Section are also required to comply with Items b or d of this Section provided, however, that the 270-day period provided for in such Items b and d and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 68-B shall be extended in accordance with Table No. 68-C. Each such extended time limit, except the time limit for commencing construction shall begin to run from the date the order is served in accordance with Section 91.6806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

TABLE NO. 68-C
EXTENSIONS OF TIME AND SERVICE PRIORITIES

Rating Classification	Occupant Load	*Extension of Time* if Wall Anchors are Installed	*Minimum Time* Periods for Service of Order
I (Highest Priority)	Any	1 year	0
II	100 or more	3 years	90 days
III	100 or more	5 years	1 year
	More than 50, but less than 100	6 years	2 years
	More than 19, but less than 51	6 years	3 years
IV (Lowest Priority)	Less than 20	7 years	4 years

SEC. 91.6806. ADMINISTRATION:

(a) Service of Order. The Department shall issue an order, as provided in Section 91.6806(b), to the owner of each building within the scope of this Division in accordance with the minimum time periods for service of such orders set forth in Table No. 68-C. The minimum time period for the service of such orders shall be measured from the effective date of this Division. The Department shall upon receipt of a written request from the owner, order a building to comply with this Division prior to the normal service date for such building set forth in this Section.

(b) Contents of Order. The order shall be written and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this Division and, therefore, is required to meet the minimum seismic standards of this Division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.6805 which sets forth the owner's alternatives and time limits for compliance.

(c) Appeal From Order. The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this Division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.6806(b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor, by the Department and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this Division, shall be made in accordance with the procedures established in Section 98.0403.

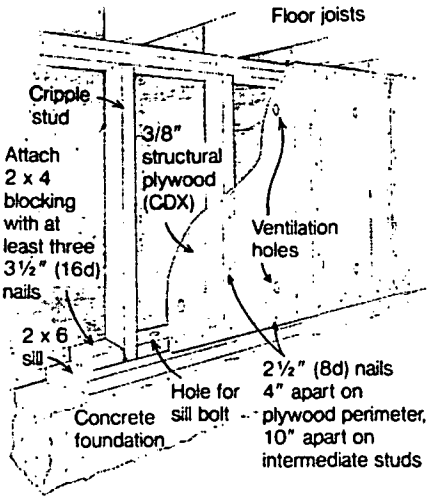
(d) Recordation. At the time that the Department serves the aforementioned order, the Superintendent of Building shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 68 is not exhibited.

If the building is either demolished, found not to be within the scope of this Division, or is structurally capable of resisting minimum seismic forces required by this Division as a result of structural alterations or an analysis, the Superintendent of Building shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of Division 68 — Earthquake Hazard Reduction in Existing Buildings — of the Los Angeles Municipal Code.

(e) Enforcement. If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this Division within any of the time limits set forth in Section 91.6805, the Superintendent of Building shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board and the Superintendent may order its demolition in accordance with the provisions of Section 91.0103(o) of this Code.

More ambitious safeguards: brace the cripple walls, bolt the foundation

NORMAN A. PLATE



Foundation cripple walls *should be sheathed with plywood to reduce chance of collapse in a quake. Where sill is a 2 by 6, add blocking as shown to create flush surface for nailing. If sill is a 2 by 4, you can nail the plywood directly to it. To prevent condensation, cut ventilation holes (not necessary if insulation is added)*

the diameter of the bolts used.)

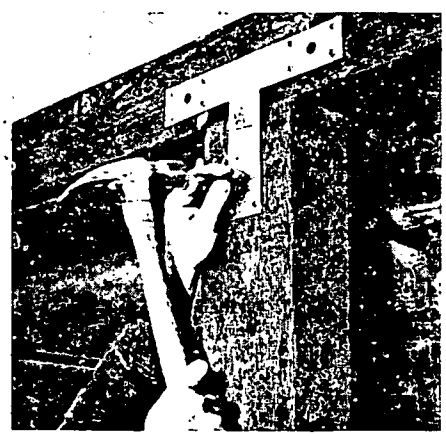
In houses with bolted sills, make sure that bolting is adequate; install any missing washers and tighten loose nuts; inspect all wood members for decay and termite damage and replace if necessary.

Foundation cripple walls. Many older homes and some modern ones have inadequately braced foundation cripple walls (they're usually a few feet high and run along the top of the foundation wall). Unless properly braced, they are highly subject to collapse in a quake—as happened to the house on page 104. Use plywood to strengthen them.

Sheathe cripple studs with plywood as shown above. Each 4-by-8 sheet costs about $9. Close nailing is important to ensure rigidity. It's best to sheathe all cripple stud walls, but if that isn't possible, you should at least sheathe the cripple studs at the corners. For a single-story house, sheathing sections on each wall should be at least 8 feet long; for a two-story house, 12 feet long. (In all cases, sheathing should be at least twice as long as the height of studs.) Cut openings to avoid blocking vents.

Walls. Wood-frame walls that lack solid sheathing often suffer costly damage to inside and outside surfaces. To reduce this damage, it's a good idea to add plywood to unsheathed walls whenever possible, such as when remodeling. Attach to studs and bottom and top plates with nailing like that shown for cripple walls.

Walls of masonry (brick, adobe, or concrete blocks) with no steel reinforcement tend to perform poorly, suffering severe cracking and often collapse.



Metal connectors *like this T-strap strengthen connections between posts and beams; nail and lag-screw them on exposed framing in basements, garages, porches*

Walls with masonry veneer (usually brick over wood framing) often lose the veneer in quakes, so be sure to locate children's play areas away from where the veneer might drop.

If you are not sure whether your house walls are solid masonry or wood frame with veneer, you might check for studs by examining walls from the basement or crawl space, or by removing an electrical outlet plate or drilling a small hole from the inside.

If your house has solid masonry walls, determining whether they're reinforced may prove to be a tricky process. In general, masonry-wall structures built before the early 1930s were not reinforced; houses built as late as 1955 may not have been reinforced either. Your local building inspector may be able to tell you the construction practices common when your house was built. You could use a hobby metal detector to check for reinforcing bars (these would be at regular intervals, except around openings). Or consult a materials testing lab (an engineer may be able to direct you to one) for a more sophisticated —and more expensive—test.

Whatever kind of walls your house has, if you notice any cracks that go all the way through them, or cracks larger than ⅛ inch, better consult a professional.

Chimneys. Though chimneys are often constructed of unreinforced masonry, even those that are reinforced are vulnerable in earthquakes. If the mortar shows deterioration and crumbles when probed with a screwdriver, you may need to rebuild the chimney.

In many cases, chimneys aren't adequately tied to the house. You can reduce the extent of possible damage by adding metal straps to tie the chimney to ceiling joists (and to upper-floor joists in a two-story house).

Consider replacing the top section of a tall masonry chimney with a lightweight metal flue.

Bracing a masonry chimney is no guarantee it won't collapse. If your roof doesn't have solid sheathing, you can reduce the hazard by nailing a shield of ⅝- to ¾-inch-thick plywood to the ceiling joists around the chimney where it might fall (see the large cutaway drawing). Use 2½-inch (8d) nails.

For details on chimney reinforcement, consult the books listed below.

Garages. Houses that have two-car garages supporting living quarters above may suffer severe damage in even moderate quakes, as shown on page 104. If you live in a high-risk area, and your house has this design, better have an engineer evaluate whether the house needs extra bracing.

Whatever kind of garage you have, check to make sure that the sill is adequately bolted to the foundation.

Roofs. Roofs of wood-frame houses usually haven't suffered great damage in earthquakes, but the weight of terra cotta or slate tiles can buckle walls in multistory houses. Make sure all tiles are securely wired; loose ones could fall.

Getting more information and professional engineering help

Four books are of special value:

For detailed technical information on house construction, see *Home Builder's Guide for Earthquake Design* (Applied Technology Council, 2150 Shattuck, Berkeley 94704; 1980; $8). For broad

DARROW M. WATT

Bolting wood sill to foundation. *After drilling sill with wood drill (not shown), use masonry drill with a carbide bit to penetrate concrete. After blowing out concrete dust with a long piece of plastic tubing, gently tap in expansion anchor bolts ($2 to $3 each). Then tighten nut to secure it to washer and ensure grip of expansion mechanism*

coverage of earthquake topics, including construction and safety, see *Peace of Mind in Earthquake Country*, by Peter Yanev (Chronicle Books, San Francisco, 1974; $5.95). Basic points are covered succinctly in *Earthquake Hazards and Wood Frame Houses* (Center for Planning and Development Research, 373 Wurster Hall, University of California, Berkeley 94720; 1982; $4.50).

For background information on earthquakes and major faults of California, along with revealing photographs of damage, see *Earthquake Country*, by Robert Iacopi (Lane Publishing Co., Menlo Park, Calif., 1971; $5.95).

If your house has a structural problem requiring professional help, consult a structural or civil engineer (look in the yellow pages under Engineers). A foundation or soils engineer, or a geologist, can help you with site problems.

Since most engineers do not examine single houses or homesites, you may have to ask for a referral to one who will. Officials of building departments may be willing to suggest names. Or ask them to help you locate the nearest branch of the professional association for the type of engineer you need, and then ask the association for members in your area who examine houses.

Expect to pay $60 to $100 per hour. Usually, verbal reports are less costly than written ones.

Reducing nonstructural hazards

Batten down hazards. Virginia Kimball, author of *Earthquake Ready* (Peace Press, Culver City, Calif., 1981; $5.95), suggests: "Try to visually shake each room. Tall furniture will probably tip or fall; the television, lamps, and other loose objects will also move or fall; chandeliers and heavy lamps will swing, modular units may separate, tip, or collapse."

Secure as many of these items as you can. Check the cutaway drawing of the house on pages 106 and 107 for suggestions and other potential danger points. Metal angle braces (L-brackets), fastened to studs with lag screws, are excellent for securing top-heavy furniture. All screws used to attach heavy items to walls should be sunk into studs.

Secure cabinets, breakables. To reduce the risk of raining glassware, crockery, pots and pans, and food supplies, add sturdy latches to cabinets. Best are positive latches for attachment on the cabinet faces. But strong spring-loaded latches (pictured on page 106) or heavy-duty magnetic latches attached inside cabinets will also reduce losses.

A lip or low barrier across shelves may prevent breakables from walking across and off shelves. You can tie small wall-hung breakables (picture frames, for example) to the wall with piano wire or heavy-test monofilament fishing line

Earthquake insurance: cost, the deductible, the exclusions

Should you purchase earthquake insurance? To answer that question, assess your own circumstances. First, consider the possible hazard of your homesite and the potential weaknesses in your house's structure. Remember that even expert earth scientists and engineers cannot tell you how much shaking your house might suffer in a quake, let alone how much damage.

For example, in the "moderate" quake that shook San Fernando, California, in 1971, a fourth of the houses in the hardest-hit area suffered damage equivalent to more than 5 percent of their value (some were a total loss). The other houses in this area sustained little damage. (Most homes in this region are wood frame.) In a "great" earthquake, such as a magnitude 8, the shaking might have lasted five times longer and caused much more damage.

How do you arrange coverage? You can usually obtain an earthquake rider (earthquake extension endorsement) to your standard homeowner's policy. The amount of coverage provided by the rider would be the same as that of your present policy.

How much does it cost? The premium for this rider varies, depending on your house's construction and location.

Generally, insurance companies consider wood-frame houses among the lowest risks; they merit a rate of about $1.65 to $3.25 per $1,000 of coverage (most common rate is about $2 per $1,000). If your house is not wood-frame (for example, walls of masonry), you'll pay $7.75 to $15 per $1,000 coverage.

You may have to pay more if your house is on a vulnerable site such as a known landslide area, or on some landfill areas. Insurance companies have divided many states into hazard zones; in areas they consider higher risks, rates go up.

What about that deductible? Most policy riders require a 5 to 10 percent deductible for each earthquake. The deductible is based on the total amount of insurance on the house at the time of damage. (Underwriters define a single earthquake as any shocks that occur within a 72-hour period. If later aftershocks damage your house further, you may be liable for another 5 to 10 percent deductible.)

How about other quake-caused problems? Fire insurance policies usually cover blazes started by earthquakes, but the insurance company would compensate you only for the value of the structure *after* it had suffered quake damage (unless your policy covered earthquakes).

Generally, earthquake insurance will not cover damage caused by a quake-triggered flood or tsunami; you must get separate flood insurance.

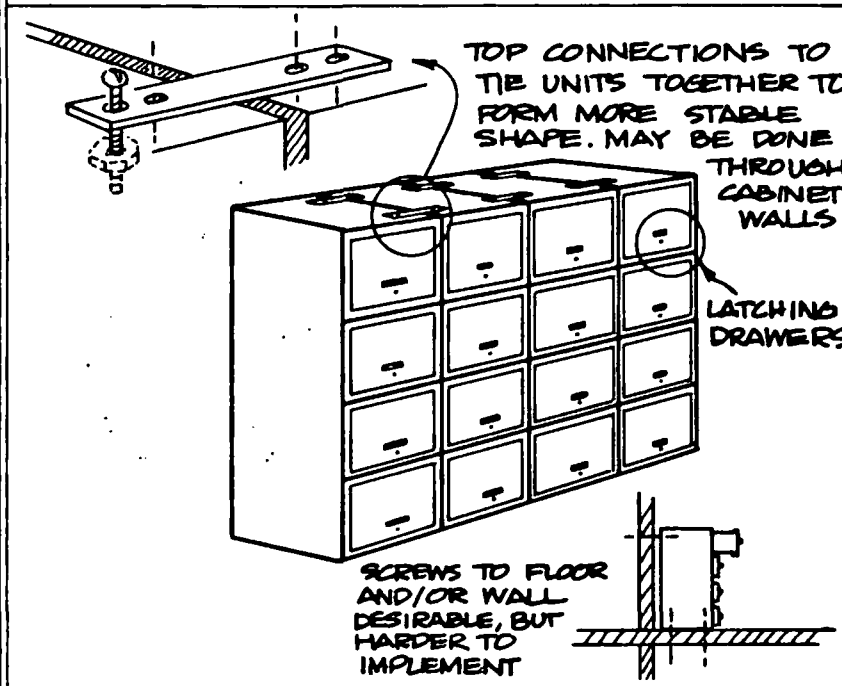
But what about disaster relief? The federal government sometimes provides small loans as relief to homeowners. These often don't reflect current costs of house construction or repair, and if you're already carrying a large mortgage, payments on these loans would add to your financial burden.

TALL FILE CABINETS

DAMAGE EXAMPLE

earthquake: 1979 Imperial Valley, California
credit: BSD, Inc.

PROTECTIVE COUNTERMEASURE



APPROXIMATE COST: $5 per pair of cabinets; latching models standard

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0–5%	low
MODERATE	occasional tipover if drawers unlatched and if top heavy	mod	5–20%	mod
SEVERE	tipover of most tall cabinets	mod	20–50%	high

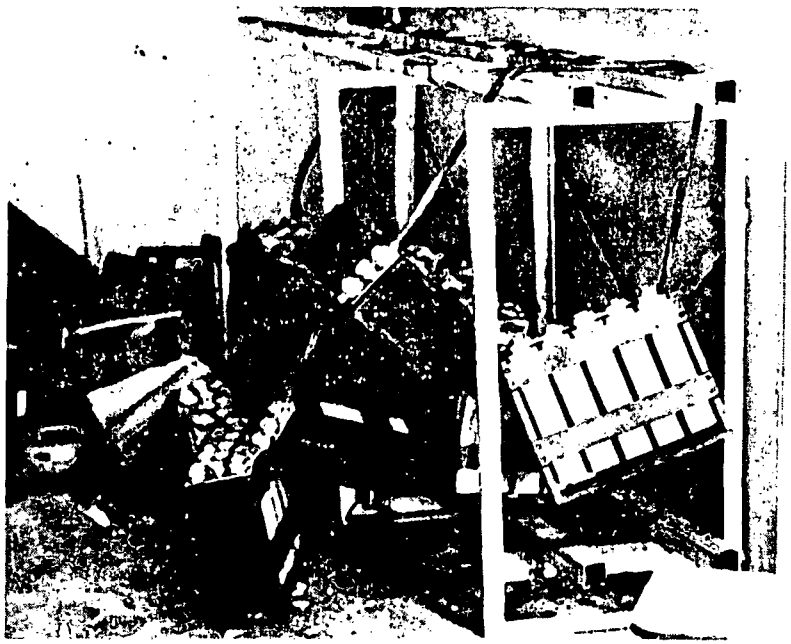
UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage limited to spillage of occasional individual unlatched drawer	low	0–10%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

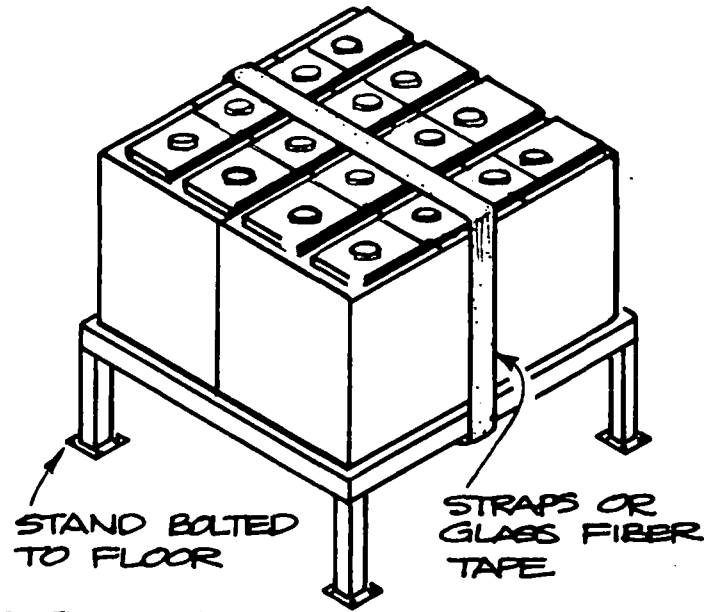
EMERGENCY POWER GENERATORS

DAMAGE EXAMPLE



earthquake: 1971 San Fernando
credit: John F. Meehan

PROTECTIVE COUNTERMEASURE



FOR GENERATOR ANCHORAGE, SEE HEATING-VENTILATING - AIR CONDITIONING EQUIPMENT CHART.

APPROXIMATE COST: $10 per rack for strapping
$50 for bolting

EXISTING VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	slight chance of piping connection break	low	0–5%	mod
MODERATE	slight shifting of equipment; batteries slide	low	5–20%	high
SEVERE	lurching of generator off supports; batteries fall	mod	20–50%	high

UPGRADED VULNERABILITY

SHAKING INTENSITY	EFFECTS	✚	$	▦
LIGHT	no damage	low	0%	low
MODERATE	no damage	low	0%	low
SEVERE	damage to rest of electrical system more likely than generator damage	low	0–5%	low

✚ LIFE SAFETY HAZARD $ % OF REPLACEMENT VALUE DAMAGED ▦ POST-EARTHQUAKE OUTAGE

"NON SUBMITTAL OF PROPOSAL" FORM

NOTE: If your organization doesn't expect to propose under this solicitation but wants to remain on our annual Earthquake RFP mailing list, please complete & return this form. (This response does not affect our official contract office "Bidders Mailing List".)

WRONG ADDRESS? Please provide correct (or new) mailing address here:

( ) We do not plan to submit a proposal.

Reason: _____

( ) Retain on list for next year's RFP
( ) Remove from EHRP solicitation mailing list

Name: _____

Title: _____

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Fold Fold

From: Univ. of Utah Research Institute
Earth Science Laboratory
Attn: Dr. Phillip Wright
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

Affix Stamp Here

To: U. S. Geological Survey
Branch of Procurement & Contracts
205 National Center
Reston, VA

Solicitation Number: RFP 1586
Closing Time & Date: 5:00p.m. - 03/04/85
Contracting Officer: Duleep I. Pandite

[Please tape closed]

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

EARTHQUAKE HAZARDS REDUCTION PROGRAM

PROGRAM SOLICITATION

RFP No. 1586

Issuing Date: December 19, 1984

Closing Date and Time: March 4, 1985

NOTICE TO ALL OFFERORS

The U.S. Geological Survey (USGS) invites your organization to submit research proposals that will assist in achieving the goals of the National Earthquake Hazards Reduction Program (NERHP), as set forth in this solicitation. The USGS welcomes proposals on behalf of all qualified sources, and encourages woman owned and small disadvantaged businesses to compete fully in any of the research and research-related programs described in this document.

The goal of NEHRP is to mitigate earthquake losses that can occur in many parts of the nation by providing earth science data and assessments essential for warning of imminent damaging earthquakes, land-use planning, engineering design, and emergency preparedness decisions. The USGS participates in the NEHRP with the National Science Foundation (NSF), the National Bureau of Standards (NBS), and the Federal Emergency Management Agency (FEMA); the latter having the lead role to plan and coordinate the national effort. In addition to activities performed by USGS staff, expertise in earthquake studies that exist outside the Federal Government is applied through a substantial program of grants, cooperative agreements and/or contracts with universities, state, regional and local government agencies, and private industry. External research is solicited in order to develop information, knowledge and methods which are relevant to three major program elements:

- o Current Tectonics and Earthquake Potential
- o Earthquake Prediction, and
- o Regional Earthquake Hazards Assessments

Specific objectives and research tasks identified as measures of progress towards the goals of these program elements are described in greater detail in Part I of this solicitation. Proposals for research projects not covered by one of these program objectives are not solicited. Proposals for research not covered in the program objectives may be submitted as unsolicited proposals; however, the U.S. Geological Survey does not budget or reserve funds for that purpose.

Guidelines for preparation of proposals, reporting requirements, general instructions for proposal submissions and evaluation criteria, are found in Part II of this program solicitation. A list of current research projects, including both USGS internal projects and external research grants and contracts supported by the Earthquake Hazards Reduction Program is provided in Part III for each program objective.

Additional information regarding the Earthquake Hazards Reduction Program may be found in summaries of Technical Reports Volume XVIII--National Earthquake Hazards Reduction Program, USGS Open-File Report 84-628.

Availability of Fiscal Year 1986 Funds

Funds are not presently available for awards that may result from this solicitation. The Government's obligation for awards under this solicitation is contingent upon the availability of appropriated funds from which payment can be made. No legal liability on the part of the government for any payment may arise until funds are made available to the Contracting Officer, and the Contractor or Recipient receives notice of such availability, to be confirmed

in writing by the Contracting Officer.

Submit Proposals to:

Branch of Procurement and Contracts
U.S. Geological Survey
Mail Stop 205C, Room 1D104
12201 Sunrise Valley Drive
Reston, Virginia 22092

ALL PROPOSALS FOR FISCAL YEAR 1986 SOLICITATION OBJECTIVES MUST BE RECEIVED BY THE BRANCH OF PROCUREMENT AND CONTRACTS, U.S. GEOLOGICAL SURVEY, RESTON, VIRGINIA, AT OR BEFORE 5:00 P.M. LOCAL TIME ON MARCH 04, 1985.

Proposals received after the exact time and date shown above must be treated as late proposals and cannot be considered unless the proposal clearly meets one of the exceptions set forth in the "Late Proposals..." clause in this solicitation. Because there are no circumstances under which a late, hand carried proposal can be considered, we caution against relying on overnight delivery by courier for timely receipt of your proposal(s). To help avoid mishandling, the proposal should be clearly labeled, on interior and exterior containers, as a response to this RFP 1586.

If you do not plan to submit a proposal in response to this solicitation, we request that you advise us whether or not you are interested in receiving future annual solicitations for this program's research. Your notice may be provided by letter or postcard or by completing the enclosed form, "Non-submittal of Proposal," and returning it to the address shown on the form. Recipients not responding to this RFP, by proposal or other expression of interest, can expect their names to be deleted from our mailing list for this program's annual solicitation.

/s/ Duleep I. Pandite

Duleep I. Pandite
Contracting Officer

TABLE OF CONTENTS

PART I

PROGRAM SOLICITATION

In addition to the general areas of interest discussed above there are a number of specific objectives within each program element which are of immediate priority for research and information. Each of these objectives is presented in greater detail in the following pages. **THE U.S. GEOLOGICAL SURVEY HEREBY SOLICITS DETAILED FORMAL PROPOSALS FOR RESEARCH PROJECTS RELEVANT TO THESE SOLICITATION OBJECTIVES.**

Formal proposals should emphasize the performance aspects of the research approach, including data and information sources, analytical methods, project plan, and the nature of expected results. Cost sharing is encouraged. The USGS, anticipates allocation of approximately $8 million for awards in the three main program elements for fiscal year 1986. Formal proposals should be submitted in accordance with specifications provided in this document. Formal proposals are subject to an advisory peer review conducted by professionals not employed by the USGS, who are knowledgeable in the proposal objectives, and who are selected to represent a balance of interests. Reviews are based on the evaluation criteria discussed in Part II. If peer review determines that none of the proposals submitted under a given objective merits funding, the USGS reserves the right to decline funding on that particular solicitation objective.

Projects may be designed to run more than one year, provided that annual and final reports are included in the project plan. Funding in subsequent years will be contingent upon the availability of funds and satisfactory performance.

RESEARCH ELEMENTS

ELEMENT I. CURRENT TECTONIC AND EARTHQUAKE POTENTIAL STUDIES

Seismological and geological analyses of the current seismic activity, active geologic faults, tectonic framework, and earthquake potential of all seismic regions in the United States.

Objective T-1: Regional Seismic Monitoring

Proposals under this objective are not sought by this solicitation.

Objective T-2: Analysis of Regional Seismic Network Data

Analyze and synthesize data on local earthquakes recorded by regional seismic networks. Combine results with other geological and geophysical data to determine their characteristics and delineate active fault zones at seismogenic depths.

Task T.2.1: Conduct studies of earthquake locations, focal depths, focal mechanisms, source parameters and crustal structure to determine regional tectonic framework and map subsurface expression of active fault zones.

Task T.2.2: Conduct highly focused studies of specific seismogenic features, including preshock-mainshock-aftershock sequences, to determine spatial and temporal characteristics of earthquakes and the geometry of crustal fault zones at seismogenic depths.

Task T.2.3: Develop new methods for the analysis and interpretation of local earthquake seismograms for use in high resolution studies of active faults and the crustal rocks that contain them.

Objective T-3: Identification of Source Zone Characteristics

Identify and map active crustal faults, using geological and geophysical data to interpret the structure and geometry of seismogenic zones.

Task T-3.1: Identify and map active crustal faults in seismic regions.

Task T.3.2: Combine geophysical and geological data to interpret tectonic setting of seismogenic zones and determine their source zone characteristics.

Objective T-4: Earthquake Potential Estimates

Through a combination of geological and geophysical investigations, estimate earthquake potential for specific fault zones. This work combines data on fault slip rates, paleoseismicity, historical earthquake activity, strain accumulation and related tectonic studies for specific faults or seismogenic zones.

Task T.4.1: Conduct detailed studies of fault slip rates, earthquake recurrence intervals, and paleoseismic rupture zones in specially designated study areas for focused earthquake prediction studies defined in task P.2.

Task T.4.2: Estimate fault-slip rates, earthquake recurrence intervals and maximum earthquakes for late Pleistocene and Holocene faults in seismic areas in the Western United States, including California, Utah, Nevada, southern Alaska and Washington.

Task T.4.3: Estimate fault-slip rates, earthquake recurrence intervals and maximum earthquakes for seismogenic zones in the Central and Eastern United States.

ELEMENT II. EARTHQUAKE PREDICTION RESEARCH

Collect observational data and develop the instrumentation, methodologies, and physical understanding needed to predict damaging earthquakes.

Objective P-1: Prediction Methodology and Evaluation

Develop methods to provide a rational basis for estimates of increased earthquake potential. Evaluate the relevance of various geophysical, geochemical and hydrological data for earthquake prediction.

Task P.1.1: Develop, operate and evaluate instrumentation for monitoring potential earthquake precursors.

Task P.1.2: Analyze and evaluate seismicity data collected prior to medium and large earthquakes.

Task P.1.3: Obtain and analyze data from seismically active regions of foreign countries through cooperative projects with the host countries. Relevance to program objective must be demonstrated.

Task P.1.4: Systematically evaluate data and develop statistics that relate observations of specific phenomena to earthquake occurrence.

Task P.1.5.: Develop, study and test prediction methods that can be used to proceed from estimates of long-range earthquake potential to specific short-term predictions.

Objective P-2: Focused Earthquake Prediction Experiments

Conduct data collection and analysis experiments in areas of California capable of large earthquakes, with emphasis on areas within or near large population centers. The experiments will emphasize improved coordination of data collection, data reporting, review and analysis according to set schedules and standards. Collaborative projects related to earthquake prediction experiments that focus on using a variety of techniques in a single region are invited and encouraged. Proposals involving the collection and analysis of data for earthquake prediction experiments in the following regions using methods which complement existing U.S. Geological Survery

monitoring of seismicity, geodetic strain and continuous borehole strain in the same vicinity will receive highest priority under this objective.

Task P.2.1: The 25-km-long segment of the San Andreas fault centered near Parkfield, as well as the 40-km-long extension of the fault to the southeast.

Task P.2.2: Specific segments of approximately 25 km length along the southern San Andreas fault between Tejon Pass and the Salton Sea, such as the following regions: Tejon Pass, Pearblossom, Cajon Pass, San Gorgonio Pass, and the northeast shore of the Salton Sea (Bombay Beach).

Task P.2.3: The two identified seismic gaps on the San Jacinto fault, each about 40-km-long, near Anza and near San Bernardino.

Task P.2.4: The Hayward-Calaveras fault system north of the source region of the 1984 Morgan Hill earthquake: from San Leandro to San Pablo Bay on the Hayward fault, and Morgan Hill to Concord on the Calaveras fault.

Task P.2.5: The San Andreas fault in the San Francisco Bay region from about Woodside to San Juan Bautista.

Objective P-3: Theoretical, laboratory and fault zone studies.

Improve our understanding of the physics of earthquake processes through theoretical and laboratory studies to guide and test earthquake prediction observations and data analysis. Measure physical properties of those zones selected for focused earthquake prediction experiments, including stress, temperature, elastic and anelastic characteristics, pore pressure, and material properties.

Task P.3.1: Conduct theoretical investigations of failure and pre-failure processes and the nature of large-scale earthquake instability.

Task P.3.2: Conduct experimental studies of the dynamics of faulting and the constitutive properties of fault zone materials.

Tasks P.3.3: Through the use of drilled holes and appropriate down hole instruments, determine the physical state of the fault zone in regions of earthquake prediction experiments.

Tasks P.3.4: Study the causes and effects of induced seismicity and determine the physical conditions and tectonic settings of reservoir impoundment and fluid injection or withdrawal that give rise to associated seismicity.

ELEMENT III. REGIONAL EARTHQUAKE HAZARDS ASSESSMENTS

Delineate, document, evaluate, and assess earthquake hazards and risks in earthquake-prone geographic regions with large urban centers. Regions of interest in order of priority are: 1) Wasatch Front, 2) California, 3) Anchorage region, 4) Puget Sound, 5) Mississippi Valley, 6) Puerto Rico, 7) Charleston, South Carolina, region, 8) Boston region, and 9) Buffalo-Rochester region. The research objectives for each of these regions are as follows:

Objective R-1: Mapping and synthesis of geologic hazards and establishment of information systems.

Prepare syntheses of existing geologic, geophysical, seismological, and engineering data for the regional definition and mapping of at least one of the following hazards: ground shaking, surface faulting, liquefaction potential, ground failure, and tectonic deformation. Research to generate new data and interpretation may be proposed when prior synthesis has identified critical gaps in knowledge for a specific region. Creation of a basic information system(s) that will document the data and permit efficient communication with other researchers and policymakers should be addressed.

Objective R-2: Loss estimation modeling.

Develop and apply techniques for estimating earthquake losses.

Objective R-3: Implementation.

Develop and apply techniques that will foster the utilization of the basic data, synthesis reports, and research results. The eventual goal is for State and local governments to devise and implement loss-reduction measures.

PART II

SOLICITATION GUIDELINES

Proposals should cover the items listed below and should be direct, concise and informative. All items should be covered in the order shown. Proposals under objective (P-2) may be designed to run more than one year, provided that annual and final reports are included in the projects plans. The USGS reserves the right to make award selection for one or two years contingent on the recommendations of reviewers, satisfactory performance, programmatic considerations, and availability of funds.

General Guidelines:

* Applicants/offerors should limit the narrative portion of their applications/proposals to 15 single-spaced pages excluding figures, tables, references, etc.
* Separate proposals for collaborative studies from two or more organizations will be considered, but proposals should clearly define which tasks will be performed by which organization should two or more awards be made.
* Proposals for research on data from seismic networks are included in this solicitation; proposals for operating networks and standard analysis of data from these networks are not included in this solicitation.
* Proposals to use existing seismic or other data for studies pertaining to earthquake hazards assessments and earthquake prediction are encouraged.
* Earthquake hazard proposals that incorporate use of results by local or State agencies to mitigate hazards or reduce risk are encouraged.
* Proposals for studies in geographical areas where potential earthquake losses are low are not encouraged.
* Proposals for geologic investigations shall be clearly oriented toward earthquake hazards.
* Proposals to fund research in foreign areas will be considered if the following criteria are met: 1) where specifically invited in the individual element or task (see P-1), and 2) when the research will provide knowledge or new techniques transferable to a US seismogenic zone.
* Proposals for foreign research must be based on cooperation with scientific groups in host countries, with host country personnel being used for operational functions and host countries providing financial support for such personnel. Proposals for cooperative efforts with agencies of foreign governments may be subject to additional approvals within the U.S. Government.
* Proposals dealing with fundamental earthquake studies not directly related to the program goals, with earthquake engineering, or with research for utilization of technological findings in earthquake hazards mitigation (e.g. the preparedness, relief and rehabilitation, and the socio-economic

aspects of earthquake prediction) should be directed to the National Science Foundation.

* Two portable seismograph networks using digital recording, each with the capability of continuously recording up to twelve remote seismometers, are available for temporary deployment. Among proposals to use this equipment, the highest priority will be given to proposals to deploy the array(s) in the northeastern United States. One of these arrays is presently deployed in the New York City area, under the operation of Lamont-Doherty Geological Observatory of Columbia University. The other is still being operated in Pennsylvania by its developers at Pennsylvania State University. Proposals to use this equipment should include in their budgets funds to acquire any necessary radio links.

FORMAL PROPOSALS

Fifteen (15) copies of each formal proposal (signed original plus 14 copies) bearing all required official signatures should be sent or delivered directly to:

U.S. Geological Survey
National Center MS 205c
Branch of Procurement and Contracts
Room 1D104
12201 Sunrise Valley Drive
Reston, Virginia 22092

PROPOSALS MUST BE RECEIVED AT THE ABOVE LOCATION NO LATER THAN 5:00pm LOCAL TIME, ON MARCH 04, 1985.

For ease of handling, we request that proposals be submitted as simple photocopies, stapled rather than bound. Since left margin bindings must be removed in order to file the proposals, it is particularly inconvenient to handle proposals with Velo-type or other permanent bindings.

1. Cover Sheet -
   The cover page must include the information shown in Appendix A of this solicitation. The signed original should be so identified unless clearly distinguishable from copies. Remaining copies need not be signed. Each proposal submitted must indicate on the cover page the one program objective to which it responds. Please show the key symbol for the objective (i.e. T-3, P-1,) as shown in the "Research Elements" section of this solicitation. Where a proposal overlaps two or more program objectives the one program objective that is the most appropriate should be selected. Secondary key symbols may be shown if they are clearly labeled as such. Notwithstanding the objective indicated on the proposal, the USGS reserves the right to evaluate or fund a proposal under the program objective which the Survey believes the proposal most closely addresses.

2. Abstract - Summary for the Smithsonian Science Information Exchange (signed original). Include identification of the problem and a summmary of the approach, project objectives, anticipated results, and the implications of the project results. The Smithsonian Science Information Exchange page should conform to the format shown in Appendix B. Leave

blank the spaces entitled "Project No." and "Date project started." This page also serves as an abstract for use during the review process and should be included in each copy of the proposal. We also need an original to be submitted separately from proposal copy. This will be submitted to the Smithsonian Science Information Exchange only if the project is funded.

3. Table of Contents

4. Budget - a proposed budget should be prepared in the format which follows. Where the total cost of the proposed effort is expected to exceed the budget requested from the USGS, proposers must indicate the sources from which additional funds are committed and the amounts of those funds. Unusual items should be fully explained or justified as budget notes. The budget should indicate total project costs by major activities (if severable) or annually, if a multiyear project. Prior to negotiation and award, offerors usually will be requested to provide updated cost information and additional supporting detail, including incurred cost data from any previous or ongoing projects. The following information must be supplied in the proposal.
   a. Salaries and Wages. Identify individuals or categories of salary and wages, estimated hours or percent of time and rate of compensation proposed for each person or category. Identify any amounts included for overtime, premium pay, and/or shift differential. If the rate of pay shown is higher than the current rate of pay, include an explanation of amounts included for projected increases.
   b. Fringe Benefits/Labor Overhead. Propose rates/amounts in conformance with offeror's normal accounting procedures. Explain what costs are covered in this category and the basis of rate computations. Indicate whether rates are used for proposal purposes only or whether they are also fixed or provisional rates for billing purposes. (This element does not need to be shown separately from item "i." if the offeror's standard practice is to include such costs in a single overhead rate.)
   c. Equipment. Itemize any proposed permanent equipment acquisitions and show the estimated cost of each item. Include only items which are essential to the successful performance of the proposed research and of a type not chargeable to an indirect cost pool. (Also see paragraph "d" of this subpart.)
   d. Supplies and Expendable Equipment. Indicate amounts estimated for office, laboratory, computing, and field supplies separately. Provide detail on any specific item or other subcategory which represents a significant portion of the proposed amount. If fabrication of equipment is proposed, list parts and materials required for each and show costs separately from the other items.
   e. Subcontracts or Consultants. Identify the specific project tasks or problems for which such service would be used. List the contemplated subcontractors (including consultants), the estimated amount of time required, and the quoted rate per day or hour. If known, state whether the consultant's rate is the same as he/she has received for similar services commercially or under Government contracts.
   f. Travel. Itemize estimated travel costs to show the number of trips required, destinations, the number of people traveling and per diem rates, cost of transportation, and miscellaneous expenses for each trip. Calculations of other special transportation costs (such as

charges for use of contractor-owned vehicles or vehicle rental costs) should also be shown.

g. Publication Cost. Show estimated costs of publication (normally in scientific journals) of the results of the proposed research. Include costs for drafting or graphics, reproduction, page or illustration charges, and a minimum number of reprints. If not included under "Direct Labor" or "Other Direct Costs," the cost of manuscript typing may also be included here. Specific journals and page charges need not be shown unless the proposed costs are unusually high.

h. Other Direct Costs. Itemize different types of costs not included elsewhere, such as shipping, telemetry, computing, equipment use charges, age dating, or other services. Where appropriate, provide breakdowns showing how the cost was estimated. For example, computer time should show the type of computer, estimated time of use, and the established rates.

i. General and Administrative/Indirect Costs. Show proposed rate, cost base and proposed amount for allowable G & A or indirect costs based on the cost principles applicable to the offeror's organization. If the applicant/offeror has separate rates for recovery of Labor Overhead and G & A costs, each charge should be shown in the proposal in the most logical location. Explain the distinction between items included in the two costs pools.) Applicants/Offerors should propose rates for evaluation purposes which they are also willing to establish as fixed or ceiling rates in any resulting award. A copy of the approved rate agreement should be submitted.

j. Cost sharing. If only partial support for the research is requested, detail the nature and amount of the contribution to be made by each participant (including contributions "in-kind").

k. Total estimated cost.

l. Facilities Capital Cost of Money (CAS 414) (if applicable). Proposed amount must be supported be computations showing allocation base units identified with the contract and capital cost of money factor for the corresponding indirect cost pool. Form CASB-CMF should be used, if available.

m. Fee (if any).

n. Total estimated cost plus fixed fee.

o. Government-furnished materials or services. If performance of the project incorporates materials or services to be provided by the USGS and paid from operating funds of the Earthquake Hazards Reduction Program, identify these items and, if known, include an estimate of their costs.

5. Identification and Significance of the Project - a discussion of the specific problem being addressed and its importance. Also included should be a discussion of the significance of the contribution the project will make to the Earthquake Hazards Reduction Program and to the specific program objective addressed.

6. Project Plan - a discussion of the specific hypotheses or research questions, the conceptual framework or model to be used, the data collection and analysis plans, and continuing efforts. Plans should also include procedures to be used to insure objectivity and balance in the project. Plans for evaluation should also be discussed in this section.

7. Related Efforts - a description of significant related studies conducted by members of the project staff or by others, and discussion of any

planned coordination with other work in the field.

8. Final Report and Dissemination - the plans for dissemination of project outputs to relevant audiences should be discussed. The proposal should agree to provide a final report to the U.S. Geological Survey not more than ninety (90) days following the end of the award period.

9. Project Personnel and Bibliography of Directly Related Work - brief curricula vitae for the professional staff, summarizing education, related experience, and bibliographic information related to the proposed work.

10. Institutional Qualifications - should cover the resources available at, and the relevant experience of, the institution. Resources include personnel, computer, and library facilities, and ties to both sources of data and potential users of the results.

11. Project Management Plan - should include the time and cost schedule for the proposed work and the time allocations and responsibilities for the project staff members. It should also schedule progress reports.

12. Current Support and Pending Application - a listing of all sources of support, in addition to the proposed effort, to which the senior research personnel have committed a portion of their time for the period of the time covered by the proposal. The information should account for 100 percent of the work time of the senior investigators, and include titles, dates, and grant numbers of current grants or contracts, source of funds, annual budget levels, and the person-months committed in each case. The proposal must also list research which is being considered by or will be submitted to other possible sponsors. Concurrent submission will not jeopardize the likelihood of an award.

13. Government Property and Equipment Acquisitions
    a. Specify any Government-owned facilities, equipment or special tooling intended to be used in the performance of the proposed project, the Government contract under which the item is currently accountable, and other relevant information i.e., acquisition value, manufacturer, government control number, serial number,and model number. This listing should include any items valued over $1,000 authorized to be fabricated or purchased under current or pending contracts. If property controlled by another federal agency is needed to perform the proposed work, indicate whether their approval for its use has been obtained. State whether or not your organization has an approved Government Property Control System and provide the name of the approving agency.
    b. On Government contracts, the contractors are expected to provide all facilities and equipment necessary for performance of the contract. The USGS also expects grantees to furnish "standard use" items of equipment. USGS regulations state that funding for equipment acquisition normally will be limited to special and unique equipment that is required for the particular research project, but which would not be of great value as residual equipment. Therefore, if any new acquisitions are proposed, the offeror should include here an explanation of how the new equipment will be used and why it is essential for successful or efficient performance of the research.

14. ADDITIONAL DOCUMENTS -- In addition to the 15 copies of the formal proposals, we require a single, signed original of each of the following documents:
    1. Summary for the Smithsonian Science Information Exchange (Appendix B).
    2. Standard Form 424 (Appendix D).
    3. Representations, Certifications and Other Statements of Applicant/Offeror (Appendix E).

PROJECT MONITORING AND ADMINISTRATION

The Branch of Procurement and Contracts, U.S. Geological Survey, Reston, Virginia monitors management practices and fiscal matters concerning awards. Technical monitoring will be conducted by the Deputy and External Program staff. Reports on the progress of research projects will be required on all awards under this program. The types of reports and frequency of reporting will be as follows:

1. Technical Reports. Annual technical reports (8 copies) will be required on all projects. Such reports include a detailed discussion of scientific accomplishments, theoretical results and recommendations for continued research. An additional final report will be required upon the completion of the project, if it runs beyond one year. Although it is usually expected that research findings will also be discussed in journal articles, such publications will not be accepted in lieu of a report. Selected technical reports may also be published as U.S. Geological Survey Open-File Reports.

2. Project Summary. A project summary, not exceeding three pages, must be submitted semiannually for both contracts and grants. The project summaries are published in the semiannual Summaries of Technical Reports of the National Earthquake Hazards Reduction Program.

3. USGS Data Archive Submissions. For those awards that include collection of geophysical data over extended periods of time, a semi-annual data submission will be required for the USGS Data Archive. This submission shall include an index and/or narrative describing archiving procedures and a current catelog of available data. The computer format should be indicated.

4. Management Reports. Management Reports on contracts and Interim Progress Reports on grants are required quarterly. These are submitted in letter format and normally do not exceed one or two pages. Such reports are used to monitor project status and should briefly describe activities during the period and problems encountered. They also included administrative information such as status of funds, subcontracts awarded or property acquired during the period.

5. Samples, Photographs, Charts, Maps, Recording. Other data collected or recorded during the project period may also be requested by the Survey. For example, when the research project involves a matter of public concern or safety, the Survey may request and the recipients/offerors shall promptly provide, copies of, access to, or real time transmission of any data recorded or developed under an award resulting from this solicitation.

6. Published Papers. Five offprints of each published paper reporting USGS-supported contract, grant, or cooperative agreement will be required. Photocopies will be acceptable if off-prints are not available.

EVALUATION CRITERIA

Panels composed of expert scientists and engineers drawn from government, universities and private industry will evaluate the proposals submitted in response to this solicitation. Mail reviews may supplement panel evaluations. All proposals will be considered in accordance with the criteria set forth below. Each criterion (or factor) will carry equal weight in the evaluation.

1. Relevance and timeliness of the proposed research to the goals of the program.
2. Technical quality of the proposal. This factor considers the scientific merit of the proposed approach and the probability of achieving positive results within the designated period.
3. Competence of the investigator and his organization to perform the work. This factor considers the experience and competence of the proposing investigator(s) to perform the proposed research successfully, including their records of performance, and the capability of the investigators' organization to provide the necessary facilities and support, to insure that the proposed research will be completed satisfactorily.
4. Appropriateness and reasonableness of the budget. This factor considers whether the proposed budget is commensurate with the level of effort needed to accomplish the project objectives, and whether the cost of the project is reasonable relative to the value of the anticipated results.

The assembled panels will make recommendations and provide advice by ranking proposals into priority groupings. The results of the review will assist the USGS Office of Earthquakes, Volcanoes and Engineering in making final award selections under this RFP.

INSTRUCTIONS, CONDITIONS AND NOTICES TO APPLICANTS/OFFERORS

The applicant/offeror must follow the instructions contained herein and supply all information required. Failure to furnish necessary information may serve to disqualify a proposal. PROPOSALS MUST SET FORTH FULL, ACCURATE AND COMPLETE INFORMATION AS REQUIRED BY THIS SOLICITAION (INCLUDING ATTACHMENTS). THE PENALTY FOR MAKING FALSE STATEMENTS IS PRESCRIBED IN 18 U.S.C. 1001.

1. Proposals under all elements should follow the instructions in this Part II regarding preparation and submission of proposals. Except where specifically stated, the solicitation instructions and evaluation procedures for contract and asssistance proposals are the same.

2. Eligibility for Award
Any organization eligible to participate in competitive solicitations of the U.S. Government, meeting the rsponsibility standards in FAR Subpart 9.1 (for contracts), and complying with the administrative standards of OMB Circulars A-110 or A-102 (for assistance) is eligible for award under this solicitation. U.S. Government agencies and Federally-funded research and development centers are not eligible to participate.

3. Foreign Organizations
Proposals submitted by organizations outside the United States should be submitted in English and in U.S. dollars. Awards involving entities of foreign governments may require additional coordination and approval by the U.S. Department of State.

4. Notice of Applicable Small Business Size Standard: Non Set-aside
Research solicited under this RFP falls under Standard Industrial Classification code 7391. Therefore, the following small business size standard applies to this solicitation: 500 employees [FAR 19.102-4(b)]. This procurement is not set-aside for Small Business.

5. Exceptions to Solicitation Terms or Provisions
The submission of a proposal under this RFP will be construed as the applicant's/offeror's acknowledgement and acceptance of the terms and conditions of this solicitation, unless exceptions are specifically taken. Any such exceptions must be stated in a cover letter conveying the proposal.

6. Solicitation Provisions Incorporated by Reference (Contracts only)
(APR 1984) FAR 52.252-1
This solicitation incorporates the following provisions by reference, with the same force and effects as if they were given in full text. Upon request, the Contracting Officer will make their full text available. These provisions will be applicabe to Contracts Awarded.

I. FEDERAL ACQUISITION REGULATION (48 CFR CHAPTER 1) SOLICITATION PROVISIONS

Provision No.	Provision Title (and Date)
52.215.05	Solicitation Definitions (APR 1984)
52.215-07	Unnecessarily Elaborate Proposals or Quotations (APR 1984)
52.215-08	Acknowledgement of Amendment to Solicitations (APR 1984)

52.215-09	Submission to Offers (APR 1984)
52.215-10	Late Submissions, Modifications, and Withdrawals of Proposals (APR 1984)
52.215-13	Preparation to Offers (APR 1984)
52.215-14	Explanation to Prospective Offerors (APR 1984)
52.215-15	Failure to Submit Offer (APR 1984)
52.215-16*	Contract Award (APR 1984)
52.215-18	Order of Precedence (APR 1984)
52.220-01	Preference for Labor Surplus Area Concerns (APR 1984)
52.222-45*	Notice of Compensation for Professional Employees (APR 1984)
52.222-46*	Evaluation of Compensation for Professional Employees (APR 1984)

* Indicates provision applicable only to contracts.

II. DEPARTMENT OF THE INTERIOR ACQUISITION REGULATION (48 CFR CHAPTER 14) SOLICITATION PROVISIONS

Provision No.	Provision Title (and Date)
1452.215-70	Use and Disclosure of Proposal Information--Department of the Interior (APR 1984)

7. Examination of Solicitation

Applicants/Offerors are requested to examine the solicitation and its Table of Contents to make sure that all sheets and pages mentioned are attached. Any material found to be missing will be supplied upon request. The Government assumes no responsibility for a proposal submitted on the basis of an incomplete solicitation package.

8. Limitation of Government Obligations

A. Issuance of this solicitation does not constitute an award commitment on the part of the Government. This request does not commit the Government to pay for costs incurred in submission of a proposal or in anticipation of receiving a contract award. It is understood that your proposal will become part of the official file on this matter without obligation to the Government.

B. The Contracting Officer is the only individual authorized to commit the Government to an expenditure of public funds. No cost incurred before receipt of a signed contract/grant can be charged to the proposed award without the specific written authorization of the Contracting Officer.

9. Availability of Referenced USGS Open File Reports

Copies of USGS Open File documents referenced in this solicitation can be obtained by interested offerors at standard Open File prices. Copies should be requested from Open File Services Section, MS-306, U.S. Geological Survey. Box 25425, Denver Federal Center, Denver, Colorado 80225.

10. Award Selections

Awards will be made to responsible applicants/offerors whose offers conform to the solicitation and are determined to be most advantageous to the Government, individually and as part of the assembled program. The USGS reserves the right to select proposals for award (full or partial) based on original offers received, without affording offerors an opportunity to supplement or improve their proposals. Accordingly it is important that each proposal include all

the information needed for evaluation, and that it be submitted on the most favorable terms, from a cost and technical standpoint, that the applicant/offeror can submit to the Government.

11. Notification to Applicants/Offerors

A. It is expected that preliminary award selections will be made in June or July of 1985, and that all applicants/offerors will be notified in writing of the status of their proposal(s) shortly thereafter. To expedite this process, we request that Principal Investigator (P.I.) and (if different) Business Office mailing addresses be provided on the proposal cover page. If separate P.I. and Business Office addresses are not shown, a single notice will be sent to the general organizational address. If more than one P.I. is shown, a notice copy will be sent only to the first investigator listed. Please do not call the USGS with inquiries about funding status, as no advance information will be provided.

B. No debriefing will be provided to unsuccessful applicants/offerors unless specifically requested. In accordance with regulations applicable to negotiated procurements, information concerning a proposal cannot be disclosed to another party until after award, and then may be released only as authorized by the Freedom of Information Act.

REQUIREMENTS AND CONTENTS OF RESULTANT AWARDS

1. Awards on selected proposals are expected to be made between October 1985 and April 1986.

2. Types of Awards

The Government contemplates award of cost-reimbursement (cost, cost-sharing, or cost-plus-fixed-fee) contracts, as well as grants and/or cooperative agreements.

3. Contract Form

In most cases, contracts awarded under this solicitation will be completion form requiring achievement of a stated milestone or goal or completion of specified tasks. In a few cases, such as research involving multiyear data collection and analysis efforts, level-of-effort or term form contracts, requiring devotion of a specified level of effort over a stated period of time, may be considered more appropriate.

4. Applicable Cost Principles

Cost principles for resulting awards (grants and contracts) will be selected from those described in FAR, Part 31, entitled "Contract Cost Principles and Procedures," incorporating the current revision of the Office of Management and Budget (OMB) Circular applicable to the offeror's type of organization. These are:

FAR 31.2 Commercial Organizations and certain Nonprofit Organization excluded from coverage of OMB.Circ. A-122
FAR 31.3 OMB Circ. A-21 (Feb. 79)-Educational Institutions
FAR 31.6 OMB Circ. A-122 (May 84)-Nonprofit Organizations
FAR 31.7 OMB Circ. A-87 (Jan. 81)-State and Local Governments

5. Indirect Cost

Applicants/Offerors will be bound to establish, in the resulting grant or contract, predetermined or ceiling rate(s) for reimbursement of indirect costs (including G & A) no higher than the rate(s) included in the offeror's cost

proposal.

6. Assistance Awards

Grants or Cooperative Agreements will include the Assurances found in Appendix C of this RFP, as well as DOI and USGS assistance provisions incorporating the administrative standards and requirements of OMB Circulars A-102 (for state and local governments) and A-110 (for educational institutions and other non-profit organizations).. For-profit concerns are also eligible for assistance awards and will be expected to comply with the standards of OMB Circular A-110 until separate standards are issued by OMB. Assistance awards may not include any element of fee or profit.

7. Contract Awards

Contracts awarded under this RFP will contain clauses required by the Federal Acquisition Regulation, Department of the Interior Acquisition Regulation, OMB Circulars, and USGS procedures in effect at time of award. Following are lists of clauses currently required, as applicable, to contract awards under this program, and which will be incorporated into resultant contracts unless superceded by subsequent regulatory changes. The (*) following the clause number indicates a provision which may not be applicable to all awards.

8. Clauses Incorporated by Reference

The resulting contracts will incorporate the following clauses by reference. Upon request, the Contracting Officer will make the full text of any or all of these clauses available.

I. FEDERAL ACQUISITION REGULATION (48 CFR CHAPTER 1) CLAUSES--

Clause No.	Clause Title (and Date)
52.202-01	Definitions (APR 1984)
52.203-01	Officials Not to Benefit (APR 1984)
52.203-03	Gratuities (APR 1984)
52.203-05	Covenant Against Contingent Fees (APR 1984)
52.215-01	Examination of Records by Comptroller General (APR 1984)
52.215-02	Audit-Negotiations (APR 1984)
52.215-30	Facilities Capital Cost of Money (APR 1984)
52.215-31	Waiver of Facilities Capital Cost of Money (APR 1984)
52.216-07	Allowable Cost and Payment (APR 1984)
52.216.08*	Fixed Fee (APR 1984)
52.216-11*	Cost Contract-No Fee (APR 1984)
52.216-11*	Cost Contract-No Fee--Alternate I (APR 1984)
52.216-12*	Cost Sharing Contract No Fee (APR 1984)
52.216-12*	Cost Sharing Contract No Fee--Alternate I (APR 1984)
52.216-15*	Predetermined Indirect Cost Rates (APR 1984)
52.219-08	Utilization of Small Business Concerns and Small Disadvantaged Business Concerns (APR 1984)
52.219-13	Utilization of Women-Owned Small Businesses (APR 1984)
52.220-03	Utilization of Labor Surplus Area Concerns (APR 1984)
52.222-03	Convict Labor (APR 1984)
52.222-20	Walsh-Healy Public Contracts Act (APR 1984)
52.222-26	Equal Opportunity (APR 1984)
52.222-29*	Notification of Visa Denial (APR 1984)
52.222-35	Affirmative Action for Special Disabled and Vietnam Era Veterans (APR 1984)

52.222-36	Affirmative Action for Handicapped Workers (APR 1984)
52.225-03	Buy American Act-Supplies (APR 1984)
52.228-06*	Insurance-Immunity From Tort Liability (APR 1984)
52.228-06*	Insurance-Immunity From Tort Liability - Alternate I (APR 1984)
52.229-08*	Taxes-Foreign Cost Reimbursement Contracts (APR 1984)
52.232-09	Limitation on Withholding of Payments (APR 1984)
52.232-17	Interest (APR 1984)
52.232-18*	Availability of Funds (APR 1984)
52.232-20*	Limitation of Cost (APR 1984)
52.232-22*	Limitation of Funds (APR 1984)
52.232-23	Assignment of Claims (APR 1984)
52.233-01	Disputes (APR 1984)
52.244-05	Competition in Subcontracting (APR 1984)
52.245-05*	Government Property (Cost Reimbursement, Time and Material, or Labor-Hour Contracts- Alternate I (APR 1984)
Clause No.	Clause Title (and Date)
52.246-09	Inspection of Research and Development (Short Form) (APR 1984)
52.246-25	Limitation of Liability-Services (APR 1984)
52.247-01	Commercial Bill of Lading Notations (APR 1984)
52.247-34	F.o.b. Destination (APR 1984)
52.247-63	Preference for U.S. Flag Air Carriers (APR 1984)
52.247-64*	Preference for Privately Owned U.S. Flag Commercial Vessels (APR 1984)
52.247-64*	Preference for Privately Owned U.S. Flag Commercial Vessels-Alternate I (APR 1984)
52.249-05*	Termination for the Convenience of the Goverrnment (Educational and Other Non-Profit Institutions) (APR 1984)
52.249-06*	Termination (Cost Reimbursement) (APR 1984)
52.249-06*	Termination (Cost Reimbursement) - Alternate II (APR 1984)
52.249-14*	Excusable Delays (APR 1984)
52.251-01*	Government Supply Sources (APR 1984)
52.251-02*	Interagency Motor Pool Vehicles and Related Services (APR 1984)
52.242-01	Notice to Intent to Disallow Costs (APR 1984)
52.243-02	Changes-Cost Reimbursement-Alternate V (APR 1984)
52.244-02	Subcontracts Under Cost Reimbursement and Letter Contracts (APR 1984)

Additional clauses required over $100,000:

52.215-22	Price Reduction for Defective Cost or Pricing Data (APR 1984)
52.215-24	Subcontractor Cost or Pricing Data (APR 1984) The dollar threshold of $500,000 cited in FAR 52.215-24 is hereby reduced to $100,000.
52.222-02	Payment for Overtime Premium (APR 1984)
52.232-02	Clean Air and Water (APR 1984)

Additional clauses required over $500,000:

52.219-09*	Small Business and Small Disadvantaged Business

52.219-09*	Subcontracting Plan (APR 1984)
52.220-04*	Labor Surplus Area Subcontracting Program (APR 1984)
52.230-03*	Cost Accounting Standards (APR 1984)
52.230-04*	Administration of Cost Accounting Standards (APR 1984)
52.230-05*	Disclosure and Consistency of Cost Accounting Practices (APR 1984)
52.230-06*	Consistency in Cost Accounting Practices (APR 1984)

II. DEPARTMENT OF THE INTERIOR ACQUISITION REGULATION (48 CFR CHAPTER 14) CLAUSES

Clause No.	Clause Title (and Date)
1452.204-70	Release of Claims -- Department of the Interior (APR 1984)
1452.215-70	Examination of Records by the Department of the Interior(APR 1984)

III. DEPARTMENT OF DEFENSE FAR SUPPLEMENT (48 CFR CHAPTER 2) CLAUSES

52.227-7015	Rights in Technical Data - Specific Acquisition (MAR 1979)
52.227-7030	Technical Data - Withholding of Payment (JUL 1976)

9. Additional Clauses

The additional clauses listed below will be included in full text in resulting contracts, as applicable.

I. FEDERAL ACQUISITION REGULATION (48 CFR CHAPTER 1) CLAUSES

Clause No.	Clause Title (and Date)
52.252-6	Authorized Deviations in Clauses (APR 1984)
52.232-12*	Advance Payments - Alternate I, Alternate II, Alternate IV all (APR 1984), (Letter of Credit)

NOTE: Letter of credit financing is available only to state and local governments, public and educational institutions, and other nonprofit organizations meeting requirements of Treasury Department Circular 1075 (31 CFR 205) and implementing regulations and instructions. No other form of advance payments will be made under resultant contracts.

II. DEPT. OF THE INTERIOR ACQUISITION REGULATION (48 CFR CHAPTER 14) CLAUSES

Clause No.	Clause Title (and Date)
1452.228-7	Insurance--Liability to Third Persons (APR 1984) FAR 52.228-7 (DEVIATION) (APR 1984)
1452.228-70	Indemnification--Department of Interior (APR 1984)

III. CLAUSES NOT YET FOUND IN AGENCY ACQUISITION REGULATIONS, BUT WHICH REMAIN APPLICABLE TO U.S. GOVERNMENTS CONTRACTS

Reference	Clause Title (and Date)
Temp. Reg.70	Contract Work Hours and Safety Standards Act--Overtime Compensation (JUL 1983) (FPR 1-12.303 a)
Temp. Reg.70	Payrolls and Basic Records (JUL 1983) (FPR 1-12.303 c)
OMB Circ. A-124	Standard Patent Rights Clause (APR 1984)

PART III

LIST OF CURRENT RESEARCH PROJECTS

I. Current Research Contracts and Grants Supported by the Earthquake Hazards Reduction Program

II. Research Projects Conducted by the U.S. Geological Survey FY85

PART III

I. CURRENT RESEARCH CONTRACTS AND GRANTS SUPPORTED BY THE EARTHQUAKE HAZARDS REDUCTION PROGRAM

The current research projects supported by the Earthquake Hazards Reduction Program are grouped under the major areas of interest in this solicitation. When a project overlaps two or more of the subject areas it is listed under the subject area most applicable.

PROGRAM ELEMENT I - RECENT TECTONICS AND EARTHQUAKE POTENTIAL

Objective T-1: Regional Seismic Monitoring

Institution	Principal Investigator(s)	Title
California Institute of Technology	Allen	Support of Joint USGS-Caltech Southern California Seismograph Network
University of California, San Diego	Berger Brune	Seismic Source Mechanism Studies in the Anza-Coyote Seismic Gap
University of Colorado	Kisslinger Billington	Central Aleutian Islands Seismic Network
Lamont-Doherty Geol. Obs. of Columbia University	Jacob	Seismic Monitoring of the Shumagin Gap' Alaska
	Seeber Sykes	Earthquake Hazard Studies in North-eastern United States
University of Nevada, Reno	Ryall Vetter Nicks	Western Great Basin - Eastern Sierra Nevada Seismic Network
Saint Louis University	Stauder Herrmann	Regional Microearthquake Network in the Central Mississippi Valley
University of Southern California	Teng Henyey	Earthquake Hazard Research in the Greater Los Angeles Basin and its Offshore Area
University of Utah	Arabasz Smith	Regional Seismic Monitoring Along the Wasatch Front Urban Corridor and Adjacent Intermountain Seismic Belt
University of Washington	Crosson Malone	Regional Seismic Monitoring in Western Washington

Objective T-2: Source Zone Characteristics

Institution	Principal Investigator(s)	Title
University of California, Santa Cruz	McNally	Fault Mapping to Determine Source Zone Structure and Influence on Variable Rupture Mode of Earthquakes in California
Humboldt State University	Kelsey Carver	Investigations of Recent Crustal Deformation in Northwestern California
Lamont-Doherty Geol. Obs. of Columbia University	Seeber Sykes	Earthquake Hazard Studies Using Network and Geologic Data in New York State
Lamont-Doherty Geol. Obs. of Columbia University	Sykes Seeber	Great Earthquakes and Great Asperities, Southern California: A Program of Data Analysis
Pennsylvania State University	Langston	Waveform Analysis of New Brunswick Earthquake Aftershock Data
Rondout Associates, Inc.	Sutton	Prediction of Ground Motion from the Goodnow, New York Earthquake of 7 October 1983
Saint Louis University	Herrmann	Earthquake Hazard Research in the Central Mississippi Valley
University of Utah	Smith Arabasz	Integrated Studies of Earthquake Source Zone Characteristics, Hazards & Prediction in the Wasatch Front Urban Corridor & Adjacent Intermountain Seismic Belt
University of Washington	Crosson	Earthquake Hazard Investigations in the Pacific Northwest

Objctive T-3: Earthquake Potential

Institution	Principal Investigator(s)	Title
University of Arizona	Bull Pearthree Fonseca	Detailed Geomorphic Studies to Define Late Quaternary Fault Behavior and Seismic Hazard, Central Nevada Seismic Belt

Institution	Principal Investigator(s)	Title
Boston College	Ebel	Measurements of Northeastern North America Earthquake Magnitudes from 1938 to 1975
California Institute of Technology	Sieh Stuiver Brillinger	Very Precise Dating of Earthquakes at Pallett Creek and Their Interpretation
California Institute of Technology	Sieh	Active Tectonics of the San Andreas Fault System in Southern California
Foothill-DeAnza Community College	Hall Hay Cotton	The Use of Radiocarbon in Paleoseismic Investigations on the San Andreas Fault
University of Idaho	Cochran Sprenke	Dating of Holocene Fault Movements in Idaho using Primary Tephra
Lamar-Merifield Geologists, Inc.	Lamar Merifield	Additional Work to Date Probable Earthquake Deformed Beds in Kern Lake, Kern County, California
Lamar-Merifield Geologists, Inc.	Merifield Lamar	Study of Seismic Activity by Selective Trenching Along the San Jacinto Fault Zone, Southern California
Massachusetts Institute of Technology	Toksoz Pulli	Source and Path Effects for Northeastern U.S. Earthquakes - Implications for Earthquake Hazards
University of Nevada, Reno	Ryall Vetter Corbett	Earthquake Research in the Western Great Basin
Oregon State University	Yeats Berryman	Recognition of Individual Earthquakes on Thrust Faults
San Diego State University	Rockwell	Late Quaternary Tectonic Rates Agua Blanca and Borderland Faults

PROGRAM ELEMENT II - EARTHQUAKE PREDICTION RESEARCH

Objective P-1: Prediction Methodology and Evaluation

Institution	Principal Investigator(s)	Title
California Institute of Technology	Kanamori	Seismological Study on Rupture Mode of Seismic Gaps

Institution	Principal Investigator(s)	Title
University of California, San Diego	Zumberge Agnew	Absolute Gravity Measurements in Long Valley, California
University of California, Santa Barbara	Malin	Study of Parkfield Earthquakes Using Vertical Seismic Profiling
University of California, Santa Cruz	McNally	Determination of "Whole Earthquake Cycle" Systematics: Cont. Studies of Large Earthquakes (M_S=7-7.5)...to Refine Methodologies & Models for Earthquake Prediction
University of Colorado	Levine	Installation of a Borehole Tiltmeter at Pinon Flat Observatory, California
Cornell University	Isacks	Search for Precursors to Earthquakes in the Vanuatu Island Arc by Monitoring Seismicity and Tilt
Georgia Institute of Technology	Habermann	Quantitative Determination of the Detection History of the California Seismicity Catalog
Lamont-Doherty Geo. Obs. of Columbia University	Bilham Beavan	Crustal Deformation Observatory Part F
Lamont-Doherty Geo. Obs. of Columbia University	Bilham Beavan	Crustal Deformation Measurements in the Shumagin Seismic Gap, Alaska
Lamont-Doherty Geo. Obs. of Columbia University	Jacob Taber	Analysis of Seismic Data from the Shumagin Seismic Gap, Alaska
Massachusetts Institute of Technology	Toksoz	Seismicity and Earthquake Prediction Studies in Turkey Earthquake Source Asperities and Their Relationship to Precursors
Northwestern University	Rudnicki	Coupled Deformation - Pore Fluid Diffusion Effects in Fault Rupture
University of Queensland	Gladwin	Tectonomagnetic Monitoring of Large Earthquakes in the South Pacific Region

Institution	Principal Investigator(s)	Title
Redwood Research, Inc.	Kelleher	Seismicity Processes Before Great Chilean Earthquakes
University of Southern California	Aki	Analysis of USGS Local Seismic Network Data for Earthquake Prediction
		Theory and Strategy of Earthquake Prediction
	Hauksson Teng	Analysis of Earthquake Data from the Greater Los Angeles Basin and Adjacent Offshore Area, Southern California

Objective P-2: Earthquake Prediction Experiments

Institution	Principal Investigator(s)	Title
California Institute of Technology	Allen Sieh	Continuation of Creep and Strain Studies in Southern California
	Kanamori Allen Clayton	Earthquake and Seismicity Research Using SCARLET and CEDAR
University of California, Berkeley	McEvilly	In Situ Seismic Wave Velocity Monitoring
		Differential Measurement of Seismic Wave Amplitude and Travel-Time Changes at Parkfield, California
University of California, Los Angeles	Jackson Davis	Crustal Deformation Observatory, Part A: Organization and Data Analysis
University of California, San Diego	Agnew Wyatt Jackson Zurn	Crustal Deformation Observatory: Part J Askania Borehole Tiltmeter
	Agnew Berger Wyatt	Pinon Flat Observatory: A Facility for Studies of Crustal Deformation
		Crustal Deformation Observatory Program and Related Studies at Pinon Flat Observatory

Institution	Principal Investigator(s)	Title
University of California, Santa Barbara	Sylvester	Nearfield Geodetic Investigations of Crustal Movements, Southern California
University of California, Santa Cruz	McCally	Seismicity Studies for Earthquake Prediction in Southern California
Cambridge University	Owen	Crustal Deformation Observatory Part E
University of Colorado	Whitcomb	Continuation of Gravimetric Monitoring in Southern California
Lamar-Merifield Geologists, Inc.	Merifield Lamar	Hydrological & Geochemical Monitoring in Area of Palmdale Uplift and San Jacinto Fault Zone, Southern California
Lamont-Doherty Geol. Obs. of Columbia University	Bilham Beavan	Tectonic Tilt Measurement: Salton Sea
Massachusetts Institute of Technology	Toksoz Reilinger	Analysis & Interpretation of Releveling & Other Geodetic Obs. in Seismically Active Areas in the Western U.S.: Implications for Earthquake Prediction
University of Queensland	Gladwin	Deep Borehole Plane Strain Monitoring
Saint Louis University	Morrissey	Tiltmeter & Earthquake Prediction Research Program in Southern California and at Adak, Alaska
		Crustal Deformation Observatory, Part I, Borehole Tiltmeters
		Southern California Cooperative Tiltmeter Program at Parkfield and Mammoth Lake
San Francisco State University	Galehouse	Theodolite Measurements of Creep Rates on San Francisco Bay Region Faults
University of Southern California	Henyey Lund	Deepwell Monitoring Along the Southern San Andreas Fault
	Leary	Strainmeter and Creepmeter Studies Along the Southern San Andreas Fault

Institution	Principal Investigator(s)	Title
University of Southern California	Teng	Groundwater Radon Studies for Earthquake Precursors in Southern California

Objective P-3: Theoretical, Laboratory and Fault Zone Studies

Institution	Principal Investigator(s)	Title
Brown University	Tullis Weeks	Experiments on Rock Friction Constitutive Laws Applied to Earthquake Instability Analysis
Harvard University	Rice	Stressing, Seismicity and Rupture of Slip-Deficient Fault Zones
Lamont-Doherty Geol. Obs. of Columbia University	Das	Numerical Studies of Spontaneous Fracture Processes and Earthquake Fault Mechanics
University of Liverpool	Watterson	Direct Measurement and Contouring of Variable Slip on Single Fault Planes and Fault Plane Arrays
University of Southern Maine	Swanson	Shear Fracture Geometry of Pseudotachylyte Generation Zones and the Internal Structure of Brittle Seismic Fault Systems
Massachusetts Institute of Technology	Li	3-D Fault Behavior with Rate-Dependent Fault Constitutive Laws and Full Coupling to the Asthenosphere
Texas A & M University	Logan	Laboratory and Theoretical Studies of Constitutive Relations and Fault Zone Properties
University of Utah	Bruhn Parry	Thermal, Mechanical and Chemical History of Wasatch Fault Cataclasite and Phyllonite Traverse Mountain - Corner Creek Area, Salt Lake City, Utah

Objective P-4: Induced Seismicity Studies

Institution	Principal Investigator(s)	Title
Lamont-Doherty Geol. Obs. of Columbia University	Simpson Leith Davis	Earthquake Prediction and Induced Seismicity in Soviet Central Asia
Lamont-Doherty Geo. Obs. of Columbia University	Simpson	Induced Seismicity at Aswan Reservoir
University of South Carolina	Talwani	Study of Reservoir Induced Seismicity in South Carolina
University of Wisconsin, Madison	Haimson Roeloffs	Effects of Rock Mass Discontinuities and Heterogeneities on Strength Changes Under Reservoir Loads

PROGRAM ELEMENT III - EVALUATION OF REGIONAL AND URBAN EARTHQUAKE HAZARDS

Objective U-2: Mapping and Synthesis of Geologic Hazards

Institution	Principal Investigator(s)	Title
California Institute of Technology	Sieh	Evaluation of Quaternary Fault Slip Rate Data as a Basis for Assessing Seismic Hazard in California
Dames & Moore	Keaton Currey	Earthquake Hazard Evaluation Jordan Valley Fault Zone, Salt Lake City Urban Area, Utah
Saint Louis University	Nuttli Herrmann	Preparation of a Book Manuscript that Will Provide a Dynamic Account of the 1886 South Carolina Earthquake
Stanford Universiy	Shah	Investigations of the Applicability of Fuzzy Calculus to Seismic Risk Determination for the Eastern United States
Utah State	Anderson Keaton	Development of a Liquefaction Potential Map for the Northern Wasatch Front, Utah
Woodward-Clyde Consultants	Moriwaki Youngs	Evaluation of Ground Failure Susceptibility, Opportunity and Potential in the Anchorage, Alaska Urban Area

Objective U-3: Ground Motion Modeling

Institution	Principal Investigator(s)	Title
S-Cubed	Barker Stevens	Rayleigh Wave Inversion for Estimation of Local Site Effects in the Imperial Valley and Urban San Diego
University of Southern California	Dravinski	Strong Ground Motion of the Los Angeles Basin
University of Texas, Austin	Stokoe	Field Investigation of Gravelly and Sandy Soils Which Did and Did Not Liquefy During the 1983 Borah Peak, Idaho Earthquake

Objective U-4: Loss Estimation Modeling

Institution	Principal Investigator(s)	Title
State of California Division of Mines & Geology	Davis Steinbrugge	Evaluation of the Effects of a Large Earthquake on the Newport-Inglewood Fault: Development of an Earthquake Response Planning Scenario
J.H. Wiggins Co.	Taylor	A Systems Approach to Wasatch Front Seismic Risk Problems

PART III

II. RESEARCH PROJECTS CONDUCTED BY THE USGS IN FY85

EARTHQUAKE HAZARDS ELEMENT I - CURRENT TECTONICS AND EARTHQUAKE POTENTIAL STUDIES

OBJECTIVE 1: REGIONAL SEISMIC MONITORING

Project Leader	Project Title
Lester	No. California Seismic Studies
Lahr	Alaska Seismic Studies
VanSchaack	Field Experiment Operations
Hall	Central California Net Operations
Stewart	Consolidated Digital Recording
Bekins	Seismo. Data Processing
VanSchaack	Data Processing Center

OBJECTIVE 2: IDENTIFICATION OF SOURCE ZONE CHARACTERISTICS

Project Leader	Project Title
Pohn	Eastern U.S. Earthquakes
Wentworth	Neotectonic Studies of the U.S.
Hanks	Recurrence Intervals
Weaver	Geoth. Seismo-Tectonic Studies
Oppenheimer	Earthquake Studies, Geysers Area
Plafker	Alaska Geological Earthquake Hazards
Harding	Invest., Seismic Wave Propagation
Irwin	Tectonics, Central-North California
Ross	Basement Tectonic Framework Studies
Sharp	Salton Trough Tectonics
Sims	Geological Studies, Central San Andreas
Langer	Seismological Field Investigations
Bufe	Applied Global Tectonics
Unger	Reflect. Seis., Eastern U.S.

OBJECTIVE 3: EARTHQUAKE POTENTIAL ESTIMATES

Project Leader	Project Title
Bucknam	Characteristics, Active Faults
Lajoie	Coastal Tectonics, Western USA
Bonilla	Surface Faulting Studies
Clark	Slip Rates, California, Active Faults
Brown	Tectonic Synthesis, N. San Andreas

EARTHQUAKE HAZARDS ELEMENT II - EARTHQUAKE PREDICTION RESEARCH

OBJECTIVE 1: DEVELOP METHODS TO PROVIDE A RATIONAL BASIS FOR ESTIMATES OF INCREASED EARTHQUAKE POTENTIAL

Project Leader	Project Title
Evernden	Intensities and China Program
Castle	Holocene and Quaternary Studies
Choy	Remote Monitoring
Cockerham	Seismic Analysis, Northern California
White	Central American Seismic Studies
Lee	Microearthquake Data Analysis
Johnson	So. California Seismic Network
Bakun	Digital Processing, Seismic Data
Reasenberg	Seismic Studies, Fault Mechanics
Prescott	Crustal Strain
King	Fault Mechanics and Chemistry
Mueller	Magnetometer Net Operations
Sato	Geochemical, Gas-forming Elements
Jachens	San Andreas Earthquake
Jensen	Instru. Development and Quality Control
Wesson	Earthquake Processes

OBJECTIVE 2: CONDUCT EARTHQUAKE PREDICTION EXPERIMENTS

Project Leader	Project Title
Boatwright & Fletcher	Natural Seismicity at Anza
Lindh	Parkfield Seismic Project
Mooney	Crustal Studies
Lachenbruch	Drilling Operations
Thatcher	Modeling/ Monitoring Crustal Deformation
Langbein	Geodetic Strain Monitoring
Burford	Parkfield Areal Strain Monit.
Urban	Borehole Studies
Myren	Dilatometer Net Operations
Zoback	Technical Support
Allen	On-line Seismic Processing
Mavko	Creep/Alinement Arrays
Herriot	Low Frequency Data Network
Mortensen	Tilt & Strain Instrumentation
Johnston	Tilt, Strain & Mag. Field Obs.

OBJECTIVE 3: IMPROVE UNDERSTANDING OF THE PHYSICS OF THE EARTHQUAKE PROCESS AND DETERMINE THE PROPERTIES AND CHARACTERISTICS OF FAULT ZONES THROUGH THEORETICAL, LABORATORY, AND FIELD STUDIES

Project Leader	Project Title
Julian	EQ & Crustal Heterogeneity
Segal	Mechanics fo Geologic Structures
Simpson	Fault Patterns and Strain Budgets

Stuart	Earthquake Forecast Models
Shaw	Geologic Rate Processes
Robertson	Rock Deformation
Byerlee	Rock Mechanics
Kirby	Experimental Rock Mechanics
Dietrich	Mechanics of Earthquake Faulting
Harper	Machine Shop Services
Byerlee	Permeability of Hot Rocks
Lachenbruch	Geothermal Studies
Healy	In-Situ Stress Measurements

OBJECTIVE 4: UNDERSTAND THE CAUSE AND EFFECTS OF INDUCED SEISMICITY

Project Leader	Project Title
Spence	Delores River Desalinazation
Iyer	Koyna Reservoir, India
Byerlee	Permeability of Fault Zones

EARTHQUAKE HAZARDS ELEMENT III - REGIONAL EARTHQUAKE HAZARDS ASSESSMENTS

Data Processing

OBJECTIVE 1: EARTHQUAKE HAZARDS ASSESSMENTS OF THE URBAN REGIONS OF THE WESTERN UNITED STATES, ALASKA, AND HAWAII

Project Leader	Project Title
Morton	Geologic Map, San Bernardino Area
Tinsley	Quaternary Framework, Los Angeles
Harden	Soil Development
Jaksha	Socorro Magma Bodies
Tarr	Source Properties, G. Basin EQs
Tarr	Seismic Data Processing
Schmoll	Coal Resources of Alaska
Matti	Earthquake Hazards, Southern Calif.
Yerkes	Eq. Hazards, Transverse Ranges
Wallace	Tectonics of Active Faults
Youd	Liquefaction Potential
Ziony	So. Calif. Earthquake Hazards
Chen	Analytical Inves., Liquefaction
Zoback	Geoph./Tec. Inves., Intermountain
Algermissen	Reg./Natl., Hazards & Risk Assess.
Anderson	Hazards, Eastern Great Basin
King	Urban Hazards Investigations
Buchanan	Seismic Hazards, Hilo, Hawaii
Espinosa	Seismic Hazards, Anchorage
Rogers	Ground Shaking--Wasatch Front
Madole	Landslide Ages and Recurrence
Campbell	Geol./Slopes, West. Trans. Ranges
Joyner	Estimation Strong Ground Motion
Harp	Slope Stability, Wasatch Front
Hays	Implementation, Wasatch

OBJECTIVE 2: EARTHQUAKE HAZARDS ASSESSMENTS IN THE URBAN REGIONS OF THE EASTERN UNITED STATES, PUERTO RICO, AND THE U.S. VIRGIN ISLANDS

Project Leader	Project Title
Ratcliff	Northeastern Seismicity & Tectonics
Mckeown	Intraplate Seismic Source Zones

EARTHQUAKE HAZARDS ELEMENT IV. - DATA AND INFORMATION SERVICES TO THE PUBLIC

Data Processing

OBJECTIVE 1: INSTALL, OPERATE, MAINTAIN, AND IMPROVE STANDARDIZED NETWORKS SEISMOGRAPH STATIONS AND PROCESS AND PROVIDE DIGITAL SEISMIC DATA ON MAGNETIC TAPE IN NETWORK-DAY TAPE FORMAT.

Project Leader	Project Title
Kerry	Seismic Observatories
Britton	WWSSN & Coop Obs.
Clark	Systems Engineering
Reynolds	Digital Network Operations
Peterson	Global Network Eval. & Devel.
McCarthy	Seismic Review and Data Services
Hoffman	Data Processing

OBJECTIVE 2: PROVIDE SEISMOLOGICAL DATA AND INFORMATION SERVICES TO THE PUBLIC AND TO THE SEISMOLOGICAL RESEARCH COMMUNITY

Project Leader	Project Title
Carlson	U.S. Seismic Network
Dewey	Reanalysis, U.S. Earthquakes
Spence	Seismicity and Tectonics
Choy	Earth Structure and Wave Tect.
Buland	Digital Data Analysis
Person	Natl. Earthquake Inform. Center
Stover	U.S. Earthquakes
Engdahl	Global Seismicity
Taggart	Natl. Earthquake Catalog

EARTHQUAKE HAZARDS ELEMENT V. - ENGINEERING SEISMOLOGY

OBJECTIVE 1: STRONG MOTION DATA ACQUISITION AND MANAGEMENT

Project Leader	Project Title
Vinton	Natl. Strong Motion Data Center
Warrick & Borcherdt	Digital Data, Strong Motion Seis.
Brady & Bycroft	Strong Motion Data Management
Brady & Bycroft	Soil Structure/Structural Response
Borcherdt	Coord., Natl. Strong Motion Program

Etheredge	Strong-Motion Net Operations
Vanschaack	Portable Digital Instrum. Develop.

OBJECTIVE 2: STRONG GROUND MOTION ANALYSIS AND THEORY

Project Leader	Project Title
Etheredge	Strong Ground Motion Data Analysis
Boore	Ground Motion Prediction
Joyner	
Andrews	Physics of Source, Ground Motion
Liu	Wave Propagation, Anelestic Media
Peselnick	
Borcherdt	Anelastic Wave Prop., GEOS, GAP
Fedock	Structural Response
Liu	
Spudich	Strong Ground Motion Prediction
Heaton	Northwest U.S. Subduction Zone

PART IV

Appendix A

Proposal Submitted to the U.S. Geological Survey
in Response to RFP 1586

TITLE OF RESEARCH PROJECT

Organization and Address
Congressional District Number

Program Objective: (Show key symbols, e.g. T-2)

Cost for First Year:

Total Requested Amount:

Proposed Duration:

Desired Starting Date:

Principal Investigator(s): (Show name, organizational mailing address, and telephone number.)

Authorized Institutional Representative: (Show name, organizational mailing address, telephone number of business, sponsored research or contracting offices to which proposal status or award notices should be sent.)

For renewal or continuing award request, list previous award no.:

Principal Investigator/ Project Director	Authorized Institutional Representative	Other Endorsement (optional)
Name:	Name:	Name:
Signature:	Signature:	Signature:
Title:	Title:	Title:
Date:	Date:	Date:

Appendix B

SUMMARY FOR THE SMITHSONIAN SCIENCE INFORMATION EXCHANGE

Congressional District:

Project Title:

Date Project Started:

Program Objective:

Principal Investigator(s):

Organization and Address:

Estimated cost for current fiscal year:

States (or foreign countries) to which project pertains:

Key Words (to indicate major emphasis of project):

In 200 words or less, give a succinct statement of the project objectives, work plans, and implications of anticipated results for the proposed duration of the project:

Signature of Principal Investigator:_____ Date:_____

Appendix C

ASSURANCES (Rev. 3/84)

The applicant hereby assures and certifies that he will comply with the regulations, policies, guidelines and requirements, including Executive Order No. 12372, OMB Circular Nos. A-21, A-87, A-88, A-102, A-110, and A-122, as applicable to the recipient, as they relate to the application, acceptance and use of Federal funds for this federally-funded project. Also the Applicant assures and certifies that:

1. It possesses legal authority to apply for the grant; that a resolution, motion or similar action has been duly adopted or passed as an official act of the applicant's governing body, authorizing the filing of the application, including all understandings and assurances contained therein, and directing and authorizing the person identified as the official representative of the applicant to act in connection with the application and to provide such additional information as may be required.

2. It will comply with the Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and in accordance with Title VI of that Act, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the applicant receives Federal financial assistance and will immediately take any measures necessary to effectuate this agreement.

3. It will comply with the Age Discrimination Act of 1975, as amended (42 USC 6101) prohibiting age discrimination in programs receiving Federal financial assistance.

4. It will comply with requirements of the provisions of the Uniform Relocation Asssistance and Real Property Acquisition Act of 1970 (Public Law 91-646) which provides for fair and equitable treatment of presons displaced as a result of Federal and federally assisted programs.

5. The Hatch Act which limits the political activity of employees, is applicable unless the applicant is exempt. [ ] Check if exempt under 5 CFR 151.10(d)(2).

6. It will comply with the minimum wage and maximum hours provisions of the Federal Fair Labor Standards Act, as they apply to the recipient.

7. It will establish safeguards to prohibit employees from using their positions for a purpose that is or gives the appearance of being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business, or other ties.

8. It will give the sponsoring agency or the Comptroller General through any authorized representative the access to and the right to examine all records, books, papers, or documents related to the grant.

9. It will comply with all requirements imposed by the Federal sponsoring agency concerning applicable laws, OMB Circular, and program and administrative requirements specified in the solicitation.

10. It will supervision which shall be utilized in the accomplishment of the project are not listed on the Environmental Protection Agency's (EPA) list of Violating Facilities and that it will notify the Federal grantor agency of the receipt of any communication from the Director of the EPA Office of Federal Activities indicating that a facility to be used in the project is under consideration for listing by the EPA.

11. It will comply with the flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973, Public Law 93-234, 87 Stat. 975, approved December 31, 1976. Section 102(a) requires, on and after March 2, 1975, the purchase of flood insurance in communities where such insurance is available as a condition for the receipt of any Federal financial assistance for construction or acquistion purposes for use in any area that has been identified by the Secretary of the Department of Housing and Urban Development as an area having special flood hazards.

    The phrase "Federal financial assistance" includes any form of loan, grant, guaranty, insurance, payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance.

12. It will assist the Federal grantor agency in its compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (16 U.S.C. 470), Executive Order 11593, and the Archeological and Historic Preservation Act of 1966 (16 U.S.C. 469a-1 et seq.) by (a) consulting with the State Historic Preservation Officer on the conduct of investigations, as necessary, to identify properties listed in or eligible for inclusion in the National Register of Historic Places that are subject to adverse effects (see 36 CFR Part 800.8) by the activity, and notifying the Federal grantor agency of the existence of any such properties, and by (b) complying with all requirements established by the Federal grantor agency to avoid or mitigate adverse effects upon such properties.

OMB Approval No. 0348-0006

FEDERAL ASSISTANCE

SECTION I—APPLICANT/RECIPIENT DATA

1. TYPE OF SUBMISSION *(Mark appropriate box)*
☐ NOTICE OF INTENT (OPTIONAL)
☐ PREAPPLICATION
☐ APPLICATION

2. APPLICANT'S APPLICATION IDENTIFIER
a. NUMBER
b. DATE *Year month day* 19

3. STATE APPLICATION IDENTIFIER
NOTE: TO BE ASSIGNED BY STATE
a. NUMBER
b. DATE ASSIGNED *Year month day* 19

Leave Blank

4. LEGAL APPLICANT/RECIPIENT
a. Applicant Name .
b. Organization Unit .
c. Street/P.O. Box .
d. City . e. County
f. State . g. ZIP Code.
h. Contact Person *(Name & Telephone No.)* .

5. EMPLOYER IDENTIFICATION NUMBER (EIN)

6. PROGRAM *(From CFDA)*
a. NUMBER
MULTIPLE ☐
b. TITLE

7. TITLE OF APPLICANT'S PROJECT (Use section IV of this form to provide a summary description of the project.)

8. TYPE OF APPLICANT/RECIPIENT
A—State
B—Interstate
C—Substate Organization
D—County
E—City
F—School District
G—Special Purpose District
H—Community Action Agency
I—Higher Educational Institution
J—Indian Tribe
K—Other *(Specify):*
Enter appropriate letter ☐

9. AREA OF PROJECT IMPACT *(Names of cities, counties, states, etc.)*

10. ESTIMATED NUMBER OF PERSONS BENEFITING

11. TYPE OF ASSISTANCE
A—Basic Grant
B—Supplemental Grant
C—Loan
D—Insurance
E—Other
Enter appropriate letter(s) ☐☐

12. PROPOSED FUNDING

a. FEDERAL	$	.00
b. APPLICANT		.00
c. STATE		.00
d. LOCAL		.00
e. OTHER		.00
f. Total	$	.00

13. CONGRESSIONAL DISTRICTS OF:
a. APPLICANT
b. PROJECT

15. PROJECT START DATE *Year month day* 19

16. PROJECT DURATION *Months*

18. DATE DUE TO FEDERAL AGENCY ► *Year month day* 19

14. TYPE OF APPLICATION
A—New
B—Renewal
C—Revision
D—Continuation
E—Augmentation
Enter appropriate letter ☐

17. TYPE OF CHANGE *(For 14c or 14e)*
A—Increase Dollars
B—Decrease Dollars
C—Increase Duration
D—Decrease Duration
E—Cancellation
F—Other *(Specify):*
Enter appropriate letter(s) ☐☐☐

19. FEDERAL AGENCY TO RECEIVE REQUEST

a. ORGANIZATIONAL UNIT (IF APPROPRIATE)

b. ADMINISTRATIVE CONTACT (IF KNOWN)

c. ADDRESS

20. EXISTING FEDERAL GRANT IDENTIFICATION NUMBER

21. REMARKS ADDED
☐ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT►
To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

a. YES, THIS NOTICE OF INTENT/PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE _____

b. NO, PROGRAM IS NOT COVERED BY E.O. 12372 ☐
OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW ☐

23. CERTIFYING REPRESENTATIVE
a. TYPED NAME AND TITLE
b. SIGNATURE

SECTION III—FEDERAL AGENCY ACTION

24. APPLICATION RECEIVED *Year month day* 19

25. FEDERAL APPLICATION IDENTIFICATION NUMBER

26. FEDERAL GRANT IDENTIFICATION

27. ACTION TAKEN
☐ a. AWARDED
☐ b. REJECTED
☐ c. RETURNED FOR AMENDMENT
☐ d. RETURNED FOR E.O. 12372 SUBMISSION BY APPLICANT TO STATE
☐ e. DEFERRED
☐ f. WITHDRAWN

28. FUNDING

a. FEDERAL	$	.00
b. APPLICANT		.00
c. STATE		.00
d. LOCAL		.00
e. OTHER		.00
f. TOTAL	$	.00

29. ACTION DATE► *Year month day* 19

30. STARTING DATE *Year month date* 19

31. CONTACT FOR ADDITIONAL INFORMATION *(Name and telephone number)*

32. ENDING DATE *Year month date* 19

33. REMARKS ADDED
☐ Yes ☐ No

GENERAL INSTRUCTIONS FOR THE SF-424

This is a standard form used by applicants as a required facesheet for preapplications and applications submitted in accordance with OMB Circular A-102. It will be used by Federal agencies to obtain applicant certification that states which have established a review and comment procedure in response to Executive Order 12372 and have selected the program to be included in their process have been given an opportunity to review the applicant's submission.

APPLICANT PROCEDURES FOR SECTION I

Applicant will complete all items in Section I with the exception of Box 3, "State Application Identifier." If an item is not applicable, write "NA." If additional space is needed, insert an asterisk "*," and use Section IV. An explanation follows for each item:

Item

1. Mark appropriate box. Preapplication and application are described in OMB Circular A-102 and Federal agency program instructions. Use of this form as a Notice of Intent is at State option. Federal agencies do not require Notices of Intent.

2a. Applicant's own control number, if desired.

2b. Date Section I is prepared (at applicant's option).

3a. Number assigned by State.

3b. Date assigned by State.

4a-4h. Legal name of applicant, name of primary organizational unit which will undertake the assistance activity, complete address of applicant, and name and telephone number of the person who can provide further information about this request.

5. Employer Identification Number (EIN) of applicant as assigned by the Internal Revenue Service.

6a. Use Catalog of Federal Domestic Assistance (CFDA) number assigned to program under which assistance is requested. If more than one program (e.g., joint funding), check "multiple" and explain in Section IV. If unknown, cite Public Law or U.S. Code.

6b. Program title from CFDA. Abbreviate if necessary.

7. Use Section IV to provide a summary description of the project. If appropriate, i.e., if project affects particular sites as, for example, construction or real property projects, attach a map showing the project location.

8. "City" includes town, township or other municipality.

9. List only largest unit or units affected, such as State, county, or city.

10. Estimated number of persons directly benefiting from project.

11. Check the type(s) of assistance requested.

   A. Basic Grant—an original request for Federal funds.

   B. Supplemental Grant—a request to increase a basic grant in certain cases where the eligible applicant cannot supply the required matching share of the basic Federal program (e.g., grants awarded by the Appalachian Regional Commission to provide the applicant a matching share).

   E. Other. Explain in Section IV.

12. Amount requested or to be contributed during the first funding/budget period by each contributor. Value of in-kind contributions should be included. If the action is a change in dollar amount of an existing grant

Item

(a revision or augmentation under item 14), indicate only the amount of the change. For decreases, enclose the amount in parentheses. If both basic and supplemental amounts are included, breakout in Section IV. For multiple program funding, use totals and show program breakouts in Section IV. 12a—amount requested from Federal Government. 12b—amount applicant will contribute. 12c—amount from State, if applicant is not a State. 12d—amount from local government, if applicant is not a local government. 12e—amount from any other sources, explain in Section IV.

13b. The district(s) where most of action work will be accomplished. If city-wide or State-wide, covering several districts, write "city-wide" or "State-wide."

14. A. New. A submittal for project not previously funded.

   B. Renewal. An extension for an additional funding/budget period for a project having no projected completion date, but for which Federal support must be renewed each year.

   C. Revision. A modification to project nature or scope which may result in funding change (increase or decrease).

   D. Continuation. An extension for an additional funding/budget period for a project with a projected completion date.

   E. Augmentation. A requirement for additional funds for a project previously awarded funds in the same funding/budget period. Project nature and scope unchanged.

15. Approximate date project expected to begin (usually associated with estimated date of availability of funding).

16. Estimated number of months to complete project after Federal funds are available.

17. Complete only for revisions (item 14c), or augmentations (item 14e).

18. Date preapplication/application must be submitted to Federal agency in order to be eligible for funding consideration.

19. Name and address of the Federal agency to which this request is addressed. Indicate as clearly as possible the name of the office to which the application will be delivered.

20. Existing Federal grant identification number if this is not a new request and directly relates to a previous Federal action. Otherwise, write "NA."

21. Check appropriate box as to whether Section IV of form contains remarks and/or additional remarks are attached.

APPLICANT PROCEDURES FOR SECTION II

Applicants will always complete either item 22a or 22b *and* items 23a and 23b.

22a. Complete if application is subject to Executive Order 12372 (State review and comment).

22b. Check if application is not subject to E.O. 12372.

23a. Name and title of authorized representative of legal applicant.

FEDERAL AGENCY PROCEDURES FOR SECTION III

Applicant completes only Sections I and II. Section III is completed by Federal agencies.

26. Use to identify award actions.

27. Use Section IV to amplify where appropriate.

28. Amount to be contributed during the first funding/budget period by each contributor. Value of in-kind contributions will be included. If the action is a change in dollar amount of an existing grant (a revision or augmentation under item 14), indicate only the amount of change. For decreases, enclose the amount in parentheses. If both basic and supplemental amounts are included, breakout in Section IV. For multiple program funding, use totals and show program breakouts in Section IV, 28a—amount awarded by Federal Government. 28b—amount applicant will contribute. 28c—amount from State, if applicant is not a State. 28d—amount from local government, if applicant is not a local government. 28e—amount from any other sources, explain in Section IV.

29. Date action was taken on this request.

30. Date funds will become available.

31. Name and telephone number of agency person who can provide more information regarding this assistance.

32. Date after which funds will no longer be available for obligation.

33. Check appropriate box as to whether Section IV of form contains Federal remarks and/or attachment of additional remarks.

APPENDIX E to U.S. Geological Survey RFP 1586

REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFEROR

(THIS PART MUST BE COMPLETED AND RETURNED ALONG WITH YOUR PROPOSAL.)

The following representations and certifications shall be filled in by the offeror (check or complete appropriate boxes or blanks) and must be executed by an official authorized to bind the offeror. Offerors must set forth full, accurate and complete information as required by this solicitation (including attachments). As used in this document, the term "offeror" shall be understood to mean "applicant or offeror." The penalty for making false statements in offers and quotations is prescribed in 18 U.S.C. 1001.

1. CONTINGENT FEE REPRESENTATION AND AGREEMENT (APR 1984) FAR 52.203-4

(a) Representation. The offeror represents that, except for full-time bona fide employees working solely for the offeror, the offeror--

[Note: The offeror must check the appropriate boxes. For interpretation of the representation, including the term "bona fide employee", see Subpart 3.4 of the Federal Acquisition Regulation.]

(1) [ ] has, [ ] has not employed or retained any person or company to solicit or obtain this contract; and

(2) [ ] has, [ ] has not paid or agreed to pay to any person or company employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

(b) Agreement. The offeror agrees to provide information relating to the above Representation as requested by the Contracting Officer and, when subparagraph (a)(1) or (a)(2) is answered affirmatively, to promptly submit to the Contracting Officer--

(1) A completed Standard Form 119, Statement of Contingent or Other Fees, (SF 119); or

(2) A signed statement indicating that the SF 119 was previously submitted to the same contracting office, including the date and applicable solicitation or contract number, and representing that the prior SF 119 applies to this offer or quotation.

2. TYPE OF BUSINESS ORGANIZATION (APR 1984) FAR 52.215-6

The offeror or quoter, by checking the applicable box, represents that it operates as [ ] a corporation incorporated under the laws of the State of _____, [ ] an individual, [ ] a partnership, [ ] a nonprofit organization, or [ ] a joint venture.

3. PLACE OF PERFORMANCE (APR 1984) FAR 52.215-20

(a) The offeror or quoter, in the performance of any contract resulting from this solicitation, [ ] intends, [ ] does not intend (check applicable block) to use one or more plants or facilities located at a different address from the address of the offeror or quoter as indicated in this proposal or quotation.

(b) If the offeror or quoter checks "intends" in paragraph (a) above, it shall insert in the spaces provided below the required information:

Place of Performance (Street Address, City, County, State, Zip Code)	Name and Address of Owner and Operator of the Plant or Facility (If Other than Offeror or Quoter)

4. SMALL BUSINESS CONCERN REPRESENTATION (APR 1984) FAR 52.219-01

The offeror represents and certifies as part of its offer that it [ ] is, [ ] is not a small business concern and that [ ] all, [ ] not all supplies to be furnished will be manufactured or produced by a small business concern in the United States, its possessions, or Puerto Rico. "Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the size standards in this solicitation.

5. SMALL DISADVANTAGED BUSINESS CONCERN REPRESENTATION (APR 1984) FAR 52.219-02

(a) Representation. The offeror represents that it [ ] is, [ ] is not a small disadvantaged business concern.

(b) Definitions.

"Asian-Indian American," as used in this provision, means a United States citizen whose origins are in India, Pakistan, or Bangladesh.

"Asian-Pacific American," as used in this provision, means a United States citizen whose origins are in Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territory of the Pacific Islands, the Northern Mariana Islands, Laos, Cambodia, or Taiwan.

"Native Americans," as used in this provision, means American Indians, Eskimos, Aleuts, and native Hawaiians.

"Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards in 13 CFR 121.

"Small disadvantaged business concern, as used in this provision, means a small business concern that (1) is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged, or a publicly owned business having at least 51 precent of its stock owned by one or more socially and economically disadvantaged individuals and (2) has its management and daily business controlled by one or more such individuals.

(c) Qualified groups. The offeror shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Asian-Indian Americans, and other individuals found to be qualified by the SBA under 13 CFR 124.1.

6. WOMEN-OWNED SMALL BUSINESS REPRESENTATION (APR 1984) FAR 52.219-03

(a) Representation. The offeror represents that it [ ] is, [ ] is not a women-owned small business concern.

(b) Definitions.

"Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominate in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards in 13 CFR 121.

"Women-Owned," as used in this provision, means a small business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business.

7. CERTIFICATION OF NONSEGREGATED FACILITIES (APR 1984)

FAR 52.222-21 is hereby incorporated by reference.

8. AUTHORIZED NEGOTIATORS (APR 1984) FAR 52.215-11

The offeror or quoter represents that the following persons are authorized to negotiate on its behalf with the Government in connection with this request for proposals or quotations:

Names	Titles	Telephone Numbers
_____	_____	_____
_____	_____	_____

9. PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (APR 1984) FAR 52.222-22

The offeror represents that--

(a) It [ ] has, [ ] has not participated in a previous contract or subcontract subject either to the Equal Opportunity clause of this solicitation, the clause originally contained in Section 310 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114;

(b) It [ ] has, [ ] has not filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

10. AFFIRMATIVE ACTION COMPLIANCE (APR 1984) FAR 52.222-25

The offeror represents that (a) it [ ] has developed and has on file, [ ] has not developed and does not have on file, at each establishment, affirmative action programs required by the rules and regulations of the Secretary of Labor (41 CFR 60-1 and 60-2), or (b) it [ ] has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

11. CLEAN AIR AND WATER CERTIFICATION (APR 1984) FAR 52.223-1

The Offeror certifies that--

(a) Any facility to be used in the performance of this proposed contract [ ] is, [ ] is not listed on the Environmental Protection Agency List of Violating Facilities;

12. CLEAN AIR AND WATER CERTIFICATION (Cont'd)

(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the Environmental Protection Agency, indicating that any facility that the offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

13. CONTRACTOR "DATA UNIVERSAL NUMBERING SYSTEM" (DUNS) IDENTIFICATION

The offeror's DUNS Contractor Establishment Number is _____.
(If offeror does not have a DUNS number, please enter "NONE".)

14. COST ACCOUNTING STANDARDS NOTICES AND CERTIFICATION (NONDEFENSE) (APR 1984) FAR 52.230-2

Note: This notice does not apply to small businesses or foreign governments.

(a) Any contract over $100,000 resulting from this solicitation shall be subject to Cost Accounting Standards (CAS) if it is awarded to a business unit that is currently performing a national defense CAS-covered contract or subcontract, except when--

(1) The award is based on adequate price competition;
(2) The price is set by law or regulation;
(3) The price is based on established catalog or market prices of commercial items sold in substantial quantities to the general public; or
(4) One of the exemptions in 4 CFR 331.30(b) applies (also see Federal Acquisition Regulation (FAR) 30.301(b)).

(b) Contracts not exempted from CAS shall be subject to full or modified coverage as follows:

(1) If the business unit receiving the award is currently performing a national defense contract or subcontract subject to full CAS coverage (4 CFR 331), this contract will have full CAS coverage and will contain the clauses from the FAR entitled Cost Accounting Standards (52.230-3) and Administration of Cost Accounting Standards (52.230-4).

(2) If the business unit receiving the award is currently performing a national defense contract or subcontract subject to modified CAS coverage (4 CFR 332), this contract will have modified coverage and will contain the clauses entitled Disclosure and Consistency of Cost Accounting Practices (52.230-5) and Administration of Cost Accounting Standards (52.230-4).

A. Certificate of CAS Applicability

The offeror hereby certifies that--

[ ] The offeror is not performing any CAS-covered national defense contract or subcontract. The offeror further certifies that it will immediately notify the Contracting Officer in writing if it is awarded any national defense CAS-covered contract or subcontract subsequent to the date of this certificate but before the date of the award of a contract resulting from this solicitation. (If this statement applies, no further certification is required.)

[ ] The offeror is currently performing a negotiated national defense contract or subcontract that contains the Cost Accounting Standards clause at FAR 52.230-3.

[ ] The offeror is currently performing a negotiated national defense contract or subcontract that contains the Disclosure and Consistency of Cost Accounting Practices clause at FAR 52.230-5.

15. CAS NOTICES AND CERTIFICATION (NONDEFENSE) (Cont'd)

B. Additional Certification--CAS Applicable Offerors

[ ] The offeror subject to Cost Accounting Standards further certifies that practices used in estimating costs in pricing this proposal are consistent with the practices disclosed in the Disclosure Statement where it has been submitted pursuant to CAS Board regulations (4 CFR 351).

C. Data Required--CAS Covered Offerors

The offeror certifying that it is currently performing a national defense contract containing either CAS clause (see A above) is required to furnish the name, address (including agency or department component), and telephone number of the cognizant Contracting Officer administering the offeror's CAS-covered contracts.

Name of Contracting Officer: _____

Address: _____

_____

Telephone Number: _____

16. PARENT COMPANY AND IDENTIFYING DATA (APR 1984)

(a) A "parent" company, for the purpose of this provision, is one that owns or controls the activities and basic business policies of the offeror. To own the proposing company means that the parent company must own more than 50 percent of the voting rights in that company. A company may control an offeror as a parent even though not meeting the requirement for such ownership if the parent company is able to formulate, determine, or veto basic policy decisions of the offeror through the use of dominant minority voting rights, use of proxy voting, or otherwise.

(b) The offeror [ ] is, [ ] is not owned or controlled by a parent company.

(c) If the offeror checked "is" in paragraph (b) above, it shall provide the following information:

Name and Main Office Address of Parent Company (incl. Zip Code)	Parent Company's Employer's Identification Number
_____	_____
_____	
_____	

(d) If the offeror checked "is not" in paragraph (b) above, it shall insert its own Employer's Identification Number on the following line _____.

17. IMMUNITY FROM TORT LIABILITY

The offeror [ ] does, [ ] does not represent that as a state agency or charitable institution, the offeror is [ ] partially immune, or [ ] totally immune from tort liability. Indicate below the applicable statute or code under which such immunity is provided:

_____

_____

18. LSA PREFERENCE IN OFFER EVALUATION -- NON SET-ASIDE

As required by FAR 52.220-1 (incorporated by reference in Part II), to be entitled to LSA preference in offer evaluation, the offeror must identify, below, the Labor Surplus Area(s) in which costs will be incurred, amounting to 50% or more of the contract price.

_____

_____

19. DUPLICATION OF COST

The offeror represents and certifies that any charges contemplated and included in his estimate of cost for performance are not duplicative of any charges against any other Government contract, subcontract or other Government source.

20. OFFEROR'S DATA CERTIFICATION (NOV 1983) USGS P&P 83-19

The offeror shall certify below whether he has delivered or is obligated to deliver to the Government under any contract or subcontract the same or substantially the same technical data included in his offer; if so, he shall identify one such contract or subcontract under which such technical data was delivered or will be delivered, and the place of such delivery.

_____

_____

_____

21. CONFLICT OF INTEREST CERTIFICATION -- USGS EMPLOYEE

The offeror hereby certifies that:

(a) The offeror [ ] is, [ ] is not, a present or former USGS regular or special employee whose USGS employment terminated within one year prior to submission of this proposal.

(b) The offeror [ ] does, [ ] does not, employ a present or former USGS regular or special employee whose USGS employment terminated within one year prior to submission of this proposal and who will be involved directly or indirectly in the management, administration, or performance of any contract resulting from this proposal.

(c) The offeror [ ] will, [ ] will not, employ as a consultant on any contract resulting from this proposal a current or former regular or special USGS employee whose USGS employment terminated within one year prior to submission of this proposal.

(d) A current or former USGS employee whose USGS employment terminated within one year prior to submission of this proposal or such employee's spouse or minor child [ ] does, [ ] does not, hold a controlling interest in the offeror firm.

22. OFFEROR'S ACCOUNTING SYSTEM

Indicate whether or not offeror's accounting system has been approved by any U.S. Government agency and whether offeror has had an audit by any Government contracting agency within the last year; if so, state:

(a) Name and location of cognizant audit agency:

_____

_____

_____

(b) Name and telephone number of cognizant auditor:

_____ _____

(c) Types of contracts and payments for which system is approved:

_____

23. BUSINESS MANAGEMENT INFORMATION

(Note: Completion of this #28 is not required of educational institutions or state and local government agencies.)

(a) Indicate the percentages of offeror's business performed for commercial customers and under Government contracts (including subcontracts under Government contracts).

Commercial _____ Government _____

(b) Provide the names and locations of any other divisions or subsidiaries which will perform under proposed contract, if awarded.

Name	Location
_____	_____
_____	_____
_____	_____

(c) Indicate date offeror was organized: _____

24. BUSINESS MANAGEMENT INFORMATION (Cont'd)

(d) Indicate, by number, your manpower resources as follows:

(1) Total employees _____

(2) Total technical employees qualified in an area similar or related to the proposed effort _____

(3) Total direct labor employees who will perform proposed contract _____

(e) Indicate the volume of work similar to that covered by this solicitation that the offeror could perform in a 12 month period:

_____

(f) Experience

If offeror has received an award under this program within the past three years, the following information is not required. Other offerors are requested to identify two previous contracts awarded by a U.S. Government agency for similar research activities, including any performed within the past three years.

(1) Contract Number _____

Agency _____

Date of Award _____ Completion Date _____

Type of Contract _____ Amount $_____

Name and Telephone Number of Contracting Officer:

_____

(2) Contract Number _____

Agency _____

Date of Award _____ Completion Date _____

Type of Contract _____ Amount $_____

Name and Telephone Number of Contracting Officer:

_____

If your firm has not previously been awarded Government contracts for this work, provide the above information for commercial contracts on which similar work was performed.

25. OFFEROR NAME AND ADDRESS

Offeror should provide below the correct legal name under which his offer is submitted and to which any resultant award should be made.

Offeror Name _____

Address _____
Number and Street

_____
City State Zip Code

_____
County Congressional District

26. ADDRESS OF PAYMENT

Offeror should state below the address to which payment should be mailed, if such address is different from that shown for the offeror.

_____

_____

_____

_____

27. OFFEROR'S CERTIFICATION

The foregoing representations, certifications and acknowledgments are submitted in response to RFP No. 1586.

Signature _____ Date _____

Name & Title _____ Telephone Number _____

END OF APPENDIX E