EARTHQUAKE PLANNING SCENARIOS FOR MAGNITUDE 8.3 EARTHQUAKES ON THE SAN ANDREAS FAULT NEAR LOS ANGELES AND NEAR SAN FRANCISCO, CALIFORNIA

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SUMMARY

Earthquake planning scenarios for Magnitude 8.3 earthquakes on northern and southern segments of the San Andreas fault were developed based on events similar to the 1857 Fort Tejon earthquake in southern California and the 1906 San Francisco earthquake in northern California.

Flexible contingency plans must provide medical resources, supplies, and material to save lives during the first 72 hours. Planners must take into account the different geographic and demographic patterns and the socio-economic structure of the study areas.

Pre-earthquake planning will enhance response capabilities of the public, private, industrial, and governmental sectors.

INTRODUCTION

The Governor's Emergency Task Force on Earthquake Preparedness was established in February 1981. Earthquake planning scenarios were developed by the California Division of Mines and Geology (CDMG) in 1982 for hypothetical Magnitude 8.3 earthquakes on northern and southern segments of the San Andreas fault. The scenario earthquake for southern California was assumed to be similar to the 1857 Fort Tejon earthquake; the scenario earthquake for northern California was assumed to be similar to the 1906 San Francisco earthquake.

Shaking intensity maps (Rossi-Forel scale) were adopted from a U.S. Geological Survey model, together with geologic revisions and interpretations of liquefaction susceptibility developed by the CDMG. These maps depict shaking intensity distribution for the two scenario areas. Potential damages to lifelines are described, planning insights are

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identified, and alternatives are recommended for lifeline facilities in each study area. These scenarios are the basis for improved emergency response plans.

LIFELINE FACILITIES

The earthquake planning scenarios and maps portray the anticipated damage to the highway, airport, railway, marine, communication, water supply, waste disposal, electrical power, natural gas, and petroleum lifelines that service the metropolitan areas of the Los Angeles Basin and the San Francisco Bay areas. The combined impacts of all lifelines being simultaneously impaired in either area will greatly complicate any major emergency-response effort. The added strain of many casualties will overwhelm local governmental and individual capabilities to cope unless adequate prior plans are developed for emergency response.

Los Angeles Basin

Highway damage will essentially isolate, or limit access to, areas from north and northeast of the Los Angeles Basin, such as San Fernando Valley and Ventura, but routes southward to San Diego should be usable. The San Bernardino and Riverside areas will have damage to throughway routes. Transportation routes through the mountains to the north will be impaired and access from the high desert areas near Palmdale and Victorville will be affected during the initial post-earthquake period. Distribution of materials and emergency response personnel within the Los Angeles Basin will be difficult because of the size of the geographic area. See Figures 1A and 1B.

Major air facilities are expected to be in a condition capable of receiving military C-130 and C-141 cargo aircraft for landing.

Rail service from the north and east via Palmdale and Cajon Pass will be seriously impaired by ground ruptures and ground failure but service within the basin may be feasible.

Marine facilities should have only minor damage.

Telephone communications will be overloaded and initial reliability will be minimal. Radio systems will be 40 to 75 percent effective. Microwave systems will be 30 percent or less effective.

Two of the three major aqueduct systems which cross the San Andreas fault will be ruptured and water from existing storage and the Colorado River Aqueduct may be the only source for three to six months. Los Angeles region will have to rely primarily on existing reservoir storage and the Colorado River aqueduct. There will be local shortages. Waste water treatment plants will be impaired by loss of power and damage to some facilities. Collection lines will be impaired causing significant contamination to some local water supplies.

A significant portion of the electrical transmission lines will be

affected. Power generated at the five hydroelectronic plants north of Castaic and Devil's Canyon will be cut off and power generation capacity at Etiwanda and the coastal plants may be impaired. Electrical power may be reduced to about 50 percent of normal level.

Natural gas pipelines into the Los Angeles area will be breached near Tejon Pass and south of Palmdale. Damage to pumping stations may also reduce gas transmission. Some underground storage will be available locally.

Petroleum fuels pipelines crossing the San Andreas fault near Tejon Pass and Cajon Pass may be damaged.

San Francisco Basin

Highway and bridge approach damage in and out of the City of San Francisco and much of San Mateo County will isolate these areas. Use of the Golden Gate, San Francisco-Oakland Bay, Richmond-San Rafael, and San Mateo bridges will be impossible for an extended period. Some major arteries in and around the Bay margin area will be restricted. Routes will be open from the east, however. See Figure 2.

San Francisco International and Metropolitan International airports as well as Alameda Naval Air Station and Hamilton Field will not be available for major airborne relief operations. San Jose Municipal, Hayward Municipal, and Buchanan Fields will be available with limitations. Travis Air Force Base near Fairfield is the closest air field for large-scale emergency operations.

Railroad transport to and from the San Francisco Bay area will not be available during the initial 72-hour period following the event. Bay Area Rapid Transit (BART) system will be damaged or will require safety inspections to an extent that will render the system totally inoperative during the 72-hour post-earthquake period.

Various marine port facilities on piling supports should withstand significant damage. Facilities constructed on fill will be seriously impaired. Major bayside facilities should be accessible for tug boat and barge transport of equipment and supplies. South Bay facilities will be inaccessible to water traffic.

Telephone communications will be overloaded and the situation will be complicated by damage to equipment and auxiliary power sources. Radio systems will be 40 to 50 percent effective.

Damage to major aqueducts which deliver imported water will cause temporary water supply interruptions. Major reservoirs in the area provide ample water storage but local distribution facilities will be impaired. One major dam will be damaged and downstream areas will have been evaluated. Sewage collection systems and treatment plants adjacent to the Bay will be damaged and there will be discharge of raw sewage into the Bay.

The complex electrical power network may be reduced up to 50 percent, and restoration may take extended periods of time. Hospitals, fire and police stations, water pumping stations, and communications centers in San Francisco, San Mateo, Santa Clara, and Marin Counties will require standby generating equipment.

Natural gas pipelines will be locally impaired in areas of intense shaking (mainly in the peninsula and south Bay areas) and there will be loss of service for extended periods.

Petroleum fuels pipelines and storage tanks will be subject to damage locally, depending on ground stability conditions. Major damage is expected for trans-Bay lines.

PLANNING/PREPAREDNESS INSIGHTS

The emergency response plans are systematic strategies that are closely related to the special circumstances of the area for which they are designed.

In southern California, the strategy for bringing supplies and assistance into the Los Angeles Basin following the earthquake should emphasize ground transportation, which will probably be possible by freeway and by railroad from San Diego. Also, air transport into the area will be feasible if auxiliary power supplies are available to maintain radio communications, airfield lights, and other requirements necessary for the operation. Effective distribution of material and personnel will be a greater challenge than access to the region from the outside. The loss of hardwire communications within the area during the first 72 hours will be a major handicap to emergency response. Law enforcement in the Los Angles region should be oriented to regulating ground transportation access into stricken areas and to preventing the intrusion of sightseers, looters, and other undesirables.

In the northern study area, the San Andreas fault is nearer urban areas and approximately parallels highways that traverse the San Francisco peninsula connecting the city to other urban and suburban centers. Highway and rail routes will be severely affected during the 72 hours immediately following the earthquake. Airport facilities for cargo planes will be out of service in the Bay area. Closest usable airfields may be Buchanan near Concord and Travis near Vacaville. Helicopter transport will be needed to bring supplies into the stricken area from the outside. The feasibility of extensive marine transportation should be evaluated as a principal means of bringing personnel and materiel into the region. Loss of electrical power, water, hardwire communications, and other support lifelines will greatly complicate the emergency-response process and must be provided for in the planning. Law enforcement efforts in the San Francisco area should be directed to identify open traffic routes, control of traffic routes for high priority emergency use, and to maintain security in the stricken areas.

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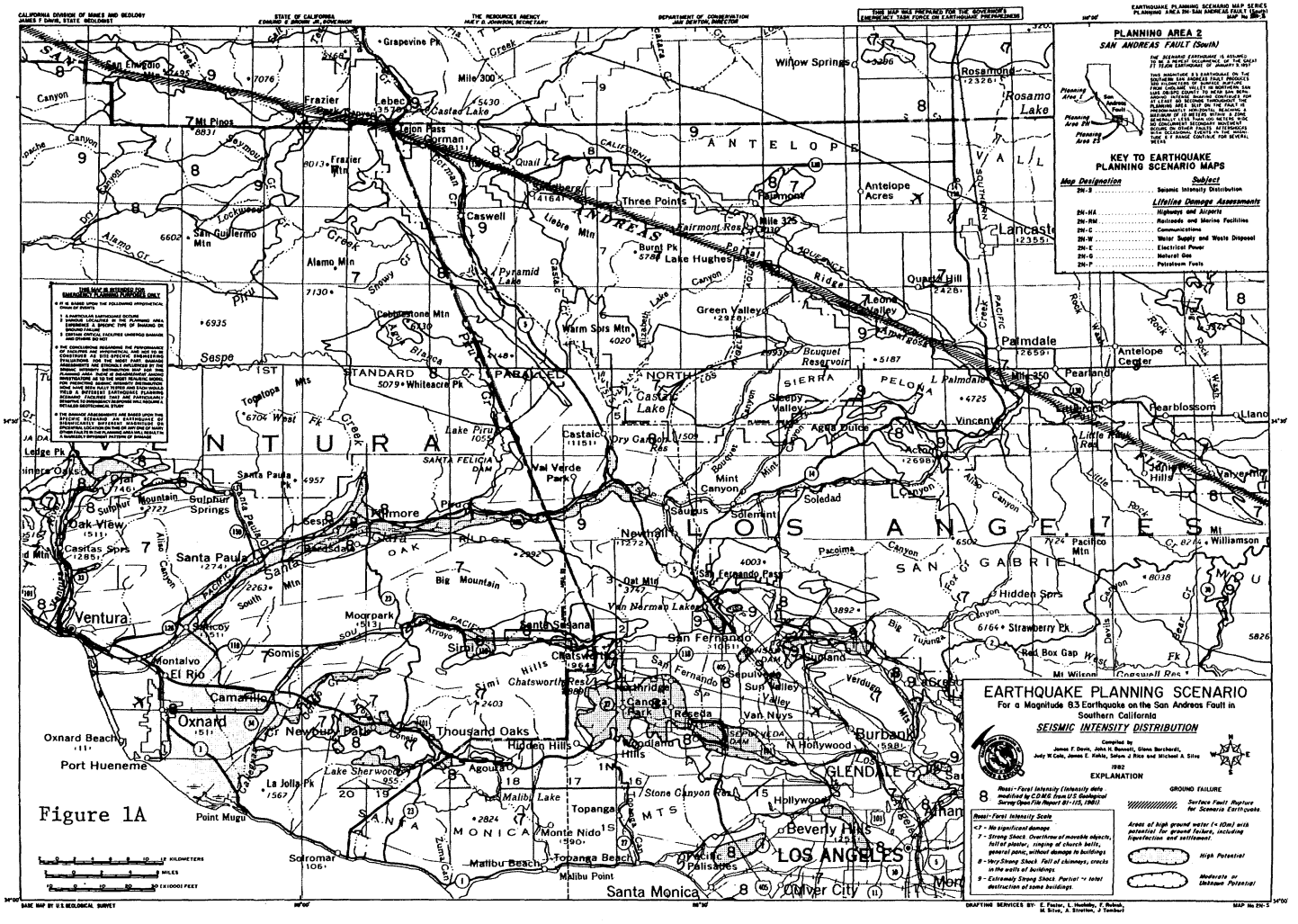


Figure 1A

PLANNING AREA 2
SAN ANDREAS FAULT (South)

THE SCENARIO EARTHQUAKE IS ASSUMED TO BE A REPEAT OCCURRENCE OF THE GREAT FT TEJON EARTHQUAKE OF JANUARY 9, 1857

THIS MAGNITUDE 8.3 EARTHQUAKE ON THE SOUTHERN SAN ANDREAS FAULT PRODUCES 320 KILOMETERS OF SURFACE RUPTURE FROM CHOLAME VALLEY IN NORTHERN SAN LUIS OBISPO COUNTY TO NEAR SAN BERNARDINO. INTENSE SHAKING CONTINUES FOR AT LEAST 60 SECONDS THROUGHOUT THE PLANNING AREA. SLIP ON THE FAULT IS PREDOMINANTLY HORIZONTAL, REACHING A MAXIMUM OF 10 METERS WITHIN A ZONE GENERALLY LESS THAN 100 METERS WIDE. NO CONCURRENT SECONDARY MOVEMENT OCCURS ON OTHER FAULTS. AFTERSHOCKS WITH OCCASIONAL EVENTS IN THE MAGNITUDE 6-7 RANGE CONTINUE FOR SEVERAL WEEKS

KEY TO EARTHQUAKE PLANNING SCENARIO MAPS

Map Designation	Subject
2N-S	Seismic Intensity Distribution
	Lifeline Damage Assessments
2N-HA	Highways and Airports
2N-RM	Railroads and Marine Facilities
2N-C	Communications
2N-W	Water Supply and Waste Disposal
2N-E	Electrical Power
2N-G	Natural Gas
2N-P	Petroleum Fuels

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.*

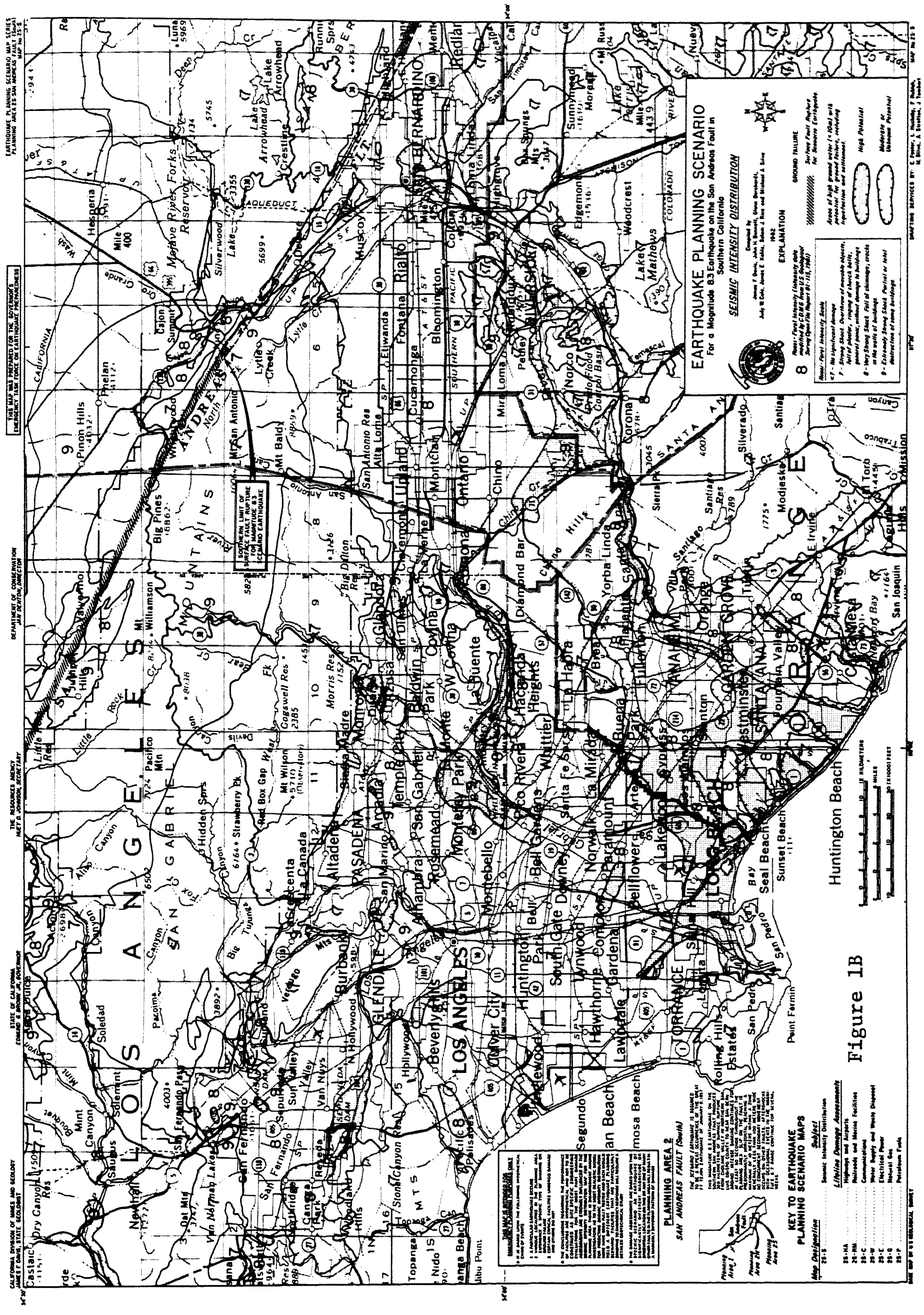
GROUND FAILURE

▨ *Surface Fault Rupture for Scenario Earthquake.*

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

THIS MAP IS INTENDED FOR EMERGENCY PLANNING PURPOSES ONLY

- IT IS BASED UPON THE FOLLOWING HYPOTHETICAL CHAIN OF EVENTS
  1. A PARTICULAR EARTHQUAKE OCCURS
  2. VARIOUS LOCALITIES IN THE PLANNING AREA EXPERIENCE A SPECIFIC TYPE OF SHAKING OR GROUND FAILURE
  3. CERTAIN CRITICAL FACILITIES UNDERGO DAMAGE AND OTHERS DO NOT
- THE CONCLUSIONS REGARDING THE PERFORMANCE OF FACILITIES ARE HYPOTHETICAL AND NOT TO BE CONSTRUED AS SITE-SPECIFIC ENGINEERING EVALUATIONS. FOR THE MOST PART, DAMAGE ASSESSMENTS ARE STRONGLY INFLUENCED BY THE SEISMIC INTENSITY DISTRIBUTION MAP FOR THIS PLANNING AREA. THERE IS DISAGREEMENT AMONG INVESTIGATORS AS TO THE MOST REALISTIC MODEL FOR PREDICTING SEISMIC INTENSITY DISTRIBUTION. NONE HAVE BEEN FULLY TESTED AND EACH WOULD YIELD A DIFFERENT EARTHQUAKE PLANNING SCENARIO. FACILITIES THAT ARE PARTICULARLY SENSITIVE TO EMERGENCY RESPONSE WILL REQUIRE A DETAILED GEOTECHNICAL STUDY
- THE DAMAGE ASSESSMENTS ARE BASED UPON THIS SPECIFIC SCENARIO. AN EARTHQUAKE OF SIGNIFICANTLY DIFFERENT MAGNITUDE OR EPICENTRAL LOCATION ON THIS OR ANY ONE OF MANY OTHER FAULTS IN THE PLANNING AREA WILL RESULT IN A MARKEDLY DIFFERENT PATTERN OF DAMAGE


EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California
SEISMIC INTENSITY DISTRIBUTION
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EXPLANATION
GROUND FAILURE
Surface Fault Rupture for Scenario Earthquake
High Potential
Moderate or Unknown Potential
Rossi - Forel Intensity Scale
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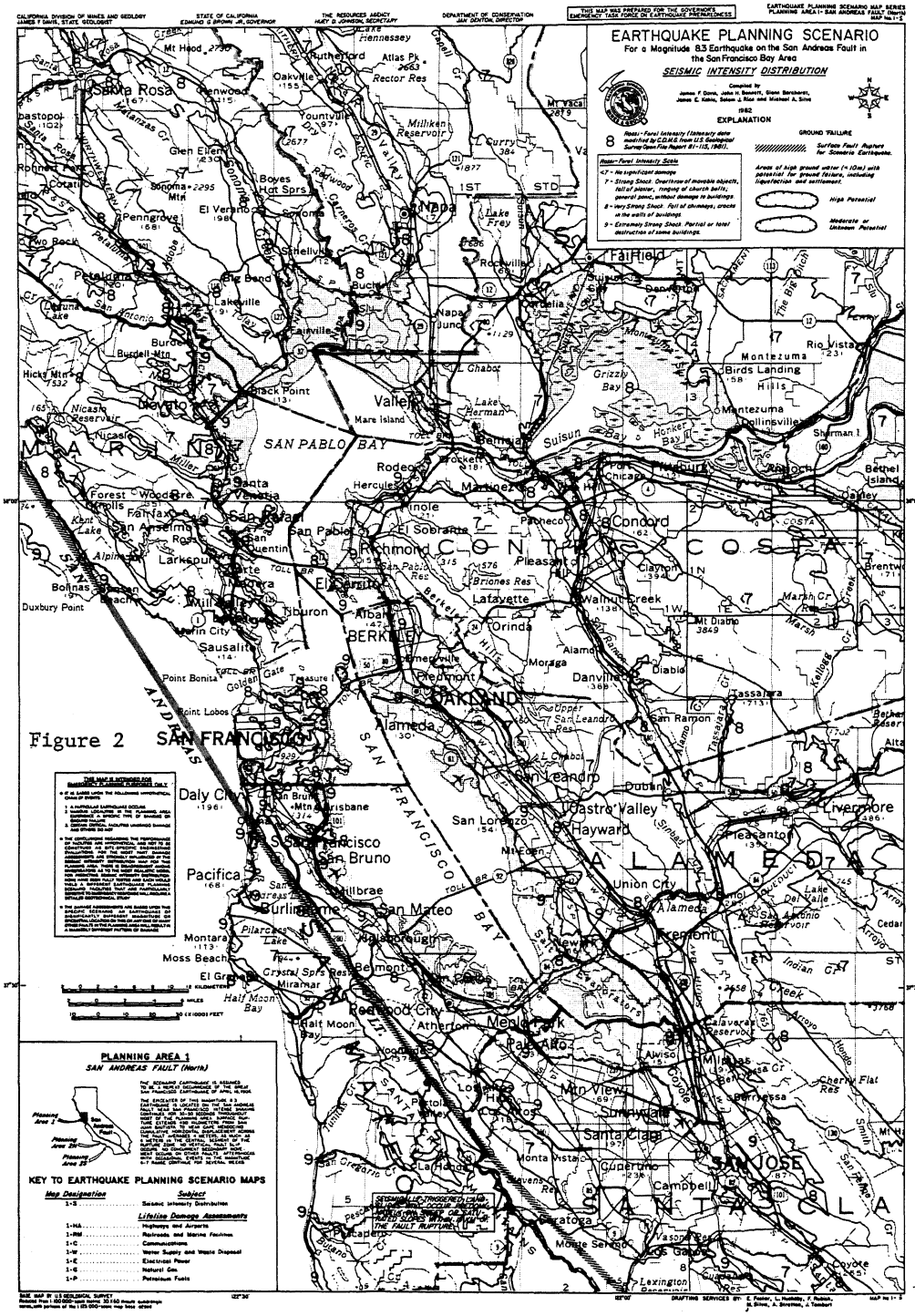
PLANNING AREA 2
SAN ANDREAS FAULT (South)
KEY TO EARTHQUAKE PLANNING SCENARIO MAPS
LOS ANGELES
PASADENA
SAN BERNARDINO
ANAHEIM
SANTA ANA
LONG BEACH
TORRANCE
Huntington Beach

Figure 1B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THIS MAP WAS PREPARED FOR THE GOVERNOR'S EMERGENCY TASK FORCE ON EARTHQUAKE PREPAREDNESS
EARTHQUAKE PLANNING SCENARIO MAP SERIES
PLANNING AREA 1- SAN ANDREAS FAULT (North)
MAP No. 1-S
EARTHQUAKE PLANNING SCENARIO
For a Magnitude 8.3 Earthquake on the San Andreas Fault in the San Francisco Bay Area
SEISMIC INTENSITY DISTRIBUTION
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N
E
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EXPLANATION
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GROUND FAILURE
Surface Fault Rupture for Scenario Earthquake.
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High Potential
Moderate or Unknown Potential
THIS MAP IS INTENDED FOR EMERGENCY PLANNING PURPOSES ONLY
SEISMICALLY TRIGGERED LANDSLIDES WILL OCCUR PREDOMINATELY ON STEEP OR SATURATED SLOPES WITHIN 15 KM OF THE FAULT RUPTURE
12 KILOMETERS
8 MILES
30 (X1000) FEET
37°30'
38°00'
122°30'
122°00'
PLANNING AREA 1
SAN ANDREAS FAULT (North)
Planning Area 1
San Andreas Fault
Planning Area 2N
Planning Area 2S
THE SCENARIO EARTHQUAKE IS ASSUMED TO BE A REPEAT OCCURRENCE OF THE GREAT SAN FRANCISCO EARTHQUAKE OF APRIL 18, 1906.
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BASE MAP BY U.S. GEOLOGICAL SURVEY
SAN ANDREAS
SAN FRANCISCO BAY
SAN PABLO BAY
MARIN
CONTRA COSTA
ALAMEDA
SANTA CLARA
SAN FRANCISCO
OAKLAND
BERKELEY
SAN JOSE
Santa Rosa
Napa
Vallejo
Novato
San Rafael
Richmond
Concord
Walnut Creek
Hayward
Fremont
Palo Alto
San Mateo
Daly City
Pacifica
Livermore

Figure 2