EVACUATION TIMES ASSESSMENT
FOR THE
DIABLO CANYON NUCLEAR POWER PLANT

PREPARED FOR
PACIFIC GAS & ELECTRIC COMPANY
SEPTEMBER 1980

prc
A Planning Research Company

Alan M. Voorhees & Associates
Transportation, Environmental and Urban Planning Consultants

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PROLOGUE

This combined report presents the results of two study phases conducted to assess the evacuation times of various zones surrounding the Diablo Canyon Nuclear Power Plant. The first study phase considered a modified 10-mile boundary surrounding the site, while in Phase II the distance was extended 12- to 18-miles to include the area known as the "Five Cities".

At the conclusion of the Phase II analysis it was not felt necessary to modify the Phase I report based upon the added input from this second cycle of effort. Consequently, the Phase II report was written to follow in sequence with the expanded analysis area. The conclusions presented at the end of the Phase II report take into account both phases of study. Although these conclusions are broader in scope than those reached at the end of Phase I due to the larger area studied, the results presented at the end of the initial study still apply to that particular evacuation boundary.

Finally, Appendix A was added to address, in the light of both study phases, questions regarding evacuation times for designated sub-areas within the overall evacuation boundary.

Because the documents combined under cover in this report were produced separately, each has been page-numbered individually. However, for the convenience of the reader, the table of contents and list of figures and tables for each section have been printed in blue to facilitate locating each individual document. The major sections are as follows:

- Phase I Report: Modified 10-Mile Boundary Including Morro Bay, San Luis Obispo and Avila Beach. (97 pages)

- Phase II Report: Approximate 12- to 18-Mile Boundary Including Morro Bay, San Luis Obispo and the Five Cities. (59 pages)

- Appendix A: Evacuation Times for Sub-Areas within the Evacuation Boundary. (9 pages)

PHASE I REPORT

EVACUATION TIMES ASSESSMENT STUDY
FOR THE
DIABLO CANYON NUCLEAR POWER PLANT

Modified 10-Mile Boundary Including
Morro Bay, San Luis Obispo and Avila Beach

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I. INTRODUCTION AND OVERVIEW

Purpose and Objectives

This report contains the results of an Evacuation Times Assessment Study conducted for the areas surrounding the Diablo Canyon Nuclear Power Plant in San Luis Obispo County, California. Evacuation times were estimated for various zones and sectors around the plant starting at "zero" time which represents the sounding of the Early Warning (Siren) System which is currently being considered for installation by Pacific Gas and Electric Company (PG&E).

The objectives of the Evacuation Times Study can be summarized as follows:

- To obtain the most recent information on resident population, special institutional facilities (e.g. hospitals, educational and correctional institutions, etc.), and recreation and beach visitors within the designated evacuation area.
- To evaluate the existing roads in the area relative to their capability to carry the traffic loads generated by an evacuation.
- To estimate the time that would be required to evacuate all individuals from within the designated evacuation area including the identification of potential delays due to inadequate road capacities and adverse weather conditions.
- To provide recommendations for selective and staged evacuation in order to prevent traffic congestion and to minimize the exposure of departing individuals to health hazards.

Evacuation Boundary

Current Federal guidelines[1/] call for an emergency planning area consisting of a 10-mile radius from the plant. However, for practical notification and evacuation purposes and to avoid bisecting communities, the evacuation boundary

1/ "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants", U.S. Nuclear Regulatory Commission, January, 1980.

was extended beyond the 10-mile radius to follow more describable topographic and jurisdictional boundaries. Figure I-1 illustrates this designated evacuation boundary as well as the 2-mile, 6-mile[1/] and 10-mile radius from the Diablo Canyon nuclear facility. Reflecting the prevailing wind directions and topographic characteristics of the area, three sectors radiating from the plant were determined as also shown in Figure I-1. While these sectors represent a slight variation from the current Federal Guidelines which call for 90° sectors between the 5- and 10-mile radius, the selected 67.5° sectors are found to be more practical and identifiable for use in an emergency situation.

The designated evacuation boundary shown in Figure I-1 is identical to the boundary utilized for PG&E's Early Warning System with the exception of the Five-Cities area to the south of San Luis Obispo. Evacuation times for the Five-Cities area (Arroyo Grande, Pismo Beach, Grover City, Shell Beach and Oceano) will be determined subsequent to this analysis and presented as an appendix to this report.

Report Contents

Chapters II, III and IV of this report describe the area characteristics, emergency planning areas and the identification of the area population respectively. Chapter V contains the various action steps involved in an actual evacuation while Chapter VI deals with the evacuation routes. Finally, Chapter VII presents estimates of evacuation times for various sub-areas for good weather as well as for adverse wind and weather conditions.

1/ A 6-mile radius, rather than 5-mile, was utilized to maintain consistency with earlier evacuation planning efforts.

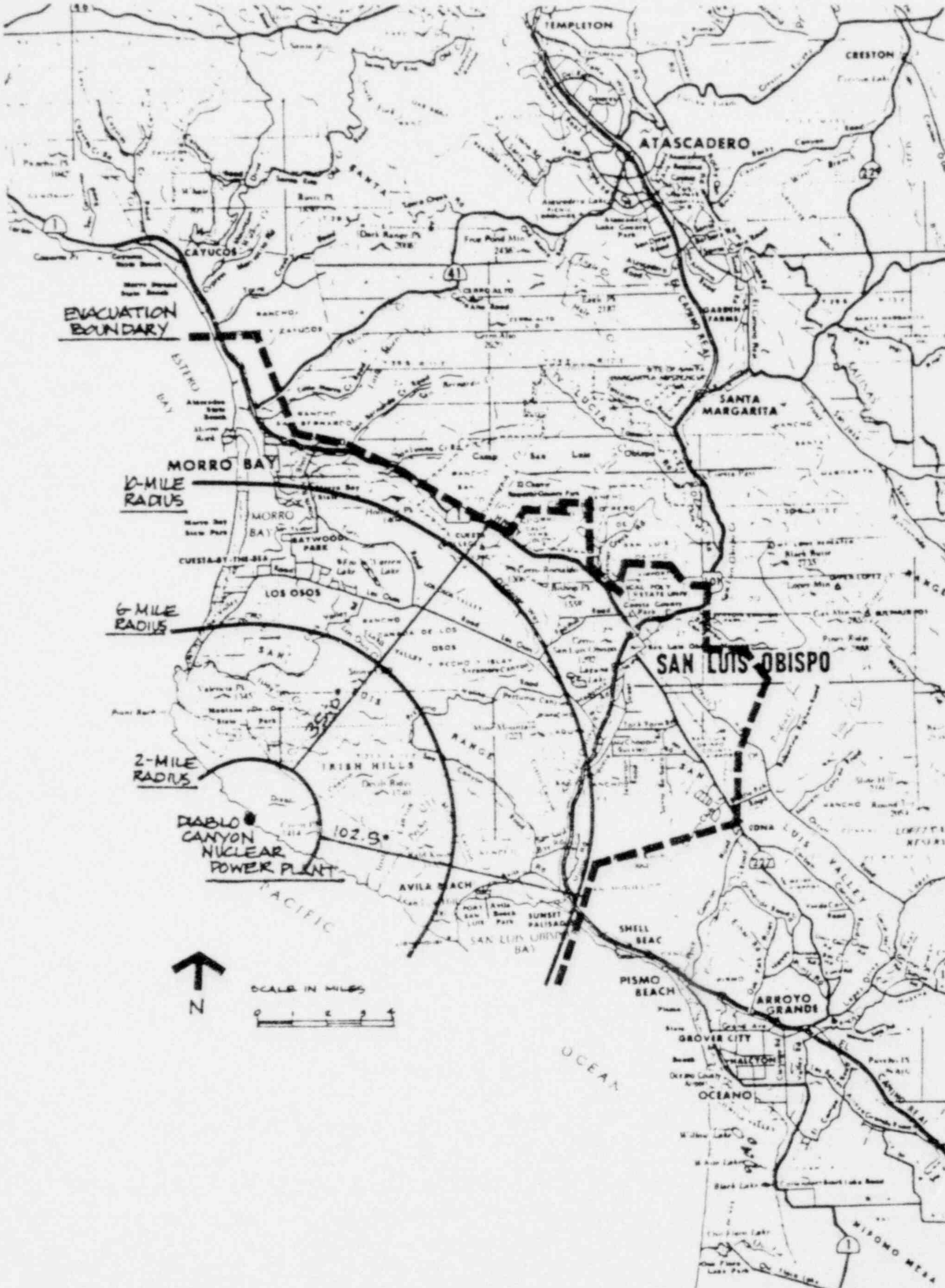

FIGURE I-1: GENERAL AREA MAP

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II. AREA CHARACTERISTICS

A. Topographic Features

The Diablo Canyon Nuclear Power Plant site is located on a coastal terrace and is surrounded by approximately six miles of steep, brush-covered mountain ridges and deep canyons known as the Irish Hills. These hills contain a number of sparsely populated valleys such as the Prefumo and See Canyons. Access to these canyons is limited: many of these canyons are served by a combination of public and private 2-lane paved roads and circuitous unimproved jeep trails. These hilly areas are illustrated in Figure II-1.

To the north beyond the Irish Hills, the Los Osos Valley extends from the City of Morro Bay to the City of San Luis Obispo and is bounded to the east by the hills of the Los Padres National Forest. The hills and large State Parks and Military Reservations in the area are some of the reasons why the present population within an approximate 10-mile vicinity of the Diablo Canyon Nuclear Facility is rather small. The development of the area is chiefly confined to the Los Osos Valley region. Development growth projections for 1990 are limited to "infill" conditions in still undeveloped areas in the Los Osos Valley region[1/] and no or little additional development is projected for the hill areas.

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1. San Luis Obispo Traffic Circulation Study. Wilbur Smith & Associates. May 1979.

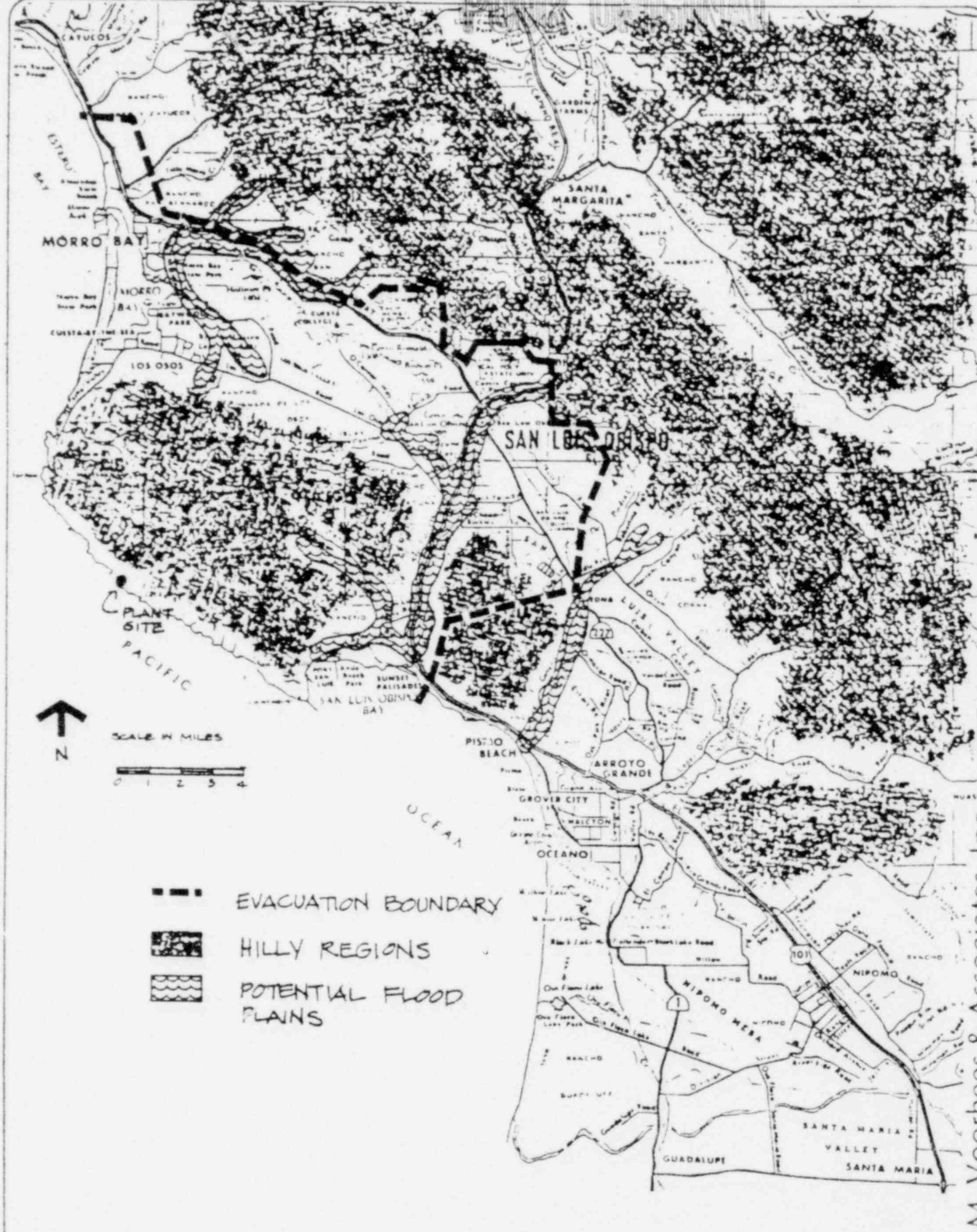

FIGURE II-1 HILLY REGIONS AND FLOOD PLAINS IN THE EVACUATION AREA

B. Climatic Conditions

Precipitation

The evacuation study area, with a climate characteristic of the central California coastal region, has small diurnal and seasonal temperature variations. During the months of May through September, the dry season, the rainfall is infrequent due to the Pacific Anticyclone, located off the California coast, which prevents Pacific storms from entering the state. During this time when surface winds are generally from the northwest, a high frequency of fog or low stratus clouds associated with a strong low-level temperature inversion is typical. This period is also characterized by its moderate to strong daytime winds and its weak nighttime off-shore drainage winds.

From November through March, or the winter season, the Pacific Anticyclone moves southward weakening in intensity, and allows the Pacific storms to enter California. During this 5-month period, the area receives 80 percent of its average annual rainfall of 16 inches. The rainfall is usually accompanied by strong southeast winds associated with storm systems.

Winds and Air Movements

In many areas the coastal mountains, which extend in a general northwest to southeast direction along the coastline, are more likely to affect the wind direction than the prevailing circulation. This range of mountains is indented by numerous canyons and valleys each with its own land-sea breeze regime. In valleys and canyons,entering winds are controlled by the local terrain features. However, where there are no gaps in the coastal range and the winds are forced along this barrier, the wind speed is increased and the wind direction variation decreases. This results in increased turbulance and vertical mixing under inversion. Thus emissions injected into this coastal regime are transported and dispersed by a complex array of land-sea breezes in both horizontal and vertical planes.

Aside from these localized micro-climates certain regional wind directions exist which influence the selection and use of potential evacuation routes. Figure II-2 illustrates the direction, speed and frequency of winds at the Diablo Canyon plant site. As can be seen, the prevailing winds are in the north-westerly direction, occuring about 40% of the time at average wind velocities of 15.5 mph.

Temperatures

The average annual temperature of this area is about 55°F, although under extreme conditions temperatures may range from a high of 100°F in the summer to a low of 25°F in the winter. The maximum summer temperature of 85°F and the minimum winter temperature of 35°F are exceeded only one percent of the time.

Fog Conditions

Within the evacuation study area there is a year-round occurrence of fog During the summer months, fog is associated with the on-shore flow of marine air. During the winter months, fog conditions form within the one-two day period following a significant rainfall when the stable air is mixed with the moisture of the Pacific storms. Fog conditions usually occur during the late night and early morning periods, and although this fog is a convection fog and not the Tule fog associated with the central California valley, it can restrict visibility at times. In 1979, there were 88 occurrences of fog conditions which resulted in visibility of 1/4 mile or less, distributed over the year as follows: 1/

1/ National Weather Service phone conversation March 31, 1980

POOR ORIGINAL

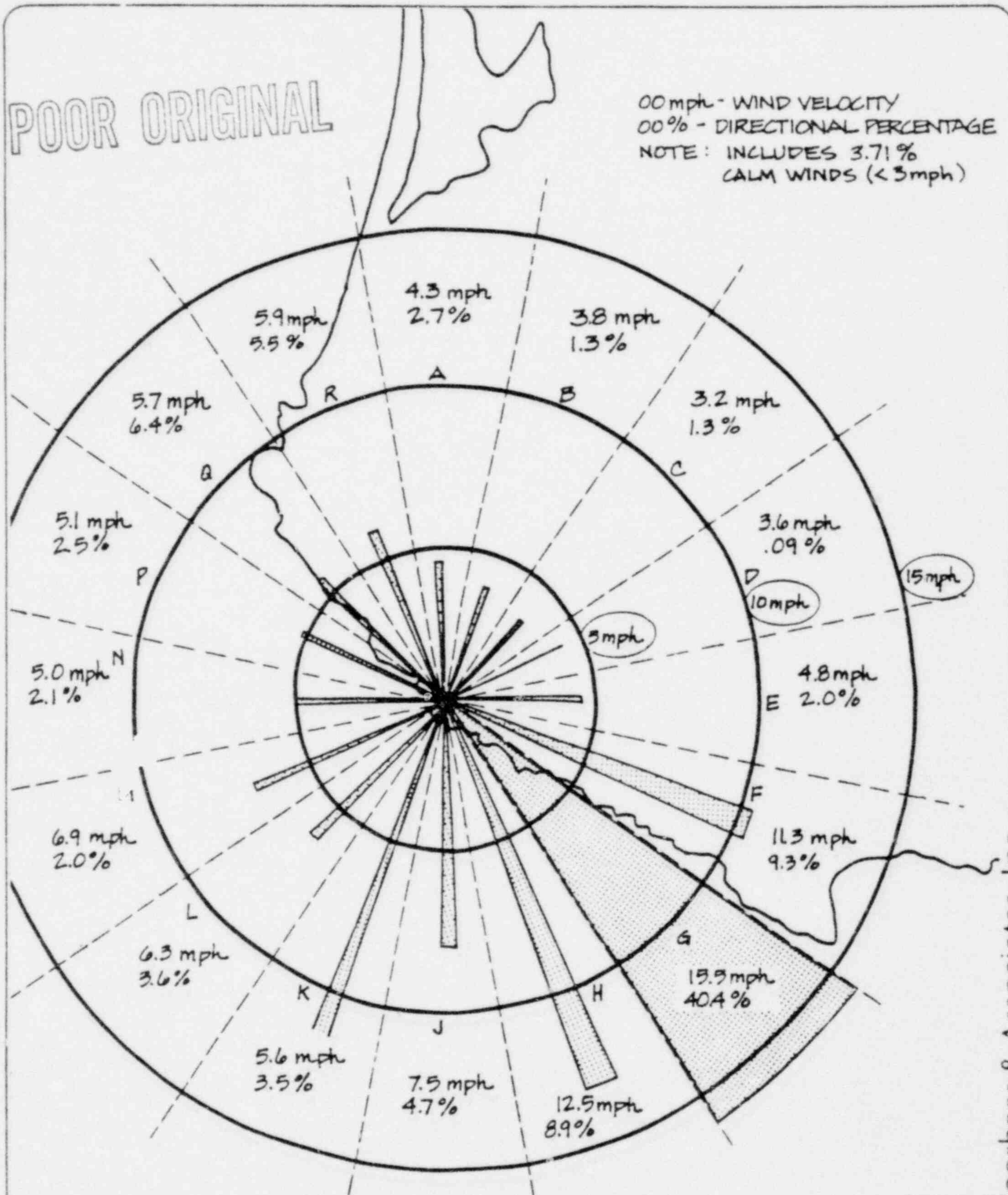

FIGURE II-2: WIND DIAGRAM

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January	5	July	8
February	4	August	10
March	5	September	12
April	6	October	12
May	6	November	7
June	7	December	6

From this list, it can be seen that the frequency of fog conditions is greatest during the summer months.

C. Infrastructure

Transportation Network

Most of the transportation demand in this area is served by highways, with Highway U.S. 101 as the major arterial (see Figure II-3). It runs along a north-south corridor connecting San Luis Obispo to Paso Robles and eventually San Francisco to the north, and to Pismo Beach and eventually Los Angeles to the south. Being the main carrier of through-traffic, U.S. 101 is a four-lane facility at partially freeway and partially expressway standards. The freeway sections are limited access divided highways while the expressway segments may include at-grade intersections.

Another main arterial is State Route 1, which diverges from U.S. 101 in San Luis Obispo and extends in a northwesterly direction to Morro Bay and up the coast. Within the study area, it is primarily an expressway consisting of four lanes.

In addition to these two main highways, there are several parallel routes which are of relatively minor significance, but which can be used as alternatives to the principal arterials. Both State Route 227 and Orcutt Road connect San Luis Obispo with Arroyo Grande to the south (see Figure II-3). Parallel to Route 1 is Los Osos Valley Road, which could serve as an alternate route for people travelling away from Morro Bay.

The facilities mentioned above are basically arterials which extend radially from San Luis Obispo. Other components of the transportation network are numerous collector roads and the urban street systems.

Transit

Public transportation in the area is provided by San Luis Transportation, Inc., a county-wide transportation company serving San Luis Obispo, the

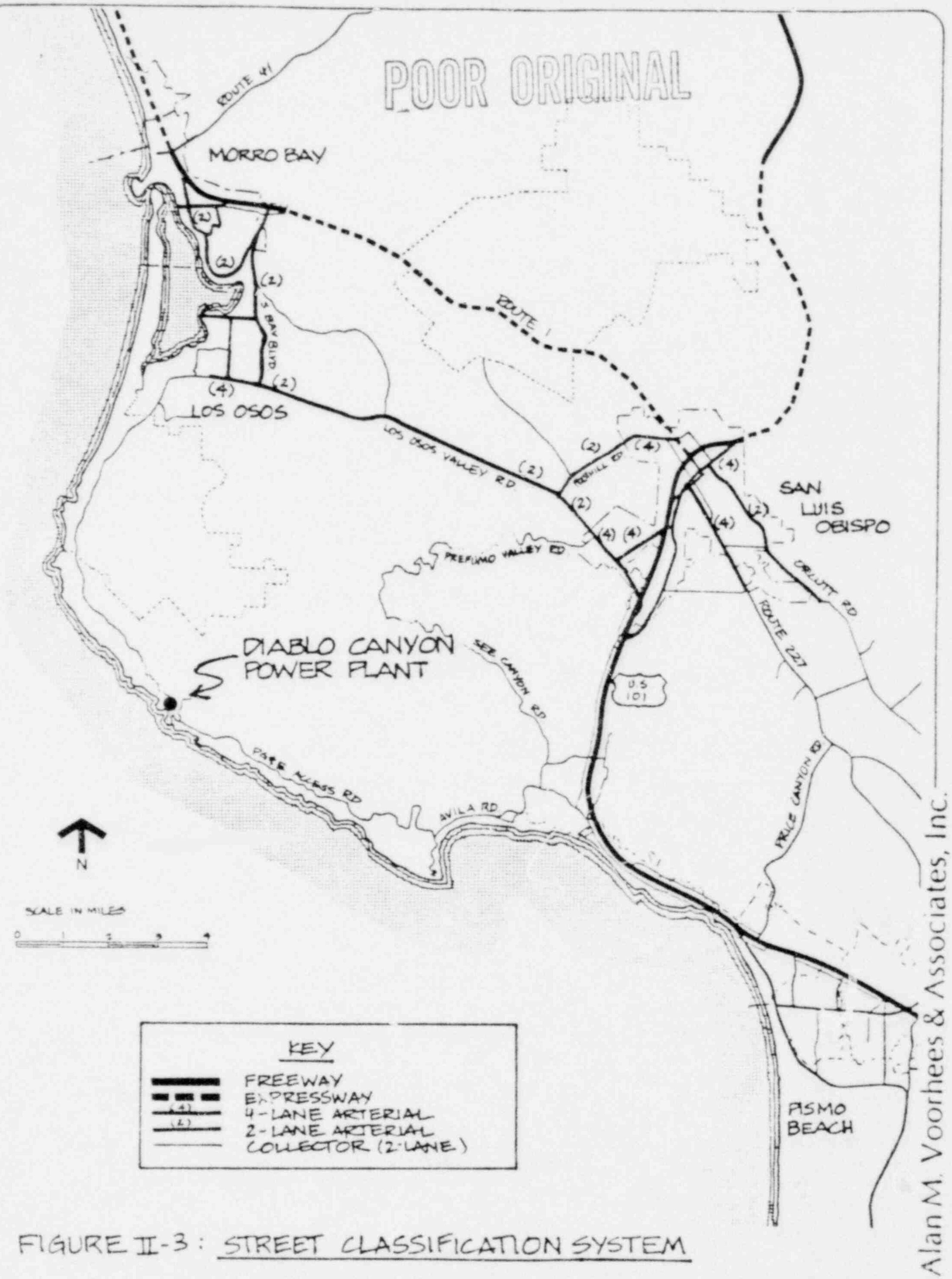

FIGURE II-3: STREET CLASSIFICATION SYSTEM northern coastal communities and the south county area. The companys' fleet consists of 15 buses, three 45-seat, six 25-seat and six 21-seat.

In the city of San Luis Obispo there are three fixed routes on which buses operate at one-hour headways. The natural gas-powered vehicles have a seating capacity of 25 passengers each and operate from 7:00 a.m. to 7:00 p.m. on weekdays, and from 9:00 a.m. to 5:00 p.m. on weekends and holidays. The north coastal line connects downtown San Luis Obispo with the Morro Bay/Los Osos/Baywood Park area. Using 45-passenger diesel buses, the system operates with two-hour headways. There are also two special shuttle services in operation: one between downtown San Luis Obispo and Cuesta College, and the other between San Luis Obispo and Cal Poly. These shuttles run at two-hour intervals on school days with minimal service on non-school days, using 45-seat buses.

The South County Area Transit (SCAT) provides service between the communities of Pismo Beach, Grover City, Arroyo Grande, and Oceano. There is no link to San Luis Obispo. The vehicles used are 25-seat coaches, which operate hourly on weekdays between 7:30 a.m. and 5:30 p.m.[1/]

In addition to the local public transit system, several other modes serve the area; Greyhound Lines operates along U.S. 101 with connections both to the north and south; Yellow Cab and Five Cities Taxi operate taxi services in the area; and there are several local van programs which cater to elderly and handicapped persons.

Pipelines

The network of pipelines in the study area includes those for water, sewage, natural gas, and oil. There are presently two major water transmission lines serving the area. One runs between Lopez Canyon Reservoir and a terminal reservoir near Arroyo Grande, where the water is then dispersed to the South

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1/ SCAT does not own these buses; contract service is provided by San Luis Transportation.

County communities. The other line links Santa Margarita Lake to the San Luis Obispo Whale Rock Reservoir and treatment plant. In addition, various distribution lines and local service lines provide connections to the users. Similarly there is a network of sewage lines from the customers to the treatment plant, and a main line which transports the treated sewage for dispersal in the ocean.

Natural gas is supplied to the area from two directions. The Southern California Gas Company line parallels U.S. 101 as it approaches the study area from Santa Maria. A second gas line, which supplies the PG&E Morro Bay generating plant, enters the area from the northeast.

There are several ocean oil terminals at Port San Luis (near Avila Beach) and in Estero Bay (near Morro Bay). From these terminals oil is transported through pipelines to and from various processing plants in the state.

Power Lines

Overhead power transmission lines criss-cross much of the study area because of the proximity of the two PG&E generating plants. From the Morro Bay Fossil Fuel Plant lines extend to the northeast, east, and southeast. The Diablo Canyon Plant is the origin of two transmission line corridors, one heading northeast and the other heading east from the site.

Another type of line is an inter-regional telecommunication cable, which generally parallels U.S. 101. In addition, a transcontinental line emerges from the ocean near Los Osos and parallels Los Osos Valley Road to the main terminal facility owned by Pacific Telephone & Telegraph. These latter facilities are all underground.

If a major earthquake were to coincide with an emergency situation at the power plant, all large underground crossings of main evacuation routes should be inspected immediately. Similarly, the aerial power lines, if dislocated

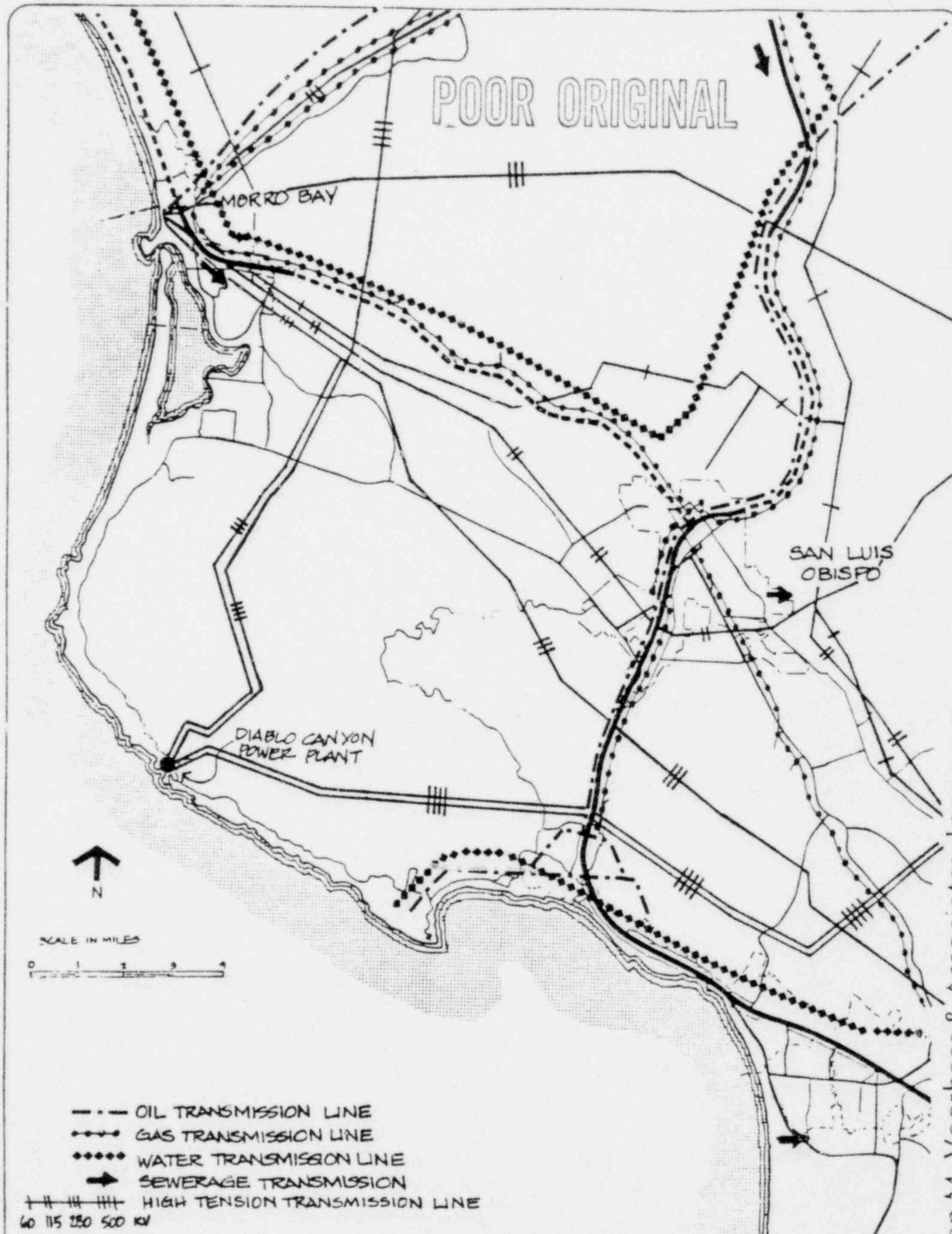

FIGURE II-4: STUDY AREA UTILITY LINES

could conceivably block evacuation routes underneath. In such a case, it would become necessary for PG&E to de-activate these lines as fast as possible and to clear fallen wires from the affected roads.

III. EMERGENCY PLANNING AREA

Federal guidelines for emergency response plan development for fixed nuclear facilities recommend a protective action area around the facility of up to a 10-mile radius to protect the population against direct radiation exposure. However, unique topographic features and population concentrations of the actual area initially require a minimal evacuation radius that goes beyond the designated 10-mile area.

To define the designated radius evacuation area for the Diablo Canyon Nuclear Power Plant, the following criteria were established:

- The designated area must encompass as a minimum the recommended 10-mile radius area as specified in the Federal guidelines.
- The designated area must be concisely identifiable and readily comprehensible to allow for effective public broadcasting of information and guidance during an emergency event requiring area evacuation.
- The perimeter of the designated area must avoid major irregularities to maintain rationality and credibility of the designated area, while avoiding an imposition of potential evacuation of major population groups well beyond the 10-mile radius.

The designated evacuation study area boundary, shown in Figure III-1, includes the Cities of San Luis Obispo and Morro Bay as well as a northern portion of the City of Pismo Beach.

A. NRC Requirements

The study area was first divided into sub-areas using the alphanumeric sector and zone designators developed by the Nuclear Regulatory Commission (NRC). Each 22 $1/2^{o}$ sector is described by a letter and the zone (or distance from the facility) by a number. Figure III-2 illustrates these study area subsections. In order to facilitate regional and nation-wide comparisons between nuclear facilities, the NRC zone system was used to summarize certain types of statistics such as population. The NRC zones were not used in the actual evaluation of evacuation times.

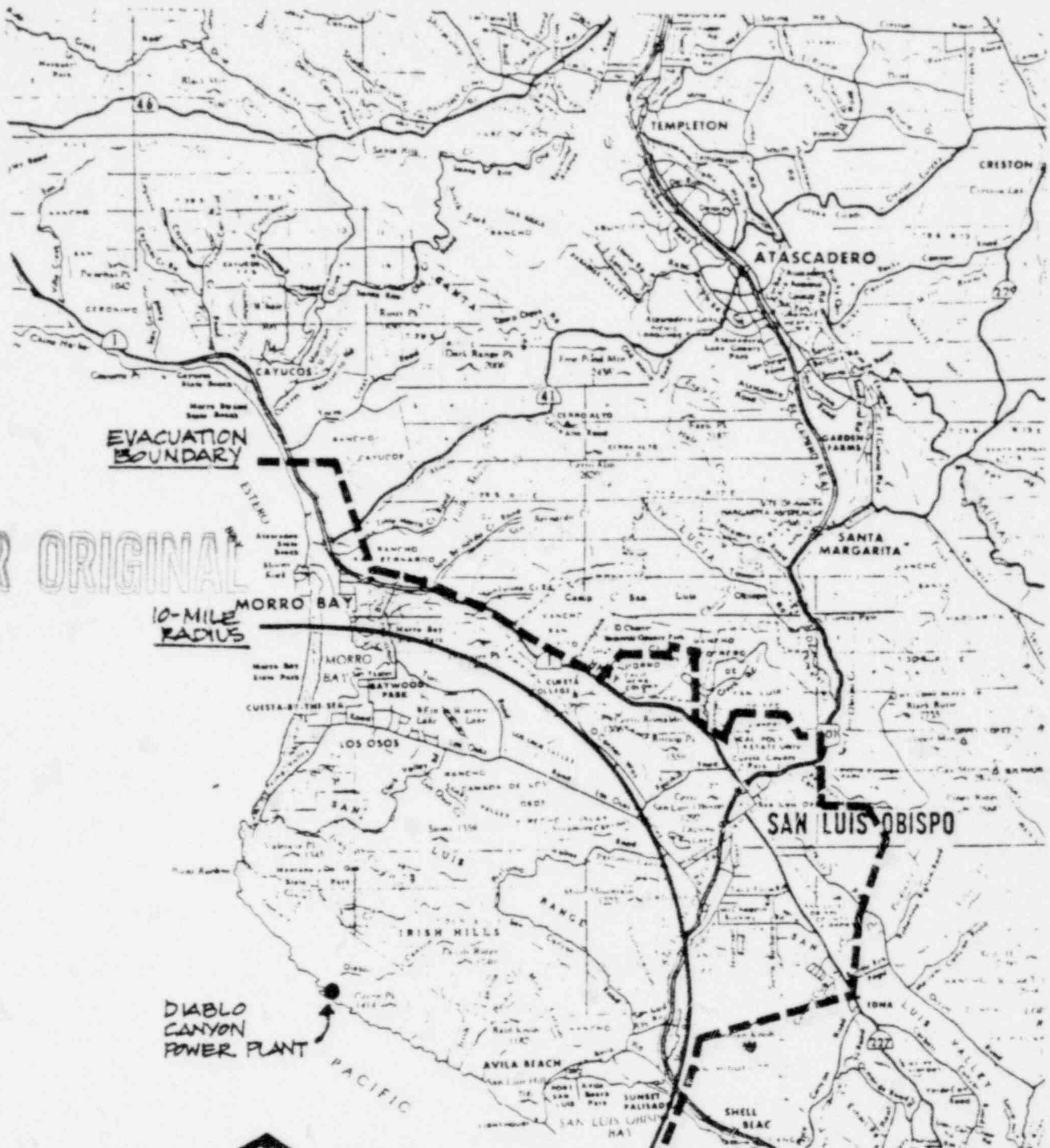

FIGURE III-1: 10-MILE RADIUS AND EVACUATION BOUNDARY

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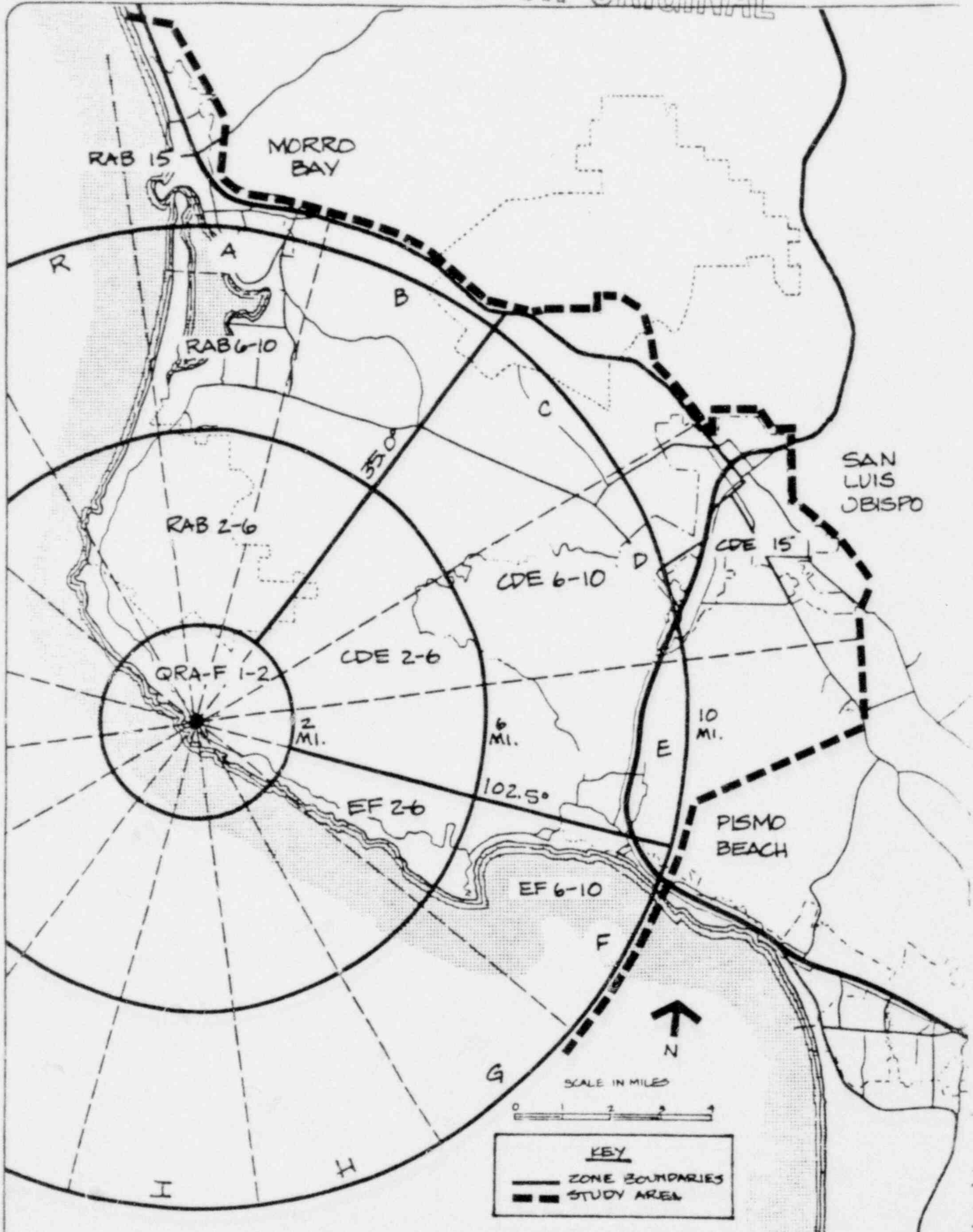

FIGURE III - 2: NRC ZONE DESCRIPTION

B. Evacuation Analysis Zones

Since the NRC-designated sub-areas are not easily defineable nor easily comprehensible by the public, a set of special evacuation analysis zones was determined by this consultant. These zones are based on population clusters and, in most cases, are divided by readily identifiable physical features as well as city limits and property boundaries. These analysis zones are shown in Figure III-3 and are described in more detail in Table III-1.

In general, the analysis zones represent traffic shed areas from which evacuation traffic would drain using a specific road or highway to reach the regional freeway network. In addition, these zones have describable boundaries and can serve as the basis for selective and staged evacuation if required. This zone system has been used throughout the evacuation times assessment study.

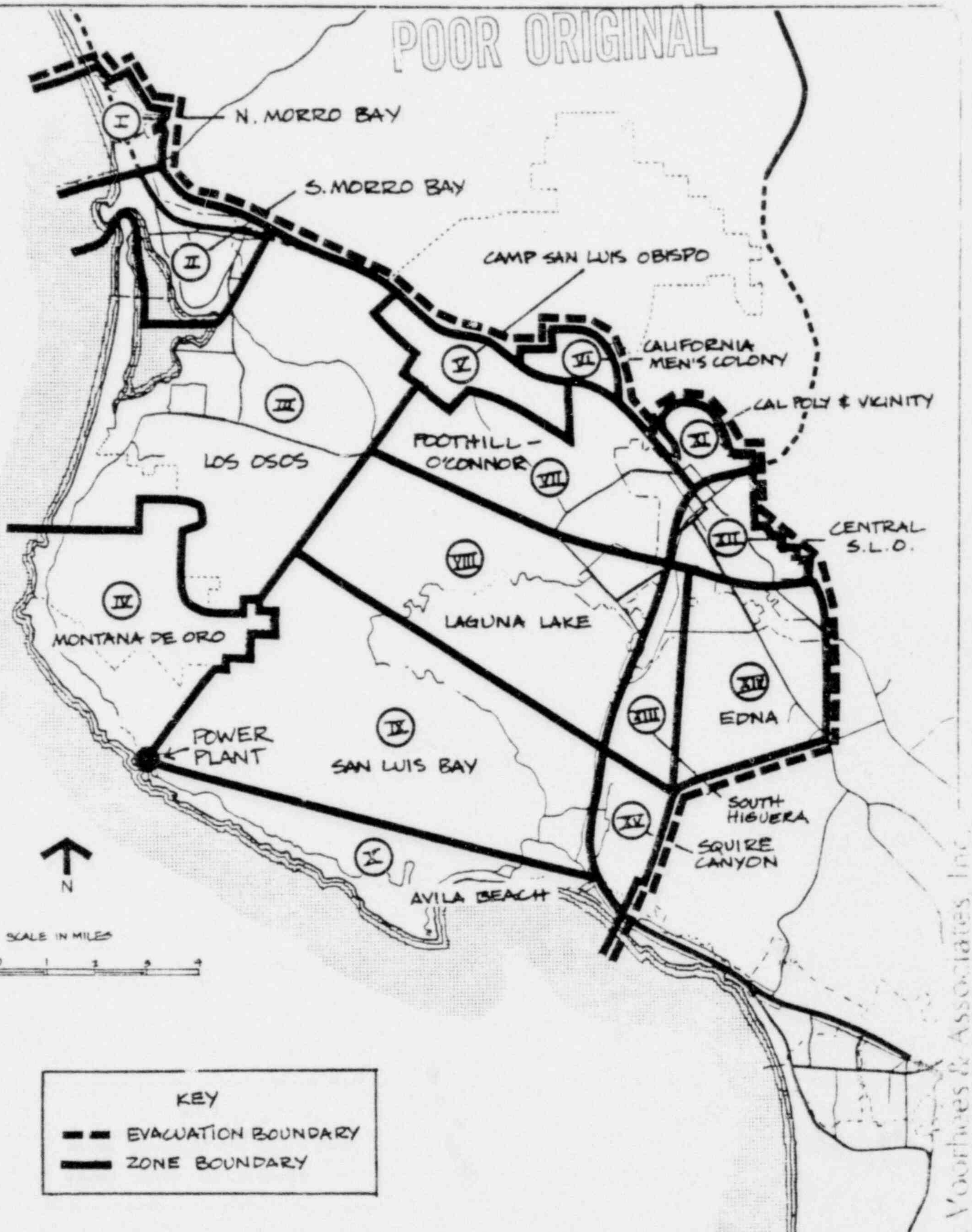

FIGURE III-3: EVACUATION ANALYSIS ZONES

Table III-1

DESCRIPTION OF EVACUATION ANALYSIS ZONES

Analysis Zone	Limits (Clockwise from North)
I North Morro Bay	- N. Morro Bay City Limits - State Route 41 - Pacific Ocean
II South Morro Bay	- State Route 41 - Ridge of Bernardo, Mountains (north of U.S. Hwy. 101) - S. Morro Bay City Limits (excluding Morro Bay State Park Penninsula) - Morro Bay-Pacific Ocean
III Los Osos	- Morro Bay City Limits - U.S. Highway 1 - Camp San Luis Obispo Military Boundary - 35.0° sector line (from PG & E Plant and approximately intersects the Los Osos Valley Road/Turri Road intersection - Northern boundary of Montana de Oro State Park - Pacific Ocean
IV Montana de Oro	- Montana de Oro State Park Boundary - 35.0° sector line - Pacific Ocean
V Camp San Luis Obispo	- Camp San Luis Obispo Property below U.S. Highway 1
VI California Men's Colony	- California Men's Colony
VII Foothill - O'Connor	- Zone V (Southern Limit) - U.S. Highway 1 - U.S. Highway 101 - Imaginary Boundary from the U.S. 101/ Marsh Street interchange to the Foothill/Los Osos Valley Road intersection. - Los Osos Valley Road/Turri intersection - 35.0° sector line

Analysis Zone	Limits
VIII Laguna Lake	- Zone VII (southern limit) - U.S. Highway 101 - Imaginary Boundary connecting Indian Knob, the Irish Hill Radio Beacon and Mt. Stony 35.0' sector line
IX San Luis Bay	- Zone VIII (southern limit) - US Highway 101 - Imaginary line from US 101/Monte Road interesection to Diablo Canyon Nuclear Power Plant - Zone IV (eastern limit) - Zone III (eastern limit)
X Avila Beach	- Zone IX (southern limit) - US Highway 101 - Spyglass Road - Pacific Ocean
XI Cal Poly and Vicinity	- California Polytechnic Institute - San Luis Obispo Campus - San Luis Obispo City Limits - U.S. Highway 101 - U.S. Highway 1
XII Central San Luis Obispo	- U.S. Highway 101 - San Luis Obispo City Limits - Orcutt Road (with an imaginary extension to the U.S. 101/Marsh Street Interchange
XIII South Higuera	- Zone XII (southern limits) - Imaginary line south to Indian Knob - Imaginary line from Indian Knob to approximately 2500' south of the U.S. 101/Higuera Interchange U.S. Highway 101
XIV Edna	- Zone XII (southern boundary) - Imaginary line through Islay Hill and Southern Pacific R.R. Line - Imaginary line through approximately 1500' south of Broad Street @ SSP RR to Indian Knob Zone XIII (eastern limit)
XV Squire Canyon	- Zone XII (southern boundary) - Imaginary line from Indian Knob to U.S. 101/Spyglass Road Intersection

C Affected Jurisdictions

The evacuation study area is entirely within San Luis Obispo County. This area includes the Cities of San Luis Obispo and Morro Bay as well as part of Sunset Palisades in the northern section of the City of Pismo Beach. In addition, this area includes the unincorporated developments of Baywood Park, Los Osos, Cuesta-by-the-Sea, and Avila Beach and other pockets of development. The following list contains the distances of these communities from the Diablo Canyon Power Plant site:

Port San Luis	6.5 miles
Avila Beach	7 miles
Los Osos/Baywood	7 miles
Los Osos Valley	8 miles
Morro Bay State Park	9 miles
Sunset Palisades	9 miles
Laguna Lake	10 miles
Morro Bay	10 miles
Pismo Beach1/	12 miles
San Luis Obispo	12 miles
Grover City1/	15 miles
Arroyo Grande1/	16 miles
Oceano1/	17 miles

1/ To be analyzed later.

IV. POPULATION, INSTITUTIONS, AND VEHICLE TRIP GENERATION WITHIN THE EVACUATION AREA

A. Residential Population and Employment Centers

In order to accurately assess the amount of time needed to evacuate the designated study area, estimates of both the population and of the number of dwelling units by evacuation analysis zones were required. These estimates were derived by using census information and forecasts of the population and number of dwelling units in the study area[1/] and by distributing them into analysis zones. The county and incorporated city population and dwelling unit estimates were furnished by local governments. These were obtained by updating census data from building permit applications, building demolition applications, and augmented with vacancy rate and household-size assumptions. In preparing the final estimate used for the study this information was analyzed for trends since the 1970 federal census and projected to July 1980. An additional straight-line projection to 1985 was done to indicate short-term growth.

The population figures used in the analysis incorporate a zero percent vacancy rate and therefore exceed county estimates which include vacancies of 30 percent or more in many coastal vacation communities. This was done to consider a hypothetical "worst-case" situation in which a summer time population peak could exist. The distribution into analysis zones was aided by the use of aerial photographs, United States Geological Survey quadrangle maps, and field surveys. Estimates of the population and of the number of dwelling units are shown by NRC zones in Table IV-1, and by evacuation analysis zones in Table IV-2. As can be seen, the total estimated population, as of July 1980, in the study area is about 63,500 persons in 25,700 households. Projections for 1985 call for an increase to about 77,200 inhabitants living in 31,000 households. Using 1970 data, it is estimated that 60 percent of the population live in urbanized areas and the remaining 40 percent live in rural areas.[2/]

1/ Information provided by San Luis Obispo County and the Cities of San Luis Obispo, Morro Bay, and Pismo Beach.

2/ U.S. Census Survey, 1970.

Table IV-1

ESTIMATED DWELLING UNITS AND POPULATION BY NRC ZONES

NRC Zones	Number of Dwelling Units		Population[1/]	
	7/80	7/85	7/80	7/85
QRAF 1-2 Diablo Canyon	3	3	5	5
RAB 2-6 Montana De Oro	13	14	35	37
CDE 2-6 Irish Hills	11	12	23	25
EF 2-6 Deer Canyon[2/]	—	—	--	--
RAB 6-10 Los Osos	4801	5778	11728	14116
CDE 6-10 Laguna Lake	1746	2158	4937	6123
EF 6-10 Avila Beach	485	524	917	993
RAB 15 Morro Bay	4784	4979	8900	9194
CDE 15 Greater SLO	13865	17551	36953	46732
TOTAL	25708	31019	63498	77225

1/ Does not include group quarters

2/ Ranchland adjacent to Diablo Canyon power plant access road

Table IV-2

ESTIMATED DWELLING UNITS AND POPULATION BY EVACUATION ZONES

Evacuation Zones		Number of Dwelling Units		Population 1/	
		7/80	7/85	7/80	7/85
I	N. Morro Bay	2157	2245	4004	4136
II	S. Morro Bay	2746	2858	5096	5264
III	Los Osos	4691	5662	11554	13936
IV	Montana De Oro	8	9	15	16
V	Camp SLO	-	-	-	-
VI	Calif. Men's Colony	-	-	-	-
VII	N. Los Osos Road	2664	3364	6952	8772
VIII	Laguna Lake	2098	2663	6034	7663
IX	San Luis Bay	97	105	189	206
X	Avila Beach	483	523	911	987
XI	Cal Poly & Vicinity	1775	2261	4616	5878
XII	Central SLO	6819	8683	18890	24052
XIII	South Higuera	1298	1648	2881	3657
XIV	Edna	822	947	2203	2501
XV	Squire Canyon	50	51	153	157
TOTAL		25708	31019	63498	77225

1/ Does not include group quarters; includes population indicated as dwelling unit population in census reports estimated with a 0% vacancy rate.

As can be derived from Table IV-1, the current (July 1980) estimated population distribution by distance from the Diablo Canyon plant is as follows:

	Number	%
Within 2 miles of plant	5	0.0%
Within 2-6 miles of plant	58	0.1%
Within 6-10 miles of plant	17,582	27.7%
Beyond 10 miles of plant	45,653	72.2%
Total	63,498	100.0%

As employment patterns indicate, the largest concentration of workers is in downtown San Luis Obispo, which is the County seat as well as the County's regional center for marketing and financial enterprises. Approximately 65 percent of all workers in San Luis Obispo live in San Luis Obispo with another 20 percent living in unspecified outlying rural areas.1/

1/ San Luis Obispo Regional Transportation Study. Phase II Technical Report JHK & Associates, EDAW Inc. November 1974.

B. Car Ownership and Vehicle Generation

The dwelling unit estimates for the fifteen evacuation zones were used to estimate the number of vehicles that each zone would generate during an evacuation. To do this, data from the 1970 U.S. census were applied to the dwelling unit estimates to determine the number of one, two, and three-or-more car owning households in each zone whether urban or rural. This information was found to be as follows:

Percentage of Car-owning Households in
San Luis Obispo County

Household Type	Urban Zones	Rural Zones
One-car Households	49.5%	55.2%
Two-car Households	32.5%	27.6%
Three-or-more-car Households	9.0%	9.3%
Non-car-owning Households	9.0%	7.9%
TOTAL	100.0%	100.0%

In order to estimate the number of vehicles that would leave a particular zone, the car-owning household characteristics had to be converted into vehicles. Thus, all of the one-car households were assumed to generate one car, while 50 percent of the two-car households would generate one car and the remaining 50 percent would generate two cars. All of the three-car households were assumed to utilize two cars for evacuation purposes. Application of these assumptions to the number of 1980 households results in just under 30,000 residential-based vehicles that are estimated to leave the study area during an evacuation as shown in Table IV-3.

The following two sections, Institutions and Recreational Facilities, will discuss the special traffic generators in the study area. These generators would require special attention for evacuation purposes and would in some cases add to the total number of vehicles. It should be pointed out that

Table IV-3

ESTIMATE OF AUTOMOBILES USED FOR EVACUATIONS[1/]

Evacuation Zone	Zone Designation (Urban/Rural)	Number of Households	Number of Vehicles Used for Evacuation	Number of Non-car-owning Households
I	U	2157	2502	194
II	U	2746	3185	247
III	R	4691	5441	371
IV	R	8	9	1
V	R	-	-	-
VI	R	-	-	-
VII	R	2664	3064	210
VIII	U	2098	2433	189
IX	R	97	112	8
X	R	483	555	38
XI	U	1775	2058	160
XII	U	6819	7909	614
XIII	R	1298	1306	103
XIV	R	822	954	65
XV	R	50	57	4
TOTAL		25,708	29,785	2,204

1/ Does not include group quarters

although these special generators would be evacuated, not all of them produce trips during the actual time when the population is leaving the area. At a high school, for example, students and employees would be expected to return home prior to evacuation. Since these people are accounted for by virtue of being "assigned" to a dwelling unit, these trips were deleted from the evacuation traffic stage of the analysis to avoid double counting. On the other hand, beach and park users were added to the evacuation traffic totals under the assumption that they could, as a maximum, be entirely comprised of non-residents or visitors. The scope of this study did not include development of the actual evacuation operations for these special facilities. However, the potential vehicle generation from these generators was considered in order to see if an identifiable amount of delay time would be caused by their presence.

Table IV-3 also indicates that there are approximately 2200 non-car-owning households in the evacuation study area which will require special attention when developing an evacuation plan.[1/] For the purposes of this study, it was assumed that non-car-owning persons would be picked-up at certain designated collection points or, in case of elderly and non-ambulatory citizens, be transported directly from their homes to designated reception centers outside the evacuation area. For conservative reasons, little ride-sharing was assumed in cases of an emergency, although in fact rides with neighbors and friends may occur. Section C below describes the evacuation action steps by the non-car-owning population in more detail.

1/ It should be noted that since these numbers were developed from county-wide averages, these estimates are approximate.

C. Institutions

Schools

Within the designated evacuation area there are 29 schools including parochial schools and college campuses. The locations of these schools are identified in Figure IV-1.[1/]

The three largest educational facilities in the evacuation study area are:

- the California Polytechnic State University (Cal Poly)
- the San Luis Obispo County Community College (Cuesta)
- the San Luis Obispo Senior High School

Cal Poly has an academic-year student/staff population of approximately 17,900 persons, Cuesta College about 3,370 persons, and San Luis Obispo High School approximately 1,300 persons.

General and Convalescent Hospitals

There are three major general hospitals and four convalescent hospitals in the evacuation study area. These medical facilities would require special attention during the evacuation process since it would require the coordination of staff personnel, ambulance service, and the relocation of bed-confined patients to temporary medical facilities located outside the evacuation area. Characteristics of the seven aforementioned hospitals are shown in Table IV-4. Figure IV-2 indicates their location.

Other Institutional Generators

The California Men's Colony, a minimum-to-medium security correctional institution, houses approximately 2550 inmates, and is patrolled by about 300 guards and staff members. At the present time, the California Men's Colony has no evacuation plans for its inmates, so the sheltering of the inmates

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1/ Includes public and private schools as listed in the 1979-80 San Luis Obispo County school directory.

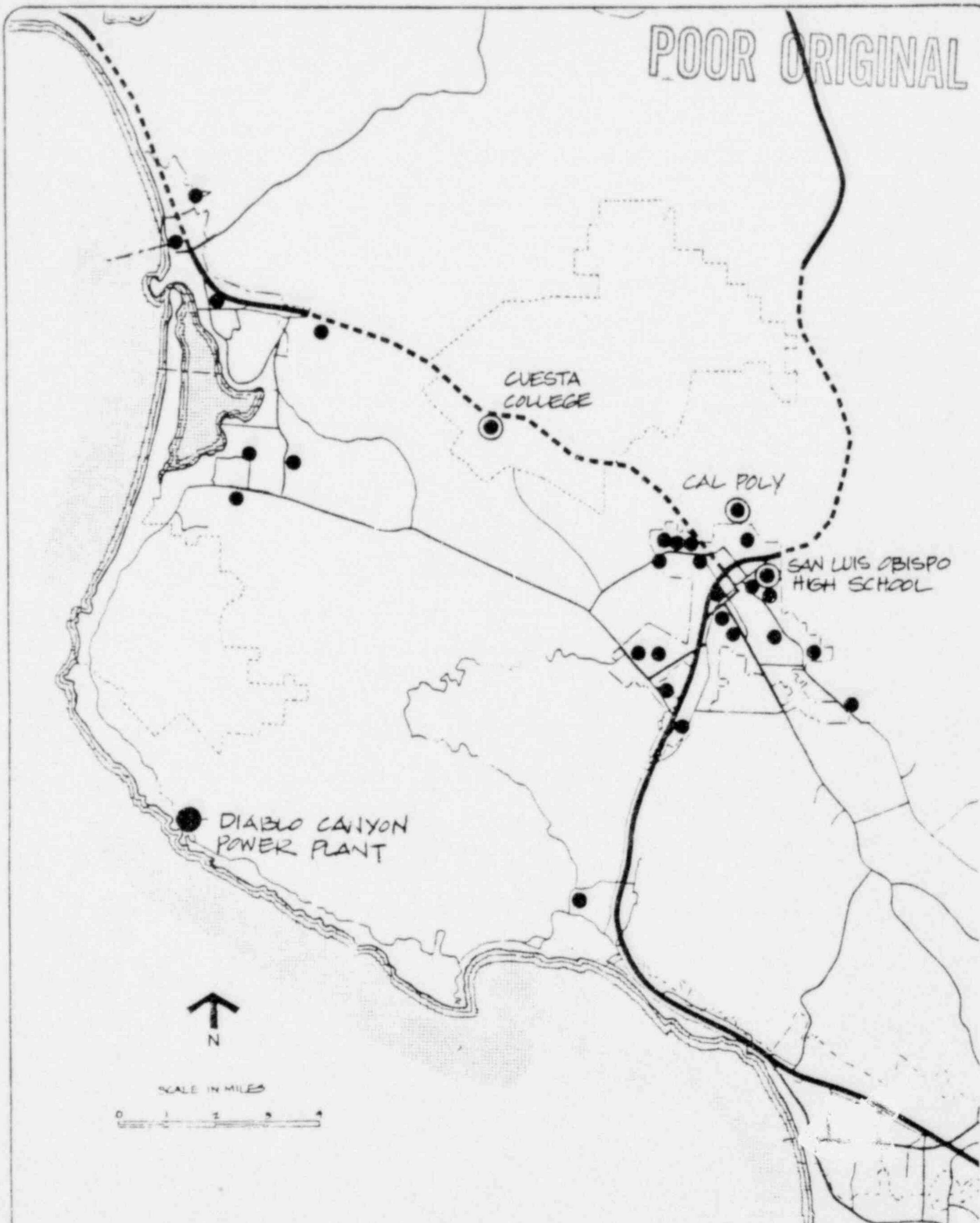

FIGURE IV-1 SCHOOL LOCATIONS

Table IV-4

ESTIMATED VEHICLE GENERATION OF GENERAL AND CONVALESCENT HOSPITALS

Facilities	Beds	Average Number of Patients	Staff	Vehicles Generated 1/
General Hospitals				
San Luis Obispo	92	50	125	77
Sierra Vista	172	137	200	284
French	138	75	100	120
Convalescent Hospitals				
Cabrillo	162	NA	NA	NA
Hacienda	163	163	100	103
Casa de Vida	99	99	50	52
Morro Bay C. Center	72	72	35	37

1/ Does not include the number of ambulance trips generated as these trips would not be characteristic of the general flow of traffic. These trips were derived by estimating the number of staff, out-patient, and visitor vehicles that would be generated.

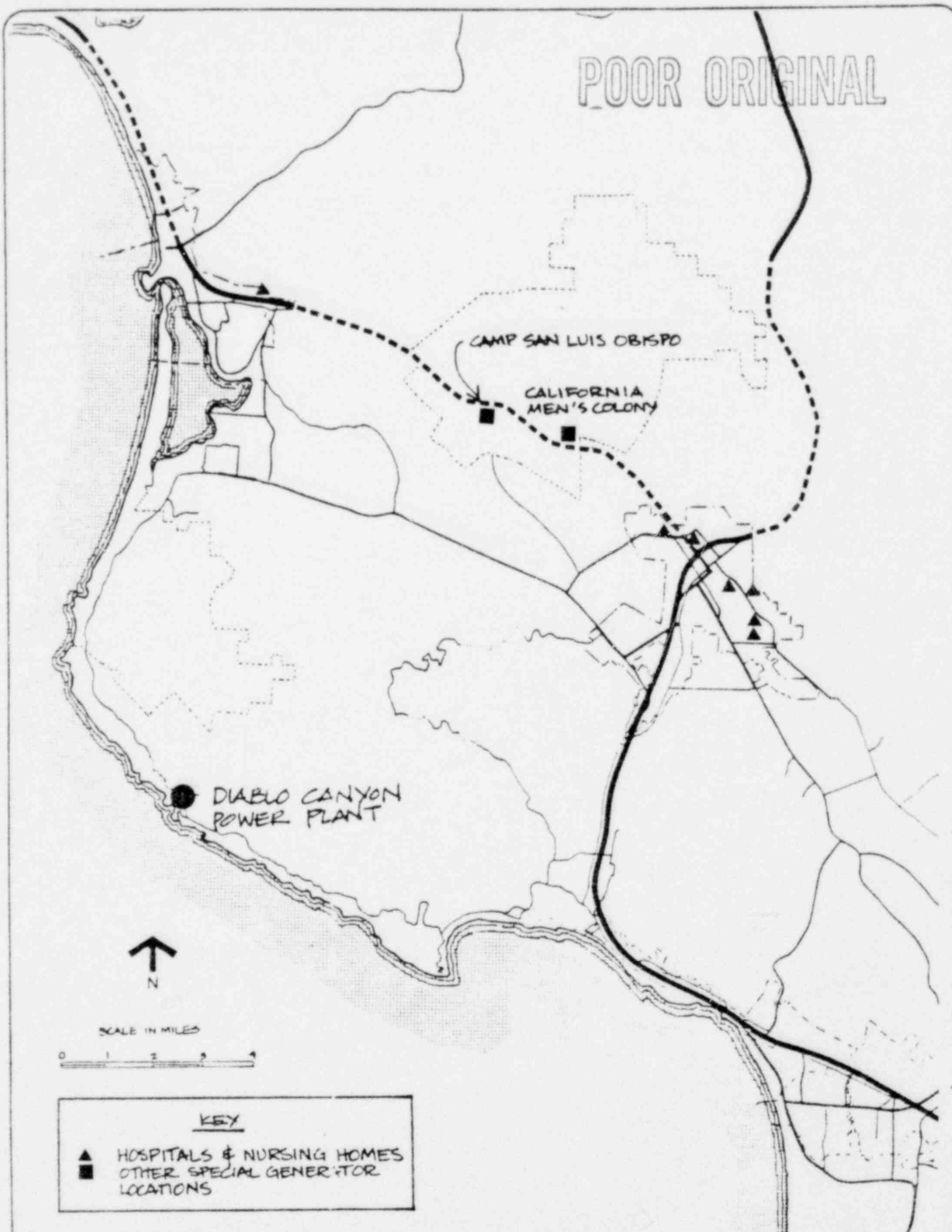

FIGURE III-2: HOSPITALS, CONVALESCENT HOMES AND OTHER SPECIAL GENERATOR LOCATIONS

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would be the most likely occurrence. If the Men's Colony should be evacuated, this facility would generate approximately 460 cars which includes staff and state cars as well as visitor vehicles, but does not include about 70 buses that may be needed for the evacuation of inmates.

Located opposite the California Men's Colony is Camp San Luis Obispo, the National Guard Headquarters. During the summer training months (peak season), there are about 1100 persons on post who in an evacuation situation would generate an estimated 300 vehicle trips.

The location of these two generators is shown in Figure IV-2.

D. Recreational Facilities

There are four major recreational facilities within the designated evacuation area: three are state facilities, and one is operated by San Luis Obispo County. The location of these recreational facilities is shown in Figure IV-3. In addition, there are three regional parks in the area which straddle the evacuation boundary.

According to information and data received from the State Park Superintendent, the Labor Day weekend represents the maximum annual attendance period. On a given day during this three-day weekend, the following number of vehicles can be expected to be generated by each of the recreational facilities:

Facility	Number of Vehicles Generated
Atascadero State Beach	160
Montana de Oro State Park	196
Morro Bay State Park	475
Avila Beach (SLO County)	600
	1431

Campers, cars, trailers, and motorhomes represent the primary mode of transportation used by 99 percent of all visitors to recreational facilities in the area. Of the remaining 1.0 percent, 0.9 percent are walk-in visitors, and 0.1 percent use public transportation. As can be seen, the beach and park visitors are quite self-sufficient in terms of transportation and would be able to evacuate with their own vehicles.

The number of vehicles generated by residential households and the special generators described above are summarized in Table IV-5.

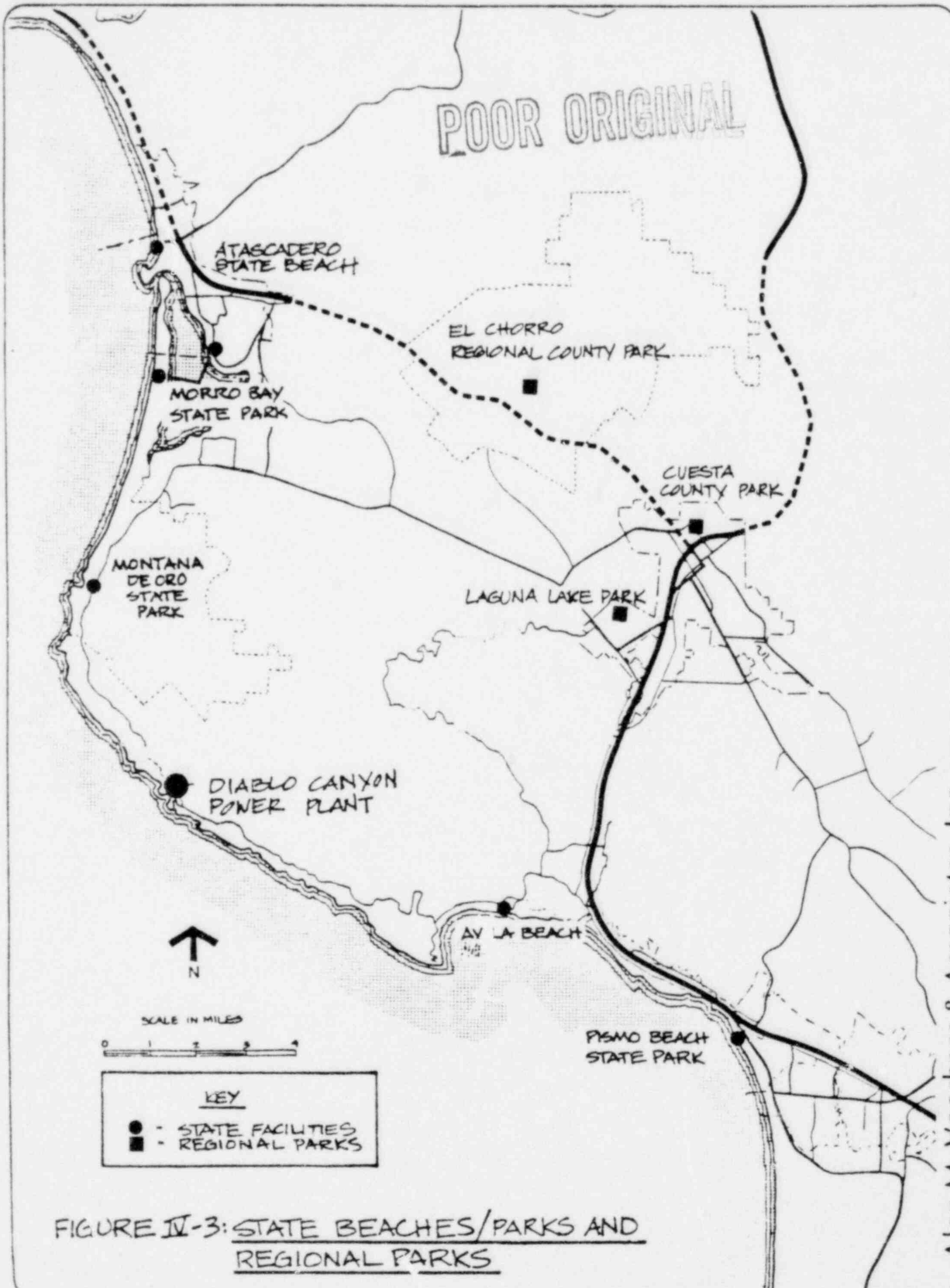

FIGURE IV-3: STATE BEACHES/PARKS AND REGIONAL PARKS

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Table IV-5

Summary of Estimated Number of
Vehicles Generated by Analysis Zone

Zones	Residential-Based Vehicles	Vehicles Added By Special Generators	Total Vehicles Generated
I	2502	160 Atascadero State Park	2662
II	3185	(37) Morro Bay Convalescent Home	3185
III	5441	475 Morro Bay State Park	5916
IV	9	196 Montana de Oro State Pk.	205
V	0	(300) Camp San Luis Obispo (1200) Cuesta College	0 0
VI	0	(460) California Men's Colony	200 1/
VII	3064	(52) Casa de Vida	3064
VIII	2433	0	2433
IX	112	0	112
X	555	600 Avila Beach	1155
XI	2058	5000 Cal Poly (284) Sierra Vista Hospital	7058
XII	7904	(225) San Luis Obispo HS (120) French Hospital (103) Hacienda Convalescent (77) San Luis Obispo General (725) Hospital Direct Evacuation	8634 2/
XIII	1506	0	1506
XIV	954	0	954
XV	57	0	57
TOTAL	29785	+ 7356	= 37141

( ) Not included in "Total" column to avoid possible double counting.
1/ Includes 200 trips for misc. farm vehicles.
2/ Includes 725 direct evacuation trips generated by hospitals

V. EVACUATION OPERATION CONCEPT

A. Critical Evacuation Time Period

The starting time of an evacuation might occur at any one of the following three time periods:

- Nighttime on a weekday or weekend
- Daytime on a weekend
- Daytime on a weekday

Each of these combinations was considered in the study with the following results: There is an essential tradeoff in any evacuation between the vehicle generation rate and the transportation system capacity. At one end of the spectrum, the population is rapidly mobilized, but their movement time is then determined by the transportation system capacity. On the other hand, if adequate capacity exists, the evacuation time will depend upon the ability to mobilize the population. A gray zone exists between these two extremes where both factors contribute. In general, the Daytime/Weekday case is the worst-case situation for the basic reason that a substantial evacuation delay occurs in mobilizing and assembling the family unit, followed by roadway capacity delays in leaving the study area.

Nighttime Evacuation

In the event an evacuation were necessary at nighttime, the notification process would be hampered by people having to wake up and comprehend the evacuation information being broadcast. Additional time would probably be required to prepare vehicles for evacuation in the dark. Nevertheless, for most segments of the population, the family unit would be intact at the time of notification. Thus, a nighttime evacuation would potentially place a demand on the transportation facilities at an earlier time and possibly at a higher rate than for a daytime situation. However, excessive delays could be avoided through the use of staged evacuation, by sheltering people in their homes rather than having them stalled more vulnerably in potential traffic congestions. The total evacuation time during a nighttime emergency would most likely be shorter than for a daytime evacuation since the vast majority of people would already be home.

Daytime/Weekend Evacuation

The daytime/weekend situation represents a case between the two other situations and may require some staged evacuation in order to be orderly. In the analysis, the sensitivity to a more peaked trip generation rate was tested which resulted in increased roadway congestion rather than in a reduction of overall evacuation time.

Daytime/Weekday Evacuation

The third analysis case selected was the daytime case where there is a considerable pre-evacuation "rush hour" period when family units are being reunited. It was found that the day/weekday case represents the worst-case situation with respect to overall evactuation time and that this time period should be utilized in determining evacuation times. In order to represent the worst time of a year, car generation rates per dwelling unit were developed assuming a 100 percent occupancy of structures. In addition, trips were estimated from beach and park areas and added to those made by residents thus assuming that all recreation population would come from outside the designated evacuation study area. Finally, the state university was considered to be in session, so that the evacuation was essentially assumed to take place on an early summer weekday daytime when both permanent residents and visitors are accumulated in the area. It should be noted that while the case analyzed is somewhat of an extreme, the overall evacuation time was not found to decrease significantly with a minor reduction in traffic generation. The time was controlled by the evacuation behavior of the population and a few key bottlenecks. While the population that would be present during an actual emergency may most likely be less than the maximum possible, delays would be reduced, making traffic control less critical, but still necessary. However, the maximum population figure was used in this analysis, for conservative reasons.

B. Implementing Agency Action Steps

The process of implementing the evacuation of the population within the designated area in the event of an emergency condition at the Diablo Canyon Power Plant would be expected to include the action elements summarily outlined below. Although a detailed evacuation plan was not produced concurrently with this study, the indicated steps were presumed in order to determine the evacuation times.

Notification[1/]

The initial step in implementing the evacuation would be the notification of the public within the designated evacuation area through the sounding of sirens indicating that an emergency condition exists and that the public is to turn to radio and television broadcasts for additional information and guidance.

Information Broadcasts

Public information, guidance and instructions would be issued to the local broadcasting stations. The broadcast information must comprise:

- Notice to evacuate the area
- An enumeration of the communities whose populations must evacuate
- An enumeration of the reception areas for persons requiring public shelter
- Notice of the public transport facilities available and actions required by persons in need of such services
- Notice of any abnormal area roadway conditions (e.g., impassability of roadways in the case of a major flood) and guidance information to use alternate roads and alternate reception areas.

1/ The details of the notification system are not analyzed in this report.

In the analysis, evacuation time t=0 was taken as the sounding of the emergency siren system. It was further assumed that the emergency broadcast instructions would be repeated in five minute intervals.

Mobilization of School and Public Transportation

The school bus fleet would be mobilized in the event that evacuation occurs while children are still at school. This mobilization task would have two basic components: (1) mobilization of the bus fleet normally available to a given school district, and (2) mobilization of additional school buses from adjacent districts, as required to meet demand. A detailed analysis of the school busing situation was not performed in the study, although the evacuation curves developed take into account the delay caused to certain segments of the population in awaiting the arrival at home of school children.

The public transportation bus fleet would be mobilized and will likely comprise both vehicles from private contractors and from public transport agencies.

Activation of Public Transportation Call-In Centers

The telephone operators (either locally or at the County Emergency Operations Center) would be mobilized to receive calls for public transport from transit dependent persons in rural areas and would dispatch buses assigned to rural area collection. Table IV-3 indicates an estimate of the number of non-car-owning households by zone based upon analysis of census information.

Mobilization of Controllers at Urban Center Public Transport Collection Points

Traffic controllers would be dispatched to fire stations, designated as public transport collection centers, in developed areas to provide information to the public transport dependents and to aid in orderly dispatching of buses.

Mobilization of Roadway Traffic Controllers

The state and local police force would be assigned to designated potentially critical locations on the area roadway system to expedite traffic flow.

Mobilization of Wreckers

Wreckers would be mobilized and assigned to selected key locations on the roadway system regardless of weather conditions. Wreckers would be required to maintain system capacity by rapid removal of stalled or out-of-gas vehicles.

C. Action Steps by the Car-Owning Population

Evacuation Curves

The calculation of evacuee departure rates leaving home is based upon the mathematics of combining probability distributions which individually represent liklihoods of certain evacuation steps taking place within a given time after task initiation. Figure V-1 conveys graphically the process which takes place for those members of the population who are at work when the alarm is sounded. The height of the curve at each point indicates the percentage of the population engaged in each particular act at a given point in time.

The graphs indicate how the "wave" of evacuees is spread over a larger and larger time frame resulting from a number of sequential steps that must be accomplished before the actual act of leaving the area can begin. For example, the first persons to evacuate, approximately at one hour after receipt of notification to evacuate, are those who very quickly grasp the evacuation notification, who are the quickest to leave work, who have the shortest driving time home and who are quickly packed once home. As a percentage, this is a very small group of people.

The following sections describe in detail the individual steps which, in combination, produce the final evacuation "wave". In the study, two different movement distributions were developed to represent different classes of population. Evacuation Distribution 1, as described below is for the working population. Distribution 2 applies to those at colleges, parks and other special generations who do not have to return home by car prior to starting the evacuation.

Public reaction to the evacuation notification and instructions would result generally in certain action steps which are described in detail as follows:

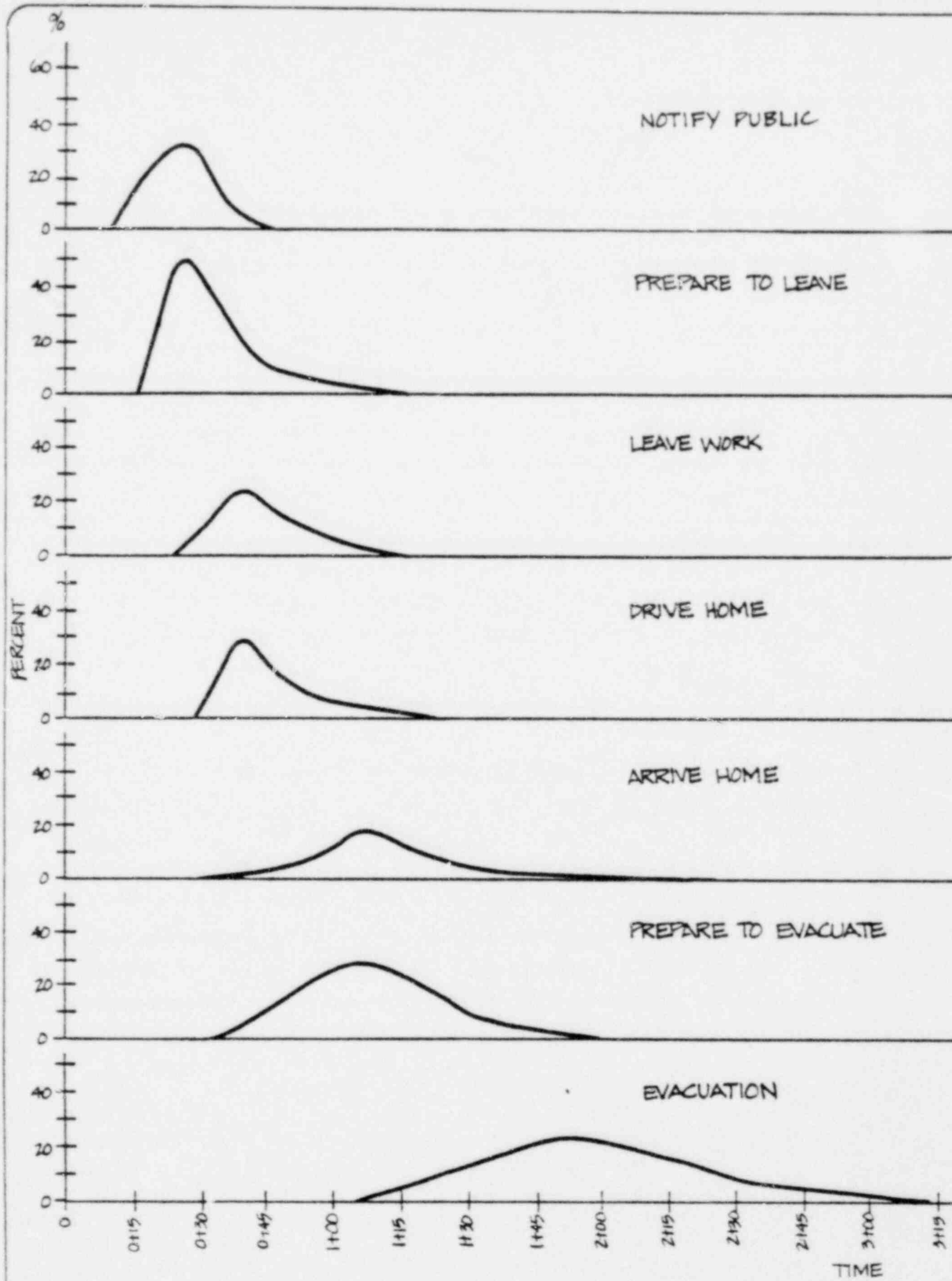

FIGURE V-1 : DEVELOPMENT OF EVACUATION CURVE

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Notification

During a daytime event, most area workers will receive the notification to evacuate at their place of work. Predicated on the assumption that the public information broadcast commences five minutes after the activation of the Early Warning System (Siren), it is estimated that the entire area population will be apprised of the broadcast information within 45 minutes. The rate at which the broadcast information is assimilated is depicted as the "Notification" curve in Figure V-I. Its shape and range have been suggested by existing studies of civil defense alerting. For analysis purposes, it was assumed that 10% of the population will become aware of the need to evacuate by time t=15, (that is 15 minutes after the sirens sound). The peak would be reached at t=30, and all notification would be complete by t=45 minutes. In the event notification was significantly slower than indicated above, the duration time of total evacuation would be extended by the additional time required to apprise everyone.

Leaving Place of Work

The rate at which area workers will leave their jobs to return home to prepare for evacuation will be quite variable, depending upon the particular work environment and upon the responsibility level of the worker. It is to be expected that a large proportion of the work force will be able to leave their jobs almost immediately, quite similar to a normal departure from work at the end of the workday. A number of workers, however, will require some job "close-down" time in work situations; for example, those that involve machinery, construction equipment, or cash registers in retail sales establishments. In addition, supervisory employees, managers, and independent business operators will generally require a greater amount of time to secure their place of work and to assure that all employees and others on the premises have departed.

Based in part upon generalizations from worker parking studies, a time distribution of workers leaving their place of work has been assumed recognizing the above noted variations. This is illustrated in Figure V-I as the "Prepare to Leave" curve. The assumed percentage of workers leaving their place of work following comprehension of the broadcasted information begins to rise rapidly with 50% leaving work within 10-minutes of recognition of the need to evacuate. All workers being evacuated were assumed to be leaving work 30 minutes following the receipt of broadcast information.

The travel time of the employees from their place of work to home has been estimated by analyzing employment and commuting patterns within the county. The maximum trip length for work journeys in the area is estimated to be about 20 miles, and the most common trip length is estimated to be three to four miles. Ten minutes of delay time has been added to the average travel times that are expected to occur in a normal rush-hour situation, to take into account the additional bunching of workers during this extreme-case rush hour. The resulting travel time curve is shown as the "Drive Home" curve in Figure V-I.

In the case of college students, beach and park visitors and other persons at similar institutions, a different pattern would evolve, which would have a significantly shorter time frame. These groups would walk either to their dormitory, in the case of students, to a parking lot, or directly "home". These people are represented as Evacuation Distribution 2 in Figure V-2, which compares the more common Distribution 1 for commuters with these other population sub-groups. (Note that the walk times are a maximum of 35 minutes versus up to an hour for drive times.)

Of course, some people would already be at home when the alarm is sounded. For those that belong to a family unit involving school children or workers, it was assumed that the family would not evacuate until all the members were broght together, hence the Distribution 1 would still apply. On the other hand, for those persons not constrained by family, immediate evacuation from the area is possible. Similarly, immediate evacuation from work is possible for those workers who commute into the evacuation

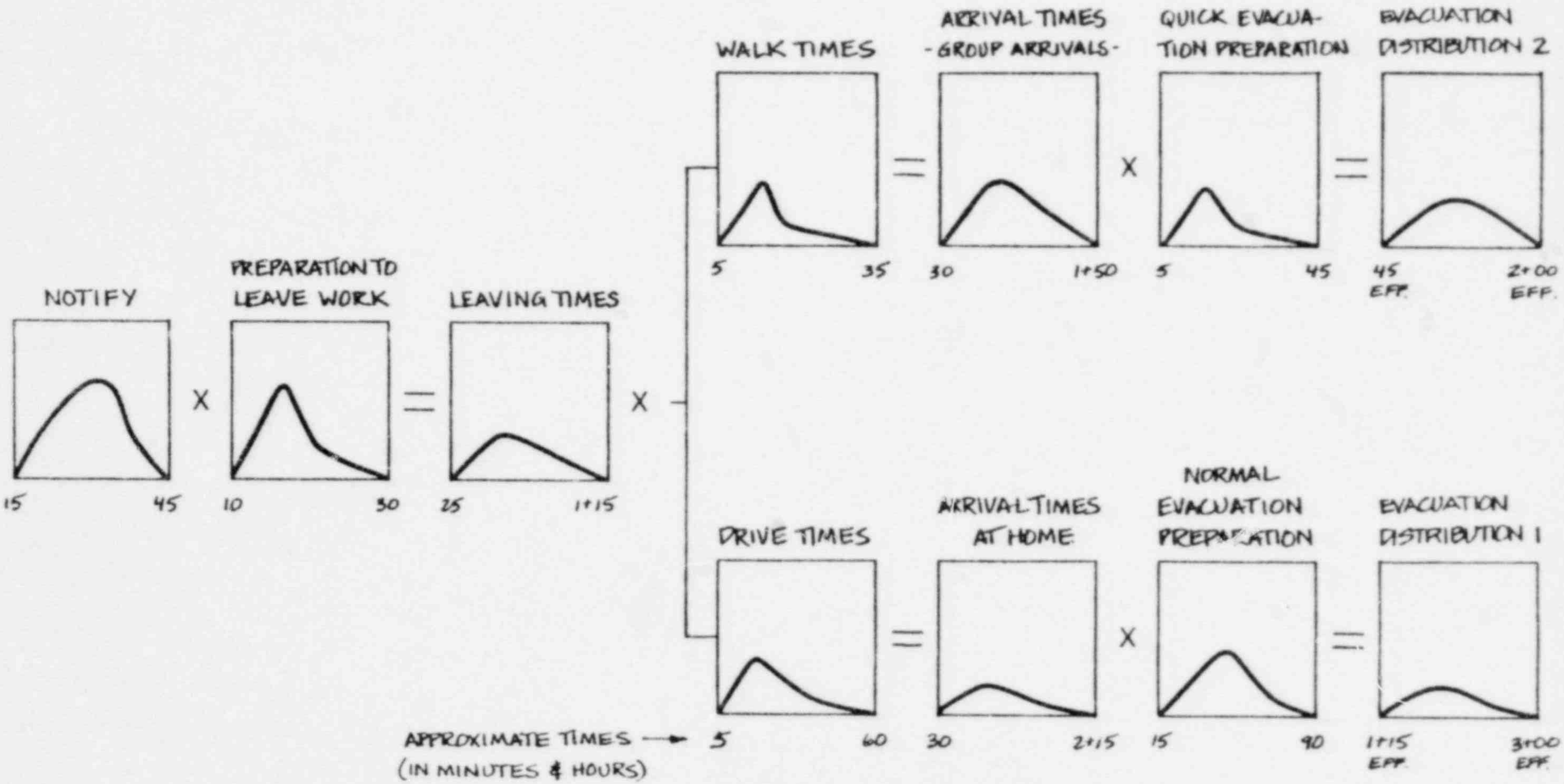


FIGURE V-2: GENERATION OF EVACUATION CURVES area from cities to the north or south of the designated evacuation area. Most of these people would evacuate before the general demand for evacuation routes has developed. If a large proportion of the population could be directly evacuated, the overall evacuation time could be reduced. Information to accurately estimate the size of this population group does not exist, so for analysis purposes it was assumed to be a small percentage of total population. Thus there would be no effect upon overall evacuation time.

Preparation for Evacuation

People can be expected to react differently to any emergency situation, and the conditions imposing an evacuation need on the area population are likely to generate great differences in the amount of time people will spend in preparing to leave their home. In order to estimate the overall evacuation time it has been necessary to attempt a prediction of time that will be needed prior to actual evacuation. The variations in this time will occur as a consequence of numerous factors. Some of the more dominant factors include:

- Selecting basic necessities for those persons evacuating to public shelter areas as opposed to persons evacuating to homes of friends and relatives
- Size of the family and number of children
- Number of cars available
- Securing animals on farms/ranches
- Individual sense of urgency

The predicted preparation times prior to evacuation, shown in the "Prepare to Evacuat :" curve in Figures V-1, were derived from the following population categorizations:

- A small percentage of the area households are single-person households, and this segment of the population could be expected to be highly mobile and ready to leave in 15 minutes.

- A larger proportion of the area residents may feel a high sense of urgency and be prepared to leave home within 30 minutes the arrival time of the worker(s).
- The largest proportion of the area residents will require some time to pack some essentials, especially in households with children, to decide on what to do with pets, to decide on auto usage in the case of mult-car households and, as a result, may require 45 minutes to one hour following assembly of the family members.
- A proportion of the area population involved in farming or in conducting a business at their home is likely to require the greatest amount of time, not only to prepare for individual family member needs but to secure equipment, livestock, etc., and as a consequence, their time needs may be well in excess of one hour.

Similarly, an evacuation curve for those at the State University and others who have fewer needs to care for is expressed in Distribution 2, allowing a maximum of 45-minutes preparation time.

The resulting evacuation departure curves and their derivation are shown conceptually in Figure V-2. It should be noted that for Distribution 1, an evacuee begins to leave at about 1:15 (one hour and fifteen minutes after notification) and has effectively left home by 3:00. For students, beach and park visitors and other special groups, the evacuation can begin effectively at time 0:45 minutes and the leaving is completed effectively at 2:00 hours after notification. The term "effective evacuation departure times" is used because the extreme (less than 1%) tails of the resulting probability distribution are ignored. The justification is that, in reality the sequential events are not truly independent. For example, if a worker were late in getting started at home, he would probably attempt to make up time in packing. Or if he were delayed getting home, another family member could begin preparations, etc. For these reasons, the "tail" of the curve has been assumed to appear at the 99th percentile.

D. Action Steps by the Non-Car-Owning Population

As indicated previously, the non-car-owning population in the area is estimated at 4564 persons and of this total nearly 62 percent reside in the urban centers with another 19 percent in urbanized, unincorporated areas such as Los Osos, and Avila Beach.

The single most important element in providing time efficient evacuation to transit dependents is the assembly of people at a limited number of designated places for pickup by buses or other designated means. Within the urban centers this can be accomplished readily by designating the local fire stations as assembly points.

A similar procedure of assembly at fire stations or at a limited selection of other locations in the rural township area would impose unrealistic walking distances of several miles in hilly terrain. For members of non-car-owning households in the rural areas, it is, therefore, proposed that these people be instructed to telephone and request bus or other transportation. As noted in Table IV-3, the number of public transport dependents in the rural areas ranges from about 500-650 with the exception of Los Osos, Baywood, Cuesta-by-the-Sea, and Avila Beach. These population numbers represent about 250 to 325 non-car-owning households and therefore about 250 to 325 telephone requests for transportation assistance. For purposes of developing an evacuation program, it was assumed that little or no ridesharing would take place. This would also represent a worst-case situtation.

There are two basic options in the designation of telephone response centers to the requests for transportation assistance. One alternative would allocate this responsibility to the local municipality or community. The telephone response center would then logically be either at the municipal offices and would be manned by municipal employees (or persons assigned by the municipality), or the center would be at a designated rural fire station and manned similarly as above. Contact between all local telephone response centers and the County Emergency Operations Center would be required to arrange for appropriate dispatching of buses, vans or other vehicles to effect the actual pickup of the public transportation dependents.

The advantages of this alternative are:

- The local municipality can designate the staff (or possibly volunteers) and provide municipal cars to ferry the transportation dependents to central bus pick-up locations within the evacuation zone.
- The local staff are familiar with the area and this will be of major value in locating the people requesting assistance.

The second alternative would allocate the responsibility for manning a countyside telephone response center for requests for transportation at or under the direct jurisdiction of the County Emergency Operations Center. The advantages of this second alternative are:

- The areawide bus mobilization coordinator function can be merged with the telephone response center and thus permit more effective distribution and dispatching of available vehicles.
- During the public information broadcast only one telephone center needs to be mentioned and thus the broadcast message content and the public action requirements are simplified.

The action sequence and bus and vehicle fleet requirements, for the evacuation of public transport dependents from urban centers and rural areas, and the evacuation of school children will require further study in developing the area-wide evacuation plan.

VI. EVACUATION ROUTES

A. Roadway System

Main Freeway/Expressway Links

US Route 101 and State Route 1 provide the prime access links for the study area. As Figure VI-1 indicates, US 101 is a continuous route from the north to the south, while Route 1 is present only as a separate facility north of the city of San Luis Obispo and south from Pismo Beach. Route 101 has two lanes in each direction and is built to full freeway design standards with limited access at grade-separated interchanges within the County. Expressway segments, containing a limited number of at-grade crossings, are found immediately north of San Luis Obispo on the Cuesta Grade and through Cuesta Pass. The Cuesta Grade extends for about five miles north of the city and has a maximum grade of nearly seven percent on the last two miles of climb. Other expressway segments on US 101 are found farther north above Paso Robles and Arroyo Grande, both of which are outside the present study area.

Route 1 going north begins in San Luis Obispo as Santa Rosa St, a four-lane road with wide median and turning pockets. There are frequent intersections and several traffic lights in this short segment inside town. Above Highland and outside the city limits the road continues as a 4-lane expressway with infrequent rural grade crossings. Continuing north, the road is generally of expressway quality to San Simeon, except for freeway segments through parts of Morro Bay and Cayucos. Beyond Cayucos, Route 1 converts to a two lane facility with some access control.

To the south, Route 1 exists between Pismo Beach and Gaviota in Santa Barbara County in varying states of improvement ranging from a 2-lane non-access-controlled route to a freeway facility. The section of Route 1 in San Luis Obispo County south to the Santa Barbara County line is two-lane, uncontrolled.

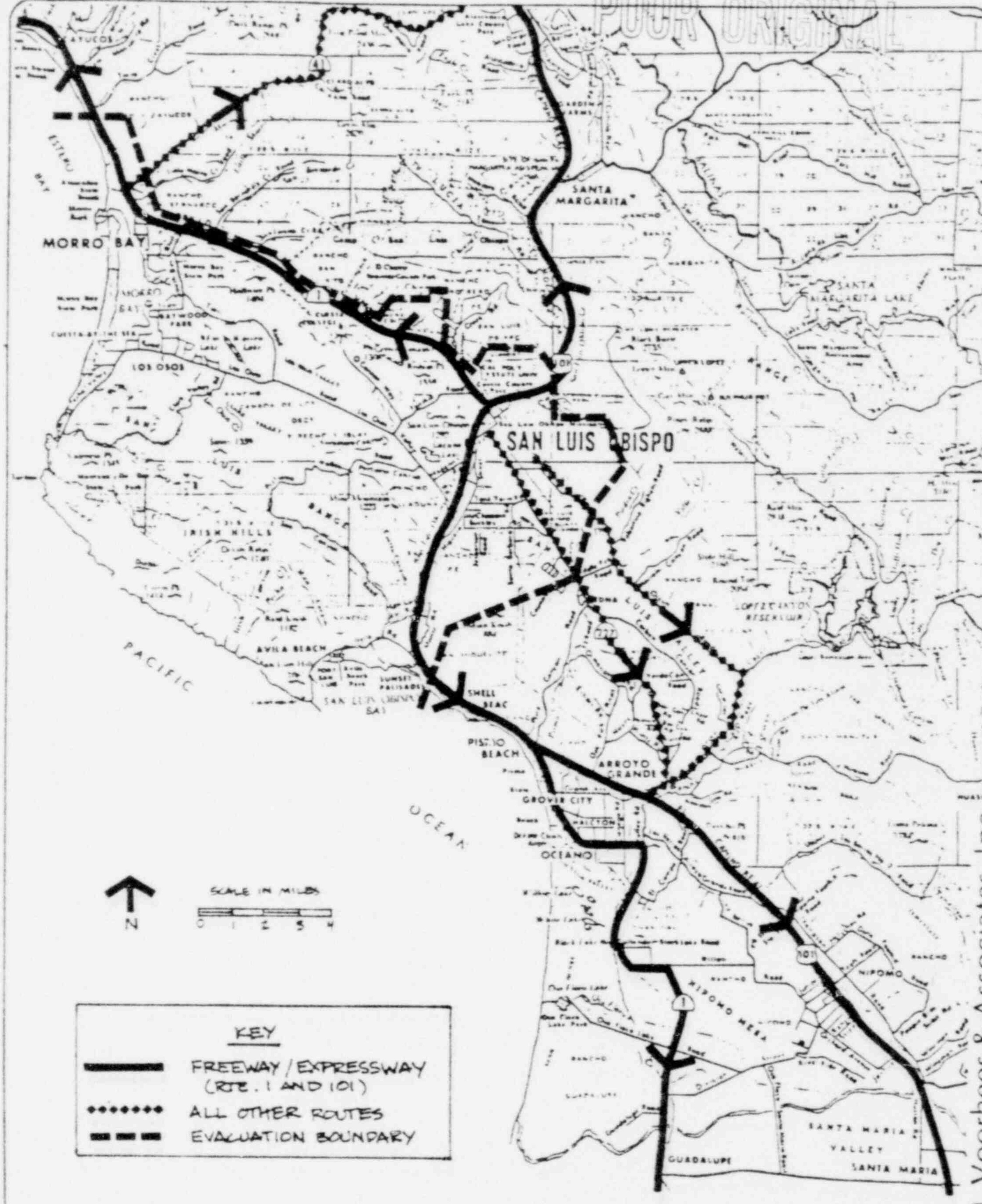


FIGURE VI-1 : EVACUATION THROUGH-ROUTES

Other Through Routes

There are a number of minor routes which would provide additional capacity in the event of an evacuation of the study area. To the north, State Route 41 provides egress from the Morro Bay area. Although this road connects back into US 101 at Atascadero, this connection occurs more than 20 miles from the site. In addition, there is reception center capacity along Route 101. Thus, this link would play an important part in an evacuation of the study area. Similarly, to the south, State Route 227 and Orcutt Road would aid in an evacuation of the immediate area, although they tie back into Route 101 at Arroyo Grande, about 16 miles from Diablo Canyon. An evacuation plan will have to consider the possibility of queuing at Atascadero and Arroyo Grande, but such an effect would not change the estimated evacuation times to the evacuation boundary.

Finally, there is additional capacity provided by the frontage road along Route 101 to the south of San Luis Obispo, which provides an uninterrupted link out of the study area, and which in fact ties in with the continuation of Route 1 south of Pismo Beach. This frontage road begins as Higuera St. in San Luis Obispo, east of Route 101. At the Higuera interchange with Route 101 south of the city it connects under the freeway to Ontario Rd., a parallel frontage road west of Route 101. This frontage road then continues past the San Luis Bay interchange, swings away from Route 101 and ties in to Avila Road immediately before the Avila interchange. South of that interchange, the frontage road is called Palisades Road, but is re-named Shell Beach Road immediately south of Sunset Palisades. Finally, in Pismo Beach, the frontage road intersects with Route 1 and changes its names to Price Street. Price St. leads directly onto 101, and there is no continuous frontage road through Pismo Beach. However, at this point Route 1 is a separate 2-lane facility which continues south out of the county.

It should be noted that there are several roads in various conditions of improvement leading into the hills to the east of San Luis Obispo. Although some of these roads cross the mountain ridges to the east and eventually leave the area, they were not judged to be of year-round availability to the typical passenger car. Thus they were not used in the analysis. Whether or not these very local roads should or could be used under an actual emergency situation remains to be determined.

Interface With Statewide Highway System

Route 101 serves as one of the two major north-south routes connecting the San Francisco/Sacramento region with the Los Angeles/San Diego region, the other being Interstate 5, located a considerable distance to the east in the central valley. Although an important tourist route, Route 1 is of lesser importance for state-wide travel. An evacuation of the study area would necessitate closing Route 101 and State Route 1 to long-distance traffic. Although the time required to evacuate the study area would not be influenced by the manner or location in which the barricading and subsequent diversion of through traffic took place, the through-traffic diversion would be an important consideration in an evacuation plan. To the south, numerous cross-connections exist in the Los Angeles area, the northernmost of which is State Route 126. Route 33 could also provide diversion from as far north as Ventura or Santa Barbara, and at the southern boundary of San Luis Obispo County Route 166 is available. North of the study area but within the county are State Routes 58, 41 and 46, with others located closer to the San Francisco Bay Area. A notable lack of cross connections between Route 1 and Route 101 exists between Cambria in San Luis Obispo County and Monterey, a distance of more than 70 miles. The potential operation of these cross connections beyond the study area will also be an important consideration in the routing of people to the reception centers.

Destinations and Reception Points

The existing county emergency plan identifies a number of short- and medium-term reception centers. These facilities would be mass-care centers to which the evacuated population would be directed. In addition, it must be noted that a proportion of the population would choose to find their own non-institutional solution to the problem, either by staying with a friend or relative, or seeking temporary shelter in a motel nearby, or leaving the area entirely. In determining and siting reception centers, several unique factors need to be considered. Firstly, a large proportion of homes within the study area are vacation homes. As an example, in the Baywood Park/Los Osos area, approximately 10 percent of homes are second homes. This condition exists in general for all of the coastal cities. A second consideration is the importance of the local tourism and its role in the region's economy. Under evacuation conditions, visitors to the area would generally depart to their original home, and thus not require sheltering.

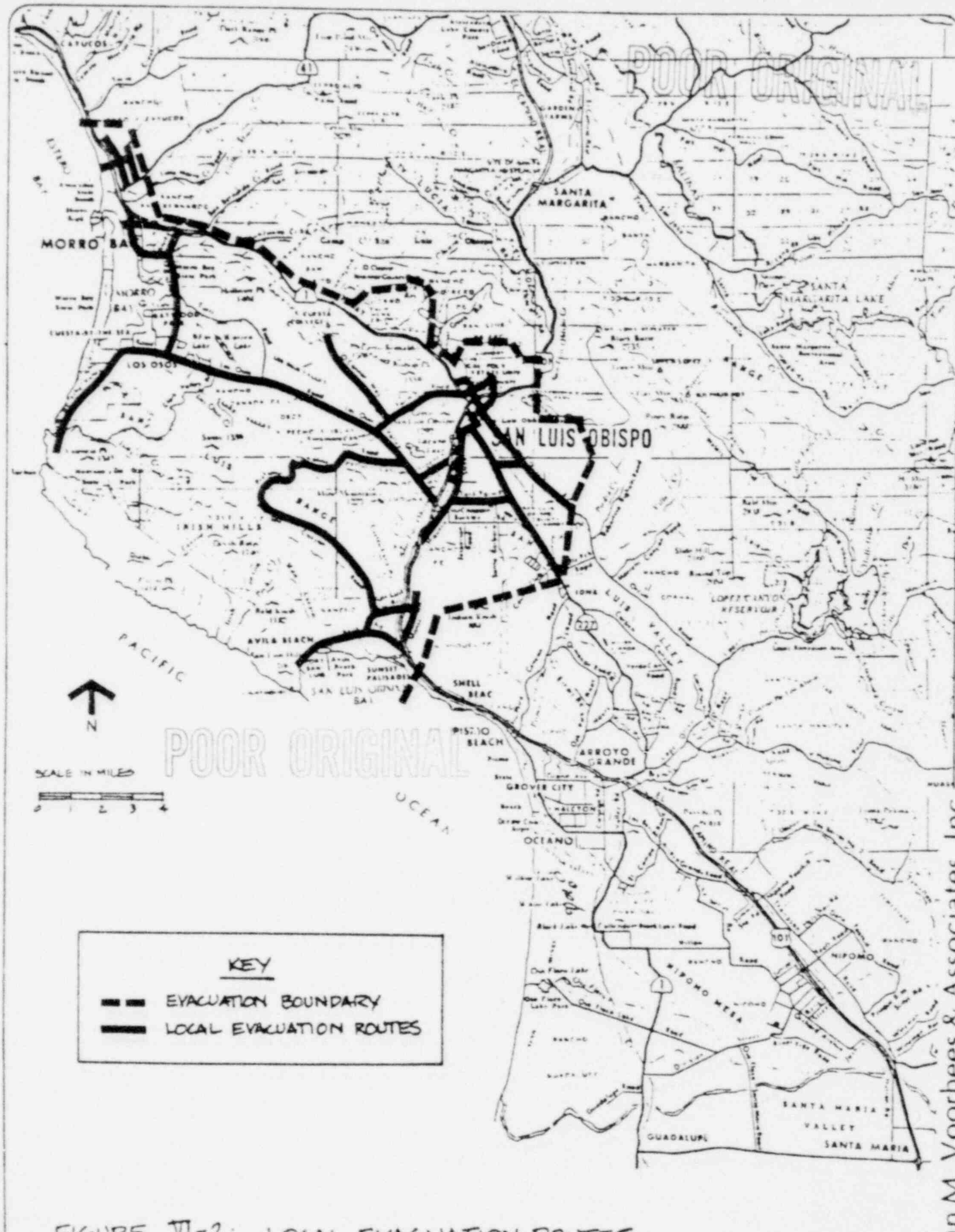
Regardless of whether evacuees are bound for a reception center or will assume personal responsibility for their continued sheltering, the travel patterns would be similar, since potential reception sites will most likely be located along major north-south highways. Among the sites which may be used are the Santa Barbara County Fairgrounds in Santa Maria or Vandenberg Air Force Base in Lompoc, both located in Santa Barbara County to the south, or the San Luis Obispo County Fairgrounds in Paso Robles or Camp Roberts near San Miguel, both north of the study area. Camp Roberts, in particular, has an estimated long-term capacity of 20,000 persons.

Local Evacuation Routes

Within the city limits of San Luis Obispo and Morro Bay there are numerous local streets which ultimately connect to the major evacuation through-routes. In the unincorporated portions within the study area, there are generally fewer routes available that connect with the major freeway links. Local routes of evacuation importance are highlighted in Figure VI-2. Table VI-1 indicates by evacuation analysis zone which routes and alternative routes, if any, are available.

Shed Areas and Uncongested Travel Times

Table VI-2 lists uncongested travel times between the population centroid



POOR ORIGINAL

FIGURE VI-2: LOCAL EVACUATION ROUTES

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Table VI-1

LOCAL EVACUATION ROUTES BY ZONE

Zone	Prime Routes	Alternate Routes
I	San Jacinto Street Main Street Ironwood Avenue	various local streets
II 3/	Main Street Morro Bay Boulevard South Bay Boulevard	various local streets
III 1/	South Bay Boulevard Los Osos Valley Road	none
IV	Pecho Road	unimproved road to Clark Valley 2/
V	Route 1 - direct access	O'Connor Way
VI	Route 1 - direct access	
VII	Foothill Road	Los Osos Valley Road
VIII 3/	Los Osos Valley Road	Foothill Road Madonna Road
IX	See Canyon Road to San Luis Bay Road	Prefumo Valley Road 2/
X	Avila Road	Cave Landing Road 4/
XI	Highland Drive Foothill Boulevard Grand Avenue California Boulevard	various local streets
XII	Marsh Street Broad Street Osos Street Monterey Street	Toro Street California Boulevard Grand Avenue Johnson Avenue etc.
XIII 3/	Higuera Street Madonna Road Prado Road	various local streets

1/ Significant risk of loosing all evacuation routes in flood or heavy rain conditions

2/ Alternate route may be impassable to regular passenger cars in rainy season

3/ Significant portions of zone may be isolated by flood condition

Table VI-1 (cont.)

LOCAL EVACUATION ROUTES BY ZONE

Continued		
XIV3/	Orcutt Road Edna Road	Tank Farm Road
XV5/	San Luis Bay Road	Monte Road

4/ Road currently closed at Sunset Palisades (locked gate)
5/ In extreme flood conditions may loose all access

Table VI-2

UNCONGESTED EVACUATION

TRAVEL TIMES

Zone	Local Street Access			Freeway Route			Total Evacuation Time (Min.)
	Distance (Miles)	Speed MPH	Time (Min.)	Distance (Miles)	Speed MPH	Time (Min.)	
I	0.8	20	2.4	1.6	35	2.7	5.1
II	1.2	20	3.6	3.5	35	6.0	9.6
III	4.0	30	8.0	4.8	35	8.2	16.2
IV	10.6	25/30	23.8	4.8	35	8.2	32.0
V	0.9	20	2.7	10.5	35	18.0	20.7
VI	0.7	20	2.1	12.2	35	20.9	23.0
VII	2.0	25	4.8	1.9	35/30	3.6	8.4
VIII	4.6	30	9.2	6.6	45	8.8	18.0
IX	3.6	30	7.2	2.4	45	3.2	10.4
X	2.7	30	5.4	1.2	45	1.6	7.0
XI-							
Rt. 1	.6	20	1.8	15.5	35	2.6	28.4
US 101	.7	20	2.1	.6	30	1.2	3.3
XII-							
US 101N	1.6	20	4.8	0.4	30	.8	5.6
Rt. 1	1.5	20	4.5	16.1	35	27.6	32.1
US 101S	2.3	20	6.9	8.2	45	10.9	17.8
XIII-							
US 101S	1.2	30	2.4	5.0	45	6.7	9.1
US 101N	1.7	30	3.4	2.9	30	4.7	8.1
XIV	3.2	35	5.5	N/A	N/A 2/	N/A	5.5
XV	0.9	25	2.2	2.4	45	3.2	5.4

1/ From each zone to designated evacuation boundary

2/ Via Route 227

of each analysis zone and the study boundary via the shortest routing. Since, in general, evacuation behavior and roadway congestion determine evacuation times rather than the free travel time, these results do not represent actual evacuation times. They do provide an indication of the relative accessibility of the various analysis zones to the cordon line, and give a measure of local road versus freeway travel for each zone.

Road Capacities

Table VI-3 indicates the assumed roadway capacities based upon facility type and location. The terms "urban" and "rural" denote different levels of capacity based upon roadway geometry, frequency of intersections, volumes of cross traffic, and similar factors. It should be noted that these are not necessarily maximum possible capacities, but rather represent a practical capacity at still acceptable levels of service, although the freedom of maneuver would be somewhat restricted. The figures in Table VI-3 are on a per-lane basis and were applied to critical links in the transportation network.

In the analysis, special attention was given to the capacities of the freeway and expressway facilities. Although hourly capacities of 2,000 vehicles and more per lane have been observed on urban freeways, such values would not be realistic under the prevailing conditions in the study area. The reason for this is that, when flow is above 1800 vehicles per lane per hour (vph) a minor disturbance such as a sudden breaking of a vehicle can cause a congested condition to occurr. In the case of Route 1 leaving San Luis Obispo, the presence of numerous intersections calls for a further reduction in carrying capacity, and for analysis purposes, a capacity of 1500 passenger cars per lane hourly was selected. For the non-freeway stretches of Routes 1 and 101 beyond the urbanized area of San Luis Obispo, however, the 1800 vph figure was used since these segments are mostly access-controlled and because the few at-grade intersections that do exist would generate rather little traffic during an evacuation.

Table VI-3

AVERAGE CAPACITIES

HOURLY VOLUMES PER LANE

Functional Category	Location 1/	
	Urban	Rural
Local Collector (2-lane facility)	1200	1500
Arterial Street (4-lane facility)	1500	1500
Freeway/Expressway (4-lane facility)	1800	1800
Ramp	1200 2/	1500

1/ Distinction to be based upon frequency of intersections

2/ Only if geometrics are constrained, otherwise 1500.

In case of an evacuation, it would become necessary to close Route 101 through the Cuesta Grade and Pass north of San Luis Obispo to heavy trucks. The reason for this would be to provide as much capacity as possible to the evacuation traffic. The seven percent grades prevailing on this freeway segment could have a considerable capacity-reducing effect if heavy truck traffic were allowed during the evacuation peak.

B. Potential Hazards and Alternative Routes

There are a number of natural hazards which could effect the performance of the evacuation by causing disruption of the road system. The primary focus of this analysis is to identify and define the range of problems which could occur rather than to place a probability or measure of risk on these various incidents and their quantitative effect on the evacuation times. An exception is the case of a rainstorm without flooding of evacuation routes, for which an estimate is presented in Section VII.

The Safety Element of the General Plan of San Luis Obispo County[1/] lists four groups of hazards: fire, flooding, geologic hazard and radiation. An additional concern not included among those is the infrequent but severe occurrence of coastal fog which could affect U.S. 101 between the Avila Beach and Arroyo Grande exits and Route 1 north of Morro Bay.

Fire

With regard to fire, the Safety Element addresses both urban and wildland fire. The presence of a major fire of either category would immediately place additional burden upon those charged with protecting the safety of the public. In the case of an urban fire, it is most likely that evacuation delays would be caused for only a small segment of the population since it would be unusual for an urban fire to close one of the main evacuation routes.

Concerning wildland fires, the Safety Element indicates that the most fire-prone areas of the county are (1) near Santa Margarita, (2) west of Nipomo, and (3) adjoining Nacimiento Reservoir. Although none of these

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1/ Safety Element, San Luis Obispo County, June 1976 are within the study area, Route 101 passes through Los Padres National Forest on its climb through Cuesta Pass out of San Luis Obispo. However, the roadway is located at the lower elevations of the fire-prone Santa Lucia Range and probably would be less affected by a potential forest fire than higher elevations. Route 41 also crosses Los Padres National Forest, but the alignment is at the bottom of a valley parallel to Morro Creek.

Flooding

Figure II-1 indicates the general locations in the study area where flooding may occur. The streams in the county that could impact an emergency evacuation by flooding are most likely San Luis Obispo Creek and Morro Creek.

In terms of number of persons affected, a severe flooding of the San Luis Obispo Creek system appears to be the major flood threat to an evacuation. Although floods have been recorded in the area since 1848, the storm of January 18, 1973 caused the most devastating flood ever reported in the San Luis Obispo Creek drainage area. Flood waters raced through the downtown area, and the California Department of Transportation reported that Route 101 was rendered unusable at two places due to flood waters. A mudflow across the Cuesta Grade blocked the road for one hour, and flooding in the vicinity of Los Osos Valley Road closed the freeway for four hours. Reports by city and county officials indicate that the entire town was isolated, as flooding was also said to have interrupted the southeastern road connections near the airport, while Route 1 was said to be out of service due to a rockslide north of the study area.

In response to the 1973 flood, a study was conducted by the U.S. Army Corps of Engineers for San Luis Obispo Creek and its tributaries in the vicinity of San Luis Obispo. The study concluded that a 100-year flood (the "intermediate regional flood") would have a flood stage lasting two hours, while the "reasonable upperlimit" flood or "standard project flood" (with no frequency specified) could persist for up to four hours.

The 100-year flood would effectively cut off the following evacuation routes: at San Luis Obispo:

- Route 101 south of San Luis closed due to flooding, (Ontario Road fronting on Route 101 to the west may open, but could not be reached by any significant amount of the population due to extensive flooding at Prefumo Creek and the San Luis Creek confluence near Los Osos Valley Road and Route 101).
- Route 101 north of the town closed at the northernmost interchange, Monterey Street.
- State Route 1 closed at Santa Rosa Street and Foothill.

In question are the two remaining two-lane routes out of town, Route 227 and Orcutt Road, both of which are crossed by creeks not included in the Corps of Engineers study. It would appear that Route 227 would probably also be closed, but that Orcutt Road would remain open. However, flooding within San Luis Obispo would make it very difficult to reach this route.

Local flooding under the 100-year condition would close Los Osos Valley Road, Madonna Road, and entirely innundate the stretch of Higuera Street from its connection with the freeway south of town up to Santa Rosa Street. In addition, flooding along Higuera would extend across town to Pismo Street between Broad and Santa Rosa. Within the county, San Luis Obispo Creek would flood the San Luis Bay crossing, eliminating direct access to Route 101 from Squire Canyon. Avila Road would remain open.

The Safety Element indicates that 100-year flooding of Morro Creek would be expected to remain within the established stream bed. However, no definite answer was given to the question of whether the Route 1 bridge across this stream could be blocked by a severe flood.

Not mentioned in the Safety Element is the "twin trestles" crossing of South Bay Boulevard over Chorro Creek and an unnamed creek in the city of Morro Bay. The frequent blockages of this route would tend to place it within a ten-year, or even less, flood zone. It has been reported that the flooding out of South Bay Boulevard has been accompanied with the closure of Los Osos Valley Road between Baywood Park and San Luis Obispo, thus isolating Baywood Park and Los Osos. If this were to happen during a plant emergency, evacuation during the course of high water would be impossible, and means of temporarily sheltering the population would have to be found. This would require sheltering up to 11,600 persons.

In summarizing the flood scenario, the following points should be made: Flooding would affect substantial numbers of people within the study area, and would isolate even a greater number. Evacuation of flooded areas would take place in any event, but not necessarily in the same manner as a general evacuation such as that caused by poisonous or radioactive gas release. Furthermore, 100-year flooding would disrupt all major evacuation routes in the vicinity of San Luis Obispo and Los Osos/Baywood Park. On the other hand, the flood stage should last only a few hours (two hours for the 100-year flood). Thus evacuation will best be accomplished by temporary sheltering followed by expediant removal of debris from critical routes. An additional concern would be bridges which may be washed out, requiring the identification of alternative routes. Due to the uncertainiies involved, a reliable time estimate could not be incorporated in this study. However, it would appear that evacuation times could be at least doubled under these conditions.

Other Effects of Heavy Rainfall

Another source of road closings due to rainfall is from landslides, rockslides and mudflows. As was mentioned above, the Cuesta Grade was briefly closed in the January 1973 storm due to a mudflow across the pavement. The concrete dividing wall which is currently being constructed in the median may prevent such an occurrence from affecting all four lanes, leaving the possibliity that reverse-direction operation may overcome the problem.

Rockslides have been a frequent cause of problems for State Route 1 to the north outside of the study area. There is some evidence of falling rock along Avila Road, and there are a number of other locations where steep slopes adjacent to evacuation routes warrant inspection. If an evacuation should occur during heavy rain falls, the positioning of earth moving equipment at these slide-prone locations and expeditions clearing of the obstacles should be considered.

Earthquake

The Safety Element of the General Plan of San Luis Obispo County addresses a number of possible hazards due to seismic activity including: active faulting, ground shaking, settlement, rising ground, soil liquefaction, landslides, tsunamis and seiches. The report dismisses seismic seiches out of hand as a problem in the county, and also concludes that a tsunami would only be of concern should it occur at high tide. The rising ground condition is a very localized situation which was not fully analyzed at the time the plan was published. With regard to the remaining major earthquake hazards, the Safety Element and the accompanying Seismic Element lay out in general terms the type of problems to be expected in various locations within the county. It would be very difficult, if not impossible to evaluate the likely amount of damage and evacuation delay time caused by a major earthquake to localized segments of the urban areas. On the other hand, it is possible to look for potential problems along the major evacuation routes.

While a detailed analysis of slope stability, settlement/liquefaction potential, abutment, retaining wall, and bridge deck failure for the evacuation route was beyond the scope of this study, the consultant has cataloged by structural type the major bridge structures along the freeway/expressway facilities leading out of the evacuation area. In addition, possible alternative routes have been identified and analyzed.

<u>Alternative Routes Due to Bridge Failure</u>

Figure VI-3 shows an inventory of bridge structures by type and configuration (overcrossings, undercrossings and freeway-carrying decks). Also indicated on the chart are available alternative routes, some of which involve using the "wrong" side of the road until the median can be recrossed to the proper side. From this inventory, the following findings can be drawn:

- <u>Route 1 Northbound</u>: Most individual bridge failures could be bypassed locally. One exception is the freeway bridge over Main Street in Morro Bay, for which there is no convenient alternative route. Traffic would have to exit from below the bridge, travel over local streets to enter on the wrong side of the road at the off-ramp, and cross back over at the first median break. The other potential problem bridge is the high structure over Chorro Creek near Camp San Luis Obispo. The alternative route is circuitous and travels over rural two-lane roads.

- <u>Route 101 Northbound</u>: If any or all of the bridges failed along that route, the San Luis Obispo city streets could serve as a bypass. The loss of a few key structures could cause tremendous disruption to traffic within the city, however.

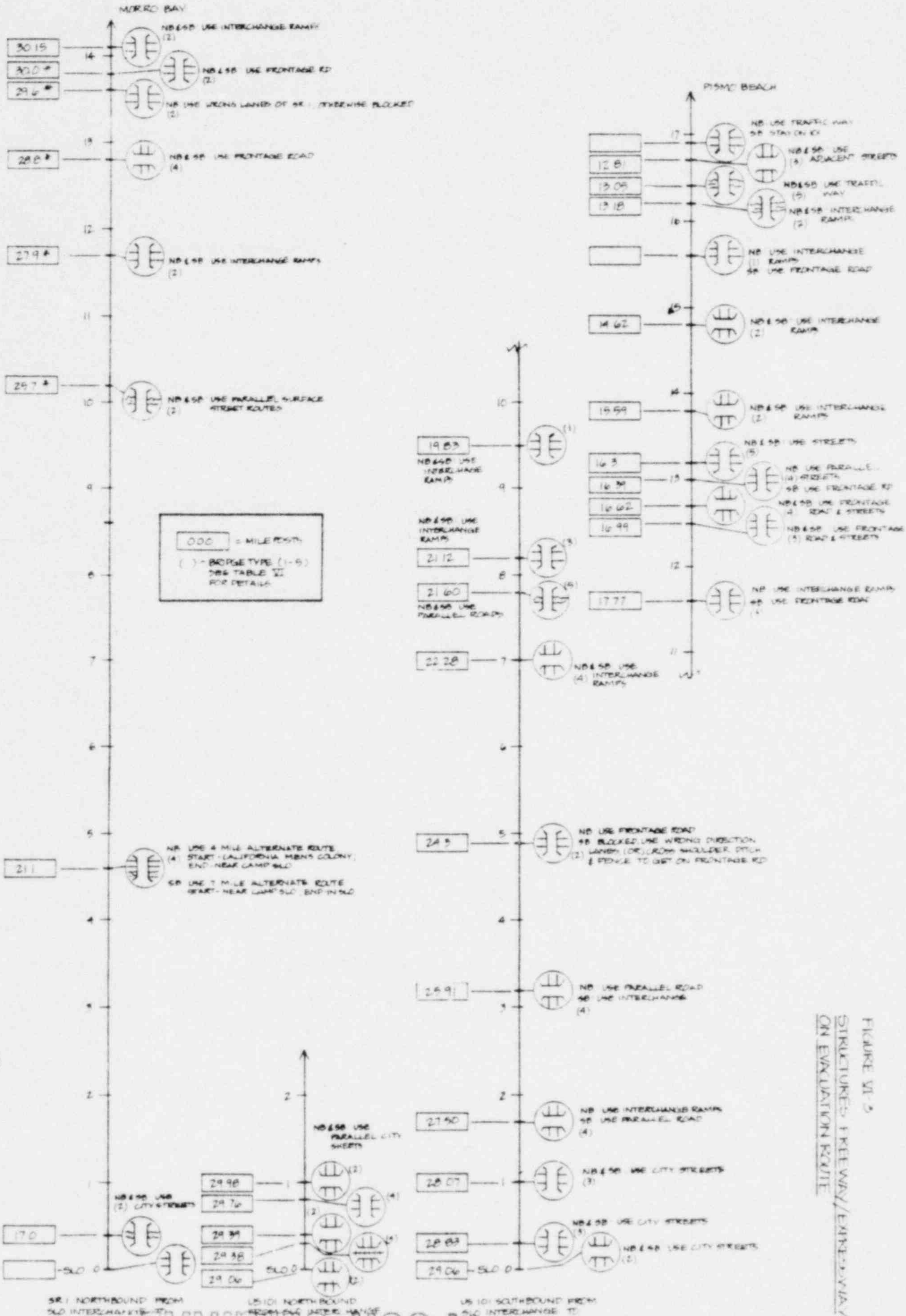


FIGURE VI-5
STRUCTURES: FREEWAY/EXPRESSWAY
ON EVACUATION ROUTE

- Route 101 Southbound: Most of the bridges have alternative routes available in the form of interchanges, ramps and the frontage road. At the Higuera Street crossing, freeway traffic would have to utilize wrong-way operation except if a fence were knocked down and temporary fill placed in a drainage ditch. Traffic could then continue down the westerly adjacent frontage road and bypass the bridge.

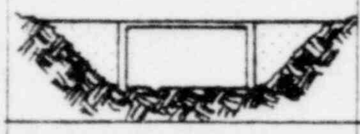
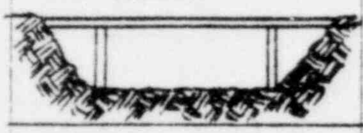
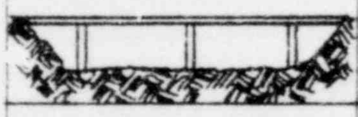
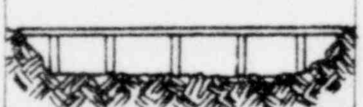
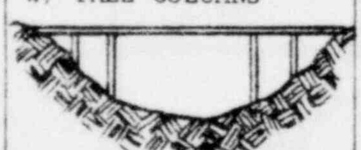
Also indicated in Figure VI-3 are numbers placing the structures into broad classification categories which tend to increase in structural vulnerability, all other factors (scale, joints, foundation and others) being equal. The accompanying Table VI-4 contains general comments about the type of failures potentially to be encountered in a major earthquake.

Dam Failure

Another area of concern in case of an earthquake is that of dam safety. The Safety Element lists three main potential dam hazards due to an earthquake: failure due to surface rupture along a fault, failure due to earth shaking and overtopping due to landslides into the impounded waters. The report notes that surface rupture is not a significant hazard within the county. With regard to landsliding, the study concluded that Whale Rock reservoir and Rhigetti Reservoir had significant hazard potential. The Safety Element indicated that, as far as failure due to earth shaking is concerned, the strength of major dams had not been determined. The report did note, however, that only Whale Rock, Rhigetti and Lopez Reservoirs would be expected to cause a major hazard should they fail. Of these potentially hazardous dams, Rhigetti is closest to the study area. Flooding would be expected to follow Corral de Piedra Creek, which crosses Orcutt Road and Route 227 southeast of the study area. With a water contents of 560 acre-feet, this dam is one of the smaller ones of the dams in the county. Lopez Reservoir is larger at 51,000 acre-feet, but it is considerably outside

Table VI-4

SUMMARY OF TYPICAL SEISMIC HAZARDS FOR BRIDGE STRUCTURES

BRIDGE TYPE	CATE-GORY	BEHAVIOR OF BRIDGE (MODERATE TO STRONG GROUND MOTION)	DAMAGE
BOX CULVERT 	1	Fill Subsidence	Road Offset in Fill
SHORT SINGLE SPAN BRIDGE 	2	Fill Subsidence Shift at Bearing (Lateral and/or Vertical	Road Offset in Fill Span Offset at Bearing
SHORT MULTIPLE SPAN BRIDGE 	3	Abutment Subsidence Column/Pier Failure or Subsidence	Span Offset at End bearing Span Shifted or Collapsed at Intermediate Bents
MEDIUM MULTIPLE SPAN BRIDGE 	4	Abutment Subsidence Shift at Bearings	Span Offset and End Bearing Span Shifted or Collapsed at Intermediate Bents
LONG BRIDGE MANY SINGLE SPANS 	5	Abutment or Bent Subsidence or Shift Progressive Bearing Lateral Shift	Span Offest with Progressive Collapse of One or Several Spans
LONG BRIDGE MULTIPLE SPANS W/ TALL COLUMNS 	6	Abutment or Column Subsidence Shift at Bearings and/or Expansion Joints Failure at Columns	Span Offset at Abutments or at Intermediate Expansion Joints Span Collapse

the study area. Flooding from that dam is expected to affect the Arroyo Grande Valley although there is no indication whether or not Route 101 would be affected. Probably the most catastrophic dam failure would be at Whale Rock, a 40,000-acre foot reservoir which is located directly above Route 1 at Cayucos. Its rapid failure would most likely destroy about one-third of the town of Cayucos, and probably make Route 1 impassable in the process.

Radioactive Contamination

The drifting of a radioactive plume over an evacuation route or the contamination of a certain sector surrounding the plant would also constitute reason to select an alternative route. On the basis of recorded wind patterns (see Figure II-2), it is most likely that the affected area would be the coastal zone from Avila Beach to the Five Cities area. Without the availability of any detailed information of the probability of such an occurrence and its dose rate, it was assumed, as an alternative scenario, that all southerly routes out of San Luis Obispo were unusable due to radioactive hazards. This scenario as well as two others are described in Chapter VII-B.

VII EVACUATION TIMES ESTIMATES

A. Analysis Methodology

Critical Screenline Analysis

In order to determine the likely evacuation times and delays a "critical screenline" analysis was performed. At key points of the evacuation route system certain screenlines or testing points were established for comparison of the projected traffic demand and the existing roadway capacity. Figure VII-1 shows the location of these screenlines and their individual critical road portals. Some of the screenlines are located where the major evacuation routes cross the designated evacuation boundary while others were placed at strategic points inside the study area.

Table VII-1 contains the estimated 15-minute capacities for the critical screenlines and for individual roads. These capacities are based on Table III-3, but have been converted to 15-minute increments for analysis purposes.

Vehicle Queueing and Delay

Evacuation delays were calculated by the following method: Critical screenlines were examined in a 15-minute interval for queueing buildup based on a comparison of capacity and evacuation demand as expressed by the evacuation curves described in Chapter V, above. Using the assumption of first-in/first-out servicing of vehicles, the resulting delay times (if any) were calculated by time frame. In order to properly reflect the level of detail of the analysis, delay results were summarized in 15-minute increments. In doing so, all queueing time estimates were generally rounded up to the next higher 15-minute amount to reflect the uncertainties of travel demand distribution, highway incidents, and other intangibles.

Figure VII-2 conceptually illustrates at a single critical portal how a roadway capacity limitation leads to a queue and hence delays for the intermediate and last vehicles. The demand curve is produced by multiplying

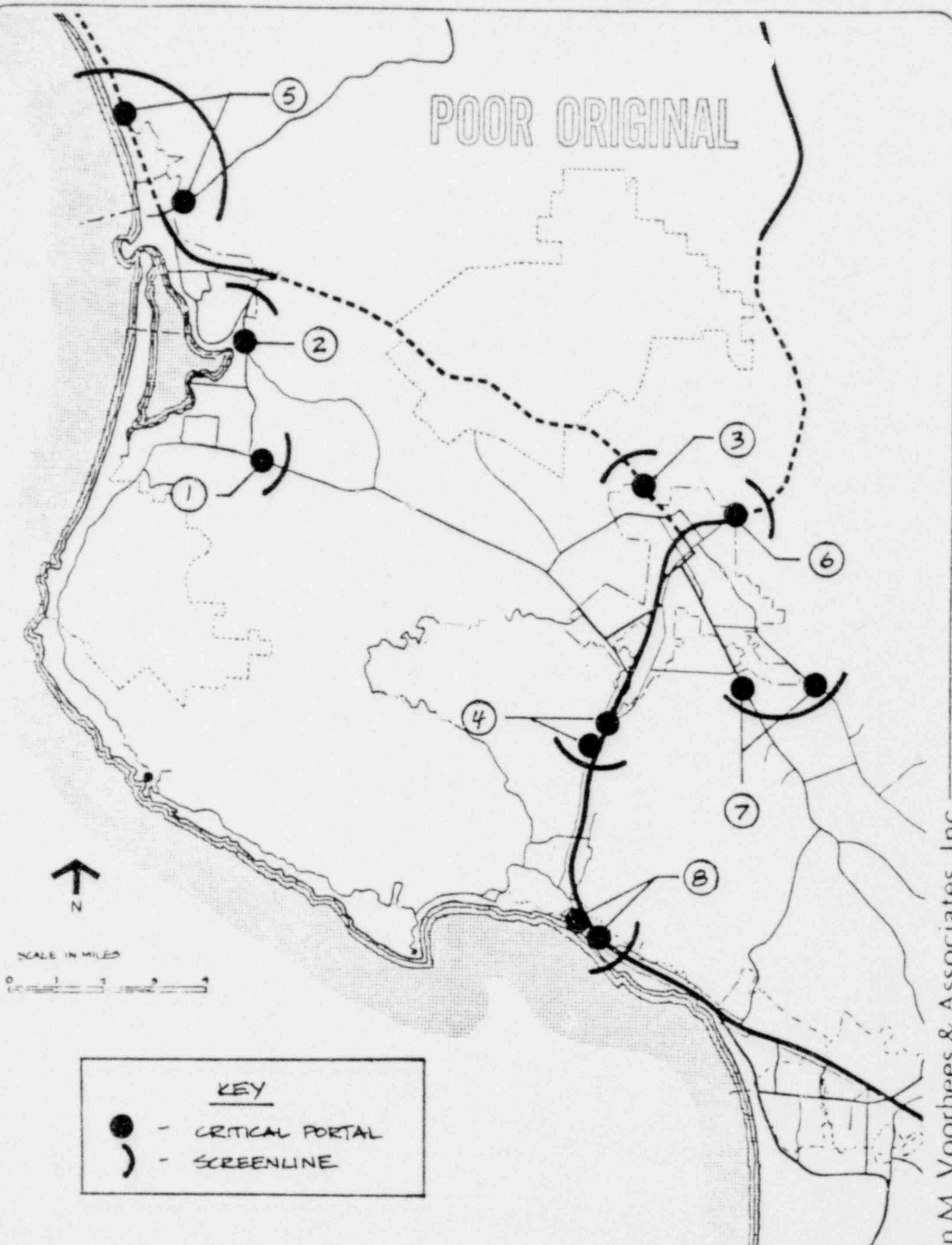


FIGURE VII-1: CRITICAL PORTALS & SCREENLINES

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Table VII-1

CAPACITIES OF CRITICAL SCREENLINES

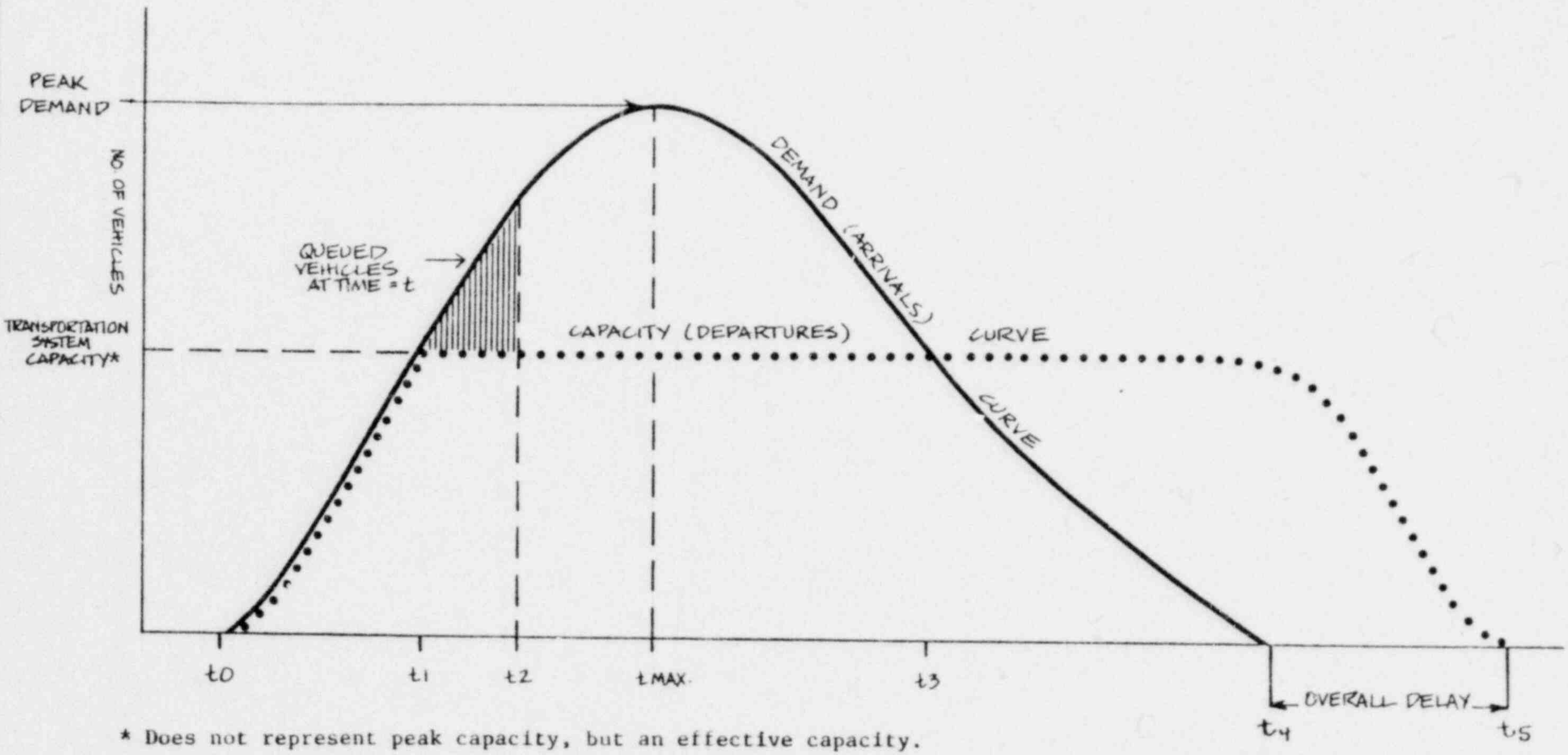
Screenline	Road(s)	15-Minute Capacity	Percent
1	Los Osos Valley Rd.	300	
2	South Bay Blvd.	375	
3	Route 1 1/	750	
4	Route 101 Frontage Rd. 1/	900 300 1200	75 25
5	Route 1 Route 41	900 375 1275	70 30
6	Route 101	900	
7	Orcutt Rd. Route 227	375 375 750	50 50
8	Route 101 Frontage Rd 2/	900 300 1200	75 25

1/ Capacity reduced by Cross-Streets.

2/ Assume 300 due to capacity loss at interchanges the appropriate evacuation distribution curve by the number of total vehicles using the particular portal. This results in the number of arrivals at each point in time. In practice, arrivals are grouped into 15-minute segments by treating all cars within the 15-minute period as though they arrived at the end of the interval. The 15-minute arrivals were then compared to the 15-minute capacity to determine the queue, if any.

As is shown in Figure VII-2, as the demand increases, departures also increase until capacity is reached. At that time (t_1) departures remain constant while a queue develops (shaded zone). Although the peak demand occurs at t_{max}, the queue continues to build until time t_3 when the arrivals drop below capacity. From time t_3 to t_4, arrivals continue to decrease, but the bottleneck continues to operate at capacity until the queue is dissipated.

The screenline analysis described above was applied to several different evacuation scenarios as summarized in the next report section.



* Does not represent peak capacity, but an effective capacity.

FIGURE VII-2: DEMAND CAPACITY ANALYSIS

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B. Evacuation Scenarios

In order to evaluate likely evacuation times for different weather conditions and different degrees of traffic control, three hypothetical evacuation scenarios were analyzed. These are:

- Scenario A1: Minimum-Control Evacuation
- Scenario A2: Route 1- Controlled-Access Evacuation
- Scenario B1: Southern-Routes-Unavailable Evacuation

These three scenarios resulted from the examination of a larger number of potential operational alternatives and represent distinctly different situations.

For each of these scenarios, estimates were prepared of the total traffic volumes generated on the various major transportation links. At critical screenlines, the likely vehicle delays and the times of the last car leaving the screenline were determined. Intermediate as well as gateway screenlines, located at the evacuation area boundary, were utilized.

Figures VII-3 through VII-5 show the estimated traffic volumes to be evacuated over the various evacuation routes for each scenario. The volume split between different highway facilities at a given screenline was determined in proportion to the available traffic carrying capacity of each roadway. Although some localized unbalanced loadings may occur in an emergency situation, it can be expected that, in general traffic will divert from congested routes to those with available capacity. Such optimum use of the available road system can also be assisted by local traffic control and monitoring of the traffic build-up during the evacuation.

Figures VII-6 through VII-8 contain the resulting traffic delays at the screenlines and their likely duration and time of occurrence. Also, the time of the "last car leaving" is indicated. As was described earlier, these times were calculated using the evacuation demand curves combined with capacity limitations, and incorporate travel times to the screenline points. This explains the longer evacuation times of the last car at the gateway screenlines.

The following sections describe each evacuation scenario in more detail and summarize the conclusions in each case.

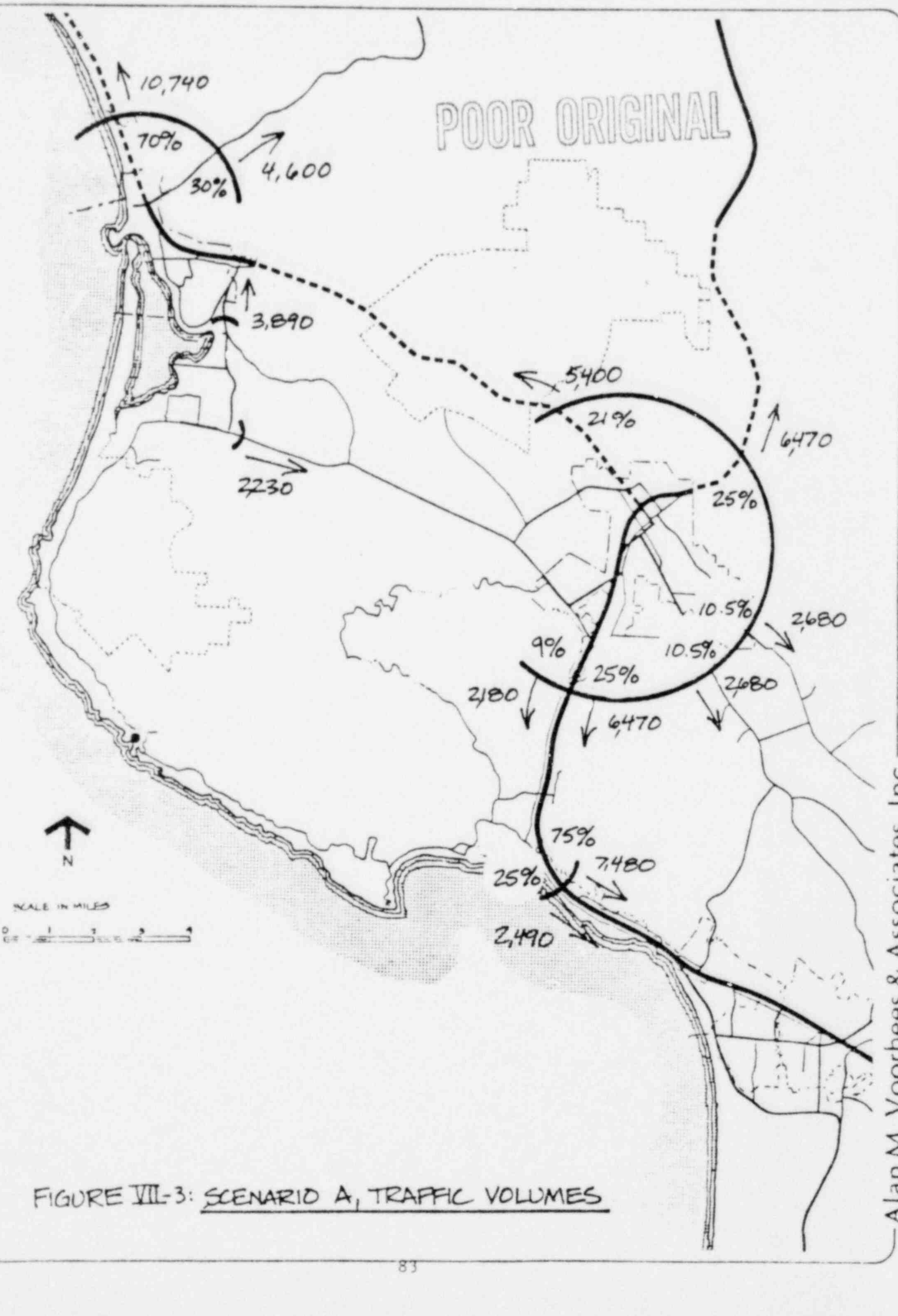

FIGURE VII-3: SCENARIO A, TRAFFIC VOLUMES

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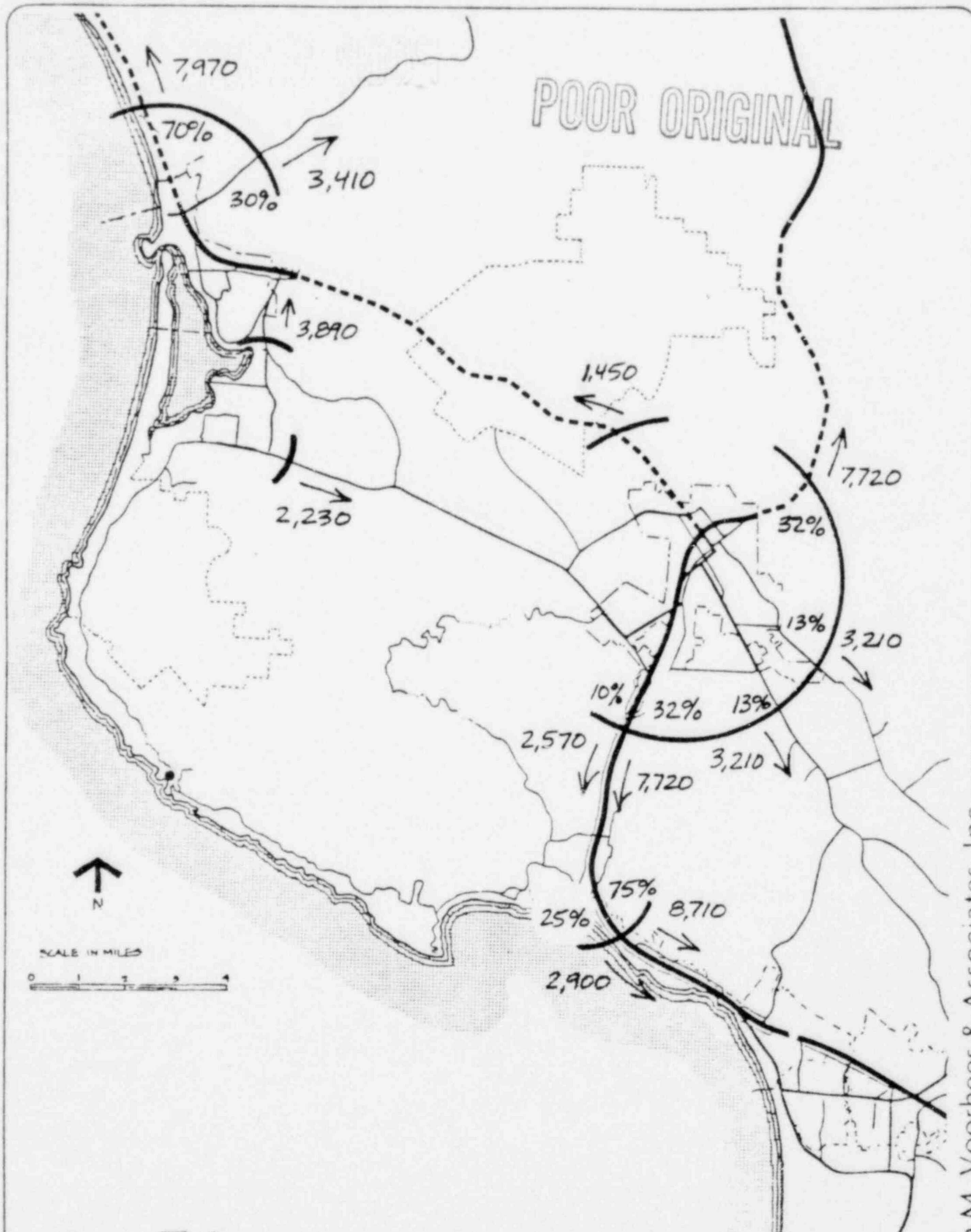

FIGURE VII-4: SCENARIO A_2 TRAFFIC VOLUMES

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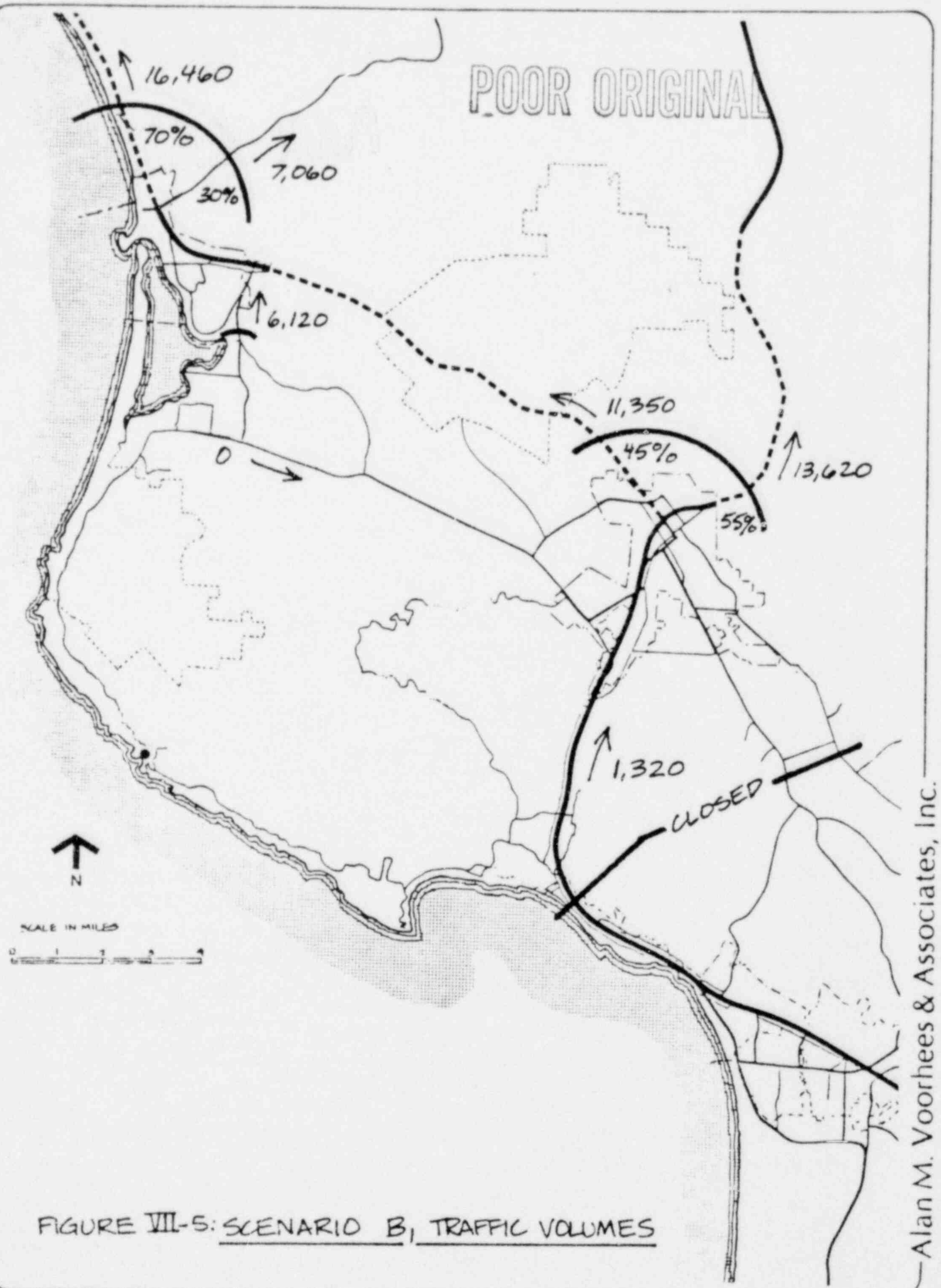

FIGURE VII-5: SCENARIO B1 TRAFFIC VOLUMES

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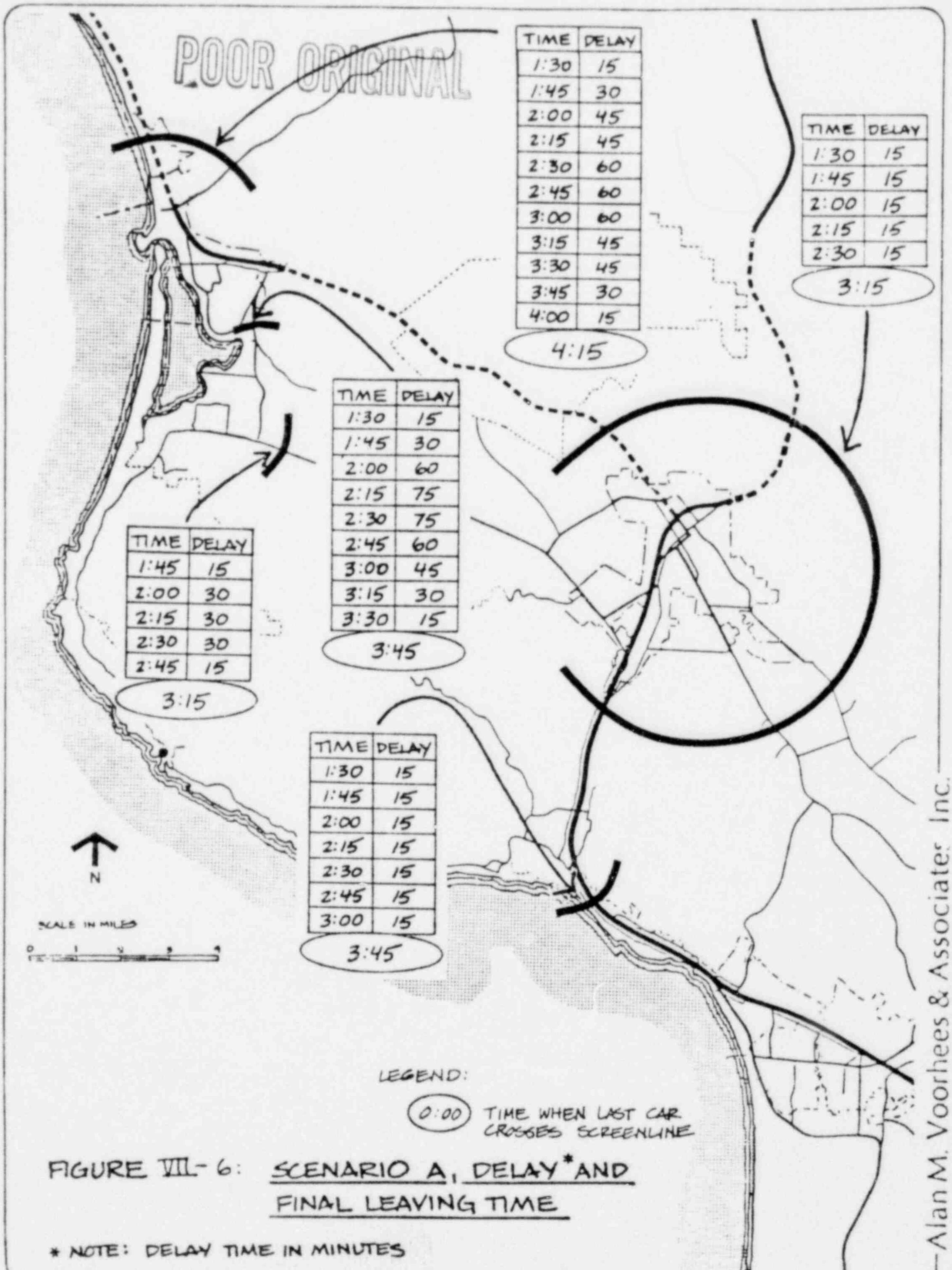


TIME	DELAY
1:30	15
1:45	30
2:00	45
2:15	45
2:30	60
2:45	60
3:00	60
3:15	45
3:30	45
3:45	30
4:00	15

4:15

TIME	DELAY
1:30	15
1:45	15
2:00	15
2:15	15
2:30	15

3:15

TIME	DELAY
1:30	15
1:45	30
2:00	60
2:15	75
2:30	75
2:45	60
3:00	45
3:15	30
3:30	15

3:45

TIME	DELAY
1:45	15
2:00	30
2:15	30
2:30	30
2:45	15

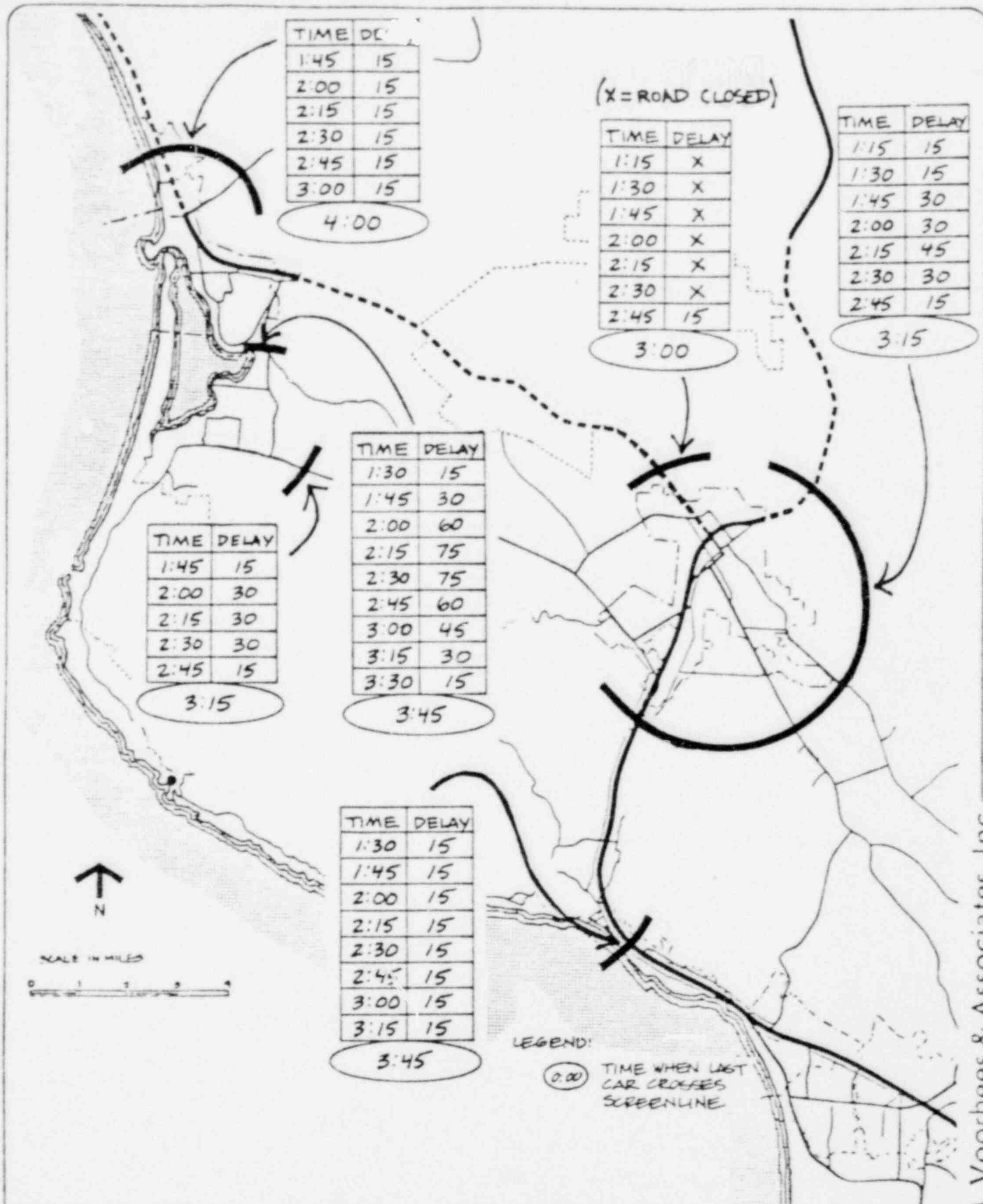
3:15

TIME	DELAY
1:30	15
1:45	15
2:00	15
2:15	15
2:30	15
2:45	15
3:00	15

3:45

FIGURE VII-6: SCENARIO A, DELAY* AND FINAL LEAVING TIME

* NOTE: DELAY TIME IN MINUTES



TIME	DELAY
1:45	15
2:00	15
2:15	15
2:30	15
2:45	15
3:00	15

4:00

TIME	DELAY
1:15	X
1:30	X
1:45	X
2:00	X
2:15	X
2:30	X
2:45	15

3:00

TIME	DELAY
1:15	15
1:30	15
1:45	30
2:00	30
2:15	45
2:30	30
2:45	15

3:15

TIME	DELAY
1:30	15
1:45	30
2:00	60
2:15	75
2:30	75
2:45	60
3:00	45
3:15	30
3:30	15

3:45

TIME	DELAY
1:45	15
2:00	30
2:15	30
2:30	30
2:45	15

3:15

TIME	DELAY
1:30	15
1:45	15
2:00	15
2:15	15
2:30	15
2:45	15
3:00	15
3:15	15

3:45

FIGURE VII-7 SCENARIO A2 DELAY* AND FINAL LEAVING TIME

* NOTE: DELAY TIME IN MINUTES

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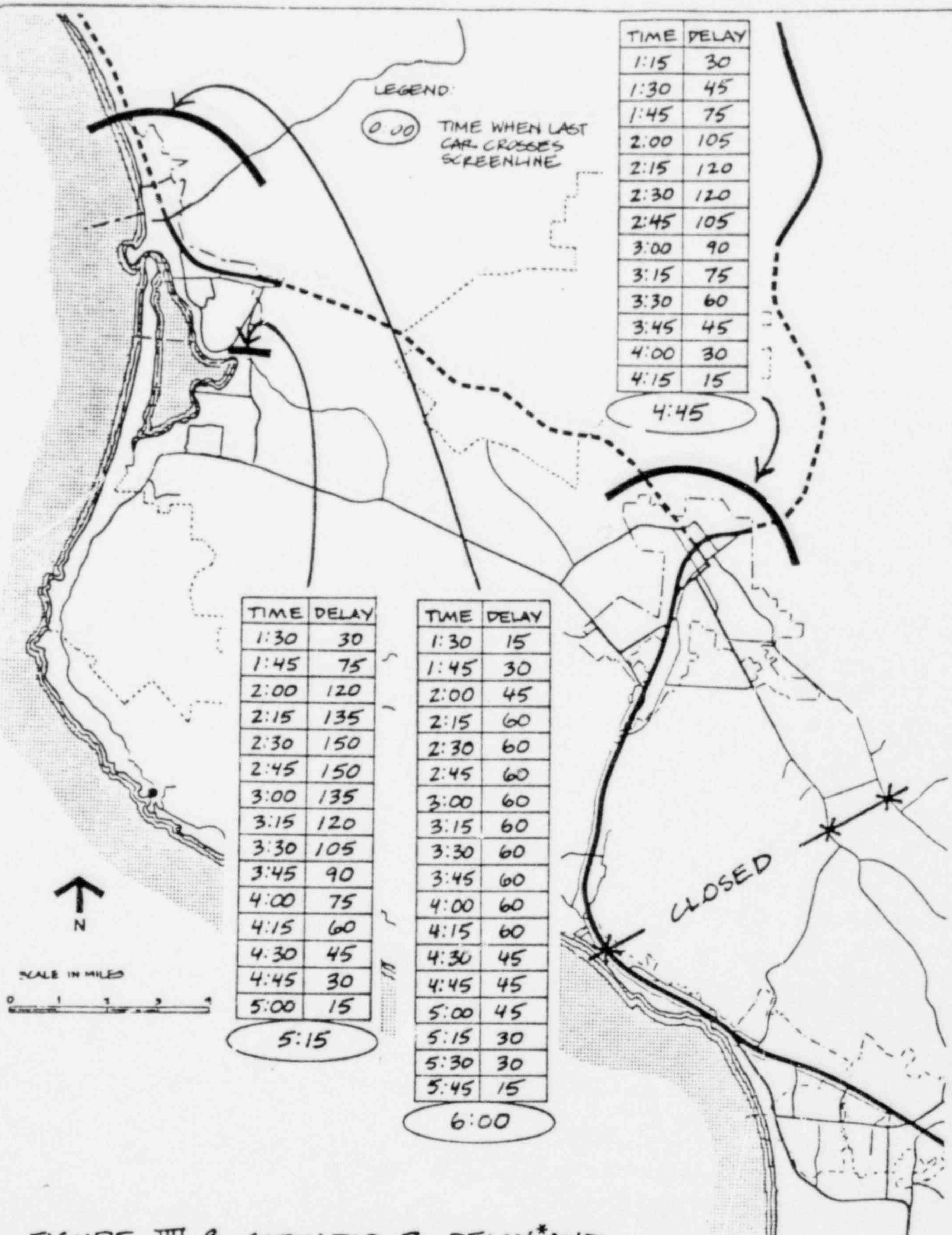

TIME	DELAY
1:15	30
1:30	45
1:45	75
2:00	105
2:15	120
2:30	120
2:45	105
3:00	90
3:15	75
3:30	60
3:45	45
4:00	30
4:15	15

4:45

TIME	DELAY
1:30	30
1:45	75
2:00	120
2:15	135
2:30	150
2:45	150
3:00	135
3:15	120
3:30	105
3:45	90
4:00	75
4:15	60
4:30	45
4:45	30
5:00	15

5:15

TIME	DELAY
1:30	15
1:45	30
2:00	45
2:15	60
2:30	60
2:45	60
3:00	60
3:15	60
3:30	60
3:45	60
4:00	60
4:15	60
4:30	45
4:45	45
5:00	45
5:15	30
5:30	30
5:45	15

6:00

FIGURE VII-8 SCENARIO B, DELAY* AND FINAL LEAVING TIME

* NOTE: DELAY TIME IN MINUTES

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Scenario A1 — Minimum-Control Evacuation

In this scenario it was assumed that no or little control was imposed on the evacuees. All routes would be open to traffic and evacuating vehicles would distribute in a natural, unconstrained manner except for diversion to lesser used roads as congestion builds up on the freeways.

At the gateway screenlines, the initial evacuation demand appears at about t=1:00, that is one hour after sounding warning sirens. At t=1:30, delay is established and persists to about t=4:00 at the Route 1 gateway, t=2:30 at the Route 101 North gateway and t=3:00 at the Route 101 South gateway. (See Figure VII-6). Traffic leaving San Luis Obispo will distribute itself in proportion to facility capacity using a total of five different road facilities. Although a trip from San Luis Obispo in southerly direction on Route 101 would be closer to the nuclear plant initially the large capacity of the freeway and its frontage road with little upstream loading makes this an attractive evacuation route. At the same time, the proximity of the San Luis Obispo evacuation zones to Route 101 north means that cars using that route will be able to clear the evacuation boundary faster than cars travelling south. The time of the "last car out" would be t=3:15 and t=3:45, respectively as shown in Figure VII-6.

The worst congestion and delays in this scenario would occur for vehicles leaving the Baywood/Los Osos area. Because of extreme competition for the single northbound lane of South Bay Boulevard towards Route 1, it would be advantageous in terms of overall time for some vehicles to leave this area by traveling east on Los Osos Valley Road. The assumed directional split between these two roads takes into account the following factors: driver experience of relative delay, drivers' perception of overall travel time required to reach the boundary, the relative capacity of the two facilites, and local traffic control efforts. While the last car out of Los Osos to the east leaves earlier than the last car northbound, that car will only reach the evacuation boundary at approximately the same time as the northbound vehicle. As can be seen, South Bay Boulevard to the north will experience vehicle delays of up to 60-75 minutes causing a considerable back-up. Even Los Osos Valley Road to the east, delays of up to 30 minutes would occur. To overcome these delays, a staged evacuation for the Los Osos/Baywood Park/Morro Bay areas should be considered. While a staged evacuation would not necessarily reduce the total evacuation time needed, people would be retained longer in their homes instead of on congested streets. This would reduce the likelihood of secondary delay effects of stalled vehicles resulting from engine overheating and running out of gas. The delays at the Route 1 North gateway, in the order of up to 60 minutes, would also be reduced by retarding the evacuation of Morro Bay in favor of Los Osos.

Another major problem with this scenario is the potential congestion on Route 1. There is not adequate capacity on this facility to handle traffic from both the northern zones (Los Osos, Morro Bay) and San Luis Obispo. Consequently, Route 1 would back up towards San Luis Obispo starting at the Morro Bay gateway screenline, about ten miles northeast of San Luis Obispo. The following is an illustration of what would most likely happen to an individual driver leaving San Luis Obispo:

The driver would experience some delay in San Luis Obispo getting access to and leaving town along Route 1. However, this delay would dissipate outside the city limit where the capacity increases. Because of this, the road would appear locally as an attractive evacuation route. After having traveled as much as five miles down the road however, the driver would be faced with congestion in a stop and go operation and a freeway back-up which would range five to seven miles in length and involve up to one-hour delays. Due to these considerable delays, Scenario A1 was judged unacceptable and a modified Scenario A2, involving access control of Route 1 in San Luis Obispo was examined as described below.

The expected delays at the remaining screenlines and gateways of Scenario A1 would be quite acceptable at about 15 minutes. Since the underlying evacuation assumptions reflect the presence of all residents, a maximum accumulation of outside visitors, and conservative roadway capacities, the 15 minute delay could actually be less.

Scenario A2 — Route 1 Controlled Access Evacuation

In this scenario, evacuation delays on Route 1 would be avoided by closing the northbound lanes of Route 1 for a certain time to allow Los Osos and Morro Bay traffic to evacuate first. While use of this route would still be allowed for commuters returning home to the Los Osos/Morro Bay area, road blocks would be set up and non-local traffic would be diverted until later in the evacuation. The analysis indicates that Route 1 should be closed at about t=1:00 and re-opened at approximately t=2:45. At that time, sufficient road capacity will be available on Route 1 in the Morro Bay area to allow a speedy evacuation of San Luis Obispo traffic.

Obviously, the closure of Route 1 will increase the evacuation delay in the San Luis Obispo area. However, the overall evacuation time for this area is not noticeably changed and the last car will still be able to clear the evacuation boundary at about the same time as in Scenario A1, at about t=3:15 (U.S.101 North and Southern routes) and t=4:00 (Route 1 North) (See Figure VII-7) Congestion on the other available evacuation routes leaving San Luis Obispo would increase somewhat due to the temporary closure of Route 1 (30 to 45 minutes of delay as compared to about 15 minutes for Scenario A1).

Scenario A2 has the effect of improving considerably the situation on Route 1 in Morro Bay, resulting in reduced delay times of about only 15 minutes as compared to 60 minutes under Scenario A1. The reduction in traffic congestion also will enable the "last car out" to cross the evacuation boundary at approximately 4:00, that is 15 minutes earlier than under the minimum-control scenario.

The delay situation at the Route 101 South gateway would not be appreciably different in the two scenarios. The last car would leave at about t=3:45, 3 hours and 45 minutes from time of notification.

A similar reduction in traffic congestion could be achieved by a delayed evacuation start of the City of San Luis Obispo. In that case, notification to evacuate would be held back by about 3 hours, again, allowing Los Osos and Morro Bay traffic to clear out first. In such a case, the overall evacuation time for San Luis Obispo residents would amount to about 5-6 hours (instead of 3-4 hours) although delays at any evacuation screenline would be 15 minutes or less. A delayed San Luis Obispo evacuation start, however, might be difficult to enforce due to the large number of routes and freeway ramps in the area. In addition, valuable roadway capacity on the southerly evacuation routes (U.S. 101 South, Highway 227 and Orcutt Road) would remain underutilized initially. It is felt that Scenario A 2, involving the temporary closure of Route 1 as described above, represents a more practical solution than the delayed San Luis Obispo evacuation. A further evaluation of the pros and cons of staged evacuation by zones should, however, be conducted as part of the preparation of the evacuation operations plan at a later time.

Scenario A2 would not be able to reduce the considerable evacuation delay projected for South Bay Boulevard out of Los Osos. Potential solutions for this problem are:

1. One-way operation in outbound direction on one or both routes leaving the area starting at about t=1:45. This would make it rather difficult or impossible for emergency and other official evacuation vehciles to enter the area.

2. Widening of the critical roadway sections of South Bay Boulevard (e.g. the Twin Bridges) to three or four lanes from the current two lanes.

3. Use of shoulder lanes on South Bay Boulevard so that two lanes can be operated in the outbound direction and one lane in the inbound direction. This potential measure may have to be combined with traffic controls at intersections, deployment of auto wreckers and tow trucks to remove parked and stalled cars and bottleneck monitoring in order to increase roadway capacity. Inbound traffic at bottlenecks (e.g. the Twin Bridges) may have to be restricted for certain intervals during the peak of the evacuation.

4. Staged evacuation of Los Osos subsections to achieve a more orderly and spread-out traffic flow out of this area. The staging would be accomplished in accordance with available road capacities.

If two lanes were available on South Bay Boulevard in the outbound direction through any of the first three actions above, the evacuation congestion delays could be reduced by about one-half from a typical delay of 60-75 minutes to about 30 minutes. In addition, "last car out" times would be improved by about 45 minutes to t=3:00.

In summary, Scenario A2 is considered to be the preferred evacuation scheme producing the least congestion delays and shortest overall evacuation times under good weather conditions.

Scenario B1: Southern-Routes - Unavailable Evacuation

This scenario assumes that evacuation would occur during heavy winds in the prevailing north-westerly wind direction. (See also Figure II-2). Under these circumstances the radioactive plume could possibly reach the southern evacuation routes prior to the peak of the evacuation and thus render the use of these routes undesirable. It was, therefore, assumed that all traffic would be directed toward US 101 North and Route 1. Obviously, this scenario assumes a "worst-case" situation since the highway capacity would be reduced to about 50% of that available for Scenarios A1 and A2.

Figure VII-8 portrays the resulting evacuation traffic volumes on the remaining available routes. In order to keep anticipated traffic delays in San Luis Obispo at a minimum, all Los Osos/Baywood Park traffic would be routed via South Bay Blvd. only.

As can be seen in Figure VII-8 , considerable delays and congestion would occur on the two freeways ranging from one hour in the Morro Bay area to up to two hours in the vicinity of San Luis Obispo. Maximum potential delays on South Bay Blvd. would be on the order of one and one-half hour. It should also be noted that not only are the actual delays larger for individual vehicles but the delays would also affect a larger number of persons over a longer time period. A staged evacuation scheme would have to be implemented to reduce traffic delays to acceptable levels and to minimize potential hazardous exposure of persons in cars.

The "last-car-out" times for Scenario B1 would range between approximately five and six hours, or about two hours longer than for the earlier scenarios. If the projected congestion would be allowed to develop, there is a potential for secondary delay effects caused by stalled vehicles and accidents. These secondary effects, although not quantifiable at this time, would tend to delay the overall evacuation time for the last vehicle even further. However, under a staged evacuation, the last-car-out time would not be appreciably longer, and potentially even shorter, than the five-to-six hours quoted above.

Adverse Weather Impacts on Evacuation Times

An estimate of the effect of heavy rains or fog on the projected evacuation time was obtained by reducing road capacities to 80% of those that would prevail under good-weather conditions. If visiblity is restricted by rain or fog, traffic would still continue to move, but at a slower speed. (A study of traffic flow under rain conditions showed the capacity of a freeway facility to be reduced to between 81 and 86 percent of normal, dry-weather capacity[1/]).

In order to simplify the analysis, a reduction in total trips was not made, even though it is doubtful that a peak vacation period would coincide with heavy rains. For some zones, vacation homes account for 30 percent or more of the population. Beach and park trips would also most likely not occur during an adverse-weather period.

If compared to dry-weather Scenario A1, the Minimum Control Evacuation. the rain scenario shows a maximum of 75 minutes of queueing delay, with the "last car out" leaving at t=5:00 hours, while the corresponding Scenario A1 values are 60 minutes delay and t=4:15. Thus a 20 percent reduction in road capacity due to adverse weather results in about an 18 percent increase in overall evacuation time, and in a 25 percent increase in queueing delay.

1/ E. Roy Jones et al., "Environmental Influence of Rain on Freeway Capacity," Highway Research Record 321, 1970

C. Summary and Conclusions

The following conclusions can be drawn from the evacuation time analysis:

- The designated evacuation boundary comprising an area of up to 10-12 miles from the Diablo Canyon Nuclear Power Plant has a population of about 63,500 persons living in 25,700 households. During an evacuation, this population would generate about 30,000 vehicles.

- The total time needed to evacuate the population from the designated area is estimated to be in the range of three to four hours. This applies to normal good-weather conditions and assumes availability of all existing roads and highways.

- If the routes leading south out of the area would be unusable due to a radioactive plume, travelling in southeasterly direction, the total evacuation time would be increased by about two hours to five to six hours.

- Similarly, adverse weather conditions with restricted visibility due to heavy rains and fog could increase the total evacuation time to between four and five hours. (All routes in use.)

- From among the three analyzed time periods into which an evacuation could fall (nighttime, daytime on a weekday, daytime on a weekend) the daytime/weekday situation is likely to produce the longest total evacuation time.

- In general, Route 1 would experience relatively greater traffic congestion than Route 101 due to its lower capacity. For the recommended evacuation scenario, delays of up to 15 minutes would exist on Route 101 and up to 30 minutes on Route 1.

- Regardless of when an evacuation would occur, some degree of overall traffic control will be desirable in order to avoid the severe congestion on Route 1 which would be caused by San Luis Obispo and Morro Bay/Los Osos/Baywood evacuation traffic. Such controls should include closing of Route 1 to evacuation traffic from San Luis Obispo until such a time when most traffic from Los Osos and Morro Bay has left the evacuation area.

- Localized bottlenecks caused by lack of adequate road capacity in the Los Osos/Baywood area would require a high degree of local traffic control to insure an orderly evacuation. Specific operational strategies such as a staged evacuation within this zone or a 2-lane northbound operation of South Bay Boulevard should be considered to avoid delays and congestion during an evacuation.

- The total evacuation time would not be significantly affected by staged evacuation but persons would be sheltered in their homes rather than being exposed to potential health hazards in their cars.

- Depending upon the location of reception centers, the degree of local traffic control and other factors, additional bottleneck situations may develop along Route 1 north of Cayucos outside of the designated evacuation boundary where fewer highway lanes are available. However, adequate "storage" capacity exists along the 4-lane segment to allow traffic to clear out of the evacuation area.

- Evacuation times for the Five Cities area consisting of Grover City, Arroyo Grande, Pismo Beach, Oceano and Shell Beach will be analyzed separately and incorporated into this report as an appendix at a later time. In additiou, it is understood that details of an Evacuation Operations Plan will be developed jointly by the County of San Luis Obispo and PG & E.

PHASE II REPORT

FIVE CITIES ADDENDUM

EVACUATION TIMES ASSESSMENT STUDY
FOR THE
DIABLO CANYON NUCLEAR POWER PLANT

Approximate 12- to 18-Mile Boundary Including
Morro Bay, San Luis Obispo and the Five Cities

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I. INTRODUCTION AND OVERVIEW

This report contains the results of an evacuation times assessment study for an expanded study area surrounding the Diablo Canyon Nuclear Power Plant and is intended as an extension of the previous study which considered only a ten-mile radius to the southeast of the plant.[1/] The former study included the City of San Luis Obispo, the City of Morro Bay and the unincorporated cities of Baywood/Los Osos and Avila Beach. In this study phase, the southeast boundary is extended to comprise the incorporated cities of Pismo Beach, including Shell Beach, Grover City and Arroyo Grande as well as the unincorporated area of Oceano. This added area is known locally as the "Five Cities". Both the Phase I study area and the expanded Phase II boundary are shown on Figure I-1.

Although the results of this phase of the study are explained within this document, reference is made to the previous report for general information and technical detail. In addition, the inclusion of the Five Cities within the study area has resulted in certain findings which differ from those previously reported in terms of the overall evacuation scenario.

As in the earlier phase, evacuation times were estimated for various zones and sectors starting at "zero" time representing the sounding of the Early Warning (Siren) System which is currently being considered for installation by Pacific Gas and Electric Company (PG&E). In this phase of the study, the overall evacuation boundary is essentially the same as the boundary contemplated for the early warning system.

1/ Alan M. Voorhees & Associates, "Evacuation Times Assessment Study for the Diablo Canyon Nuclear Power Plant," April 1980.

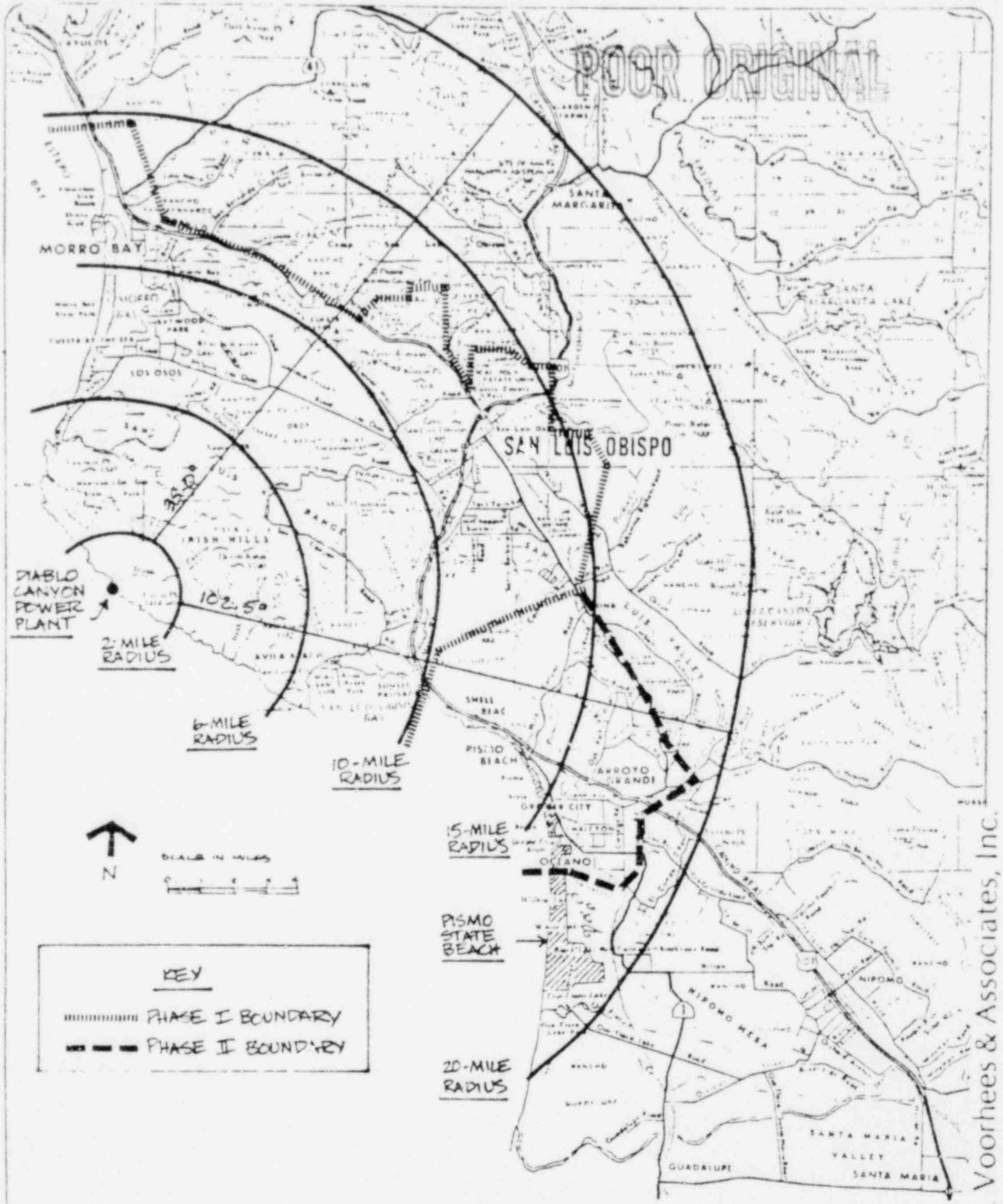

FIGURE I-1. GENERAL AREA MAP

The objectives of this Addendum can be summarized as follows:

- To obtain the most recent information on population, institutional facilities (such as hospitals and schools), and recreation and beach visitors within the expanded designated evacuation area known as the Phase II boundary.
- To evaluate the existing roads in the area with respect to their capability to carry the traffic loads generated by an evacuation.
- To estimate the time that would be required to evacuate all persons from within the designated evacuation area and to identify potential delays due to inadequate road capacities and adverse weather conditions.
- To provide recommendations for selective and staged evacuation in order to prevent traffic congestion and to minimize the exposure of departing individuals to health hazards.

Report Contents

Following this introductory chapter, Chapter II describes area characteristics for the Five Cities where they differ from those mentioned in the Phase I report. Chapter III indicates the evacuation analysis zones as defined by the Nuclear Regulatory Commission (NRC) and by the consultant in the study. Chapter IV presents population statistics based upon these zones. Chapter V explains evacuation action steps pertaining to the population groups studied for this phase of the study, and Chapter VI deals with the evacuation routes. Chapter VII presents estimates of evacuation times for various conditions studied. Also in Chapter VII, the results of this study are integrated with the previous study results and overall findings and recommendations are presented. In Chapter VII , the consultant also investigated possibilities for both staged and partial evacuations and has recommended overall scenarios for operations planning to respond to various levels of urgency in an evacuation of the entire study area.

II. AREA CHARACTERISTICS

A. Topographic Features and Development

The development pattern in the Five Cities area is strongly related to the topography. In the northern portion, in the vicinity of Pismo Beach, urbanization extends along a narrow shelf between the coastal mountain range and the Pacific Ocean. Canyons stretching inland contain lower density housing, mineral-resource industries, agriculture and ranch lands. South of Pismo Beach is a triangular portion of low-lying, flat land bounded by U.S. 101, the Nipomo Mesa, and the Pacific Ocean. Here are located Grover City, Oceano and the western half of Arroyo Grande, which together contain the majority of the population within the added study area. The urbanized area ends at Arroyo Grande Creek, south of which is the agricultural land of the Cienega Valley. Both Pismo Beach and Arroyo Grande contain densely developed areas extending short distances inland across into the valleys or canyon lands. Some new residential development is likely to occur east of U.S. 101, but most future development is projected along the established Route 101 corridor. (See also Chapter IV.)

B. Transportation Network

The transportation network has been described in detail in the previous report. Additional significant highway facilities in the Five Cities are:

- U.S. 101 continuing south to the county boundary as a four-lane freeway (with a short expressway segment south of Arroyo Grande).
- The frontage road which parallels Route 101 to the west to become Route 1 in Pismo Beach branches off in a coastal direction, south of Pismo Beach.

- The secondary evacuation routes out of San Luis Obispo to the southeast, namely State Route 227 and Orcutt Road. These roads cross-connect with a number of canyon roads and feed back to the Route 101 at the Price Canyon Road interchange in Pismo Beach, Oak Park Boulevard interchange on the Grover City/Arroyo Grande boundary, and at the E. Branch Street/Traffic Way interchanges in Arroyo Grande.

- Los Berros - Arroyo Grande Road which commences off Valley Road in Arroyo Grande and, through various connections, forms a continuous secondary route out of the county.

In addition to the major routes are the local streets which connect into the main highway system. Those local routes which would be important for evacuation purposes are described in detail in Chapter VI. Figure II-1 shows the street classification of roadway facilities within the Five Cities area.

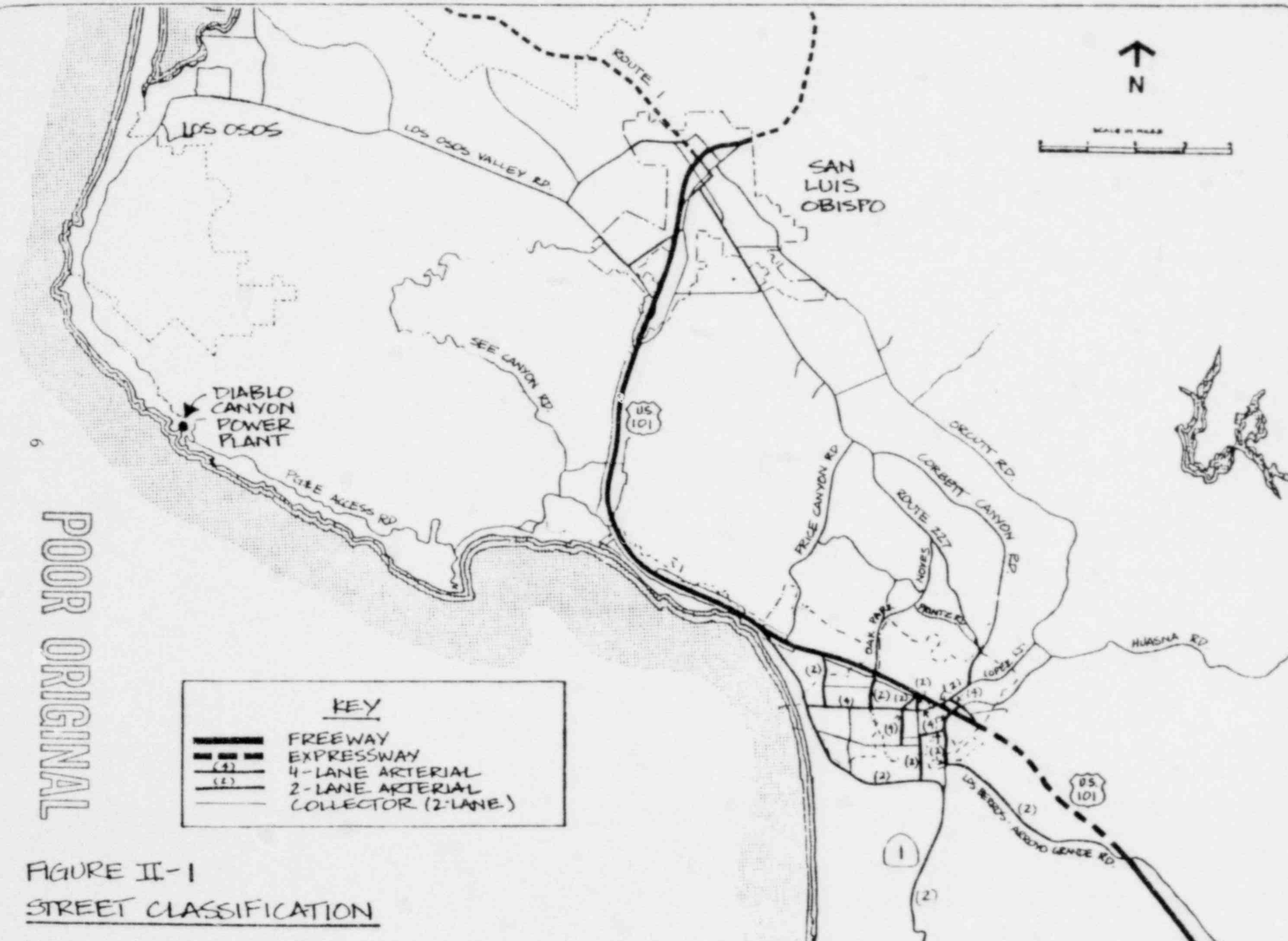

FIGURE II-1
STREET CLASSIFICATION

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III. EMERGENCY PLANNING AREA

Figure III-1 shows the Phase II evacuation boundary along with the 10-mile emergency planning zone suggested by the NRC. The NRC has established the practice of analyzing population within 22 1/2-degree angular segments which are then further subdivided into various groupings based on the distance from the plant site. These zones are indicated in Figure III-2. In the following report chapter, dwelling-unit and population estimates are presented for July 1980 and 1985 based upon those zones in order to facilitate regional or national comparisons of population characteristics.

For reasons described in the previous report, the NRC zones were not found applicable for practical evacuation planning purposes. Thus the consultant has established three evacuation zones within the expanded study area which are illustrated in Figure III-3. These zones were used in all subsequent analysis and their boundaries are listed in Table III-1. As with the NRC zones, estimates of dwelling units and population are also shown for these zones in Chapter IV.

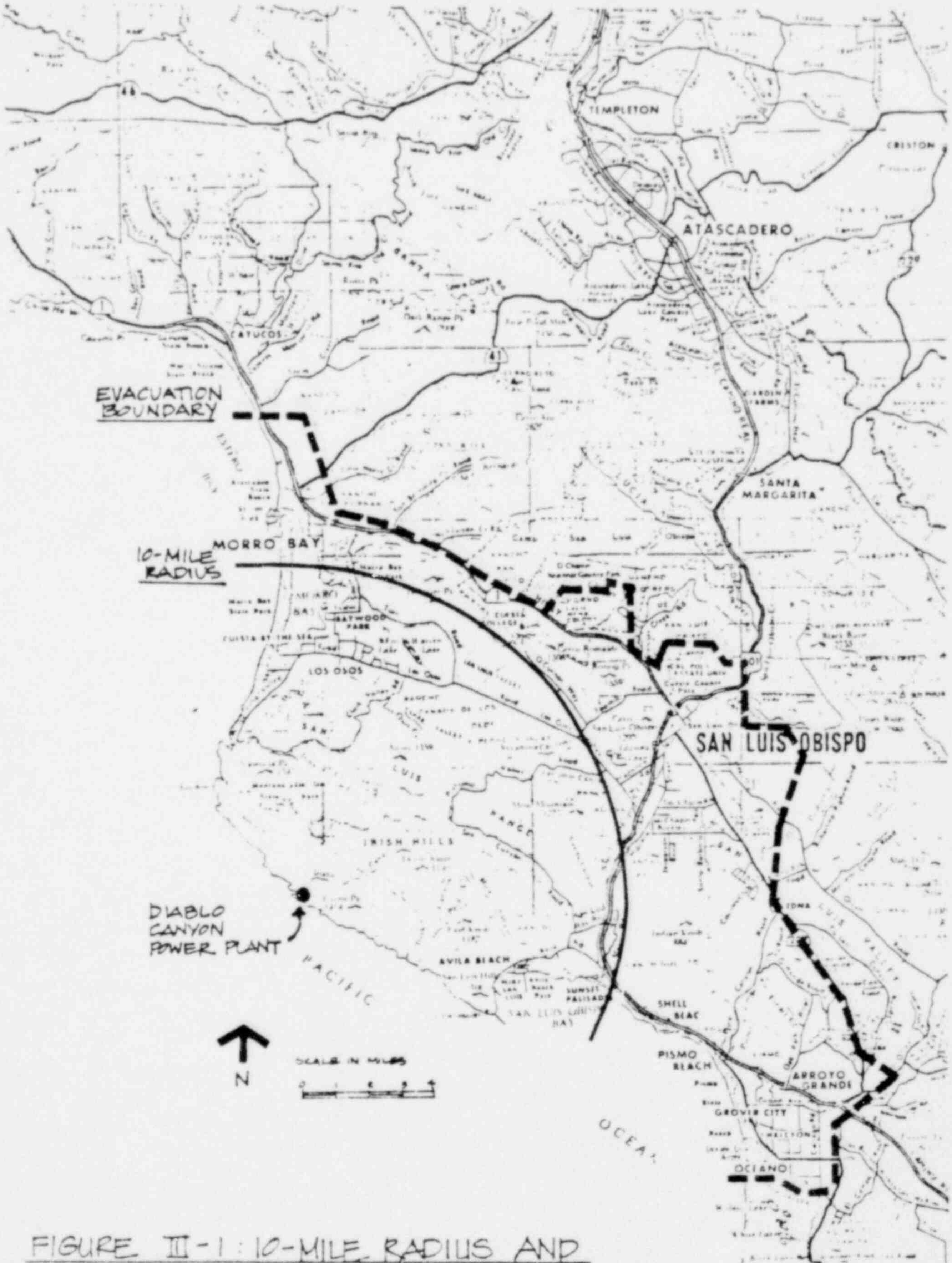

FIGURE III-1: 10-MILE RADIUS AND EVACUATION BOUNDARY

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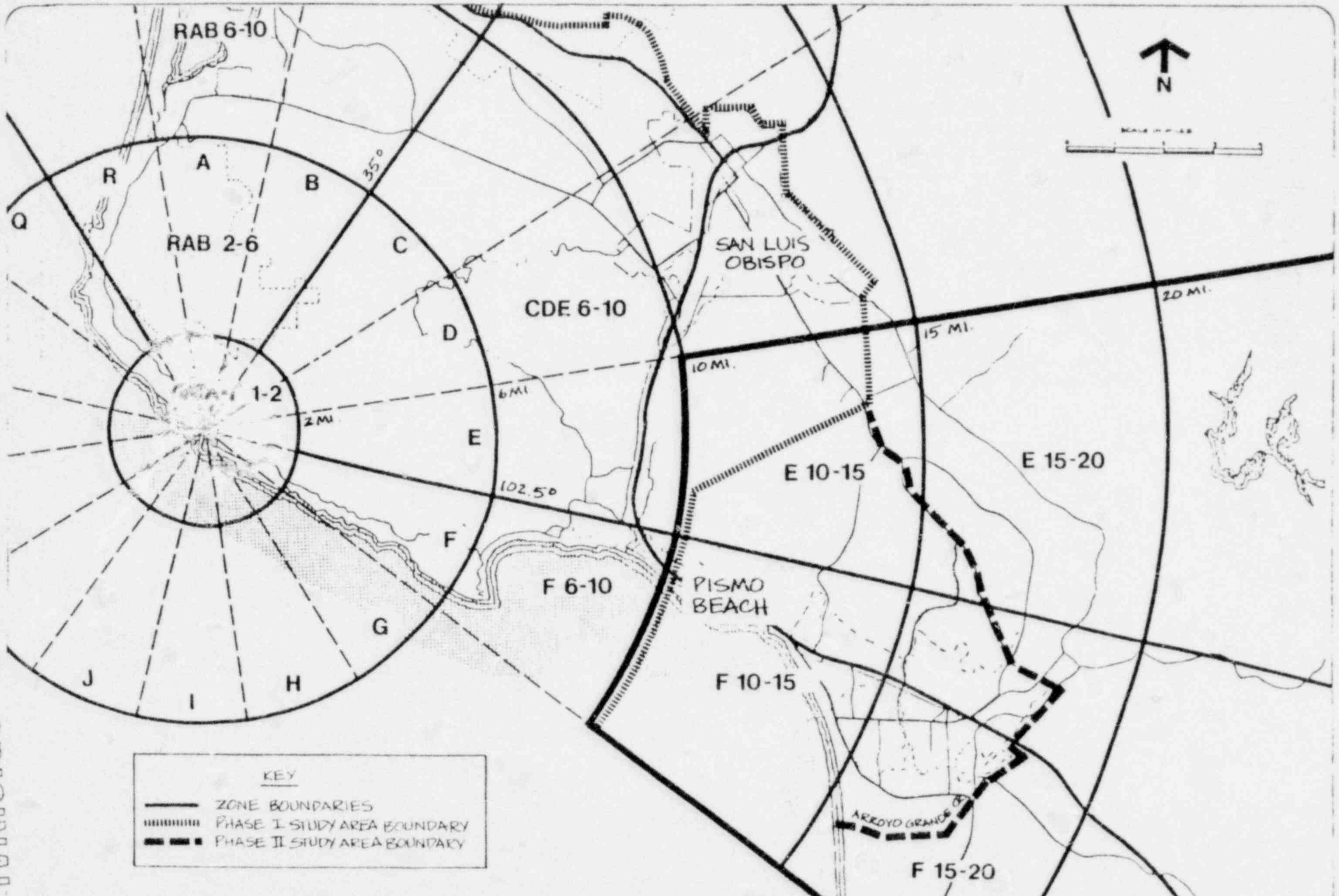

FIGURE III-2: NRC ZONE DESCRIPTION

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POOR ORIGINAL

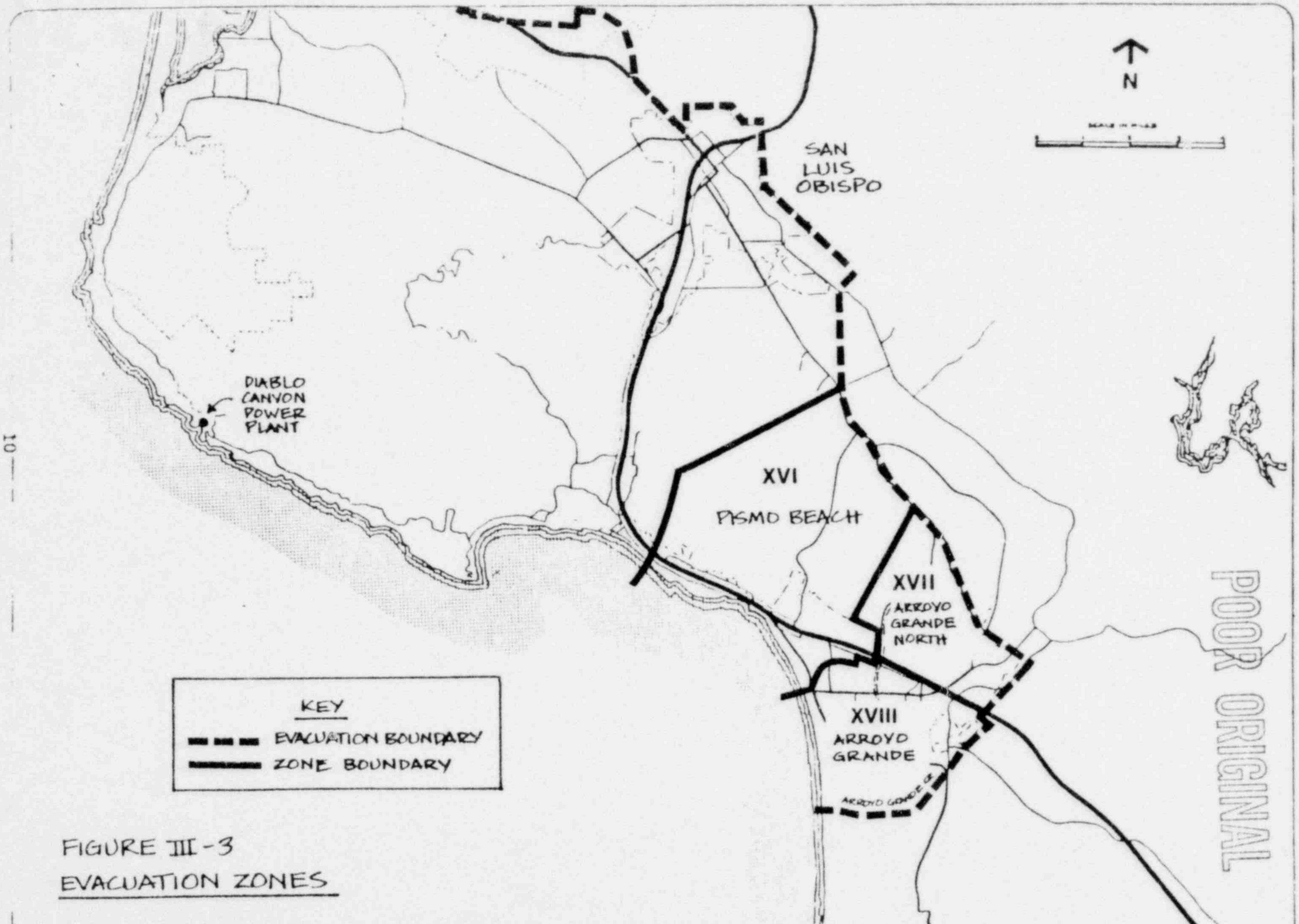

FIGURE III-3
EVACUATION ZONES

POOR ORIGINAL

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Table III-1

DESCRIPTION OF EVACUATION ANALYSIS ZONES

Analysis Zone	Limits
XVI Pismo	Commence at intersection of Southern Pacific railroad (SPRR) tracks and State route 227 - State Route 227 southeast to Canada Verde Creek - Imaginary line southwest through hills (crossing saddle of Ormonde Road to Pismo Beach city limit near U.S. 101, N. 4th Street interchange - Pismo Beach city limits east, south, west to Pacific Ocean - Pacific Ocean northwest to Spyglass Rd. (Shell Beach) interchange - Imaginary line to Indian Knob - Imaginary line from Indian Knob to intersection of SPRR and route 227
XVII Arroyo Grande North	Commence at intersection of SPRR tracks and State Route 227 - Route 227 southeast to Arroyo Grande city limits - Arroyo Grande city limits - Southeast then southwest to U.S. 101 - U.S. 101 northwest to zone XVI - Zone XVI boundary northeast to State Route 227
XVIII Arroyo Grande	Commence at U.S. 101 near N. 4th Street interchange - U.S. 101 southeast to Arroyo Grande city limits - Arroyo Grande city limits southwest to Arroyo Grande Creek - Arroyo Grande Creek west to Pacific Ocean - Pacific Ocean north to Pismo Beach city limits - Zone XVI boundary east to U.S. 101

IV. POPULATION, INSTITUTIONS, AND VEHICLE TRIP GENERATION WITHIN THE EVACUATION AREA

A. Residential Population and Employment Travel Patterns

In order to estimate the number of vehicles which would be used in an evacuation, up-to-date population estimates were utilized. These were obtained by analyzing population and dwelling unit information provided by the county and state planning departments and by projecting short-range trends to update these data. The resulting population estimates for the three analysis zones were largely based upon dwelling unit information. Since, for conservative reasons, a zero percent vacancy rate was assumed, the population figures used here are higher than the official local estimates which incorporate a vacancy rate as high as ten percent due to factors such as the large number of vacation homes in the area. Estimates were up-dated to July 1980, and July 1985 - the latter as an indication of short-range growth.

The distribution of population and dwelling units within the study area was based on established development patterns and facilitated by the fact that a number of city boundaries coincided with those of the analysis zones. Estimates of the population and of the dwelling units are shown by NRC zones in Table IV-1, and by evacuation analysis zones in Table IV-2. As of July 1980, the total estimated population in the added study area is expected to be about 31,800 persons in 13,300 dwelling units. Projections for 1985 show an increase of approximately 4,800 inhabitants and in 3,300 dwelling units. As can be seen from Table IV-1, the current (July 1980) estimated population within the entire study boundary (including both Phases I and II) is distributed by distance from the Diablo Canyon plant as follows:

Table IV-1

ESTIMATED DWELLING UNITS AND
POPULATION BY NRC ZONES

NRC Zones	Number of Dwelling Units		Population	
	7/80	7/85	7/80	7/85
E 10-15 1/	38	46	75	86
F 10-15	5,477	6,763	12,058	13,828
E 15-20	47	57	119	133
F [illegible]-20	7,801	9,711	19,589	22,533
TOTAL	13,363	16,577	31,841	36,580

1/ Includes Phase II Study area quantities only; part of this zone was included in the Phase I Study in Table IV-1 under the combined NRC Zone CDE 10-15.

Table IV-2

ESTIMATED DWELLING UNITS AND POPULATION

BY EVACUATION ZONES

Evacuation Zones	Number of Dwelling Units		Population 1/	
	7/80	7/85	7/80	7/85
XVI Pismo	3175	3878	6276	7119
XVII Arroyo Grande North	1878	2285	4774	5324
XVIII Arroyo Grande	8310	10,414	20,791	24,137
TOTAL	13,363	16,577	31,841	36,580

1/ Does not include group quarters; includes population indicates as dwelling unit population in census reports estimated with a 0% vacancy rate.

	Population	Percent
Within 2 miles of plant	5	very small
Within 2-6 miles of plant	58	0.1%
Within 6-10 miles of plant	17,582	18.4%
Within 10-15 miles of plant	57,986	60.8%
Beyond 15 miles of plant	19,708	20.7%
Total	95,339	100.0%

In addition to the analysis of population and dwelling units, an estimate of the travel time distribuiton of workers who return to their home prior to evacuation from the Five Cities area was made. This estimate was based upon the trip-end distribution for all trips whether employment based or not, as tabulated in the county regional transportation plan.[1/] Excluding those who travel internally or to adjacent rural areas, this information indicated for the Five Cities area that trips were split evenly between the City of San Luis Obispo and to Santa Maria and other cities in Santa Barbara County to the south.

B. Car Ownership and Vehicle Generation

To estimate the number of vehicles that would be used in an evacuation by the residents of the study area, assumptions and procedures identical to those used in the first phase of analysis were used. Based upon these assumptions, an estimated 15,500 vehicles would be generated in an evaucation which indicates an average vehicle occupancy factor of 2.05 for residential-based evacuation trips.

Table IV-3 indicates the number of cars generated by each evacuation zone based upon the July, 1980 population and dwelling unit information. Also included is an estimate of the amount of non-car-owning households within

1/ JHK Associates, "San Luis Obispo Regional Transportation Study Technical Report Phase II", November 1974, pg. 2-30.

Table IV-3

ESTIMATE OF AUTOMOBILES USED FOR EVACUATION

Evacuation Zone	Number of Households	Number of Vehicles Used for Evacuation	Number of Non-Car-Owning Households
XVI	3175	3690	285
XVII	1878	2180	165
XVIII	8310	9645	730
TOTAL	13,363	15,515	1180

each zone. As was discussed in the previous study, special actions would need to be taken to evacuate these transportation dependent households.

In addition to trips made by the resident population, evacuation trips would be generated by "special generators" such as schools, hospitals, and by the beach users - both day users and overnight visitors. These special population groups are discussed in more detail in sections C and D.

C. Institutions

In the case of an evacuation, institutions would need to be handled on a case-by-case basis, taking into account the special needs such as transportation requirements, demanded by each. The previous study outlined some of these needs and concerns. For reasons discussed in that report, institutions would not necessarily generate evacuation traffic of the same proportions nor time characteristics as would the residential dwelling units. On the other hand, there would be a critical need for specialized transportation services such as buses or ambulances to evacuate these generators.

General and Convalescent Hospitals

Within the added evacuation area there are currently five operating hospitals - one general hospital and four convalescent hospitals. Table IV-4 indicates the characteristics of each of these medical facilities, and indicates the number of passenger vehicles that would have to be added to the evacuation traffic. In addition, the location of each of these facilities is plotted in Figure IV-1.

Table IV-4

ESTIMATED VEHICLE GENERATION OF GENERAL AND CONVALESCENT HOSPITALS

Facilities	Beds	Average Number of Patients	Staff (Day Shift)	Vehicles Generated 1/
General Hospital				
Arroyo Grande Community Hospital	79	79	110	110
Convalescent Hospitals				
South County Convalescent Center	99	99	30	55
Patio Home Care	24	24	3	10
Oak Park Manor	24	24	4	11
The Alder House Guest Home	6	6	2	4

1/ Does not include the number of ambulance trips generated as these trips would not be characteristic of the general flow of traffic. These trips were derived by estimating the number of staff, outpatient and visitor vehicles that would be generated.

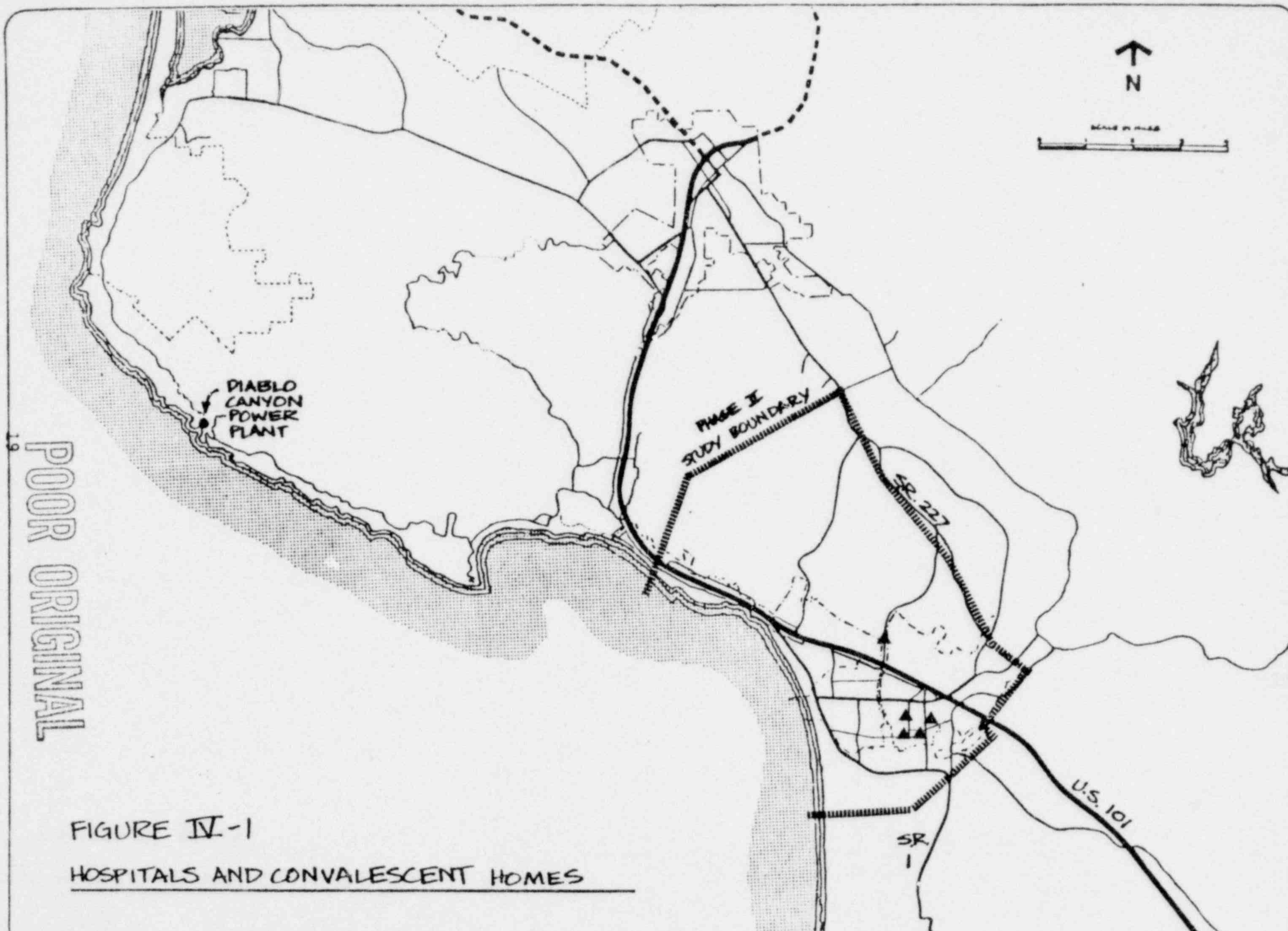

FIGURE IV-1

HOSPITALS AND CONVALESCENT HOMES

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Schools

Within the study area there are 12 public schools and three private schools of varying size.[1/] The largest is Arroyo Grande Union High School with about 2,000 students. The locations of these schools are indicated on Figure IV-2. Since the method of evacuation of the schools would depend heavily upon time of day and available transportation resources, it is difficult to predict the traffic flow which would result.

In the previous Phase I study it was assumed that students would be reunited with their families at home prior to evacuation. However, the alternative procedure of evacuating schools as a unit to pre-established reception centers and reuniting with their families there, should also be considered. The latter procedure would provide for a fast and possibly more assured evacuation provided that sufficient school and other buses can be procured for the timely evacuation of schools.

The number of vehicles involved in evacuating the schools would not significantly affect the evacuation times for the general public. On the other hand, because of the evacuation plan variables which are unresolved at this point, it is not possible to make an accurate assessment of the evacuation times for school children. However, a range of times can be indicated, based upon certain assumptions. The 1975 county-wide population breakdown by age when applied to the study area population yields the following estimate:

Age	Category	Percent	Estimated Quantity
0-4	Pre-School	7%	6700
5-9	K-3rd Grade	8%	7600
10-14	4th-8th Grade	9%	8600
15-19	High School	9%	8600
		33%	24,800 Estimate, 5-19 yrs.

1/ Includes public and private schools as listed in the 1979-1980 San Luis Obispo County School Directory.

These individuals could be evacuated in a variety of ways. The children in the pre-school category would largely be with the parent(s) or else under some form of day-care which would insure that the children were either returned to their parents' care or transported to a reception center. Of the remaining children enrolled in public or private schools, some currently walk to school, some are bused and some may drive. Although the preferred plan from an administrator's point of view may be to directly evacuate all the children to pre-determined reception points, a comparison to the number of available buses(about 120 buses countywide, representing about 6,000 seats) indicates that this would not be feasible if each piece of equipment were limited to two total trips. (Two trips could be accomplished, including mobilization, loading/unloading and driving times twice to the school and twice to the reception center, in approximately five to eight hours, which is generally the same as the overall evacuation timeframe for the evacuation of the entire study area.)

Because of this, it would probably be necessary to allow, on a pre-arranged basis, for a certain percentage of parents to pick up the children at the school, especially for the kindergarden-3rd grade age group. It may also be possible for some high school students to be authorized to be signed out from school and form car-pools. In this manner, the remaining number required to be bused would be within the limit of the immediatly available equipment, using two trips.

It should be noted, however, that the detailed method adopted will involve some key evacuation policy decisions which will still need to be resolved.

D. Recreation and Tourism

The added study area contains recreational facilities centered around Pismo Beach which draw significant numbers of non-resident visitors. Pismo Beach State Park is the single largest attraction which includes day use, camping, and off-highway vehicle (OHV) operation by permit within designated areas. Other attractions outside of the state beach include motels, recreational vehicle parks and some smaller, local beaches.

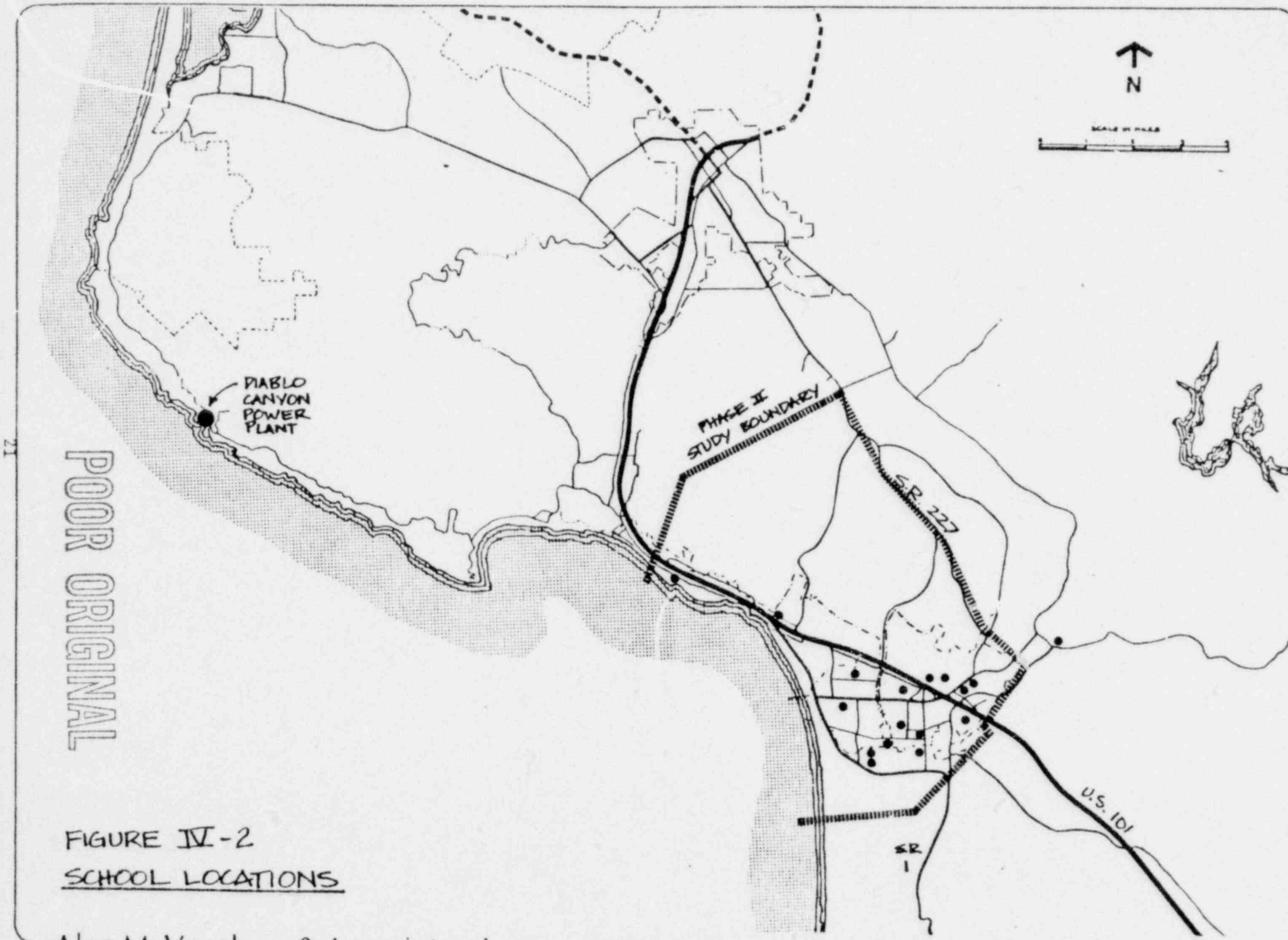

FIGURE IV-2

SCHOOL LOCATIONS

Different travel patterns are associated with these various generators. Motel occupancy is close to 100 percent during the summer months and remains at about 60 percent in the off season. By serving many users at a single spot over the course of a year, the recreational vehicle parks also have a high occupancy rate. In contrast to these facilities, the use of Pismo State Beach is more subject to summer peaks, especially during longer holiday weekends when vehicles are driven onto the beach. Consequently, two analysis cases were established and analyzed:

- A non-peak condition in which all activities except the State Beach were taken at capacity.
- Peak condition at Pismo State Beach in addition to full utilization of the other recreational facilities.[1/]

The first case represents a situation where either the Beach State Park is not evacuated, while the other recreational areas are, or a case of moderately high use and evacuation of all facilities including the Pismo Beach State Park. This case would be representative of a normal summer week-day or non-peak weekend. The second case represents a highly peaked situation such as might occur on a Memorial Day, Fourth-of-July, or Labor Day weekend.

Estimates of the total number of camping, motel and day-use visitors to the coastal zone were prepared with the aid of the State Parks Department officials at Pismo Beach and the City of Pismo Beach Planning Department. These estimates were based on the following assumptions: for minor camping and beach areas, the number of vehicles was based upon the number of available campsites or parking spaces; for motels, the number of rooms used. For the Beach State Park, the usage was based upon peak visitation data directly. The resulting estimates are shown in Table IV-5.

1/ During peak usage, recreational population at Pismo State Beach extends into areas of the beach beyond the evacuation study boundary. (See Figure I-1) However, evacuation from the beach would take place through access points located within the study boundary, and this traffic was included in Scenario C.

Table IV-5

RECREATIONAL TRIPS

Location Activity	Vehicles Estimated
Arroyo Grande	
Motel	105
RV Park	60
City of Pismo Beach	
Motel	920
RV Park	990
Beach (Shell Beach)	200
Pismo Beach State Park	
Beach (North of Arroyo Grande Creek)	100
Beach (South of Arroyo Grande Creek)	8600
Camping (North Beach Campground)	103
Camping (Oceano Campground)	84

E. Summary of Total Evacuation

Table IV-6 indicates, by analysis zone, the estimated total evacuation traffic composed of residential-based vehicles, and those private vehicles generated by special facilities, i.e. medical recreational facilities. As described above, Pismo State Beach is not included in this table, since traffic generated by this facility is treated in a separate analysis. (See Scenario "C", Chapter VI.)

Table IV-6

SUMMARY OF ESTIMATED NUMBER OF

VEHICLES GENERATED BY ANALYSIS ZONE

Zones	Residential Based Vehicles	Vehicles Added by Special Generators[1/]		Total Vehicles Generated
XVI	3690	920 200 990 2110	Motel Beach RV Park	5,800
XVII	2180	20	Misc.	2,200
XVIII	9645	105 60 190 355	Motel Camping/RV Park Hospital/Convalescent Hospital	10,000
TOTAL	15,515	2485		18,000

1/ Excluding Pismo State Beach

V. DEVELOPMENT OF EVACUATION CURVES

In order to determine the number of vehicles generated for each interval of time within an evacuation, a set of probabalistic curves was developed. These curves indicate what percentage of the total population would be leaving their home in terms of elapsed time since the initial siren notification system had been sounded. A more complete discussion of the evacuation curves was contained in the Phase I report. However, for the Five Cities study area it was necessary to develop some additional evacuation curves in order to represent the evacuation behavior of beach and recreational visitors. These curves are shown in Figure V-1.

For this study, two different beach population groups were considered, those who would have to walk to their vehicles upon evacuation notification and those who would be with their vehicles but dispersed on the beach. The second category was necessary due to the fact that Pismo State Beach is a state park where Off Highway Vehicle (OHV) operation is permitted. It was assumed in the analysis that the notification of the beach population would take place by having a mobile loudspeaker system either airborne or carried by a park patrol vehicle. The shape of the notification curve would be then a function of the distribution of population upon the beach and the speed at which the area could be traversed. Based upon analysis of these factors, it was concluded that a notification curve similar to that previously used for the Phase I study would also be applicable to the beach-recreational uses. This notification curve was then multiplied by the "prepare to leave" curves, which were different for the walkers and those driving on the beach. The "prepare to leave" curves reflect the functions of packing up belongings, gathering of groups, and actual egress time to the egress point, and were based upon the specific conditions observed at Pismo State Beach. Since during a peak holiday time the state beach has such a large proportion of the total coast visitation, separate curves were not developed for other beach

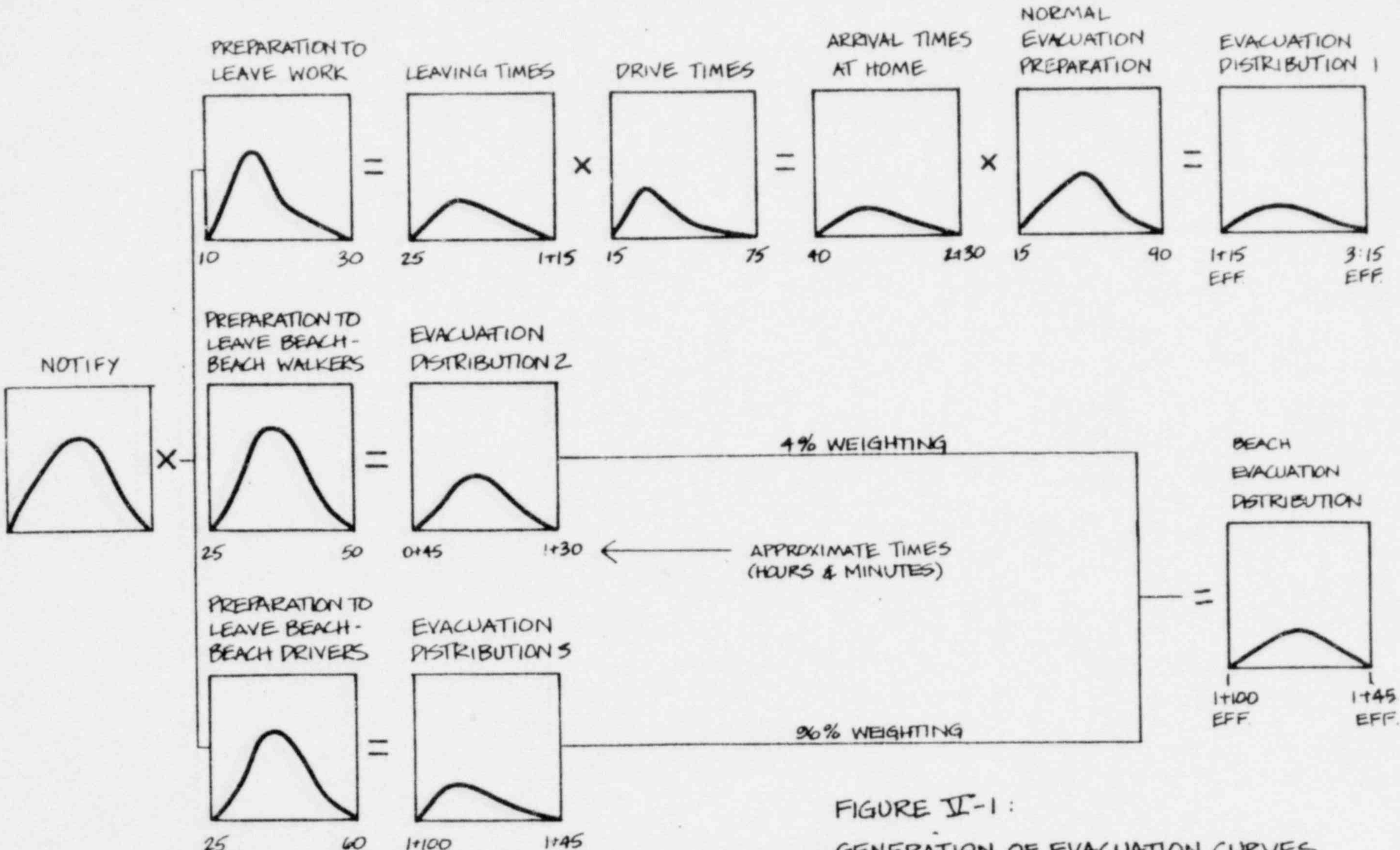

FIGURE VI-1 :

GENERATION OF EVACUATION CURVES

zones in the study area. After the evacuation characteristics of the two distinct populations on the beach were determined, the curves were weighted and combined to form a single evacuation curve for the beach visitors.

The development of the beach curves and of the working population evacuation curve are compared in Figure V-1. The main difference between the beach curves and the working population curve is due to the reduced number of sequential steps required for beach evacuation. As a consequence of this, the beach areas have the potential to be very quickly evacuated. As can be seen in Figure V-1, the maximum evacuation starting time for beach visitors would be 1:45 hours versus 3:15 hours for workers. On the other hand, unless additional alternate exit points can be located and the appropriate traffic control provided, the beach exit capacity will control evacuation time. In this case, the possibility would exist that long queues of vehicles, attempting to exit the beach would form. The resulting delay was confirmed in a special analysis, labeled "beach scenario", in Chapter VII.

VI. EVACUATION ROUTES

A. Roadway System

In this chapter, the additional qualifications are addressed concerning the roadway system which are unique to the added study area. Details outlining the relationship of the evacuation routes to the statewide transportation network, reception center locations and roadway capacities, were described and evaluated in the previous Phase I study.

Main Freeway/Expressway Links

As shown in Figure VI-1, U.S. 101 is the only freeway/expressway link within the added study area. This facility acts as a spine along which most of the development and population within the added study area are spread out. Route 101 is constructed to freeway standards throughout most of its length within the study area, and the short expressway segments of this route traverse rural areas where there would be no significant traffic interference. State Route 1 and the Los Berros - Arroyo Grande Road comprise the only other major evacuation through-routes that provide additional capacity out of the area to the south. Although Routes 1 and U.S. 101 enter the study area as a common freeway facility (Route 1 is separately defined as Dolliver Street in Pismo Beach), there exists a continuous frontage road on the west side of the freeway which provides additional roadway capacity.

It should be noted that for certain analysis scenarios described below, some of the available capacity of both Route 101 and other potential evacuation routes would be absorbed by evacuation traffic from San Luis Obispo. Not all of the full roadway capacity would, therefore, be available for Five-Cities traffic depending on the respective evacuation assumptions.

Road Capacity Assumptions

The particular vehicle capacites used for Route 1 varies depending upon the actual quality of the facility. Throughout the added study area the

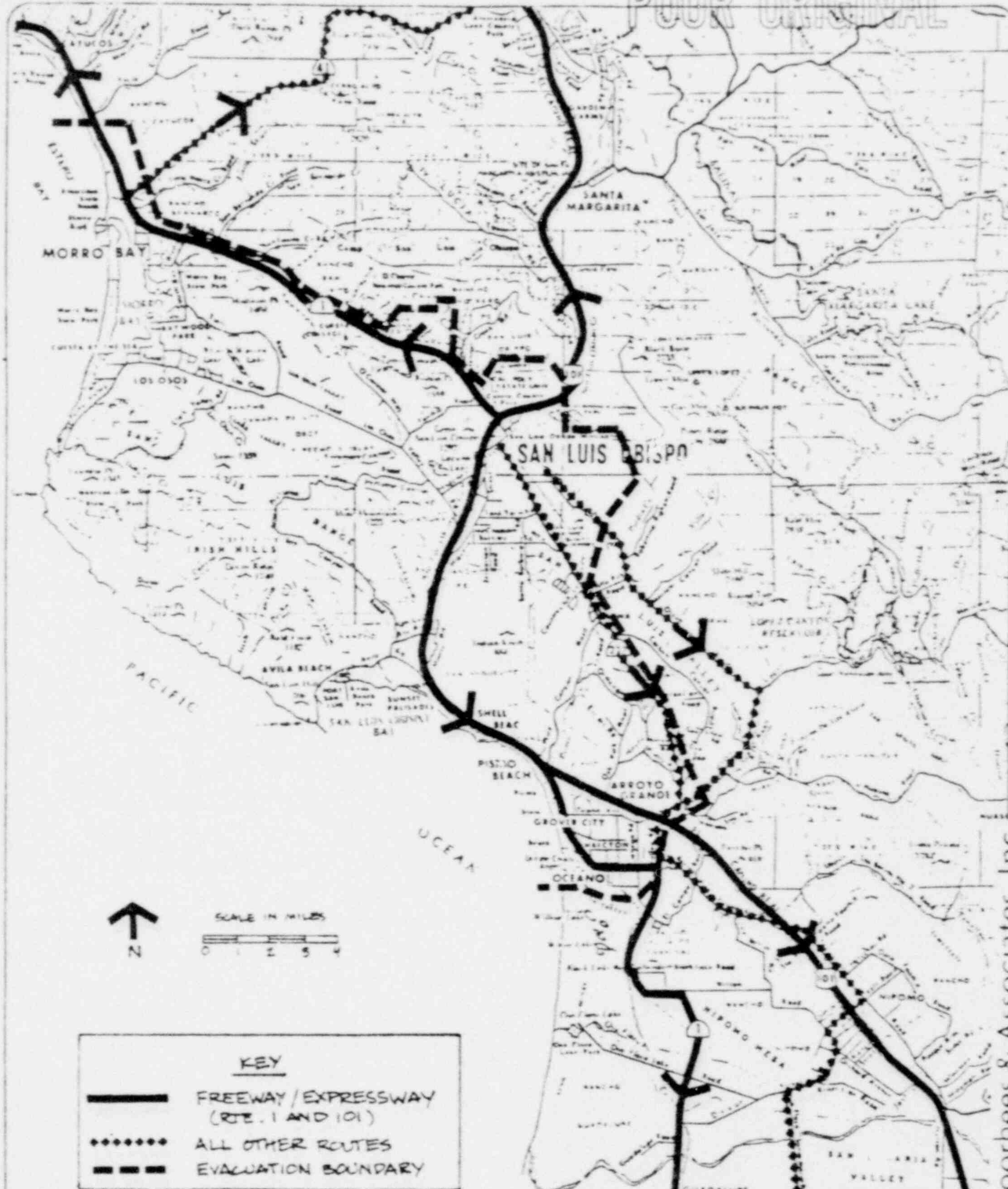

FIGURE VI-1 : EVACUATION THROUGH-ROUTES

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route functions as a two-lane road. However, within Pismo Beach there are numerous intersections. Thus a maximum capacity of 1200 vehicles per hour was used. Through Grover City, access to Route 1 is restricted to a few intersections due to the presence of the Southern Pacific Railway tracks. Similarly, south of Oceano Route 1 abuts agricultural fields and has only infrequent intersections. For these segments, an outbound capacity of 1500 vehicles per hour was used assuming little opposing flow and turning movements.

A small but important amount of additional capacity is provided by the Los Berros - Arroyo Grande Road. The analysis of this route shows that evacuation traffic leaving the study area on Los Berros Road could be directed through Nipomo via arterial streets (e.g. Thompson Road) to cross into Santa Barbara County either on Bonita School Road or along State Route 166. Because of the number of intersections involved in either of these routings, a lower capacity was assumed for this evacuation route than for Route 1.[1/]

Traffic from the North Through the Five Cities Area

In some evacuation scenarios, traffic from the San Luis Obispo area would be directed through the Five Cities area. Traffic would thus be entering the Five-Cities area along the U.S. 101 and its Frontage Road, as well as along State Route 227 and Orcutt Road approaching on U.S. 101. Traffic would be expected to remain on the freeway, and Frontage Road traffic would logically be directed onto Route 1. For analysis purposes it was assumed that Orcutt Road traffic would continue south and west through northern Arroyo Grande via Lopez Drive, Huasna Road, and Branch Street. This traffic would then be distributed onto Route 101, Los Berros Road or Route 1 depending on which of the evacuation routes leaving the study area had available capacity. Since the Orcutt Road traffic would utilize the entire capacity of the above mentioned route, it would be most sensible to load the Route 227 traffic onto Route 101 as early as possible in order to

1/ Although the bridge on Bonita School Road across the Santa Maria River was washed out this past winter, there are plans to replace the structure. The ultimate choice of route would be based upon the availability of Bonita School Road and the reception center location as Route 166 would lead traffic away to the east.

distribute the two flows to different entrance ramps. The most direct routing was found to be via Price Canyon Road, requiring the placement of barricades across Route 227 at Price Canyon Road to divert this traffi toward Pismo Beach.

Local Routes

In addition to evacuation through-routes local evacuation routes were designated which would serve as access routes to the evacuation through-routes. In general, these routes connect the local street systems with the freeway interchange ramps. Within the added study area, these routes are highlighted in Figure VI-2. They are also listed in Table VI-1, along with suggested alternative routes should the primary routes be blocked for any reason.

The analysis indicated that, relative to the initial study area of Phase I, the Five Cities area exhibits a greater redundancy of access streets to the major evacuation routes. At the same time, there are fewer potential hazards which could cause a closure of these routes in the added study area.

Shed Areas and Uncongested Travel Times

Table VI-2 lists uncongested travel times between the population centroid of each analysis zone and the southern study boundary via the shortest routing. Since, in general, evacuation behavior and roadway congestion determine evacuation times rather than the uncongested travel time, these results do not represent actual evacuation times. They do, however, provide an indication of the relative accessibility of the various anlaysis zones to the evacuation boundary, and give a measure of local road versus freeway travel for each zone.

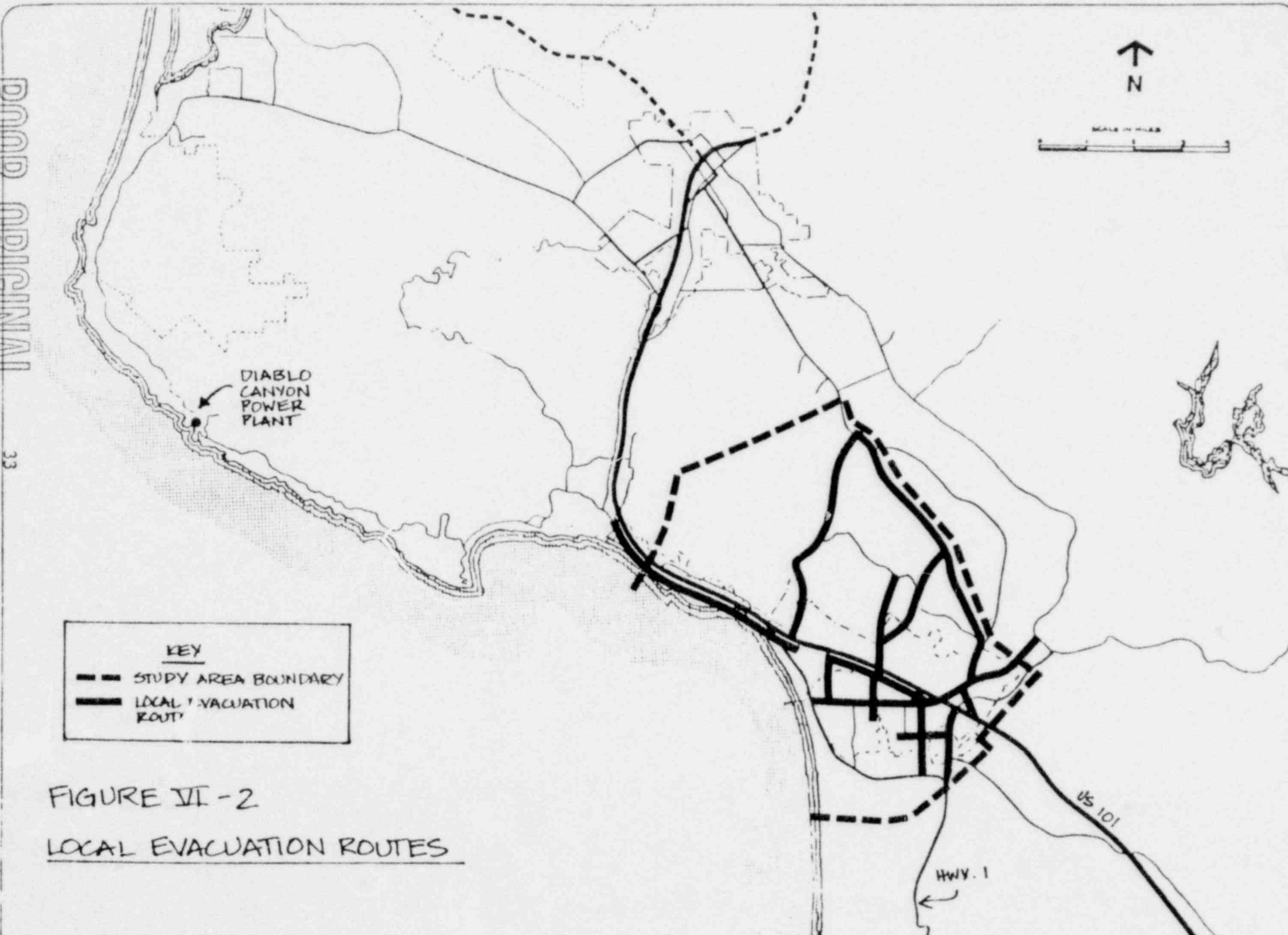

FIGURE VI - 2

LOCAL EVACUATION ROUTES

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Table VI-1

LOCAL EVACUATION ROUTES BY ZONE

Zone	Prime Routes	Alternate Routes
XVI	Price Canyon Road Shell Beach Road Price Street	Ormonde Road Mattie Road various local streets
XVII	State Route 227 Oak Park Boulevard Noyes Road Traffic Way Hausna Road	Printz Road Branch Mill Road Cherry Avenue Corbett Canyon Road various local streets
XVIII	Grand Avenue Oak Park Boulevard North Fourth Street So. Halcyon Road Valley Road Fair Oaks Avenue Frontage Road	Farroll Avenue Brisco Road So. Elm Street So. 13th Street Atlantic City Avenue No. 12th Street various local streets

Table VI-2

UNCONGESTED EVACUATION

TRAVEL TIMES

Zone	Local Street Access			Freeway Route			Total Evacuation Time (Min.)
	Distance (Miles)	Speed MPH	Time (Min.)	Distance (Miles)	Speed MPH	Time (Min.)	
XVI_1	4.8	30	9.6	4.4	45	5.9	15.5
XVI_2	0.7	20	2.1	6.3	45	8.4	10.5
XVI_3N	1.0	20	3.0	4.4	45	5.9	8.9
XVI_3S	0.5	20	1.5	4.4	45	5.9	7.4
$XVII_1$	2.2	30	4.4	2.5	45	3.3	7.7
$XVII_2$	1.2	25	2.9	0.5	45	0.7	3.6
$XVIII_1$	1.5	25	3.6	3.3	45	4.4	8.0
$XVIII_1$	1.6	25	3.8	2.5	45	3.3	7.1
$XVIII_2$	1.0	25	2.4	1.1	45	1.5	3.9
$XVIII_2$	2.3	25	5.5	NA[1/]	NA	NA	5.5
$XVIII_3$	2.1	25	5.0	NA[2/]	NA	NA	5.0

1/ Via Los Berros Road

2/ Via Route 1 southbound

Through Traffic

As was stated in the Phase I Report, the diversion of regional through traffic around the designated evacuation area would be an important consideration in an evacuation plan. Desirably, long-distance through traffic would be diverted ahead prior to reaching the Five Cities area. Road blocks would need to be set up on Route 1, 101 and 166 at or below the Santa Barbara County line, to prevent through traffic from entering the evacuation area. Adequate north-south highway facilities exist outside the study area to facilitate such through-traffic diversion as explained in the Phase I Report.

B. Potential Hazards and Alternate Routes

The Safety Element of the General Plan of San Luis Obispo County which elaborates upon the various natural hazards that are present within the county was used as a basis for evaluating which conditions could affect the integrity of the evacuation roadway system. The Safety Element addresses a number of hazard categories which are of concern, including wildland fire, flooding, dam inundation and earthquakes. The hazards which appear to be most likely to affect the evacuation routes in the Five Cities area include the following:

- Wildland fire is a frequent occurrence in the mesa west of Nipomo. This hazard could disrupt local evacuation routes Route 1, and could reduce the overall evacuation capacity to a considerable extent.
- Arroyo Grande creek is generally expected to remain within its streambed. However, should extreme flooding occur, local and major evacuation through-routes, exclusive of U.S. 101, could be affected.
- Beyond the study area, in the vicinity of Nipomo, Route 1 is posted with warning signs indicating that the road floods during heavy rainfall. The road is expected to remain passible.
- Inundation from landsliding into Lopez Reservoir could cause flooding within Arroyo Grande Valley. This flooding is expected to be slow to develop, however, due to the flatness of the valley floor.

- Severe earthquakes could substantially disrupt the infrastructure within the Five Cities area through building collapse, utility line failure, subsequent fire, and landsliding. From the point of view of evacuation, a major concern would be the integrity of the bridges and ground slopes along the U.S. 101.

A more general discussion of these problems was contained in the Phase I Report, including an analysis of bridge structure along the freeway evacuation routes. From this analysis it was concluded that it would be unrealistic and impossible to attempt assigning a specific traffic delay time to these various potential hazard conditions.

However, the study looked for the existence of available alternative routes for the major evacuation routes in the case that natural hazards should block certain road segments. Further, it is recommended that in the course of evacuation planning, these problems be addressed on an individual basis and contingencyplans be prepared accordingly. At such a time, the likely duration of road blockages and their effects on the overall evacuation time can be assessed. An exception to this would be rainfall during an evacuation. For that condition, a 20 percent increase in evacuation time was estimated in Phase I which would also apply to the Five Cities evacuation.

Finally, with regard to earthquake conditions, Figure VI-3 indicates major known utility lines within the Five Cities area. Means of verifying, or if necessary, re-establishing evacuation routes where these lines cross evacuation routes should be part of the emergency planning effort.

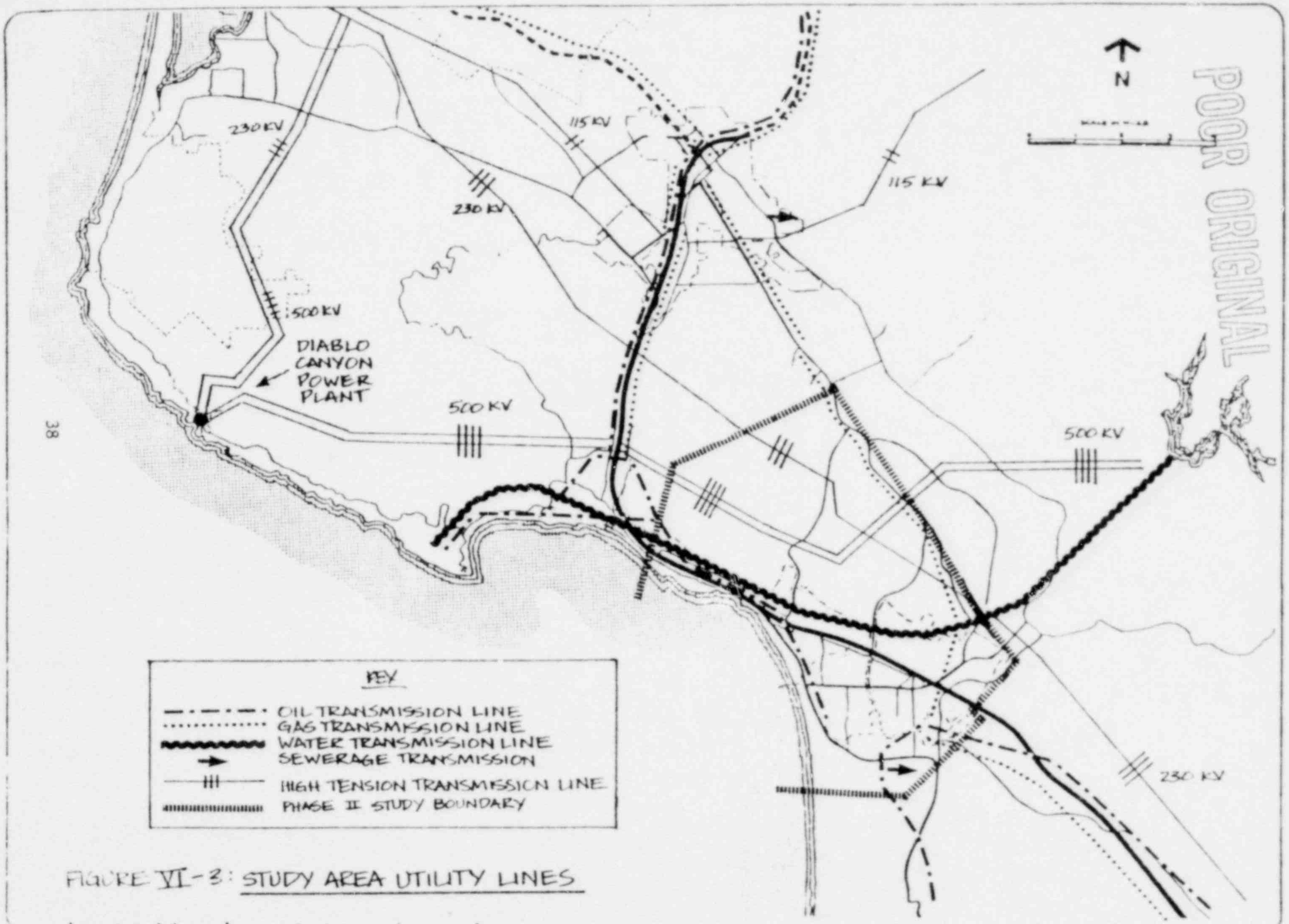

FIGURE VI-3: STUDY AREA UTILITY LINES

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VII. EVACUATION TIME ESTIMATES

This chapter contains the estimates of delays and evacuation times that might result from an emergency situation at the Diablo Canyon Nuclear Facility. In order to reflect several potentially different evacuation circumstances, three different evacuation scenarios were analyzed. Also included is a summary of the findings and conclusions that can be drawn from this study.

A. Evacuation Scenarios

Three different evacuation scenarios were tested to determine the likely times required to evacuate the population from the designated Five Cities area. In addition, potential delays due to traffic congestion were established. The conditions were selected to complement the evacuation scenarios assumed in the Phase I Study so that evacuation times for the combined study area can be determined. In addition, the evacuation scenarios allow, through careful inference, the preparation of time estimates for other possible evacuation schemes not explicitly analyzed in either report.

The alternative scenarios can be briefly described as follows:

- Scenario A2[1/] -- Simultaneous Evacuation of Five Cities area and San Luis Obispo area with partial access control of Route 1 North of San Luis Obispo (see also Phase I Study, Chapter VII-B).
- Scenario B1[1/] -- Route 101 South reserved for Five Cities evacuation traffic only; San Luis Obispo evacuated via Routes 1 and 101 North.
- Scenario C -- Similar to Scenario B1 with peak holiday traffic evacuated from Pismo State Beach.

1/ The scenario designations are identical to those used in Phase I.

Estimated traffic volumes for the three scenarios are shown in Figures VII-2 through VII-4 while delay times and final evacuation times ("last car out times) are indicated in Figures VII-5 through VII-7.

As in the previous report, results are indicated across certain "screenlines" which represent reference lines for comparison purposes. Figure VII-1 indicates the three screenline locations: Screenline 9 crossing U.S. 101 and State Route 1 immediately south of Pismo Beach, Screenline 10 crossing the same facilities immediately southeast of Grover City, and Screenline 11 crossing U.S. 101, Route 1 and Los Berros Road at the study area boundary.

The combined screenline vehicle capacities are indicated in Table VII-1. Whether the total evacuation traffic demand was distributed across the screenline in accordance with available capacity or whether different allocations were made depended upon the specific conditions expected to be encountered. In instances where it was thought to be difficult to achieve a good balance between demand and capacities the screenlines were broken and results shown separately for component facilities. This was typically done at Screenline 11.

Scenario A2 -- Evacuation with Partial Access Control of Route 1 North

In this scenario, evacuation delays on Route 1 north of San Luis Obispo would be minimized by preventing San Luis Obispo evacuation traffic from utilizing Route 1 initially. (See also Chapter VII of the Phase I Study Report.) If the Five Cities area is included in this analysis, additional delays would be incurred by evacuees from the San Luis Obispo area when they pass through the extended study area since they would need to share the roadway capacities with the Five Cities evacuation traffic.

Figure VII -2 indicates the roadway volumes resulting from the Scenario A2 evacuation. A total of about 18,000 vehicles evacuate from the north (San Luis Obispo) through the Five Cities area, while an additional 18,000 vehicles would be generated by the Five Cities area itself. The impact upon delay and evacuation time due to this overlap of traffic flows is

Table VII - 1

CAPACITIES OF CRITICAL SCREENLINES

Screenline	Road(s)	15-Minute Capacity
9	U.S. 101	900
	Route 1	375
	(north of screenline	300)
10	U.S. 101	900
	Route 1	375
11	U.S. 101	900
	Route 1	375
	Los Berros Road	300

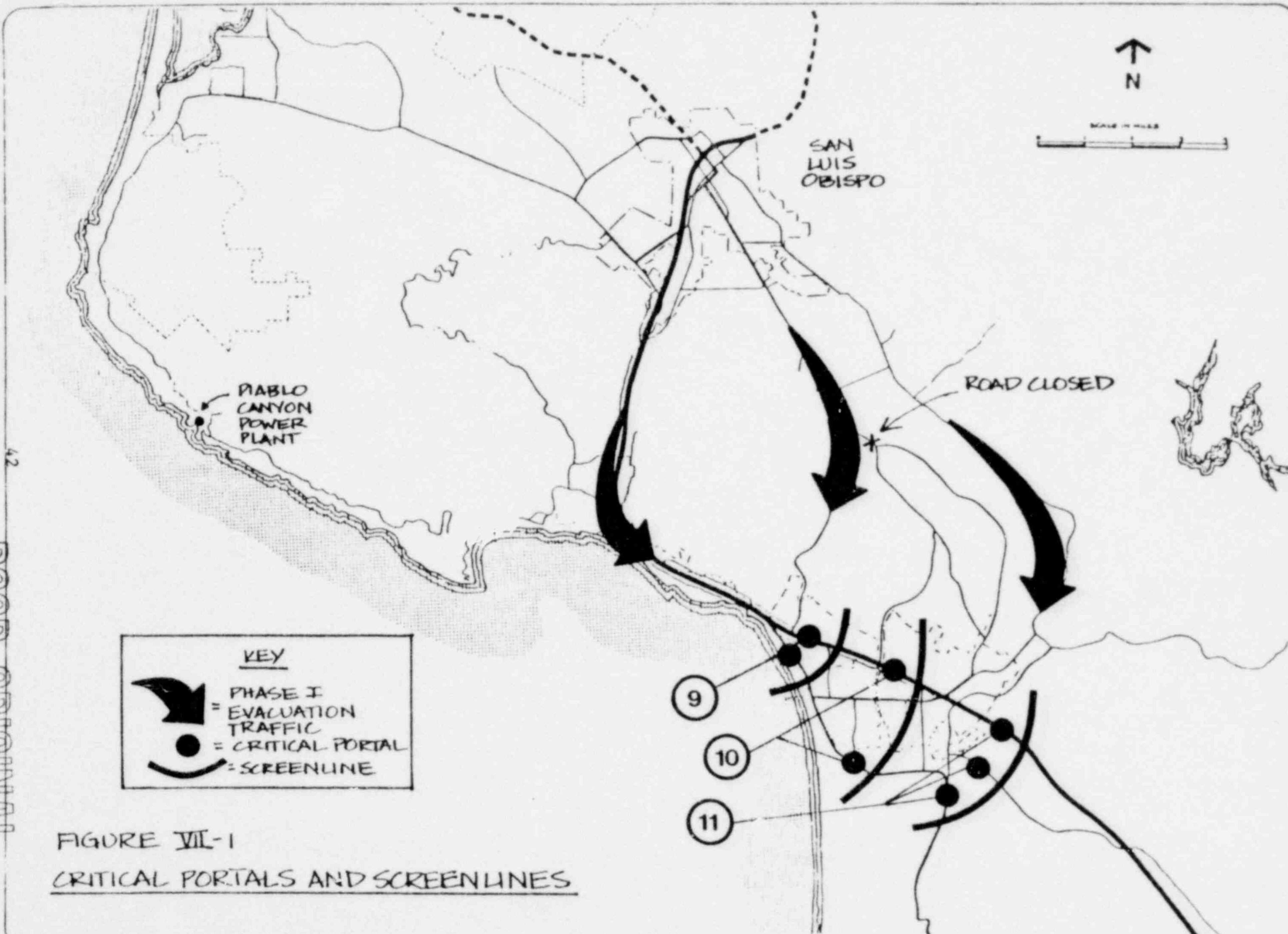

FIGURE VII-1
CRITICAL PORTALS AND SCREENLINES

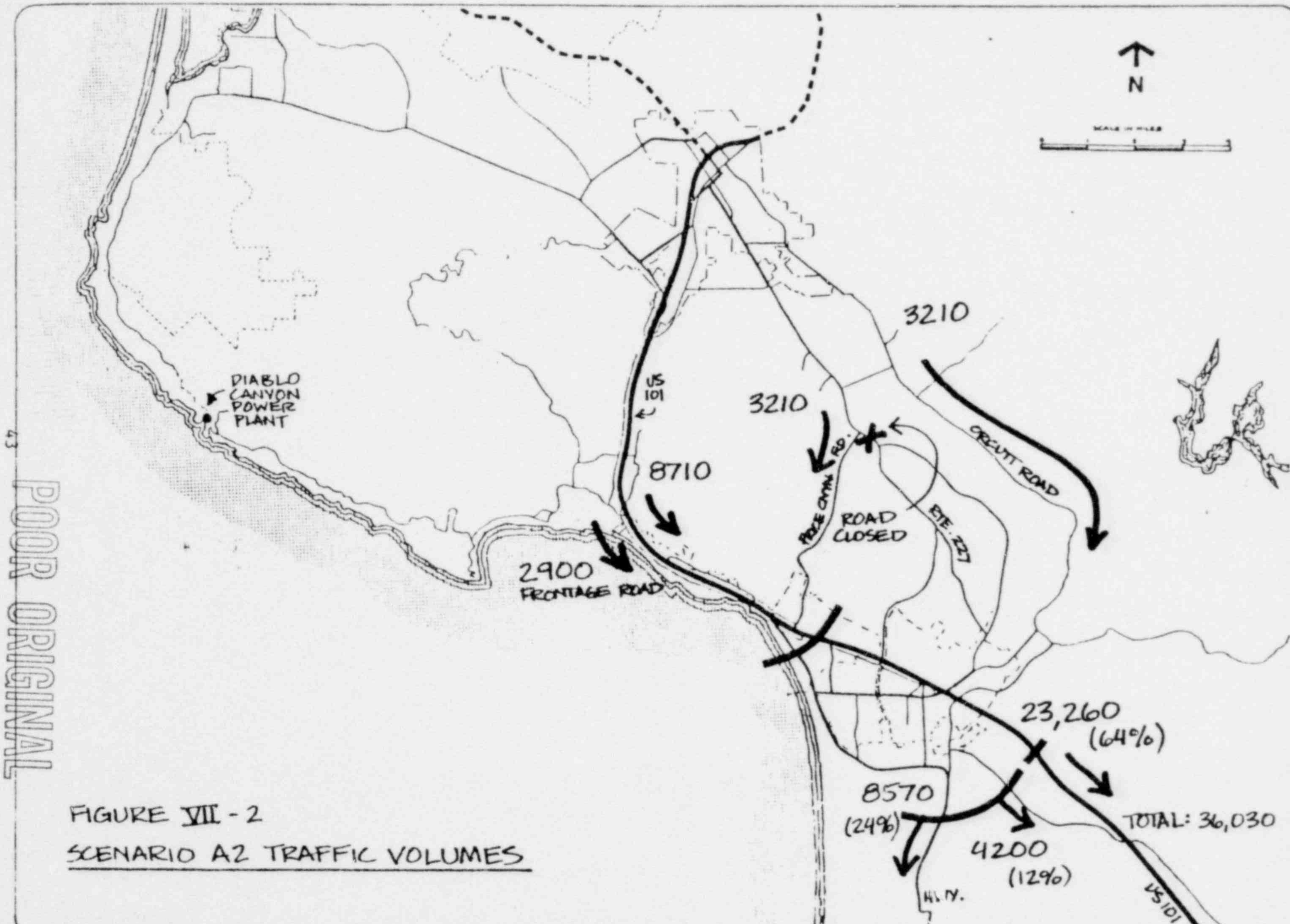

FIGURE VII - 2

SCENARIO A2 TRAFFIC VOLUMES

POOR ORIGINAL

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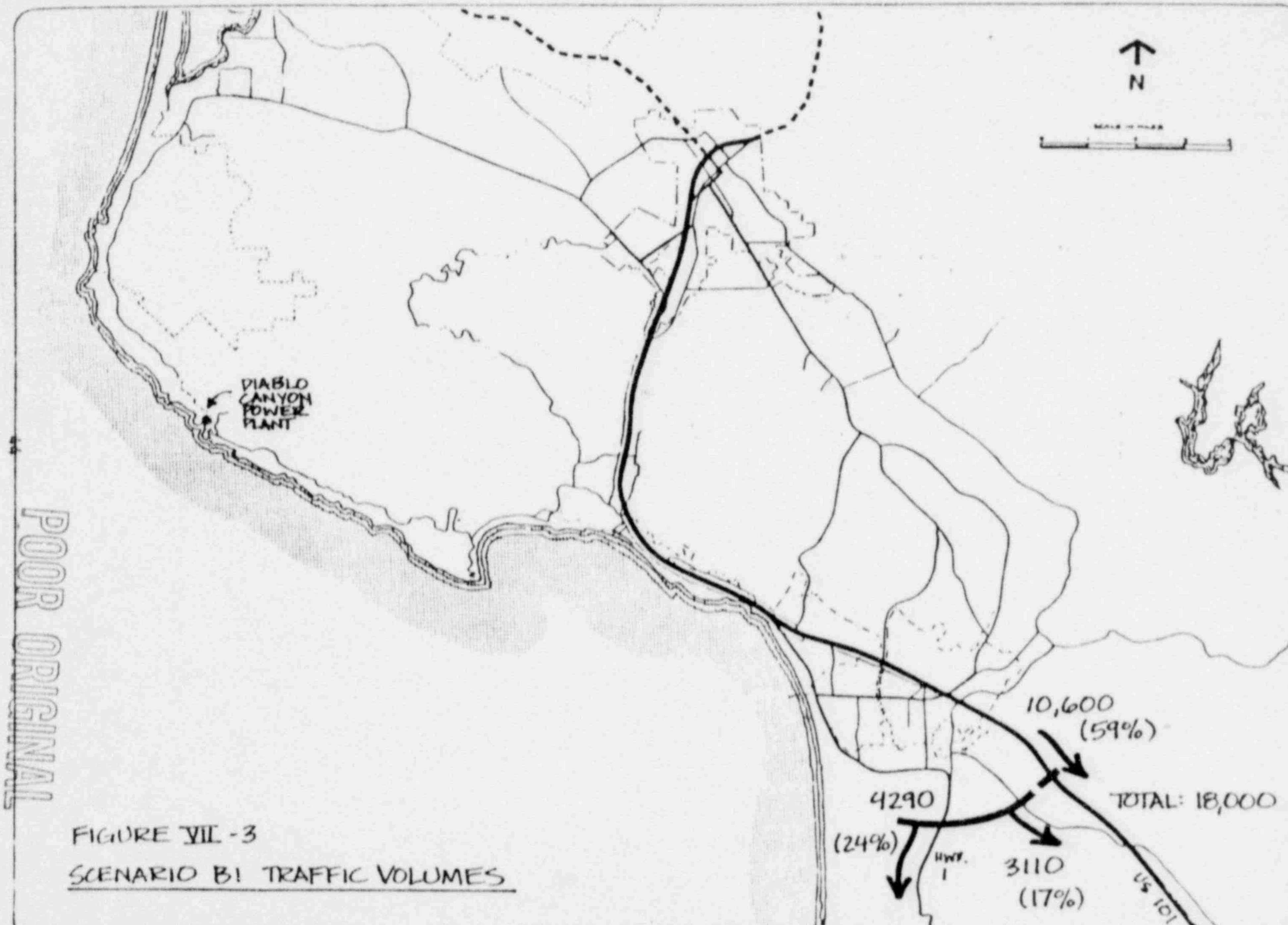

FIGURE VII - 3

SCENARIO B1 TRAFFIC VOLUMES

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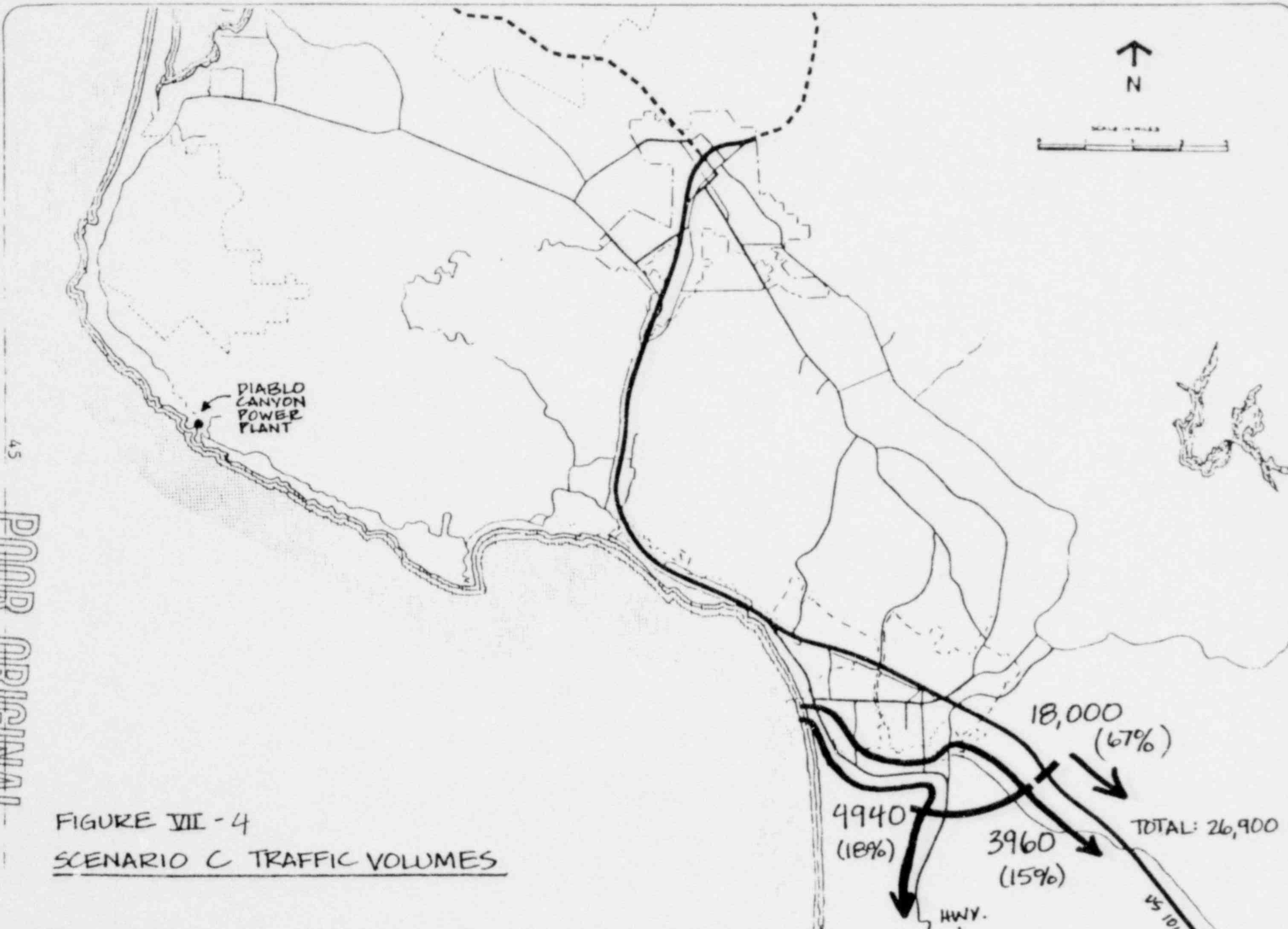
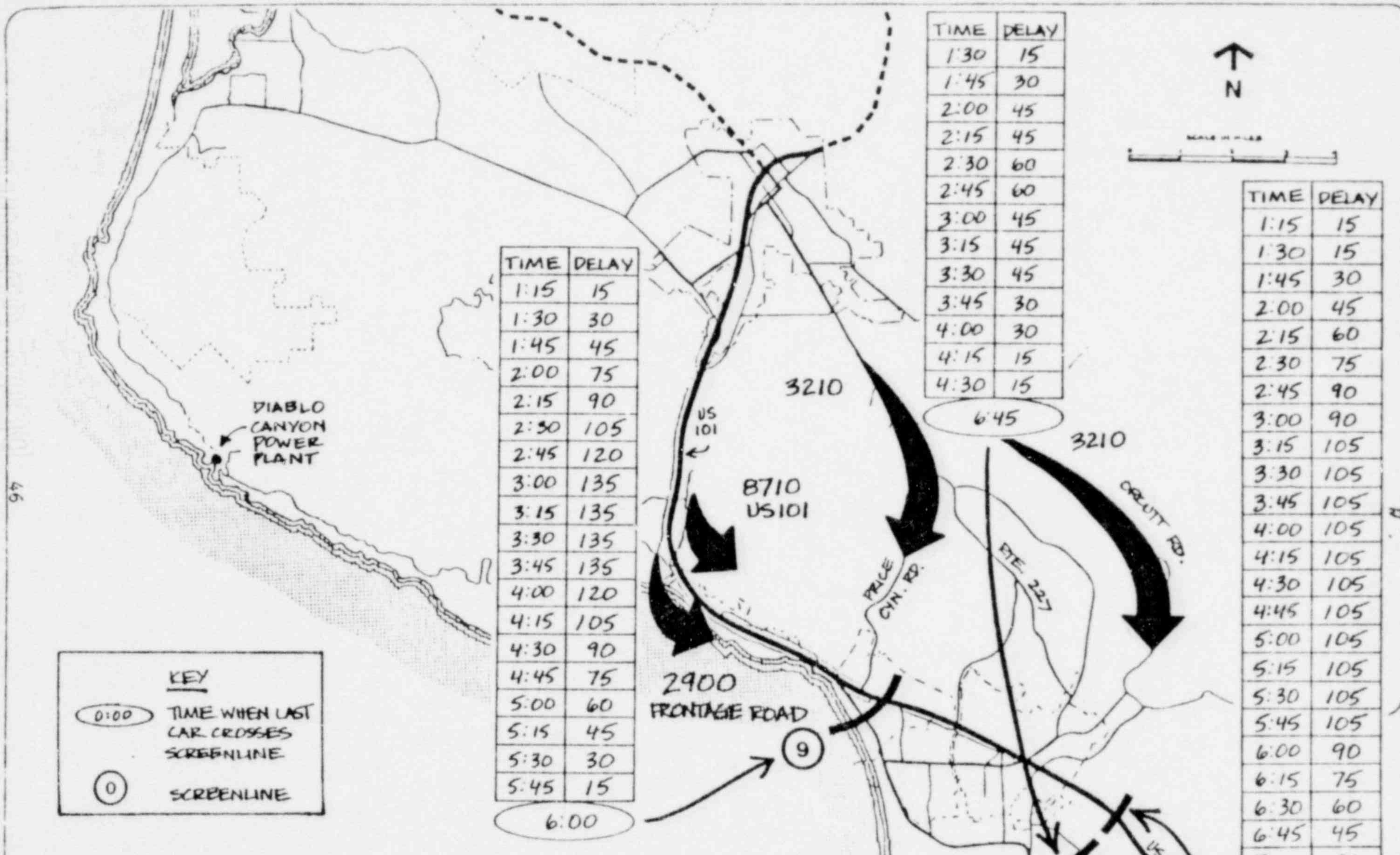


FIGURE VII - 4
SCENARIO C TRAFFIC VOLUMES



TIME	DELAY
1:15	15
1:30	30
1:45	45
2:00	75
2:15	90
2:30	105
2:45	120
3:00	135
3:15	135
3:30	135
3:45	135
4:00	120
4:15	105
4:30	90
4:45	75
5:00	60
5:15	45
5:30	30
5:45	15

6:00

TIME	DELAY
1:30	15
1:45	30
2:00	45
2:15	45
2:30	60
2:45	60
3:00	45
3:15	45
3:30	45
3:45	30
4:00	30
4:15	15
4:30	15

6:45

TIME	DELAY
1:15	15
1:30	15
1:45	30
2:00	45
2:15	60
2:30	75
2:45	90
3:00	90
3:15	105
3:30	105
3:45	105
4:00	105
4:15	105
4:30	105
4:45	105
5:00	105
5:15	105
5:30	105
5:45	105
6:00	90
6:15	75
6:30	60
6:45	45
7:00	30
7:15	15

7:30

FIGURE VII - 5

SCENARIO A 2 DELAY AND FINAL LEAVING TIMES

NOTE: DELAY TIME IN MINUTES

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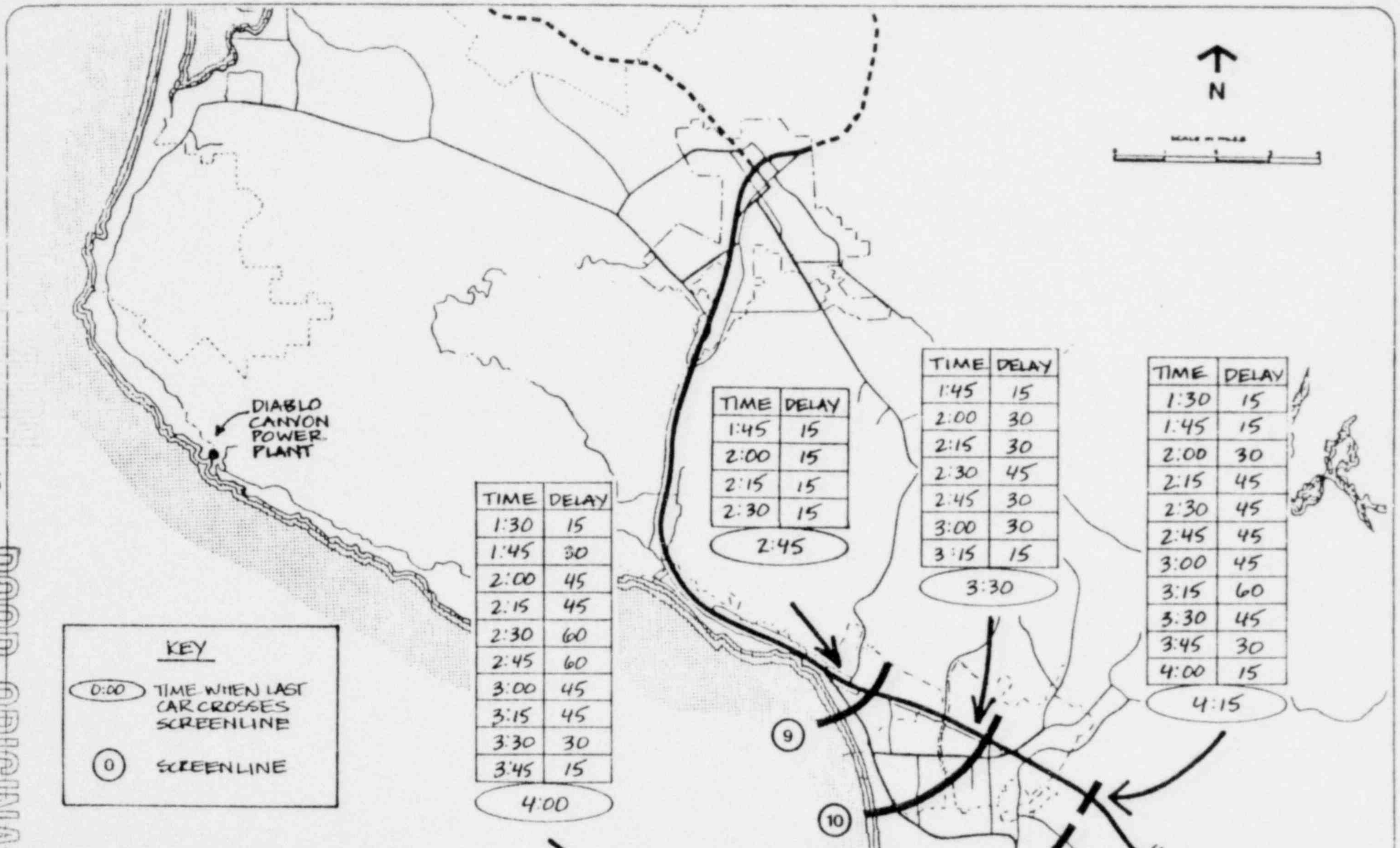


TIME	DELAY
1:30	15
1:45	30
2:00	45
2:15	45
2:30	60
2:45	60
3:00	45
3:15	45
3:30	30
3:45	15

4:00

TIME	DELAY
1:45	15
2:00	15
2:15	15
2:30	15

2:45

TIME	DELAY
1:45	15
2:00	30
2:15	30
2:30	45
2:45	30
3:00	30
3:15	15

3:30

TIME	DELAY
1:30	15
1:45	15
2:00	30
2:15	45
2:30	45
2:45	45
3:00	45
3:15	60
3:30	45
3:45	30
4:00	15

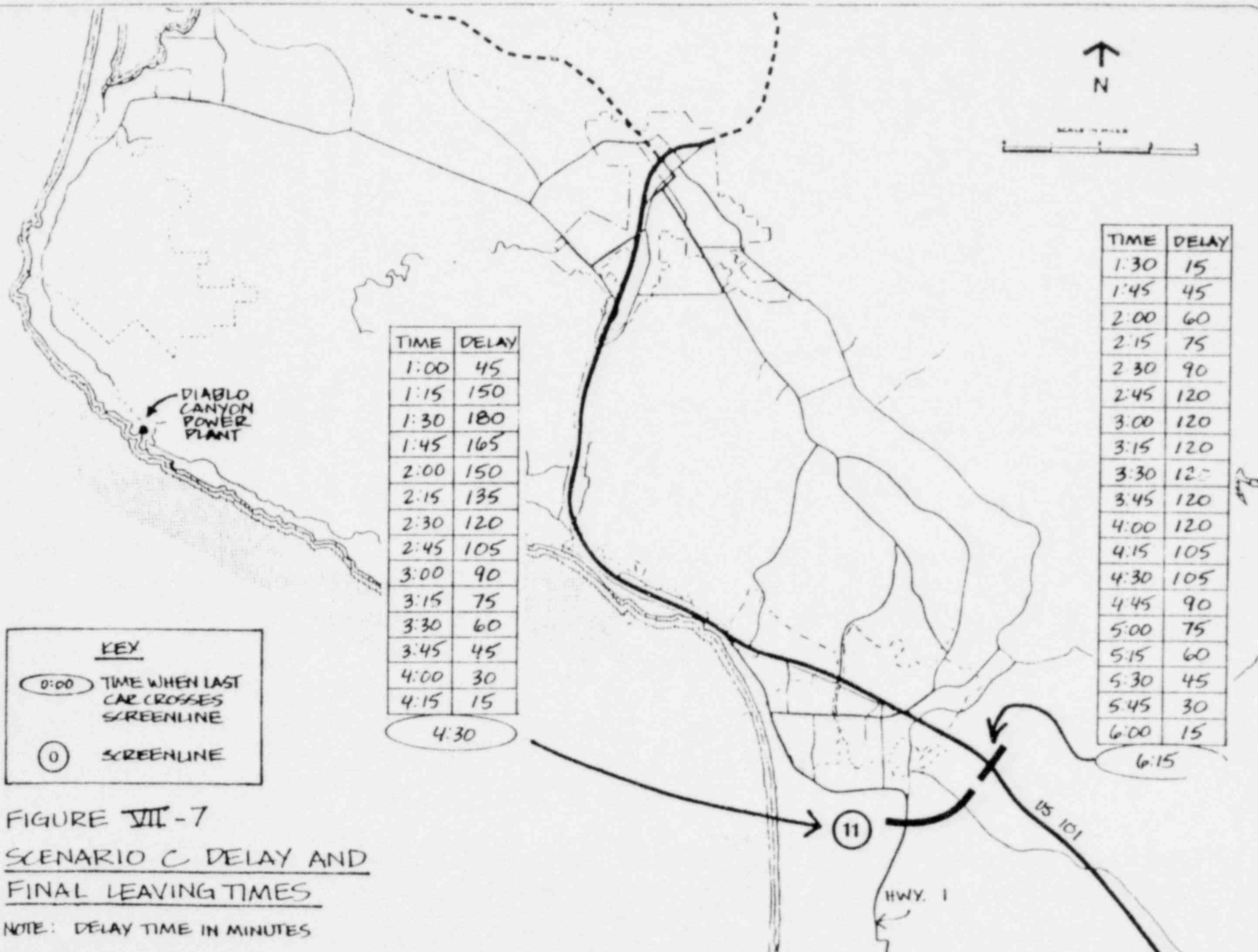
4:15

FIGURE VII-6

SCENARIO B1 DELAY AND FINAL LEAVING TIMES

NOTE: DELAY TIME IN MINUTES

Alan M. Voorhees & Associates, Inc.



TIME	DELAY
1:00	45
1:15	150
1:30	180
1:45	165
2:00	150
2:15	135
2:30	120
2:45	105
3:00	90
3:15	75
3:30	60
3:45	45
4:00	30
4:15	15

TIME	DELAY
1:30	15
1:45	45
2:00	60
2:15	75
2:30	90
2:45	120
3:00	120
3:15	120
3:30	12[illegible]
3:45	120
4:00	120
4:15	105
4:30	105
4:45	90
5:00	75
5:15	60
5:30	45
5:45	30
6:00	15

FIGURE VII-7

SCENARIO C DELAY AND FINAL LEAVING TIMES

NOTE: DELAY TIME IN MINUTES

indicated in Figure VII-5, which shows that the last vehicle would clear the evacuation boundary via U.S. 101 at about 7:30 hours after notification to evacuate. This represents about a 3 1/2 hour longer time than would be the case if the Five Cities area would not be evacuated.

The maximum delay encountered on Route U.S. 101 at the study boundary screenline is estimated at 105 minutes as also shown in Figure VII-5. As can be seen from the results at Screenline 9 there are substantial delays as far north as Pismo Beach in this scenario. In fact, the delay there exceeds that at the study boundary because the single entrance ramp in downtown Pismo Beach was found to be a major bottleneck. It should be noted that the last vehicle out of the evacuation area via U.S. 101 leaves at 7:30 as compared to 6:45 on Route 1. The reason for this imbalance is the fact that more traffic can be expected to take to Route 101 than to Route 1 since the former facility, built to freeway standards, is more attractive for longer-distance travel and is most likely perceived by the population as the better of the two facilities. At the same time, due to the much larger capacity of U.S. 101 compared to Route 1, very little time would be saved by diversion of freeway-bound traffic to the state route.

In reviewing the Scenario A2 for both phases combined, it is apparent that vehicles choosing to exit San Luis Obispo to the north would leave the evacuation area at 3:15 to 4:00 hours after notification while those traveling to the south may not clear the boundary until 7:30. Thus there is an overall imbalance in this scheme and it is not a preferred manner in which to evacuate the entire study area. Regardless, it was felt that without substantial evacuation control around the perimeter of the City of San Luis Obispo, such a condition could occur under a potential non-staged emergency evacuation.

Scenario B1 — Southern Routes Reserved for Five Cities Traffic

As explained in the previous study, this analysis case represents a condition where traffic from the north is directed to exit to the north, thus freeing up all southern access routes, Route 101, Highway 227, and Orcutt Road, for Five Cities traffic. It should be noted from the volumes shown in Figure VII-3 that almost 60% of the 18,000 evacuating vehicles would use U.S. 101, while the remaining 40% would share Route 1, and Los Berros Road. Figure VII-6 shows the corresponding delay times and time of the last car out for this scenario. Also shown is delay at all internal screenlines. The elimination of traffic from San Luis Obispo reduces the maximum evacuation time from 7:30 hours as calcualted in Scenario A2 to 4:15 hours, a savings of more than three hours.

At the same time, the evacuation times at the Route 1 North (Morro Bay) and Route 101 North (San Luis Obispo) increase to about 5:00 and 6:00 hours respectively.1/

Even with the reduced overall time for the Five Cities area, there is delay warranting local traffic control within the Five Cities area as evidenced by the up to 45 minutes delay calculated for the Grover City screenline (Screenline 10.)

In comparing the results for the southern evacuation zones to the results for the same scenario described in the previous study, it is apparent that an evacuation with controls applied as assumed here would be reasonably well-balanced across the entire study area. By inference, it is possible to assume that, with diversion of a small amount of traffic to the south, nearly equal evacuation times could result. Thus Scenario B1 would result in shorter overall evacuation times than Scenario A2.

1/ See Figure VII-8 of Phase I Study Report.

However, while the estimated maximum delay times at the southern evacuation boundary (Five Cities area)and northwestern evacuation boundary (Morro Bay) are on the order of 45 to 60 minutes, the traffic delays on Route 101 North could be expected to amount up to two hours. To reduce these delays, two optional actions should be considered:

a. To time-delay the notification to evacuate for San Luis Obispo by about 2-3 hours and then to permit use also of Route 101 South for San Luis Obispo area traffic, or

b. To not time delay the evacuation but to implement traffic control measures which would permit Route 101 to be used as a one-way outbound-only facility between San Luis Obispo and about Santa Margarita. This measure would reduce the delay to about 75 minutes or less from the up to 120 minutes delays if only two lanes were available.

Scenario C — Peak Beach Evacuation Simultaneously with Five Cities

As was noted in Chapter IV, the estimated Five Cities traffic includes a substantial amount of non-resident recreational traffic in addition to residential traffic generation. In Scenario C, an additional 8900 vehicles were assumed to be evacuated from Pismo State Beach in addition to the usual traffic, as might occur on a peak holiday weekend. Because of the vehicle mix of traffic evacuating from the beach, which would include substantial numbers of recreational vehicles and vehicles with trailers the best operational scheme would be to reserve Route 1 and Los Berros Road for beach traffic while the residents of the Five Cities would be directed to U.S. 101.

The effect upon the evacuation time is shown in Figure VII-7, which illustrates how the evacuation time for the U.S. 101 increases by about two hours to 6:15 hours as compared to 4:15 hours in Scenario B1. The long delays for beach traffic as shown in Figure VII-7 are largely the result of relatively poor access to the beach area, which is controlled by the two beach ramps.

Because the beach traffic would be assigned to the Highway 1 and Los Berros Road evacuation routes, a minor change in the traffic magnitude would not affect the evacuation time for the Five Cities traffic. If there were substantially fewer beach vehicles however, some Five Cities traffic could be shifted away from the freeway to improve the overall time. On the other hand, should there be more beach vehicles than estimated, they could be directed to U.S. 101 after the Five Cities traffic is gone. In order to fully use this capacity, though, the beach access problem would need to be solved.

As was the case for Scenario B1, no San Luis Obispo traffic was assumed to overlap with the Five Cities evacuation in Scenario C. It can be inferred from this analysis that an additional two hours would have to be added to the Scenario A2 times should a peak weekend beach evacuation be attempted while traffic from the San Luis Obispo area would be allowed to evacuate to the south.

B. Overall Evacuation Planning

In conducting the evacuation time assessment study for the Diablo Canyon site, the consultant was able to identify a number of factors which were important in determining the overall time for the evacuation. Some of those factors such as the population distribution of the study area could not be changed by adopting a different method of evacuation. However, if evacuation procedures different from those assumed in making the time estimate were to be used, there could be an impact upon the evacuation time.

The three different components of the total evacuation time identified in the study were:

1) The preparation time prior to the commencement of the actual evacuation trip.[1/]

2) The actual movement time required to leave the area at a moderate speed, but not including added delay time due to traffic congestion.

3) Evacuation-caused traffic delay time, over and above that normally required for stopping at traffic signals and other traffic control points.

In a typical evacuation scenario, half the population was estimated to have been evacuated by four hours. With reference to the above time components the four hour total would include 1.5 hours of preparation time, slightly less than 1.0 hour of movement time and about 1.5 hours of congestion delay. By contrast, the maximum evacuation time would involve 7.5 hours and would

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1/ In this report section, preparation time includes the total preparation period, beginning with notification, and including, if appropriate, leaving place of work, packing, and securing the residence.

include 3.25 hours of preparation time, 1.0 hour of movement time and 3.25 hours in total traffic delay at various points.

Based upon the above findings, it is apparent that the actual movement time is not a major portion of the total evacuation time. It should also be noted that an increase in evacuation traffic speed is not necessarily an appropriate goal since the highest volumes of vehicles are moved at more moderate speeds and more importantly, higher speeds would lead to a higher incidence of accidents.

Of the remaining two components to the total evacuation time, a reduction of the preparation time would be possible if the concept of operation were changed. Although notification time is included in the preparation time, noticeable improvement would not be gained through the use of a more sophisticated warning system -- the study findings show over one half the population would be notified within 0.5 hour of the sounding of the sirens. If evacuation time were of essence, probably the single most effective decision would be to instruct the public to directly evacuate regardless of their location at the time of notification. In other words, the public would immediately commence evacuating by means of the most readily available transportation. Although this approach is possible, there are a number of problems which would need to be resolved prior to selecting this evacuation approach. First, additional road capacity must be found, otherwise the effect of a direct evacuation policy would be to exchange preparation time for road congestion delay time. Although direct evacuation would enable some people to leave the area prior to the buildup of congestion, the study allocated the initial hour to the evacuation of those employees who work but do not reside in the evacuation zone, the clearing of the road system of through traffic, and the mobilization of official vehicles. Because the road system would need to be used to meet these demands, it is probable that little additional road capacity would exist during the initial hour of evacuation. Another problem this evacuation process would raise would be the willingness of the public to abandon the area without gathering their families, important personal belongings, and pets, and without securing their homes. Presumably this would be a less important issue than personal safety, but such a directive may lead to a great deal of panic and hence make the evacuation unmanageable. Finally, the problems that would arise in obtaining additional exiting lanes need to be addressed. Shoulder traffic and reverse-flow lanes on the major freeway facilities are an obvious method. In order for this to be done safely, there would be a significant added manpower requirement in the initial stages of the evacuation, beyond that required by a less complex plan.

The remaining major time element in the evacuation process, the congestion delay time, could be reduced by increasing roadway capacity, or by staging departures. A capacity increase would involve the same level of effort, as discussed above, but if done in the absence of a substantial direct evacuation, there would be more time in which the traffic control personnel could install barricades, signs, diverters and establish field positions. The other approach, staging, would not be expected to reduce the overall evacuation time. If properly conducted, this could reduce the problem of road congestion, and reduce the potential for panic by maintaining people in the relative safety of their homes prior the evacuation.

One of the questions regarding staging concerns compliance. To answer this, an analysis of the details of a staged evacuation may well indicate for this site the staging may not need to be followed absolutely in order to accomplish the primary goal of reducing congestion. In addition, since the prime egress routes are via freeway, the stationing of traffic control wardens at key ramp locations could allow for a high degree of control since the freeway tends to establish natural evacuation zones as it cuts through the urban areas within the Diablo Canyon evacuation study area. A recent major evacuation was successfully conducted using the staged technique in response to the threat of poisonous gas release.[1/]

1/ NUS Corporation, "Status Report, Mississauga Evacuation Study," Rockville, Maryland, March, 1980, passim.

In terms of staging sequence, the analysis of the evacuation times has provided a clear indication of the preferred manner in which to proceed provided the only concern is to minimize traffic congestion. The Baywood/Los Osos/Morro Bay area would evacuate to the north while the Avila Beach/Five Cities area would evacuate to the south. (These evacuations could take place simultaneously or in any sequence since the evacuation routes are independent.) During this time U.S. 101 heading north out of San Luis Obispo would be open as a "safety valve" to allow either voluntary or mandated evacuation from the central area. As soon as any of the coastal routes were to open up (approximately 3.5 to 4.5 hours after the notification, assuming maximum population and normal roadway operation) traffic from the high population zones in San Luis Obispo would be allowed onto the coastal routes provided there were no danger of contamination from the plume.

In providing for an evacuation the optimum emergency response plan would allow a dynamic response to the emergency situation. The plan could be based upon an evacuation of moderate expediency for the entire population within the emergency planning zone. Other plan elements could then provide for partial evacuations should the danger be restricted to certain definable sub-zones. In addition, there could be different levels of traffic control relating to the various levels of urgency. For example, the basic evacuation could be extended over time to allow for more organized departure with a minimum of control personnel required, or an extreme contigency could be drawn up in which additional exiting roadway capacity is gained at the risk of increased traffic accidents and with additional control manpower requirements and related costs. Finally, a response plan could allow certain groups to be notified for evacuation in advance of the general population, such as pregnant mothers and pre-school children (as was done at Three Mile Island), elderly people, and others with mobility limitations.

The consultant analyzed the evacuation times which would result with a minimum level of evacuation control. This was done in order to be conservative in estimating the evacuation times. In addition, the county emergency plan does not specify complex traffic control measures nor does it address the manpower problems in evacuating a zone as large as that contemplated as a result of the Three Mile Island experience. This does not mean certain expediting measures should not be instituted. As an example, additional lanes out of the Baywood/Los Osos area should be an evacuation planning goal. In addition, the capability for adding lanes on other major evacuation facilities should be investigated. As has been noted in the discussion of the evacuation scenarios for both phases, a staged evacuation is recommended to deal with the anticipated roadway congestion. Finally, as we explained earlier, direct evacuation was assumed in this analysis for certain population groups. One of the goals of developing an evacuation plan would be to determine the degree to which the direct evacuation method should be incorporated.

C. Findings and Conclusions

The following conclusions can be drawn from the evacuation time analysis for the Five Cities area:

- In the combined study area, which includes about 185 square miles surrounding the Diablo Canyon Nuclear Power Plant, the current residential population of about 95,000 could be evacuated in five to eight hours with minor control measures (Evacuation Scenario A2). Added traffic control measures could reduce this time to four or six hours (Scenario B1). An estimated 48,000 vehicles would be used in the evacuation, excluding buses and evacuation control traffic.

- If only the Five Cities area were evacuated via the southern evacuation routes, the estimated population of about 32,000 could be moved out in slightly over four hours. Some 18,000 private vehicles would be involved.

- A peak summer weekend influx of non-residents could add 8900 vehicles to the Five Cities evacuation if Pismo State Beach were heavily used. If these vehicles were evacuated simultaneously with the residential population, about two hours would be added to the evacuation of southbound traffic.

- As compared to the earlier Phase I study area, flooding hazards which could affect the evacuation routes are significantly less likely in the added study area. Although any earthquake-related destruction would be similar to that of the Phase I study area, there are in general more alternative routes available for the Five Cities area.

- If the reduction of overall evacuation time were considered to be important, the first requirement would be to gain additional capacity through the incorporation of reverse-flow lanes or other traffic operating procedures. In order to use these operating procedures, a large amount of manpower would have to be quickly mobilized prior to any evacuation to obtain the added capacity. The direct and immediate evacuation of large numbers of the population would also reduce the overall evacuation time, provided that sufficient capacity were first available.

- If, on the other hand, the goal of a detailed evacuation plan were to reduce congestion delay to evacuation and to control panic, then it would be desirable to either increase capacity as discussed above or to arrange for staging of the evacuation. In a staged evacuation, overall evacuation time would not be reduced significantly but people would remain in the relative security of their homes prior to evacuation. In addition, staging would be a relatively simple manner to reduce roadway delay resulting from lack of capacity.

- If the evacuation were to be staged, the best evacuation strategy would be to evacuate first the coastal areas which are the most likely to be affected due to the prevailing wind patterns. In this case, traffic from the Los Osos/Baywood/Morro Bay area would evacuate along the northern routes (mainly Route 1) while vehicles from the Avila Beach/Five Cities area would travel out to the south via Routes 101 and 1. During this initial evacuation time, U.S. 101 north of San Luis Obispo would be open to allow for some evacuation from that area. (In the event of urgency, the capacity could be nearly doubled by using both sides of the roadway.) At approximately four hours after the initial notification, the remaining evacuees from San Luis Obispo could be directed to the coastal evacuation routes, as they would become available, provided that there were no danger from a drifting plume.

- It is likely that the best emergency response plan will call for evacuations only as large in scope and as urgent in time as are required to respond to a particular emergency problem. In those emergency cases when the evacuation would need to be conducted in less than about eight hours, it would be essential to incorporate in the plan some expediting measures such as closure of roads, opening of additional lanes, staging of certain zones, and an immediate and direct evacuation of certain population groups to the extent that the local resources will allow.

APPENDIX A

EVACUATION TIMES FOR SUB-AREAS WITHIN THE EVACUATION BOUNDARY

A. GENERAL

Purpose

The evacuation scenarios analyzed in the Phase I and II reports were aimed at estimating the evacuation time of the entire zone within the evacuation boundary. The general extent of the the evacuation boundary for analysis purposes was established by PG&E at the initiation of the project, while the task of refining the boundary based upon practical planning considerations was left to the consultant. PG&E elected to analyze a plume exposure emergency planning zone (EPZ) in excess of the 10-mile limit suggested by NRC/FEMA because urbanized zones were situated in three different directions at, or immediately beyond, the 10-mile limit. Because of this, it was felt that any protective action such as evacuation which may be required as far as the 10-mile limit could not exactly be restricted to that distance.

On the other hand, NRC/FEMA has requested in Appendix 4 of NUREG 0654/FEMA Rep 1 that evacuation times for certain sub-zones of the plume exposure EPZ be determined. It is the purpose of this appendix to indicate evacuation times of various combinations of sub-area based upon the previous work.

Introduction

In the NRC/FEMA request for evacuation time estimates the following sub-areas were suggested for the plume exposure EPZ:

Distance	Area
2 miles	two 180° sectors
5 miles	four 90° sectors
about 10 miles	four 90° sectors

These criteria do not suit the site-specific conditions for Diablo Canyon for the following reasons:

- Of the area within a 20-mile radius of the plant site, a sector of more than 180-degrees contains the open ocean.
- The population within five to six miles of the plan is so low that an evacuation would be relatively east to accomplish.
- The existing low-population zone for Diablo Canyon is set at six miles, hence the intermediate distance could be more appropriately specified at that limit rather than five miles.
- The population groupings at and immediately beyond the 10-mile limit can be separated into distinct sectors, but they are not disposed in 90-degree quadrants as noted by NRC/FEMA.

For these reasons, all of the various combinations of evacuation zones can be reduced to a few logical alternative areas. In this appendix these alternative evacuation zones and corresponding evacuation times are presented.

B. QUALIFYING REMARKS

Sectoral Division

The disposition of the urban zones surrounding the site is such that population concentrations within a 20-mile radius of the plant occur in three separate directions within the landward 180-degrees surrounding the plant. The three sectors are divided by imaginary lines at compass bearings of 35-degrees and 102.5-degrees, as shown in Figure I-1 of the Phase II report. The three sectors include the following urban areas:

General Sector Direction	Urbanized Areas
North	- Los Osos/Baywood - Morro Bay
Eastnortheast	- San Luis Obispo
Southeast	- Avila Beach - Five Cities

Comparison of these sectoral lines with the study evacuation zones illustrated in Figure III-3 of the Phase I report and in Figure III-2 of the Phase II report shows that notification and evacuation of zones divided by these sectoral lines may be readily accomplished. Conversely, an attempt to further subdivide into smaller angular sectors would be difficult to accomplish and is probably unwarranted if the variability of the wind is taken into account.

This is not to say that subdivision of evacuation zones to allow for more orderly evacuation would not be possible; however, further division along sectoral lines is not very feasible from the point of view of notification to the public.

Uncongested Evacuation Time

In cases where a small number of vehicles would be generated, the evacuation time would not be affected by the roadway capacity. This condition was found in a number of sub-area evacuation alternatives discussed in Section C, below and the basis for estimating the evacuation time is as follows:

If the demand upon the road network does not exceed the capacity for a significant portion of the total evacuation time, then the total time will be the total movement preparation time and the uncongested evacuation travel time. The total movement preparation time is measured starting with the initiation of notification and ending when the last population member commences the evacuation trip. This is the same as the evacuation curve as developed and explained in Chapter V of the Phase I report. These times were determined for the Diablo site to be from one hour, 15-minutes to three hours. That is, the first evacuee would leave home at approximately one hour and fifteen minutes after the sounding of the siren system, while the last evacuees would commence the evacuation trip three hours after initial alerting. Since the uncongested travel times ranged from less than five to approximately 30 minutes, an uncongested evacuation would have a 1:20 hour to 3:30 hour time frame. (That is, evacuees would pass the 12- to 18-mile evacuation boundary beginning one hour, twenty minutes after initiation of notification and ending at three and one-half hours after the start of notification.)

C. EVACUATION ALTERNATIVES, 10-MILES OR LESS

Two-Mile, Omnidirectional Evacuation

As indicated by Table IV-1 of the Phase I report, there are about three residences within the two-mile radius of the plant. Clearly they could be evacuated within the time frame of the "uncongested evacuation" noted above. For this small-sized zone, the time frame to clear the two-mile radius would be from one to three hours depending upon the location of the affected people at the time of notification and the steps required to prepare to evacuate.

Six-Mile Evacuation

Since all previous planning for Diablo Canyon has been based upon a six-mile Low Population Zone (LPZ), the discussion will address the concept of a six-mile evacuation here rather than the five-mile radius suggested in NUREG 0654. A six-mile evacuation would involve residential and recreational population within the north and eastnortheast sectors previously discussed.1/ Even if both sectors were evacuated with the two-mile zone, there would be no congestion to delay the evacuation since the numbers are relatively small. (Approximately 24 dwelling units as noted in Table IV-1 of the Phase I report would be evacuated, primarily from the most remote parts of See Canyon, Prefumo Canyon and Clark Valley Roads as well as visitors and staff at Montana de Oro State Park.) Thus, a six-mile evacuation, even if conducted in all directions, could be accomplished within 3½ hours.

Ten-Mile Evacuation

As noted in the Phase I report, it is not possible to clearly define a 10-mile limit in terms of useful man-made and natural boundaries. The major population center affected is the City of San Luis Obispo, where the 10-mile limit crosses the town boundary west of the freeway. A similar condition of smaller scale exists for Morro Bay, where a small number of streets at

1/ In the sector south of the plant, there may be a very limited number of farm workers to be evacuated from a few parcels of land adjoining the plant access road.

the south end of the city are technically within the 10-mile limit. On the other hand, by reducing the boundary slightly, an approximate 10-mile evacuation could be accomplished by evacuating Avila Beach, Baywood/Los Osos, and the rural areas west of San Luis Obispo. Based upon the population involved, even if all sectors were evacuated simultaneously, the evacuation would be uncongested except at Baywood/Los Osos, where times could reach four hours if no provisions were made to obtain an additional travel lane north up to Morro Bay.

D. EVACUATION ALTERNATIVES BEYOND TEN MILES

General

Evacuation times for zones extending beyond 10 miles would be determined by which of the three sectors (as described in section B) were included. All times developed for evacuations extending to the 12- to 18- mile evacuation boundary presumed simultaneous evacuation of all areas inside of the limit, for the sector(s) included. In addition, due to the small number of people within a six-mile radius, the times developed would allow for evacuation of all sectors inside of six miles.

An important point to be made regarding these comparatively large-scale actions is that the evacuation of the northern sector is independent from the evacuation of the southeastern sector; i.e., the evacuation time for Baywood/Los Osos and Morro Bay is not changed if a simultaneous evacuation for Avila Beach and the Five Cities is being carried out.[1/] On the other hand, the evacuation of the eastnortheastern sector containing the City of San Luis Obispo would affect a concurrent evacuation of either or both of these other sectors.

Northern Sector (NRC Zones A, B)

This evacuation is illustrated by inference in the Phase I study as scenario A2, where the resulting evacuation time was determined to be approximately four hours. (See Figure VII-7 of the Phase I report.) The fact that in the A2 study scenario, San Luis Obispo was considered to be simultaneously evacuating does not change the resulting time significantly, since the analysis assumed a roadblock on Route 1 for nearly the entire evacuation time frame. However, if a contra-flow lane out of Baywood/Los Osos was temporarily added, the time could drop to about three hours and 30 minutes.

1/ This statement is based upon the number of vehicles generated as compared to the road capacity and is not meant to address the issue of evacuation control resources, which were not analyzed.

Eastnortheastern Sector (NRC Zones C, D, E)

This sector contains the major traffic generators of the City of San Luis Obispo and the California Polytechnic State University, (Cal Poly), and is the most populous of the three sectors. However, most of the population, including nearly all of the City of San Luis Obispo and Cal Poly are concentrated within the central NRC sector D (ENE), in which the annual wind propability is 0.9% (see Figure II-2, Phase I report). Thus, it is highly unlikely that a major evacuation would be extended in this direction beyond 10-miles with no prior evacuation of the more probable downwind sectors. Hence, the most applicable times for this sector are those that include evacuation of other sectors simulatneously, and the Phase I and Phase II reports were written accordingly. If, on the other hand, evacuation of the adjacent sectors had already been initiated, then the evacuation of the major sector to the east would depend upon the number of routes available. Scenario A2, as analyzed in the Phase I report, shows a time of 3:00 hours to 3:15 hours for evacuating this sector if all routes except Route 1 are available. Since this is close to the uncongested evacuation time, the full use of Route 1 would not reduce this minimum time significantly. Also in that report, Scenario B1 shows a 4:45 hours evacuation time at the San Luis Obispo city limit if 55 percent of the traffic were restricted to U.S. 101 north out of town and the remaining 45 percent used Route 1 to the north. (At Morro Bay, the traffic would clear at 5:15 hours if no evacuation from Baywood or Morro Bay were taking place simultaneously.) If only U.S. 101 to the north or south were available, times would extend to approximately eight hours, assuming no capacity - increasing measures were attempted such as adding reverse-direction lanes.

Southeastern Sector (NRC Zone F, G)

The evacuation of this sector is analogous to the Scenario B1 (Five Cities with full use of U.S. 101) as analyzed and presented in the Phase II report. In this case, the time was determined to be four hours. Although the evacuation of Avila Beach is not shown in the Phase II report under Scenario B1, it is clear that Avila Beach evacuees could be directed north along Route 101 with no change in overall evacuation time. If it were necessary to send Avila Beach traffic south with Five Cities traffic, the approximately 500 added vehicles would add a maximum of 15 minutes to the overall evacuation time.

North and Eastnortheastern Sectors (NRC Zones R, A, B, C, D, E)

The analysis for this case is identical to that presented in the Phase I report, and the evacuation times presented in that report for the various conditions that apply.

Eastnortheastern and Southeastern Sectors (NRC Zones C, D, E, F, G)

This combination of sectors would produce an evacuation that would be very similar to that analyzed as Scenario B1, with the exception that added capacity would be available on Route 1 to relieve congestion in San Luis Obispo due to the lack of traffic from Northern sector. Consequently, the evacuation times would be from approximately four hours in the south to five hours in the north.

North and Southeastern Sectors

Since these sectors are independent from each other as described above, the estimated evacuation times would be as described for each sector alone.

All Sectors

The analysis for this case is identical to that presented in the Phase II report for the combined study area, and the evacuation times presented in that report for the various conditions that apply.

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