BEVERLY HILLS FREEWAY TRAFFIC STUDY

Wilbur Smith and Associates

BEVERLY HILLS FREEWAY TRAFFIC STUDY

Wilbur Smith and Associates Prepared for CITY OF BEVERLY HILLS, CALIFORNIA - April, 1964

Wilbur Smith and Associates

CONSULTING ENGINEERS

580 MARKET STREET

SAN FRANCISCO, CALIF. 94104

YUKON 2-3221

April 14, 1964

Mr. Edward Tufte
Director of Public Works
City of Beverly Hills
Beverly Hills, California

Dear Sir:

We are pleased to transmit herewith our traffic study report, in conformity with our contract of August 3, 1962 with the City of Beverly Hills. This deals principally with the need for and desirable characteristics of the proposed Beverly Hills Freeway.

Very truly yours,

WILBUR SMITH AND ASSOCIATES

Henry K. Evans, Manager
Western Division

Registered Professional Engineer
State of California No. 7534

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

SUMMARY

This presentation deals with traffic aspects of the two alternate routings for the proposed Beverly Hills Freeway, particularly with respect to the impact on the City of Beverly Hills. The two alignments are (1) a northerly route generally parallel to and near Sunset Blvd., and (2) a southerly route generally along Santa Monica Boulevard.

Beverly Hills - One Million Population

The City of Beverly Hills, though numbering only 33,400 residents, is actually the core area of a much larger metropolitan area focused economically and physically, from a traffic standpoint on the central business district. Approximately 380,000 vehicles enter and leave the city each day, 100,000 going straight through, the remainder having origins or destinations in the city. Forty to fifty-thousand vehicles park each day in the central business district, equivalent to the parking demand in the downtown of a city of one million population. By comparison, downtown Los Angeles parks only between 60,000 and 70,000, or about 50 percent more than Beverly Hills. These comparisons serve to emphasize the importance of Beverly Hills as a traffic generator and the great importance that must be attached to the matter of providing adequate traffic service.

Traffic Volume vs. Capacity

The increased pressure of development in the Los Angeles Metropolitan Area, coupled with expanding commercial activities in Beverly Hills have driven traffic volumes steadily upward over the past years (Figure 4).

East-west streets are now loaded more heavily than north-south streets. All major east-west routes are operating at or above practical capacity (Figure 9). For all ~~streets~~ arterials between Sunset and Olympic, there is an aggregate overload of 30 percent. Sunset and Santa Monica Blvds. are both at 50 percent above capacity, Burton Way and Wilshire Blvd. are carrying loads about 20 percent above practical capacity, and Olympic is about 30 percent above capacity. This overloading indicates the need for capacity relief, as will be provided by the Beverly Hills Freeway.

Sunset Boulevard average daily traffic (ADT) has increased from 22,300 in 1947 to 30,000 today in Beverly Hills (Figure 8). Santa Monica Blvd. was carrying 32,500 back in 1947 -- today the ADT is 46,500. Wilshire Blvd. has shown no appreciable change. But Olympic Blvd. daily traffic has increased from 30,000 to 40,000 ADT over the 1947-63 period. Considering all arterial routes in the Beverly Hills corridor, between and including Sunset to Olympic, the traffic load has increased from 138,000 to about 179,000 daily (screenline east of Rexford).

Traffic in this corridor is expected to grow somewhat faster in the future, increasing by 73 percent in the year 1990.

Need For Freeway

Thus in view of the current 30 percent overload it is evident that there is no capacity available to serve future growing demand for east-west movements. Future traffic increases can only cause severe congestion and safety problems without the substantial relief provided by the proposed Beverly Hills Freeway. It will be important to keep all existing E-W arterials open and in operation, as all existing capacity will be needed as well as the additional freeway capacity. Substantially all north-south streets must remain open, also, since their capacities will be fully utilized by the year 1990.

Rapid Transit

The question might be asked - won't the planned rapid transit system absorb enough of the 73 percent increase by 1990 to make a freeway unnecessary? This can be answered simply in the negative, in view of the fact that this proposed system will subtract only 12,000 vehicles per day from the traffic stream in Beverly Hills, out of an anticipated east-west movement of 325,000 motor vehicles. This will provide important relief in the peak periods, but leaves enough demand for motor vehicle traffic to load the proposed freeway plus existing streets to capacity levels.

Although public transit now accounts for perhaps 7 percent of total 24-hour average weekday vehicular passenger movement in Los Angeles, it serves a much more important role in peak hours, particularly in the Beverly Hills traffic corridor.

As an example, buses on Wilshire Blvd. alone now transport about 1,600 passengers in both directions between 5:00 and 6:00 P.M. (at Beverly) representing 30 percent of the total auto and bus occupants on this important thoroughfare. If there were no buses -- i.e. passengers were all to be in autos -- approximately 1,000 vehicles would be added to the vehicular traffic stream, requiring another two lanes on Wilshire or on a parallel arterial. The important role of the current bus service is very plain indeed.

The proposed "Backbone Route" of the planned metropolitan area rapid transit system through Beverly Hills will provide a very substantial assistance to corridor traffic problems. According to the Metropolitan Transit Authority, 11,000 to 12,000 transit passengers will be riding the new system who would otherwise be in automobiles on the average day in the period 1970-80. The peak 20-minute rate of 1,000-1,100 passengers in the direction of heaviest movement diverted from auto riding is equivalent to the service provided by two arterial street lanes in that direction. Thus, during peak traffic hours, the proposed rapid transit line along the Wilshire Blvd. corridor may be carrying a total load equivalent to that carried on a 4-lane highway (taking both directions into account). Expressed another way, during the peak hour of the typical day, the rapid transit system may be carrying about 15 percent of the total load in the corridor.

The need for the Beverly Hills Freeway will not in any way be reduced by the rapid transit route, since even with it in operation, all existing streets plus the freeway will be needed to carry the estimated traffic volumes.

Existing and Future Traffic Patterns

To aid in analyzing freeway needs in the Beverly Hills corridor, an intensive study was made to analyze traffic origins and destinations in an area bounded generally by the Beverly Hills north city limits, La Cienega Blvd. on the east, Pico Blvd. on the south, and Beverly Glen Blvd. on the west. It was determined that 490,000 motor vehicle trips begin or end in this area on a typical day at present, 121,000 or one-quarter of these stemming from the commercial "triangle area" alone. By 1990, the overall local trip total is expected to grow by 47 percent; through trips by 97 percent. But greatly increased commercial activity is expected to increase triangle trips by 40 percent, [redacted]. Overall traffic growth of 65 percent is predicted.

It is important to note that the majority of trips in and out of Beverly Hills are locally oriented. Through traffic, that could conceivably be bypassed, is 36 percent today and will be increased to an estimated 43 percent by the year 1990 (Figure 22). Much of this, now on Olympic and Pico, will be diverted to the new Santa Monica Freeway. Purely through traffic will probably remain between 30 and 40 percent, in this corridor between Pico and Sunset.

The high percentage of local trips -- 60 to 70 percent -- points up the need for routing the Beverly Hills Freeway so as to best serve trip origins and destinations in the Beverly Hills area.

Two locations are now under consideration for the proposed Beverly Hills Freeway. One lies generally along Sunset Blvd. and the other is along Santa Monica Blvd. The route should be selected which will best serve traffic in the Beverly Hills area, in view of the fact that a high percentage of the freeway users will have origins or destinations in the local area. If the majority of traffic was simply trying to get through Beverly Hills without a stop, then the location of the route would be immaterial. The shortest and cheapest one would be the best, from the traffic service standpoint. However this is not the case here.

O-D Patterns Favor Santa Monica Routing

As indicated by Figure 24, the concentrations of present and future trip ends are south of Santa Monica Blvd., thus much better served by the more southerly of the two alternate locations. Each dot in this figure represents the location of 1,000 motor vehicle trip origins or destinations. The closer the freeway and its access points can be located to these points, the greater service it can be to these trips.

The following table summarizes anticipated daily traffic volumes on all east-west routes in the City of Beverly Hills in the center of the city crossing Rexford and Beverly Drives, in the year 1990. These data are based on detailed estimates of traffic generation, origin and

AVERAGE DAILY EAST-WEST TWO-WAY TRAFFIC IN BEVERLY HILLS
AT SCREEN LINE EAST OF REXFORD DRIVE

Route	TRAFFIC TREND			TRAFFIC CAPACITY		ESTIMATED 1990 AVG. DAILY TRAFFIC	
	1947 ADT[a]	1953 ADT[b]	1963 ADT[b]	Pract.[c]	Poss.[d]	Sunset Rte.	S.M.Rte.
Sunset Blvd.	22,300	24,000	30,000	19,500	40,000	20,000	30,000
Santa Monica Blvd.(N)	32,500	35,000	46,500	30,500	55,000	55,000	43,000
Burton Way	18,000	17,000	27,100	23,000	42,000	42,000	25,000
Wilshire Blvd.	35,000	35,000	35,000	30,500	55,000	55,000	40,000
Olympic Blvd.	30,000	34,000	40,000	30,500	55,000	45,000	45,000
Local Streets	10,000	10,000	11,000	21,000	30,000	15,000	15,000
Beverly Hills Fwy.				100,000	200,000	84,000	127,000
Diverted to Santa Monica Freeway	-	-	-	-	-	29,000	20,000
Total East-West	147,800	155,000	189,600	255,000	477,000	345,000	345,000
Growth Index	1.00	1.05	1.28	-	-	2.33	2.33

[a] Summer counts reported in A Report Upon Streets, Parking, Zoning, City of Beverly Hills, by Harland Bartholomew and Associates, St. Louis, Mo., 1948.

[b] Counts supplied by City of Beverly Hills.

[c] The practical capacity is defined as the greatest number of vehicles that can pass a given point on a roadway or in a designated lane without the traffic density being so great as to cause unreasonable delay or restriction to drivers' freedom to maneuver under prevailing roadway and traffic conditions.

[d] The possible capacity is the maximum number of vehicles that actually can be accommodated under the prevailing conditions and there will be a continual backlog of waiting vehicles.

destination, and assignments to all arterial routes, taking into account comparative travel times and distances by alternate possible routes, regardless of where trips may begin or end.

With the Beverly Hills Freeway situated in the preferred location along Santa Monica Boulevard, a daily volume of 127,000 vehicles is estimated for the year 1990, as compared to only 84,000 if located in the more northerly location. Thus it is apparent that the southerly location will serve about 50 percent more people than the other. The preferred location will divert about 34,000 more vehicles per day from parallel surface streets than the northerly route, providing a much needed relief to Wilshire, Burton Way and Santa Monica Blvd., principally, which would be operating at intolerable levels of traffic congestion otherwise.

Thus the Santa Monica Blvd. routing of the freeway not only benefits its users; it benefits all users of other parallel streets as well as property owners along those streets by relieving traffic congestion along those routes to a greater extent than would be true of the Sunset Blvd. location. Existing east-west streets will be called upon to carry an estimated 232,000 vehicles daily in 1990 if the freeway is located along the Sunset alignment -- but 198,000 if it is along the Santa Monica Blvd. alignment, representing a reduction of 34,000 vehicles per day on existing streets -- equivalent to another Wilshire Blvd. in carrying capacity. This would constitute, in effect, a "bonus" of an extra Wilshire Blvd. for Beverly Hills, provided by the preferred alignment but not by the more northerly route. Santa Monica Blvd. will carry 43,000 with the southerly route compared to a present day level of 46,500. It would be 55,000 with the Sunset alignment. It will reduce Burton Way from a current 27,100 to 25,000, in contrast to 41,000 with the Sunset alignment. Wilshire will carry an estimated 40,000 ADT, slightly more than at present, but well below the maximum possible. The Sunset route would have 55,000 on Wilshire -- an intolerable load. Olympic will carry more than at present with either freeway location. Both routes are far enough to the north, and the Santa Monica Freeway is close enough on the south to minimize the effect on Olympic.

Because the southerly route is better situated with respect to origins and destinations of through traffic (as well as local traffic), it will carry 87,000 east-west through trips per day, compared with only 65,000 for the Sunset route.

It is noted that even if all of these 87,000 trips were assigned to the Santa Monica Freeway, the Beverly Hills corridor would still require the capacity to be provided by the proposed Beverly Hills freeway.

Depressed Route

The freeway should be depressed, to allow cross-streets to remain open and to permit continued service of Santa Monica Boulevard as a major east-west arterial. The need to maintain north-south streets open for the future is supported by the traffic projections. ~~Currently, 33,100 vehicles cross Santa Monica Blvd~~. d~~aily, on 24 street traffic lanes. Although these lanes offer a capacity of~~ 5~~8,000 ADT, by 1990 the north-south movement will have grown by 50 percent~~nt t~~o 50,000 ADT, requiring retention of substantially all 24 lanes~~.

~~By depressing and covering the freeway, maximum conservation~~ of

Currently 33,100 vehicles cross Santa Monica Blvd. daily, on 24 street traffic lanes. Although these lanes offer a capacity of 58,000 ADT, by 1990 the north-south movement will have grown by 50 percent to 50,000 ADT, requiring retention of substantially all 24 lanes.

By depressing and covering the freeway, maximum conservation of land use will be achieved. Considering the value of land in Beverly Hills and the fact that 24 percent of the total city land area is now given over to streets and highways, the placing of the freeway underground where it will take up a minimum of land space will be a very desirable objective.

Covered Route

The proposal to completely cover the freeway is, in our opinion, feasible and practical from the traffic operations standpoint. Underground highway facilities of similar size are now operating successfully in various parts of the country. The Lincoln and Holland Tunnels under the Hudson River in New York are both about 1.5 miles in length and carry 81,000 and 58,500 daily vehicles, respectively. The 1.5-mile Baltimore Tunnel-Expressway, the Queens-Midtown Tunnel in New York, and the 1,300 foot Cahill Expressway in Sidney, Australia, are other examples of below-ground freeways.

Traffic operation in these underground facilities has proven to be as safe as that on conventional freeways, and considerably safer than on ordinary city streets. Perhaps the greater degree of surveillance of such highways and tunnels is part of the answer -- perhaps it is a greater attentiveness of drivers due to the unusual conditions. Whatever it is, there seems to be no extra hazard, but rather a safety advantage for underground highways, which favors the cut and cover design for the Beverly Hills freeway.

Parking Over Freeway

The space over the Beverly Hills Freeway can be used advantageously for vehicular parking, either as parking at street level between the two Santa Monica Roadways (Figure ~~31~~ 29), or in garage structures in the same location.

With the freeway in the Sunset location, this advantage would not accrue to Beverly Hills since there is no such demand for parking in the northerly location as there is along Santa Monica Boulevard. Thus this factor argues in favor of both the covering of the freeway as well as its location along the Santa Monica alignment.

A careful check of existing and projected future parking supply and demand in the Beverly Hills central business district immediately adjacent to the proposed freeway route (Santa Monica Blvd. from Rexford Dr. westerly to the city limits) reveals a need for 3,565 more parking spaces by 1990. This might be termed the maximum need, and takes into account an estimated growth of 40 percent in the commercial area business activity. Some of the new commercial building activity will probably be accompanied by provision of integral parking facilities, or by opening of new separate off-street parking garages. If we assume that all new development and increased parking demand of existing buildings in the commercial area would be satisfied by extensive new parking garages in that area(this might be regarded as an extreme assumption in the light of past history)the very minimum needs imaginable would be in excess of 600 spaces. This is the net loss of existing parking due to freeway construction along Santa Monica Blvd. plus anticipated loss of curb parking because of need for street traffic capacity improvement in the business area adjacent to Santa Monica Blvd.

It is pertinent to note that street-level parking over a "cut and cover" freeway along Santa Monica Boulevard would provide approximately 700 new spaces, thus taking care of the very minimal needs cited. The development of these as parking lots in the first instance, with later conversion to structures, if and as needs actually develop, is a logical course of action.

Parking over the freeway adjacent to the industrial area would be advantageous also, in view of a 465-space deficiency predicted for 1990. Area over the freeway would provide for 150 spaces on street level, or larger capacities in garage structures.

A logical and efficient coordination of a major access route and terminal facilities will thus be effected, by locating the parking immediately adjacent to the Santa Monica Blvd., where parkers can alight and walk to their destinations within the commercial and industrial districts.

Summary

Summarizing the foregoing: Beverly Hills east-west ~~streets~~ arterials are now overloaded by 30 percent, with prospects of a 73 percent further increase in loading. To handle the future total corridor volume of 345,000 vehicles per day, all existing streets must be kept open and functioning, without interruption or curtailment by the freeway. Rapid transit will help by carrying about 15 percent of the peak hour load, but will not diminish the need for the freeway in any respect. In view of Beverly Hills' important role as a traffic generator -- the central business district is equivalent to that of a city of one million -- the route of the freeway must be located so as to serve Beverly Hills trips best, which would be accomplished by the alignment along Santa Monica Boulevard. This route will directly serve 50 percent more total traffic than the more northerly one. An important additional benefit will accrue since this route will reduce traffic problems on existing streets to a much greater extent than is the case with the more northerly alternate. Thirty-four thousand additional vehicles per day will be removed from city streets, equivalent to gaining a bonus capacity of another Wilshire Blvd. A cut-and-cover depressed freeway along Santa Monica Boulevard will be a safe highway, will serve traffic better, will permit all important existing streets to stay open, and will make it possible to provide parking over the freeway immediately adjacent to the commercial and industrial districts where it is needed.

Chapter I

INTRODUCTION

This report deals with street and highway traffic in the City of Beverly Hills, California, a community of 33,400 residents completely surrounded by the immense urban development of the Los Angeles metropolitan area. Although the residential population has shown only a modest growth in recent years, motor vehicle trips to and through this active community have increased substantially due to a growing commercial center and effects of growth in the Los Angeles metropolitan area, generally. Besides coping with internal growth problems and policies concerning future land use types and densities, the City has had thrust upon it the matter of reaching an agreement with the State Division of Highways concerning selection of a route for the proposed Beverly Hills Freeway. This facility will function as part of the Los Angeles metropolitan area network of freeways now being constructed, and is proposed to serve east-west movements in the Beverly Hills traffic corridor. Also the development of a new metropolitan area rail rapid transit system is currently under study by various agencies, which would include a main line through Beverly Hills, serving both local and through passengers.

Recognizing the need for development of sound and comprehensive planning to guide the City agencies with respect to these and other important matters, a team of consultants was employed by the City late in 1963 to prepare a comprehensive Master Plan of development; Eisner-Stewart and Associates, Wilbur Smith and Associates, and Real Estate Research Corporation, working in the fields of city planning, traffic engineering, and economic forecasting, respectively.

Scope of Study

In view of the impending public hearings by the State Division of Highways, relative to adoption of a Beverly Hills Freeway route location, Wilbur Smith and Associates were asked by the City to study and report on the need for the freeway, the most desirable location (considering the several alternate routes under study by the State engineers), the need for keeping north-south streets open and not closed at the freeway, the propriety of having the freeway covered for the majority of its length within the City of Beverly Hills, and the effects of having no freeway ramps within the City.

Available Basic Data

Considerable data were made available as to current land usage and square footage of buildings, by types, as inventoried by the City of Beverly Hills.

Traffic volume counts were furnished by the City of Beverly Hills and the City of Los Angeles. Parking accumulation checks made by the City in 1963 were made available.

A special study of through-traffic was conducted for purposes of this study by the City of Beverly Hills.

Previous study reports utilized in the current study include the following:

A Report Upon Streets, Parking, Zoning - City of Beverly Hills, Calif., Harland Bartholomew and Associates, St. Louis, Mo., Jan., 1948.

A Parking Study for Beverly Hills, California - Volume I Development Of Parking Needs, Wilbur Smith and Associates, 1956.

A Parking Plan for Industrial Area - Beverly Hills, California, Wilbur Smith and Associates, 1957.

Traffic Plan For Century City, Los Angeles, California, Prepared for Webb and Knapp, Inc., by Wilbur Smith and Associates, 1960.

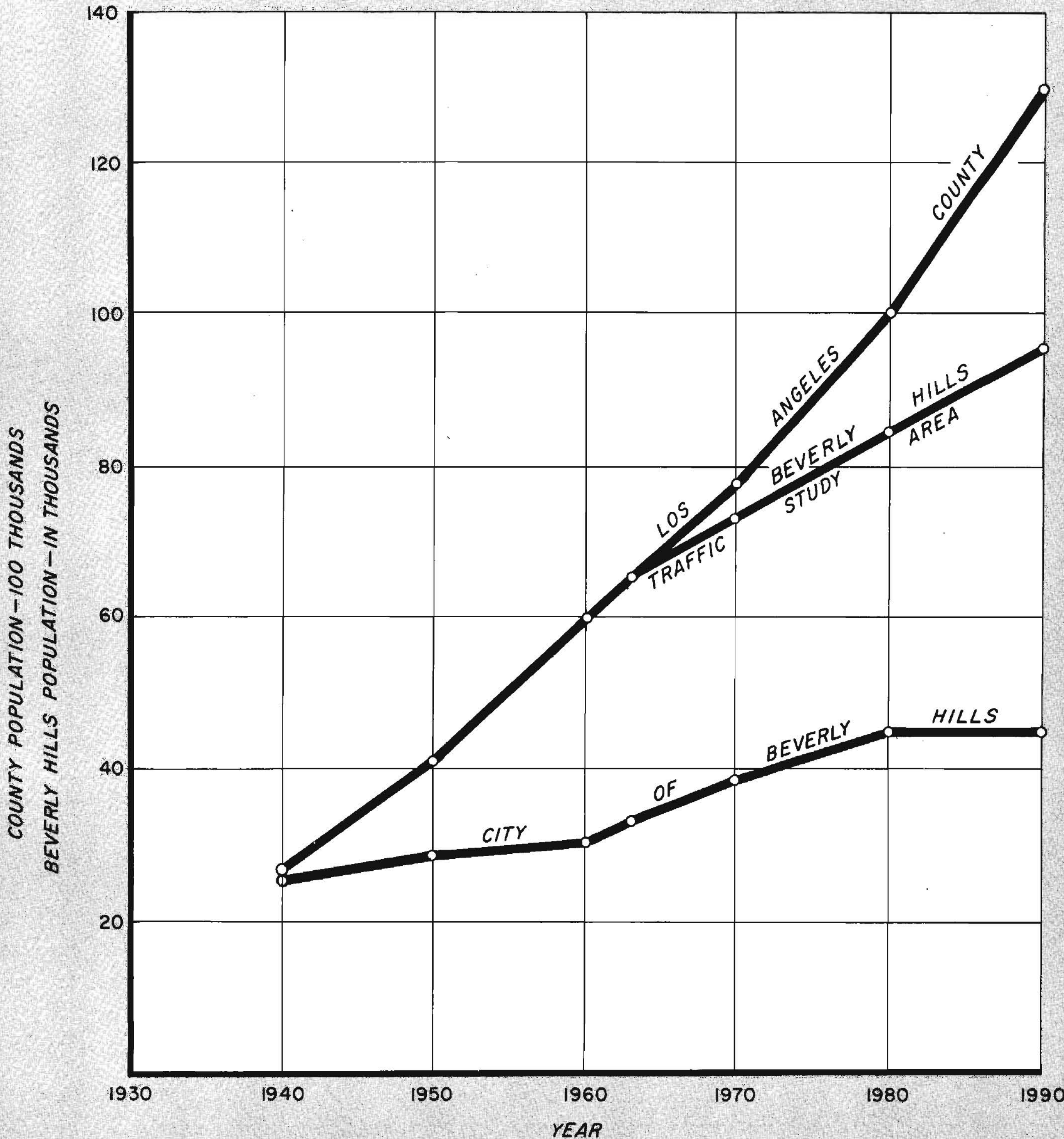
Traffic Plan - Wilshire Blvd., Beverly Hills, California, Prepared for City of Beverly Hills by Wilbur Smith and Associates, 1963.

Report on Estimated Traffic and Revenue of the Backbone Route, June 30, 1962, Prepared for Los Angeles Metropolitan Transit Authority by Coverdale & Colpitts.

The State Division of Highways provided route location data and their traffic assignment estimates. DeLeuw, Cather & Co., Consulting Engineers, provided construction cost and design data. Sverdrup and Parcel, Consulting Engineers, provided data on ventilation, lighting and freeway cover costs.

Area Growth Trends

As illustrated in Table 1 and Figure 1, considerable growth of Beverly Hills population and surroundings is anticipated. Whereas an increase of only 15 percent was experienced in the 20-year period 1940-60, the City Planning Commission estimates a 38 to 56 percent increase in the next 20-



POPULATION TRENDS AND PROJECTIONS

year period to 1980. For purposes of this study, a median figure of 47 percent was used, representing approximately a 1980 level of 45,000 (this figure has been considered as saturation; thus 1990 shows no change in Table 1). This is 35 percent above the current population.

Population growth will stem primarily from a continuation of the gradual transition from lower to somewhat higher residential densities in certain sectors of the City now zoned for apartment use, according to the Planning Commission (no rezoning is anticipated).

Table 1

POPULATION GROWTH TRENDS AND PROJECTIONS
Beverly Hills and Environs

YEAR	BEVERLY HILLS[a]		BEVERLY HILLS[b] TRAFFIC STUDY AREA		LOS ANGELES COUNTY[c]	
	Persons	Index	Persons	Index	Persons	Index
1940	26,823	0.80			2,785,643	0.43
1950	29,022	0.87			4,151,687	0.63
1960	30,817	0.92			6,059,161	0.92
1963	33,400	1.00	65,500	1.00	6,568,447	1.00
1970	38,500	1.15	73,500	1.12	7,750,000	1.18
1980	45,000	1.35	84,500	1.29	10,000,000	1.53
1990	45,000	1.35	95,500	1.46	13,000,000	1.98

[a] Census data. Projections based on City Planning Commission estimates
[b] Estimates by Wilbur Smith and Associates
[c] Projections by Los Angeles City Planning Commission to 1980. Uniform rate of increase assumed to 1990.

Traffic growth will undoubtedly exceed the population increase, because of the more rapid growth in commercial activities and through traffic, caused by the faster growth of Los Angeles County in general.

Los Angeles County population grew from 2.8 million in 1940 to 6.1 million in 1960, better than a doubling in size. Another doubling by 1990 is anticipated.

Chapter II

STREET TRAFFIC CHARACTERISTICS

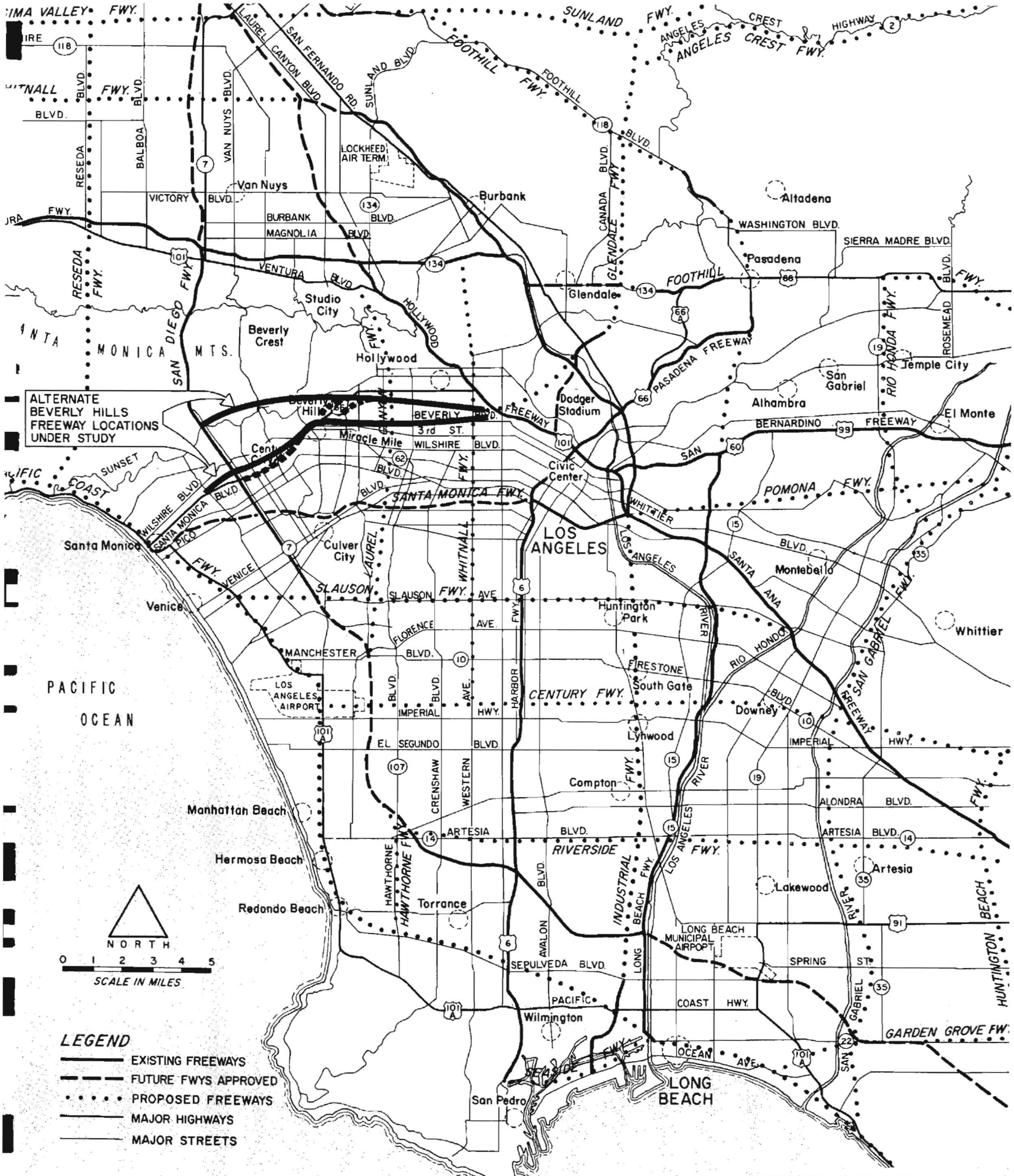
This chapter gives an account of the regional highway network, present and future, and the existing street and highway system in Beverly Hills.

Regional Routes

Situated midway between the Los Angeles city center and Santa Monica Bay and bordering the southerly slopes of the Santa Monica Mountains, the City of Beverly Hills is conveniently accessible to regional highway routes. See Figure 2.

The Hollywood Freeway lies approximately 4 miles east of the city and the San Diego Freeway is approximately 3 miles to the west. These facilities serve basically north-south traffic in this area. The proposed future Laurel Canyon Freeway will provide additional north-south capacity, connecting with the San Diego Freeway near Inglewood on the south and the Ventura Freeway in North Hollywood. While its precise alignment is not under consideration at this time, it is possible that this freeway may follow a course somewhere between La Cienega Boulevard and Fairfax Avenue east of Beverly Hills.

The Santa Monica Freeway, now under construction will serve east-west traffic in the Beverly Hills area approximately 1 to 2 miles south of Olympic Boulevard.



REGIONAL HIGHWAYS

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates **2**

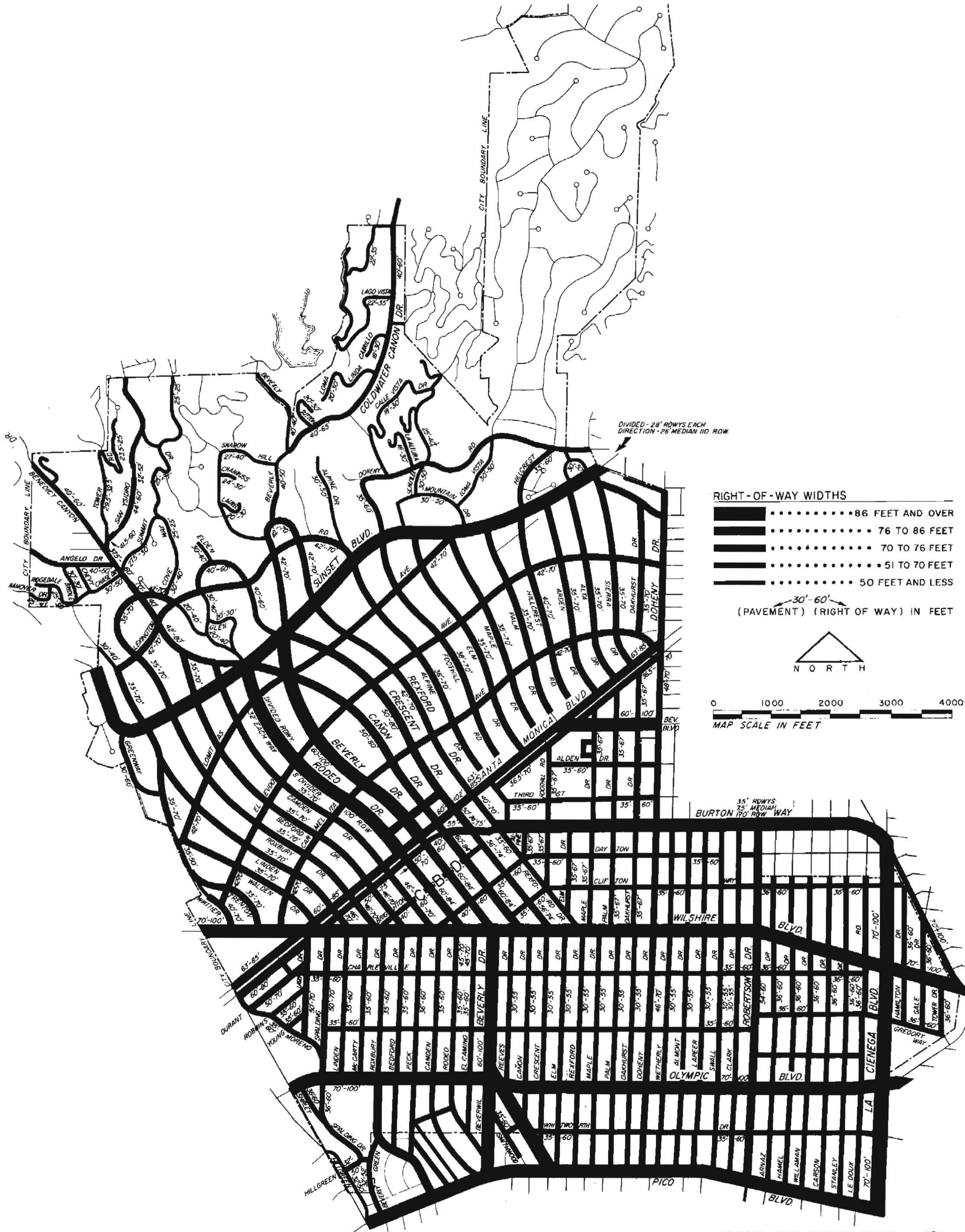
The proposed Beverly Hills Freeway, for which possible alignments are currently under study, will serve east-west traffic in a corridor bounded generally by the Santa Monica Mountains on the north and the Santa Monica Freeway on the south.

In addition to the nearby freeway routes, U.S. Route 66 and California Route 26, traversing the city on Santa Monica Boulevard and Olympic Boulevard respectively, are significant not only for their regional service but also for local access within the community.

Major Streets

The map of the existing city streets (Figure 3) illustrates the characteristic gridiron pattern of Beverly Hills' street system. Exceptions to this rectangular alignment are evident to some degree between Santa Monica and Sunset Boulevards, where gently curving streets occur, and consistenly in the hills north of Sunset where the rugged terrain has required winding streets and cul-de-sacs for residential development. It is also significant to note the angular differences in grid orientations in the area between Wilshire and Santa Monica Boulevards, with the resultant discontinuities and off-set intersections particularly on the north-south streets.

The principal east-west streets are Sunset, Santa Monica, Wilshire, and Olympic Boulevards. Their rights-of-way are approximately 100 feet wide, except for Santa Monica Boulevard which consists of two roadways, with 85-foot and 60 to 80-foot rights-of-way on the north and south roadways respectively, separated by a 60-foot wide Pacific Electric Railway Company right-



STREET SYSTEM
RIGHT - OF - WAY & PAVEMENT WIDTHS

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

3

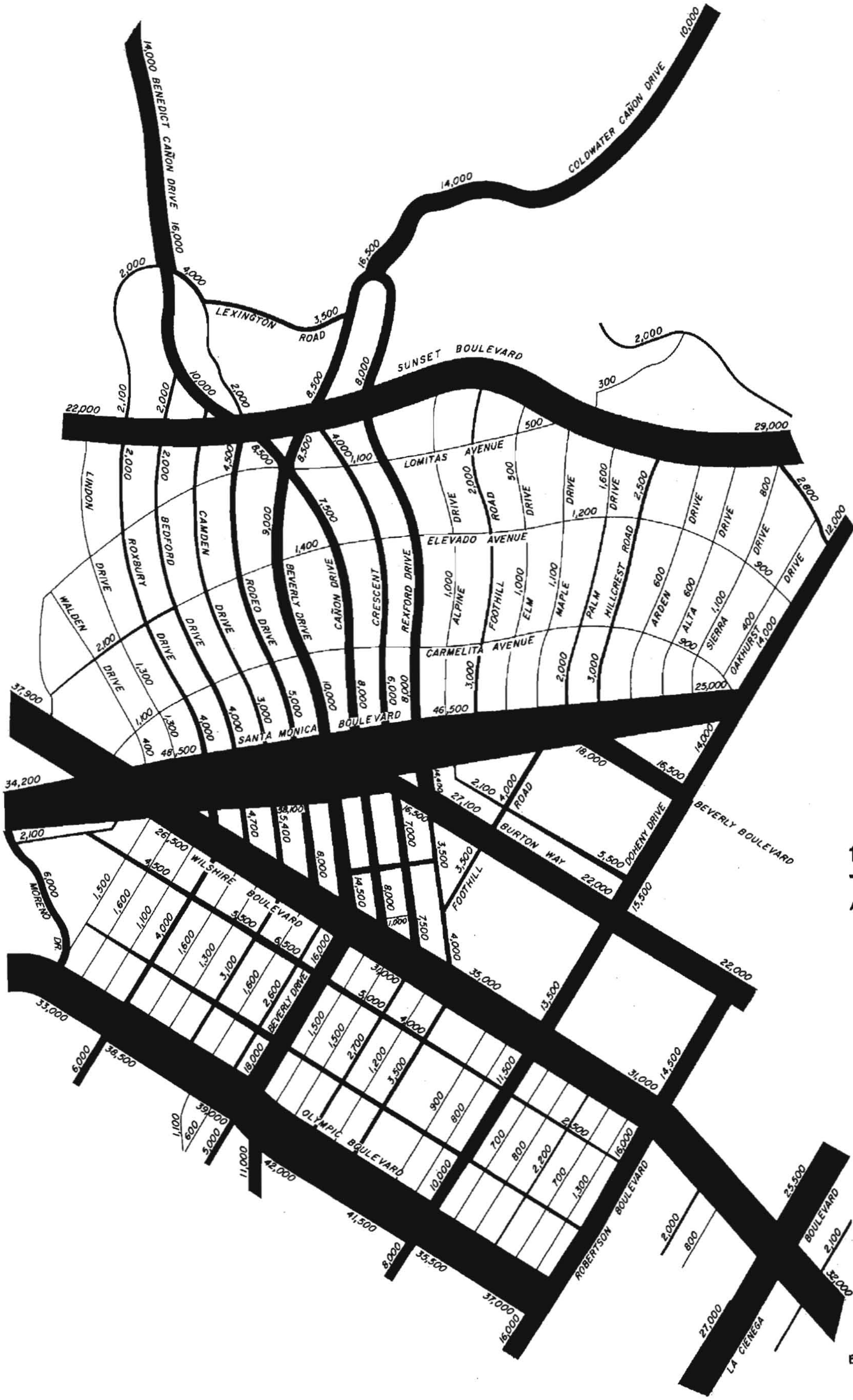
of-way and a 35 to 40-foot wide row of commercial buildings to the west of Beverly Drive. It should be noted that the south roadway is not continuous between Canon Drive and Alpine Drive. This fact establishes the north roadway as the arterial through this part of the city. The existing character of the south roadway of Santa Monica Boulevard along the north side of the business district and industrial area is essentially that of a local street serving traffic related to adjacent properties. Burton Way, also carrying significant amounts of east-west traffic, is now a divided roadway on a 170-foot right-of-way which formerly included Pacific Electric Railway Company tracts. Dimensionally these five streets are set apart from the remainder of the street system -- and in fact carry most of the east-west traffic.

The principal north-south streets vary in right-of-way width from 70 to 80 feet except for certain parts of Rodeo and Beverly Drives which are 100 feet wide.

The rights-of-way and roadway widths of the Beverly Hills major city street system are shown on Figure 3.

Traffic Volumes

The 1963 average daily traffic volumes are presented in Figure 4, with scaled band widths representing the different volumes. It is evident that the heaviest traffic flows occur in the east-west direction. The three streets with the greatest volumes are Olympic, Wilshire, and Santa Monica Boulevards, with Olympic volumes ranging from 33,000 to 42,000, Wilshire carrying from 26,000 to 38,000, and Santa Monica Boulevard serving from



4

1963 TRAFFIC VOLUMES

AVERAGE DAILY TRAFFIC

TRAFFIC SCALE

2,000 10,000 20,000 30,000 40,000

AVERAGE DAILY TRAFFIC

NOTE: *Volumes under 2,000 not scaled*

N O R T H

0 500 1000 1500

MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

25,000 at the east city limit and 34,200 at the west city limit to 58,100 near the heart of the city. The two streets with the next highest daily traffic volumes are Burton Way and Sunset Boulevard with 27,100 and 29,000 vehicles per day respectively, in their busiest portions. The directional distribution of peak hour traffic is about 60 percent eastbound in the morning peak and 60 percent westbound in the afternoon peak hour.

The principal north-south streets south of Santa Monica Boulevard are Beverly, Doheny, and Robertson Drives with daily traffic volumes varying from 12,000 to 18,000. During the morning peak period 55 percent of the traffic is southbound. During the afternoon peak there is a balanced counterflow on these north-south streets.

In the northern part of the City, Coldwater Canon Drive and Benedict Canon Drive serve the area up to Mulholland Drive and beyond. These streets carry approximately 16,000 vehicles per day each in the Beverly Hills area and connect with Rodeo, Beverly, Canon, Crescent, and Rexford Drives north of Santa Monica Boulevard. The traffic volumes on the latter streets range from 8,000 to 10,000 vehicles per day in this area.

Knowledge of the variations in traffic flow during the day is important in planning for future traffic. Daily time patterns of traffic flow on the major east-west thoroughfares are listed in Table 2, as traffic volumes per hour and as percentage of total flow for each hour. The fluctuations in hourly rates of flow show the usual correlation with the business and commercial activity of the community. The peak morning flows occur between 8:00 and 10:00 A. M.

Table 2

HOURLY TRAFFIC VOLUME VARIATIONS
Beverly Hills, California

HOUR BEGINNING	WILSHIRE BLVD. EAST OF GALE		OLYMPIC BLVD. AT DOHENEY		SUNSET BLVD. WEST OF GLENROY		NORTH SANTA MONICA BLVD. AT BEVERLY	
	Veh.	Pct.	Veh.	Pct.	Veh.	Pct.	Veh.	Pct.
12:00 Midnight	441	1.28	424	1.20	797	3.31	1,120	2.57
1:00 A.M.	179	0.52	209	0.59	554	2.30	800	1.84
2:00	110	0.32	112	0.31	309	1.28	430	0.98
3:00	54	0.16	63	0.18	153	0.64	240	0.55
4:00	47	0.14	59	0.17	93	0.39	230	0.53
5:00	99	0.29	181	0.51	71	0.29	100	0.23
6:00	319	0.94	774	2.18	155	0.64	235	0.54
7:00	1,377	4.00	2,307	6.50	453	1.88	965	2.22
8:00	2,202	6.40	2,636	7.44	836	3.47	2,305	5.29
9:00	1,916	5.57	2,387	6.73	1,136	4.72	2,740	6.29
10:00	2,049	5.90	2,172	6.13	1,342	5.58	2,490	5.72
11:00	2,239	6.51	2,251	6.35	1,384	5.75	2,600	5.97
12:00 Noon	2,375	6.90	2,153	6.07	1,558	6.47	2,790	6.40
1:00 P.M.	2,290	6.65	2,127	6.00	1,328	5.51	2,790	6.40
2:00	2,315	6.73	2,314	6.53	1,171	4.86	2,800	6.43
3:00	2,311	6.72	2,467	6.96	1,241	5.16	2,840	6.52
4:00	2,508	7.29	2,677	7.55	1,399	5.81	2,840	6.52
5:00	2,906	8.45	2,986	8.42	1,668	6.93	2,970	6.83
6:00	2,090	6.07	1,954	5.51	1,501	6.24	2,920	6.71
7:00	1,796	5.22	1,488	4.20	1,694	7.04	2,590	5.96
8:00	1,524	4.43	1,009	2.85	1,515	6.29	2,060	4.74
9:00	1,461	4.24	1,005	2.83	1,162	4.84	1,770	4.07
10:00	1,077	3.13	922	2.61	1,168	4.86	1,520	3.49
11:00	704	2.05	771	2.18	1,379	5.74	1,391	3.20
Total	34,389	100.00	35,448	100.00	24,067	100.00	43,536	100.00
Date	12-4-63		4-16-63		9-28-63		7-18-61	

Another peak in traffic occurs about midday, with somewhat greater overall movement. The principal peak movement is characteristically in the late afternoon and is seen to constitute about 8.4 percent of the daily flow on Wilshire and Olympic Boulevards and slightly less than 7 percent on Sunset and Santa Monica Boulevards.

Data on peak traffic volumes are especially significant in determining the adequacy of the traffic facilities and in their design and regulation. It is also important to consider the relationship of the peak hour to the 24-hour volumes for the different routes. Generally speaking, as total traffic increases, the peak hour percentage decreases. Table 3 lists certain peak hour flows by direction as percentages of their corresponding 24-hour volumes. Apparent in this tabulation are the typical directional peaks of important arterial routes. The eastbound morning peak and westbound evening peak on Sunset and Wilshire are greater than the combined peak, indicating the imbalance of traffic by direction at the peak periods.

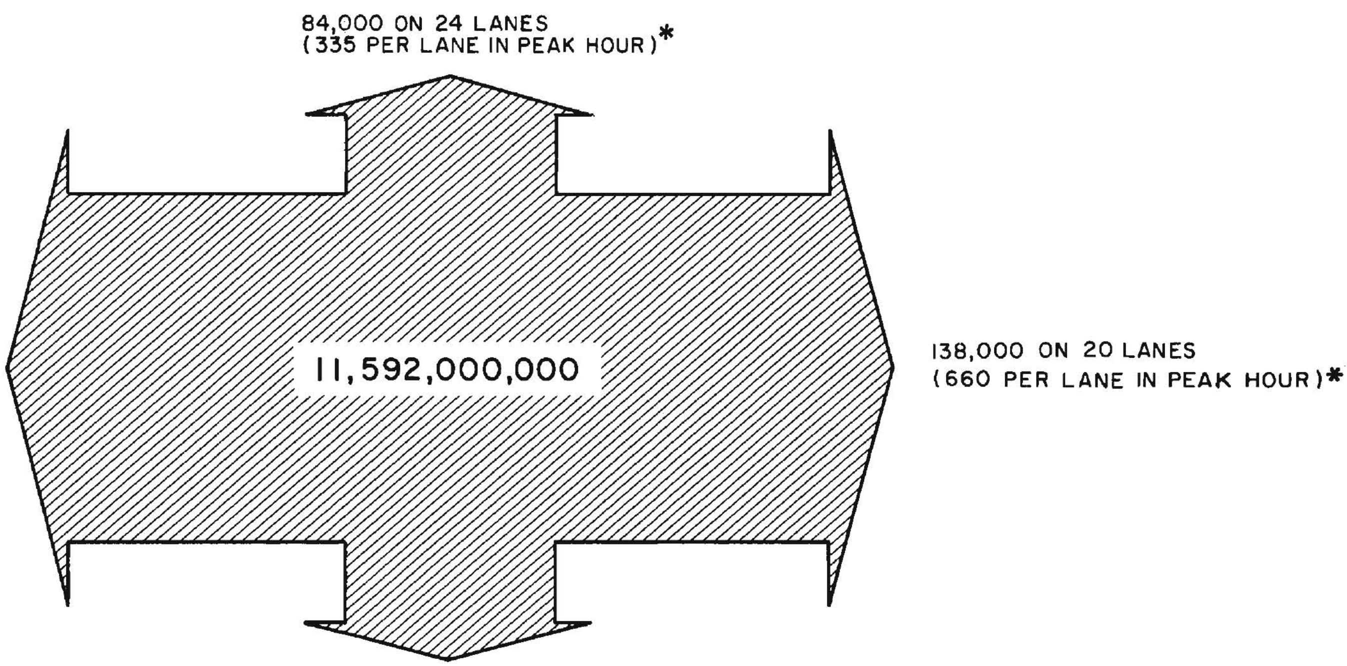
An analysis of daily vehicle intersecting flows at the major arterial intersections in the city is summarized in Figure 5. An east-west traffic volume of 138,000 vehicles using 20 traffic lanes intersects with a total north-south movement of 84,000 vehicles which use 24 lanes. Assuming the traffic to be dispersed evenly over all these lanes, the peak load on the north-south streets would average about 335 vehicles per lane per hour, a value well within the practical capacity range. On the other hand, the east-west traffic would result in average peak hour volumes of 660 vehicles per

EAST-WEST TRAFFIC ON:

SUNSET BOULEVARD
SANTA MONICA BOULEVARD
WILSHIRE BOULEVARD
OLYMPIC BOULEVARD

NORTH-SOUTH TRAFFIC ON:

11 STREETS WITH MORE THAN
7,000 VEHICLES PER DAY



* DIRECTIONAL SPLIT 60 — 40
PEAK HOUR EQUALS 8% OF ADT

DAILY VEHICLES CROSSING ON MAIN ARTERIALS

lane -- more than enough to result in congestion over considerable periods of time. In effect these intersecting flows produce 11.5 billion crossings of vehicle paths daily.

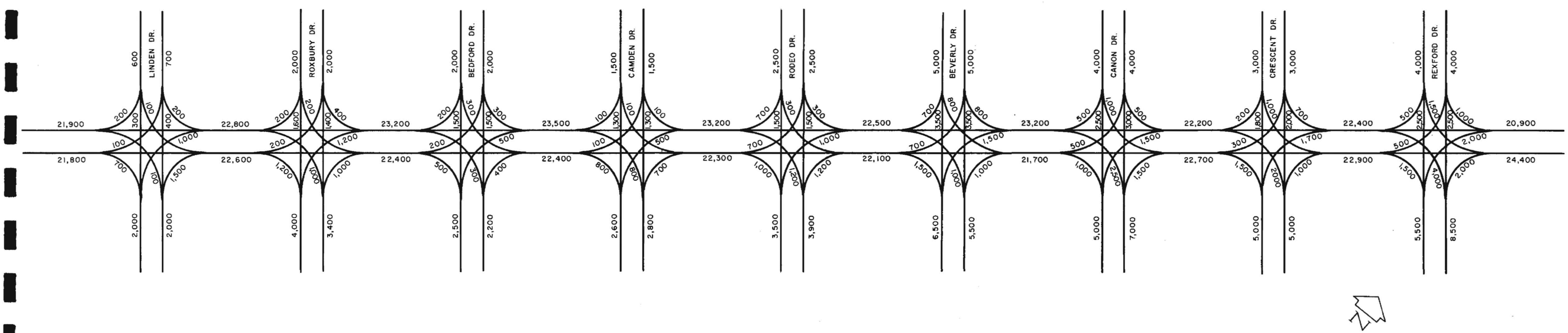
Table 3

PEAK HOUR PERCENTAGES OF DAILY TRAFFIC
Beverly Hills, California

	ROUTE	DIRECTION				
		E.B.	W.B.	N.B.	S.B.	Combined
9-28-63 Sa.	Sunset Blvd. West of Glenroy	7.9	7.3			7.0
9-29-63 Su.	Sunset Blvd. West of Glenroy	9.6	7.5			7.7
9-30-63 Mo.	Sunset Blvd. West of Glenroy	15.8	12.5			10.7
10- 8-63 Tu.	Sunset Blvd. East of Bev. Glen	11.8	11.2			8.9
10- 1-63 Tu.	Wilshire Blvd. East of Bev. Glen	9.4	9.9			8.0
1962	Wilshire Blvd. East of Beverly Dr.	8.4	9.0			8.3
1962	Beverly Dr. No. of Wilshire			9.9	8.2	9.0
10- 1-63	Beverly Glen So. of Wilshire			9.4	11.0	10.2

Note: Peak directional flows occur at different times for each direction.

Shown in Table 4 and Figure 6 are data concerning intersecting traffic flows along Santa Monica Boulevard. Approximately 65,000 vehicles approach Santa Monica Boulevard on the north-south streets in this area. It is significant that 62 percent of these are from the south and that 51 percent of the total cross the boulevard. Of the 58,000 vehicles entering or leaving Santa Monica Boulevard at these streets, over 75 percent turn to or from the south. Figure 7, a diagrammatic composite of the turning movements along this length of Santa Monica Boulevard, demonstrates the emphasis on the southerly oriented movements, related in great measure to Beverly Hills' industrial area, central business district, and civic center complex.

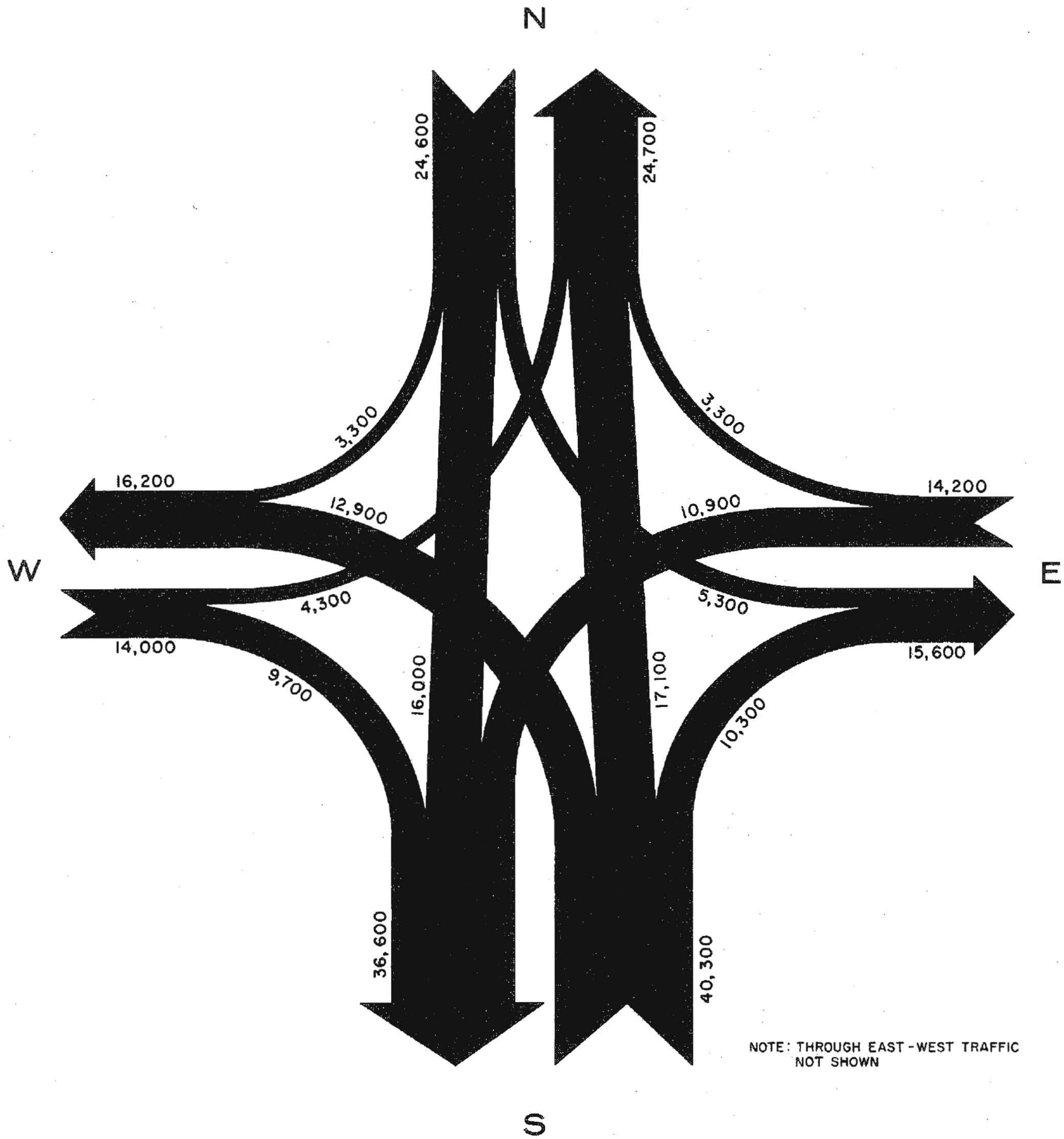


1963 TURNING MOVEMENTS - SANTA MONICA BOULEVARD
TYPICAL WEEKDAY

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

6



COMPOSITE TURNING MOVEMENTS
SANTA MONICA BOULEVARD
LINDEN DRIVE TO REXFORD DRIVE

Table 4

DAILY MOVEMENT OF VEHICLES ENTERING OR LEAVING
SANTA MONICA BLVD. INTERSECTIONS FROM AND TO THE SOUTH

CROSS STREET	CROSS STREET TRAFFIC	ENTERING SANTA MONICA FROM SOUTH: AND CROSSING (to N.)	ENTERING: & TURNING TO EAST	ENTERING: & TURNING TO WEST	LEAVING SANTA MONICA TO SOUTH: STRAIGHT ACROSS (from N.)	LEAVING: & TURNING FROM EAST	LEAVING: & TURNING FROM WEST
Linden Dr.	4,000	400	1,500	100	300	1,000	700
Roxbury Dr.	7,400	1,400	1,000	1,000	1,600	1,200	1,200
Bedford Dr.	4,700	1,500	400	300	1,500	500	500
Camden Dr.	5,400	1,300	700	800	1,300	500	800
Rodeo Dr.	7,400	1,500	1,200	1,200	1,500	1,000	1,000
Beverly Dr.	12,000	3,500	1,000	1,000	3,500	1,500	1,500
Canon Dr.	12,000	3,000	1,500	2,500	2,500	1,500	1,000
Crescent Dr.	10,000	2,000	1,000	2,000	1,800	1,700	1,500
Rexford Dr.	14,000	2,500	2,000	4,000	2,000	2,000	1,500
Totals	76,900	17,100	10,300	12,900	16,000	10,900	9,700

DAILY MOVEMENT OF VEHICLES ENTERING OR LEAVING
SANTA MONICA BLVD. INTERSECTIONS FROM AND TO THE NORTH

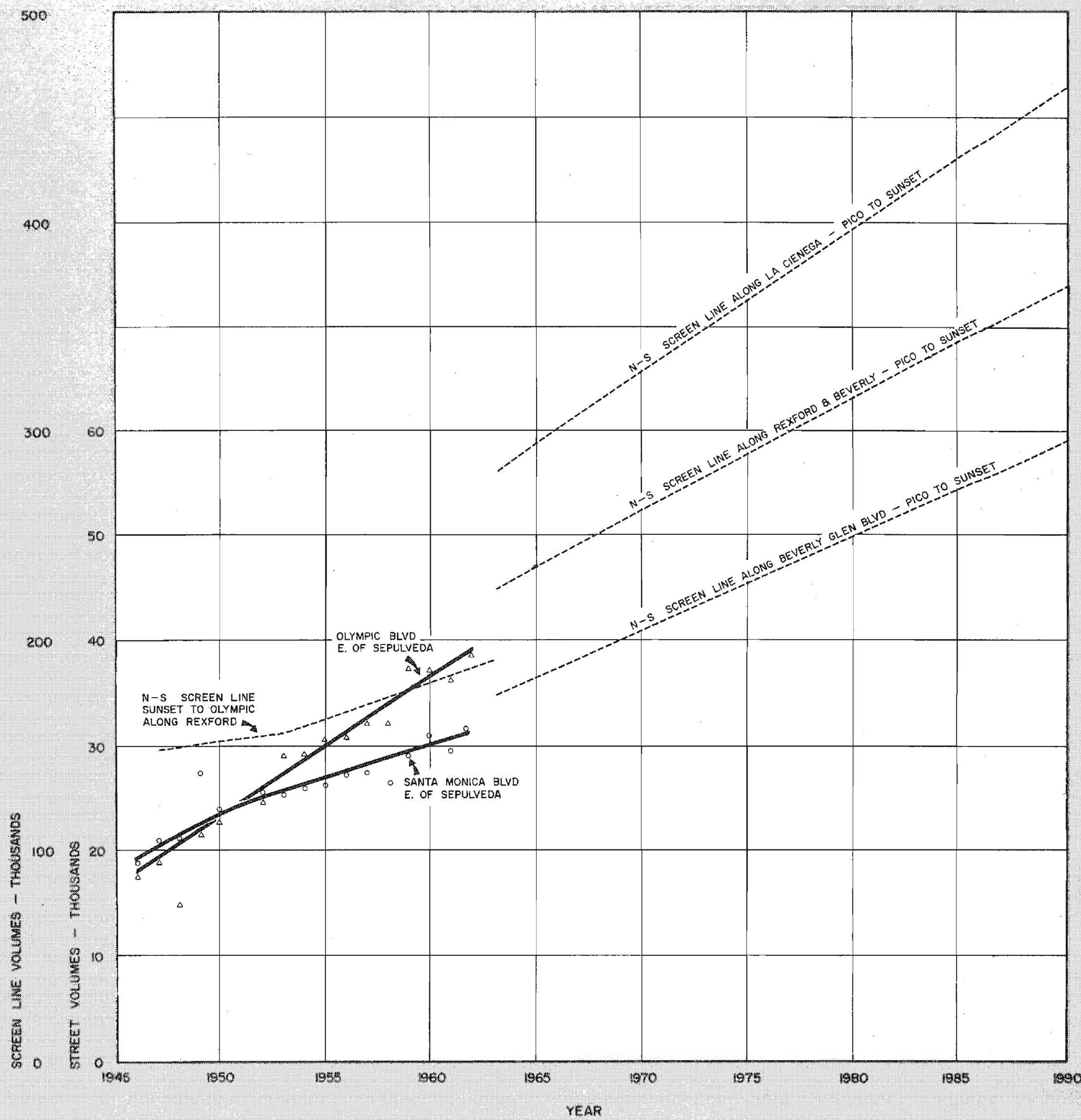
CROSS STREET	CROSS STREET TRAFFIC	ENTERING SANTA MONICA FROM NORTH: AND CROSSING (to S.)	ENTERING: & TURNING TO EAST	ENTERING: & TURNING TO WEST	LEAVING SANTA MONICA TO NORTH: STRAIGHT ACROSS (from S.)	LEAVING: & TURNING FROM EAST	LEAVING: & TURNING FROM WEST
Linden Dr.	1,300	300	100	200	400	200	100
Roxbury Dr.	4,000	1,600	200	200	1,400	400	200
Bedford Dr.	4,000	1,500	300	200	1,500	300	200
Camden Dr.	3,000	1,300	100	100	1,300	100	100
Rodeo Dr.	5,000	1,500	300	700	1,500	300	700
Beverly Dr.	10,000	3,500	800	700	3,500	800	700
Canon Dr.	8,000	2,500	1,000	500	3,000	500	500
Crescent Dr.	6,000	1,800	1,000	200	2,000	700	300
Rexford Dr.	8,000	2,000	1,500	500	2,500	1,000	500
Totals	49,300	16,000	5,300	3,300	17,100	4,300	3,300

Traffic Volume Trends

Traffic volume growth curves plotted from counts taken during the years between 1946 and 1963 shown in Table 5 and Figure 8 demonstrate the upward trend in area traffic volumes. Between 1947 and 1963 the traffic volume crossing a north-south screen line between Sunset and Olympic Boulevards increased approximately 27 percent (see Table 16). The combined traffic on Olympic and Santa Monica Boulevards near Sepulveda Boulevard increased almost 95 percent.

Traffic Capacity Vs. Volumes

Tables 6 lists ranges of peak hour and daily practical capacities for various classes of roadways. "Practical capacity" is defined as the greatest number of vehicles that can pass a given point on a roadway or in a designated lane during one hour without the traffic density being so great as to cause unreasonable delay or restriction to drivers' freedom to maneuver under prevailing roadway and traffic conditions. "Possible capacity" is a higher value, defined as the greatest number of vehicles that can pass a given point on a roadway or in a designated lane during one hour under the prevailing roadway and traffic conditions, and cannot be exceeded without changing one or more of the conditions that prevail. These figures provide generalized information regarding average street capacities. It is pertinent to note that many routes in the Los Angeles area are carrying in excess of the practical capacity levels shown in Table 6. However, such loads are being accommodated at the expense of driver convenience and freedom of movement.



TRAFFIC VOLUME TRENDS AND PROJECTIONS

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

8

Table 5

DAILY TRAFFIC VOLUME TRENDS
Beverly Hills and Vicinity

YEAR	SUNSET BLVD.	SANTA MONICA BLVD.			WILSHIRE BLVD.	OLYMPIC BLVD.		
	East of Rexford	East of Sepulveda	East of Rexford	East of Highland	East of Rexford	East of Sepulveda	East of Rexford	East of La Brea
1963	30,000		43,000[a]		35,000		40,000	
1962		31,600				39,000		44,000
1961		29,700				36,400		43,000
1960		31,700		28,850		36,600		41,700
1959		29,150		27,500		37,200		40,000
1958		26,400		29,000		31,900		
1957		27,400		29,400		31,800		
1956		27,200		28,400		30,500		
1955		26,000		28,900		30,000		
1954		25,400		25,400		29,000		
1953	24,000	25,500	35,000	23,300	35,000	29,000	34,000	
1952		25,200		26,500		24,600		
1951		24,500		21,800		26,300		
1950		23,400		22,200		22,900		
1949		27,800		21,800		22,000		
1948		21,200				15,500		
1947	22,300	21,000	32,500		35,000	19,100	30,000	
1946		19,000				17,500		

[a] North Roadway Only.

Source: State Highway Division Traffic Counts, except for 1947: Bartholomew Traffic Report, Jan. 1948, To City.

Table 6

TYPICAL ROADWAY PRACTICAL CAPACITIES

TYPE	PEAK HOUR TOTAL VOLUME	24-HOUR TOTAL VOLUME
8-Lane Freeway	8,000 - 10,000	80,000 - 100,000
6-Lane Freeway	6,000 - 7,500	60,000 - 75,000
4-Lane Freeway	4,000 - 5,000	40,000 - 50,000
6-Lane Expressway	3,000 - 5,300	30,000 - 53,000
4-Lane Expressway	2,000 - 3,500	20,000 - 35,000
6-Lane Arterial[a]	2,000 - 2,700	25,000 - 30,000
4-Lane Arterial[b]	1,500 - 2,000	17,000 - 22,000
4-Lane Major Business Street[b]	1,200 - 1,500	13,000 - 17,000
4-Lane Major Business Street[c]	900 - 1,350	10,000 - 15,000
3-Lane 1-Way[c]	1,300 - 1,800	14,000 - 20,000
2-Lane Arterial[d]	800 - 1,200	9,000 - 13,000
2-Lane 1-Way[d]	1,100 - 1,600	12,000 - 18,000

[a] 88 feet wide with parking
[b] 64 feet wide with parking
[c] 56 feet wide with parking
[d] 40 feet wide with parking

Note: Motor vehicle traffic capacities based on Highway Research Board _Capacity Manual_ and _Circular 376_ Capacity Curves with adjustments based on subsequent research. Freeway and Expressway capacities based on _A Policy on Arterial Highways in Urban Areas_, American Association of State Highway Officials. Calculations based on 60 percent signal "go" period, 10 percent trucks, 20 percent combined left and right hand turns, one direction volume two-thirds of other in peak hour, and 9 to 10 percent peak hour relation to 24-hour volume. Higher volumes can be carried, but with restrictions on freedom of movement.

Estimated capacities of the east-west streets in Beverly Hills are indicated in Figure 9 together with diagrammatic representations of their relationships to 1963 vehicle volumes. It is evident that all of the major east-west streets are currently operating at or above practical capacity during significant parts of the day. Santa Monica Boulevard is carrying over 50 percent more than its practical capacity.

Figure 10 illustrates the relation of north-south traffic at an E-W screen line lying along Santa Monica Boulevard. At all but two streets, Rexford and Beverly, daily volume is under capacity level.

Thus it is concluded that overcrowding of traffic arteries in the east-west direction is much more of a problem than in the north-south direction.

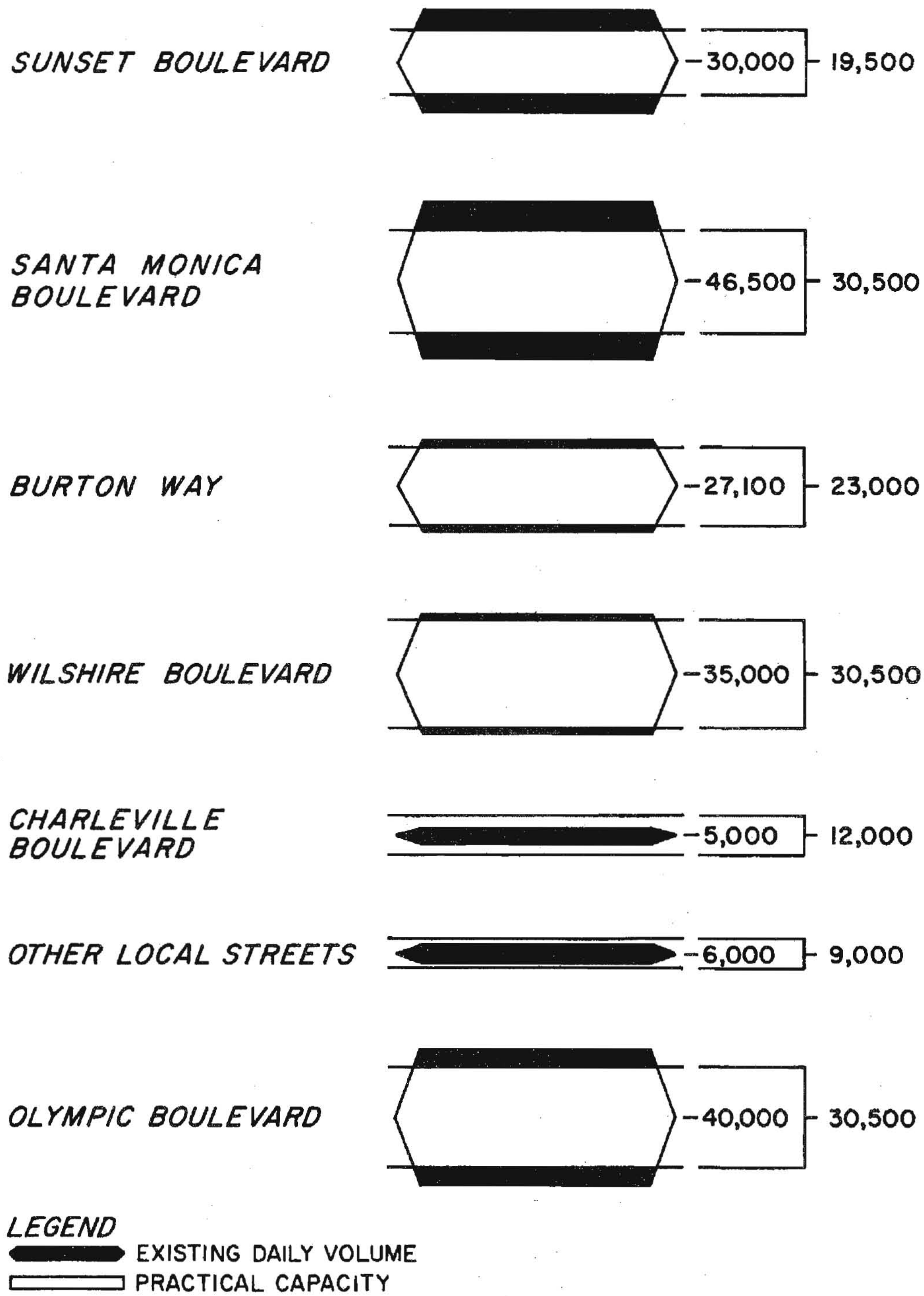
Current screen line volume and capacity comparisons may be summarized as follows:

E-W Traffic Crossing N-S screen line - 189,600 vehicles per day

Practical Capacity - 155,000

N-S Traffic Crossing E-W screen line - 118,000

Practical Capacity - 202,800



1963 TRAFFIC AT N-S SCREENLINE EAST OF REXFORD DR.

1963 TRAFFIC AT E-W SCREENLINE SO. OF SANTA MONICA

LEGEND
- EXISTING DAILY VOLUME
- PRACTICAL CAPACITY

	Existing Daily Volume	Practical Capacity
MORENO DRIVE	6,000	11,400
SPALDING DRIVE	1,500	8,000
LINDEN DRIVE	1,600	8,000
ROXBURY DRIVE	7,400	13,600
BEDFORD DRIVE	4,700	13,600
CAMDEN DRIVE	5,400	13,600
RODEO DRIVE	7,400	17,200
BEVERLY DRIVE	12,000	17,200
CAÑON DRIVE	7,500	16,500
CRESCENT DRIVE	7,000	16,500
REXFORD DRIVE	14,400	14,300
THIRD STREET	2,100	8,000
FOOTHILL ROAD	4,000	6,500
BEVERLY BOULEVARD	18,000	16,000
DOHENY DRIVE	14,000	16,000
OTHER LOCAL STREES	5,000	20,000

Chapter III

PUBLIC MASS TRANSIT

The part played by public mass transit is a significant consideration in evaluating areawide requirements for mass movement of people. Public officials are acutely aware of the need for balance in the overall transportation system and recognition is given to the fact that the private automobile alone cannot be expected to satisfy the entire demand. Relaxation in efforts to maintain this balance must not be permitted. Although the current trend in personal transportation is toward the private auto and away from public transit, it is necessary to continue efforts to bring about improvement in public transit and to assure the freedom of choice made possible by public transit service. As the overall area grows and population densities increase, mass transit will become increasingly more meaningful.

This chapter discusses the role of public transit, both existing and projected, and its relationship to the highway system.

The Role of Public Transit

In the Los Angeles area, public mass transportation is now an important component of the overall transportation system. Of the approximate 6.3 million daily person trips made in the metropolitan area now served by public transit, about 450,000 trips, or 7 percent, are via buses.[1] In Beverly Hills, transit now carries 30 percent of the total P.M. peak hour vehicle passengers on Wilshire (at Beverly).[2] If the 1,570 passengers in buses were in autos instead, another 1,100 vehicles would be added to this corridor in the one hour, 5 to 6 P.M., representing 40 percent of the load now carried by Wilshire. Thus the important role of bus transit is clearly demonstrated.

Despite the efficiency of the mass transit vehicle in terms of roadway use, the convenience and extreme flexibility of the automobile in terms of personal transport has been reflected in a continuing decrease in transit patronage. Residential decentralization and the widespread growth of outlying shopping centers and industrial areas have compelled dependence on the automobile to a significant degree. Increased wealth and car ownership have contributed to the growth of the individualized transportation mode. Changes in recreational habits resulting in part from shorter working hours and greater per capita incomes have accented the trend away from public transit in trips to the shore or the mountains, for example, rather than central city destinations served by transit routes.

The trend in the use of public transportation in Los Angeles

---

1 Based on 2.5 person trips per capita for 2.5 million people and total mass transit riders reported by The Los Angeles Metropolitan Transit Authority.

2 Wilbur Smith and Associates, Traffic Plan - Wilshire Boulevard, 1963 Prepared for City of Beverly Hills.

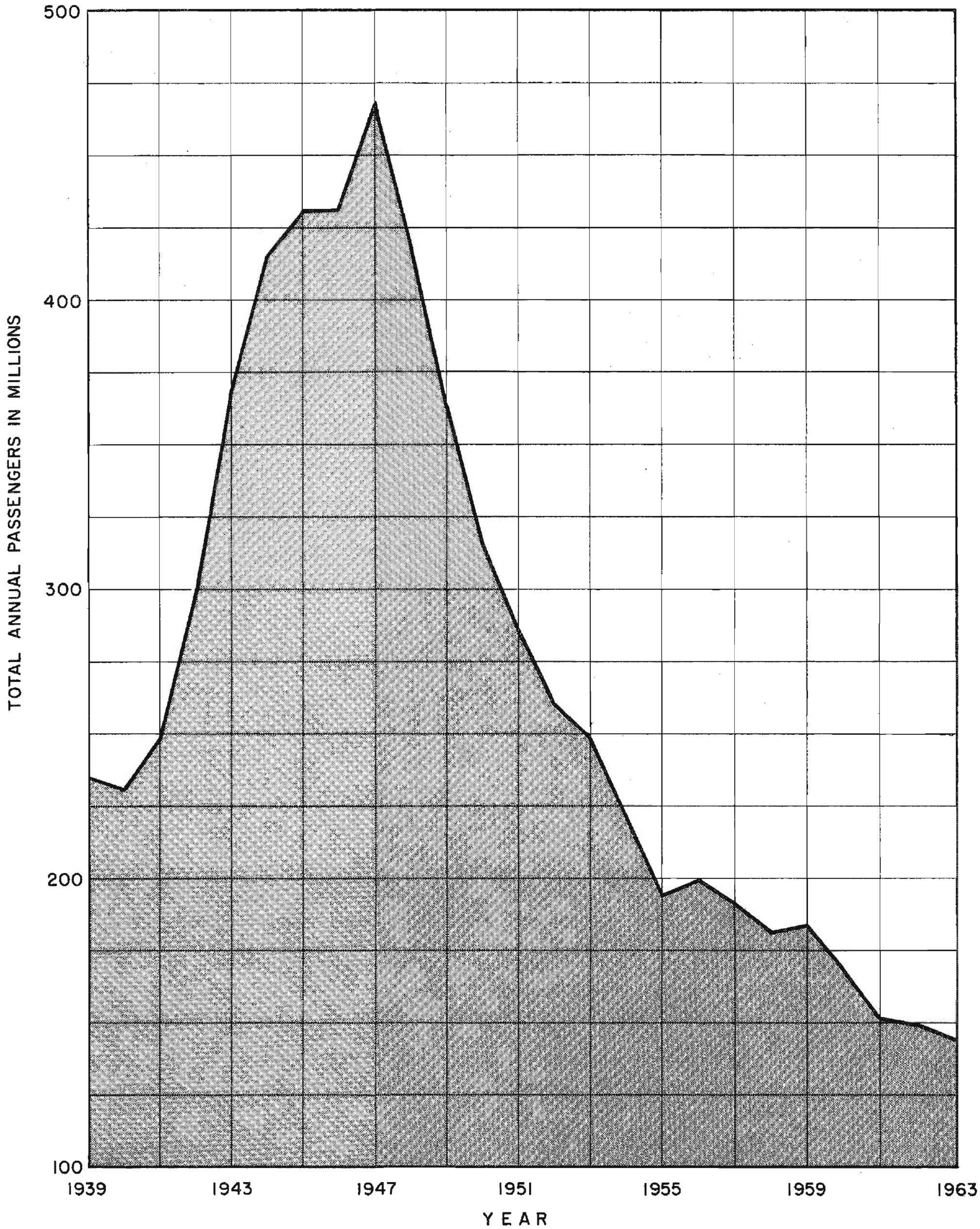
County is shown in Table 7 and Figure 11 which are based on total annual patronage of the routes making up the present Los Angeles Metropolitan Transit Authority system. Revealed clearly is the peak usage associated with World War II and the decline since that time. During this period of gradual reduction in patronage, passenger fares were increased in 1948, 1955, 1961 and again in 1962. The current basic fare is 25 cents for the first zone. Although the trend continues down it may be that a slight leveling off is occurring. The losses in passengers for 1962 and 1963 were 3.3 and 2.7 percent, respectively, in contrast to a loss of about 5 percent per year, on the average, between 1950 and 1960.

It is significant that throughout the nation the greatest decreases in daily transit patronage have been measured during off-peak periods, and rapid transit[3] has suffered less reduction than other public mass transit service. This fact correlates with the orientation of most public transporation systems toward the high density central business districts.

Rapid transit has been more successful in retaining riders, it is generally believed, because it competes better with the private auto in terms of travel speed and comfort, and is frequently a more economical, yet dependable, means of commuting to and from work.

Transit is a very important peak-hour carrier of people, especi-

3 Generally defined as those facilities operating on exclusive right-of-way permitting high speeds and scheduling, independent of general traffic conditions.



ANNUAL TRANSIT PATRONAGE
LOS ANGELES METROPOLITAN TRANSIT AUTHORITY
1939 - 1963

Table 7

ANNUAL TRANSIT PATRONAGE
1939-1963 Los Angeles Metropolitan Transit Authority

YEAR	PASSENGERS	RATE OF CHANGE (Percent)
1939	235,000,000	
1940	232,000,000	- 1.3
1941	249,000,000	+ 7.3
1942	297,000,000	+19.3
1943	368,000,000	+23.9
1944	415,000,000	+12.8
1945	430,000,000	+ 3.6
1946	437,000,000[a]	+ 1.6
1947	468,000,000	+ 7.1
1948	417,000,000	-12.2
1949	367,000,000	-13.6
1950	315,000,000[a]	-14.2
1951	285,000,000	- 9.5
1952	260,000,000	- 8.8
1953	248,000,000	- 4.6
1954	223,000,000	-11.2
1955	194,000,000[a]	-13.0
1956	199,000,000	+ 2.6
1957	193,000,000[a]	- 3.1
1958	182,000,000[a]	- 5.7
1959	184,000,000	+ 1.1
1960	167,000,000[a]	- 9.2
1961	153,000,000	- 8.4
1962	148,000,000	- 3.3
1963	144,000,000	- 2.7

a Operators' strike during year.

Source: Los Angeles Metropolitan Transit Authority ally significant for home-to-work trips along high density travel corridors. As shown in Table 8, observed peak hour use of principal rapid transit systems range from 12 percent of the daily total in Toronto to about 23 percent in Cleveland. These peak hours coincide with the peak loads on streets and highways, it must be noted. Almost half of the day's total transit traffic occurs in the four peak hours and about 85 percent between 7:00 A.M. and 7:00 P.M. Thus it offers its greatest service at the very times when relief of overcrowded streets is most needed.

The high percentage of peak usage indicates a very important service and at the same time reveals a serious operating problem. The peak hours require as much as four times the equipment capable of being operated profitably during other periods.

The role, amount of usage, and significance of public transportation in a particular urban area will be determined by such factors as trip purpose, population density, family income, and auto ownership. Work trips will be the most "transit-oriented." Business and shopping trips are less susceptible to transit, and social-recreational trips are least likely to be made by transit. Of significance to southern Californians are correlations of car ownership and transit usage revealing that transit usage decreases as the number of cars per household increases.[4]

---

4 Wilbur Smith and Associates, Future Highways and Urban Growth, 1961, Automobile Manufacturers Assn., New Center Building, Detroit, Mich.

Table 8

DAILY AND PEAK-HOUR RAPID TRANSIT PASSENGERS IN MAJOR CITIES
Typical Weekday

CITY	24-HOUR VOLUME	PEAK-HOUR VOLUME	PEAK-HOUR PERCENTAGE
Rapid Transit			
New York City	4,490,000	672,000	15.0
Boston	616,000	106,000	17.2
Philadelphia	570,000	94,000	16.5
Chicago	559,000	177,000	19.2
Toronto	250,000	30,000	12.0
Cleveland	80,000	18,000	22.5
Commuter Railroads			
New York City	466,000	104,000	22.3
Chicago	234,000	68,000	29.1
Philadelphia	100,000	24,000	24.0

Source: Gottfeld, Gunther, Rapid Transit in Six Metropolitan Areas, U.S. Government Printing Office, November, 1959.

The same relationships between central business district trips, car ownership, and population density are found to exist; but with the increases occurring at a greater rate than for all transit trips. This fact accents the special role of public transportation in serving the central city.

High density land use affords conditions favorable to mass transportation in that riders can be attracted and satisfactory service can be scheduled. In areas of low density, secondary feeder or shuttle vehicles would be required -- for all practical purposes, private autos in most parts of the country.

Rapid transit, in the future, will provide an important complement to the freeways in the mass movement of people, especially during the periods of peak demand. It will also make it possible for high density areas to exist, such as established business districts and multi-family apartment areas, by decreasing parking space demands and offering reserve capacity for future growth.

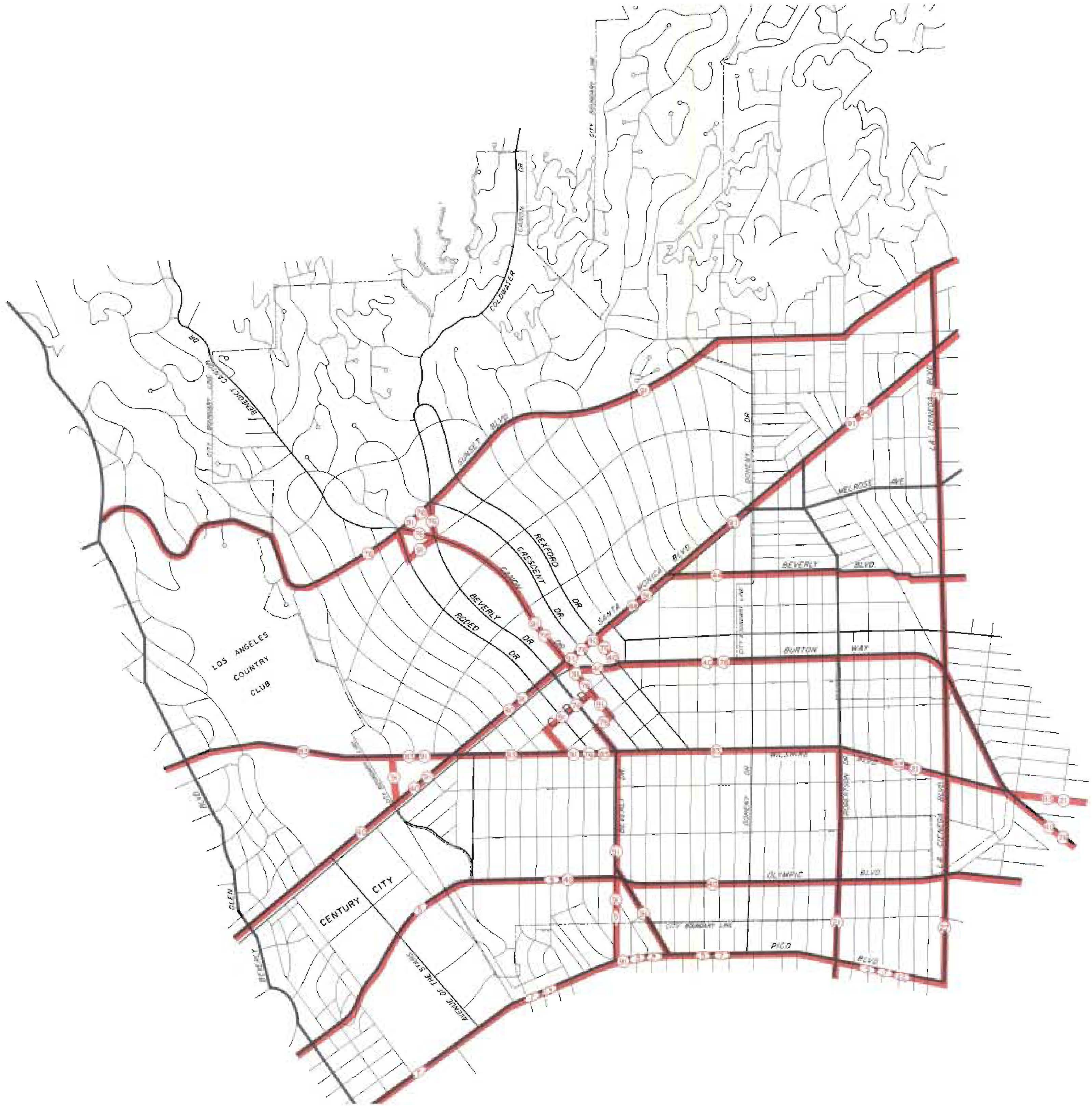
Freeways will not eliminate the need for public transport, especially in complex and densely urbanized areas such as Los Angeles County. However, neither can rapid transit be considered a substitute for the freeway system. The basic needs for the two systems are independent, although they do support each other. Freeways must continue to serve practically all off-peak, weekend, and holiday travel needs. Public transit in balance with private vehicular transport will provide the optimum service to the area's increasing population, with each mode serving the movement for which it is most appropriate.

Existing Service

As shown in Figure 12, bus routes extend over much of the Beverly Hills arterial street system, viz: Sunset Boulevard, Santa Monica Boulevard, Beverly Boulevard, Benton Way and San Vicente Boulevard, Wilshire Boulevard, Olympic Boulevard, Canon Drive, Beverly Drive, Beverwil Drive, Robertson Boulevard, and La Cienega Boulevard. Generally, service is available around the clock. However, individual sched-

12

TRANSIT ROUTES



LEGEND

LA MTA ROUTE

SANTA MONICA MUNICIPAL BUS ROUTE

NORTH

0 1000 2000 3000 4000

MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

ules reflect occasions of low demand in the increased time between buses during daily off-peak travel periods, special Saturday and Sunday scheduling, and even cessation of weekend and holiday service on certain routes such as Santa Monica routes 12 and 13, and the southerly portion of MTA route 21.

With the exception of MTA line 21, running between Burbank and Culver City, the buses travelling through or to Beverly Hills are oriented toward the Los Angeles central business district or the city of Santa Monica area. The scheduled peak hour running time on the Wilshire Boulevard MTA line 83 is approximately 1 hour from downtown Los Angeles to Beverly Hills and another 25 minutes to complete the trip to Santa Monica. During peak periods on this line a special limited semi-express service is also provided which has a somewhat shorter overall trip time. Line 4, operating on San Vicente and Santa Monica Boulevards in Beverly Hills is scheduled for about the same running times between Los Angeles and Santa Monica.

Although not currently of direct service to Beverly Hills passengers, it is noteworthy that there are in operation certain bus routes in the area using existing freeways and affording, to this degree, rapid transit service. The results of this type of service are reported to be favorable, and indicate a possible area for expanded bus service related to the development of the regional freeway system.

Rapid Transit Plans

In 1959, a study and report establishing the need for rapid transit service along four general route locations was completed.[5] This report was followed by an engineering study of specific alignment, equipment, and cost estimates.[6] The 75-mile system serving four corridors radiating from the Los Angeles central business district was estimated to cost $529 million.

In 1960, Coverdale and Colpitts, retained by the MTA, determined the estimated net earnings of this four corridor system to be inadequate for a self-liquidating project. Accordingly the Authority designated the "Backbone Route," estimated to cost $200 million[7], for a study of financial feasibility. Finally, on June 30, 1962, Coverdale and Colpitts, again retained by the MTA, reported that the combined net revenue of the entire transit system, including surface lines and the Backbone Route, would be adequate to retire a necessary bond issue of $288 million in 50 years, and termed the project economically feasible.

The Backbone Route, subject of the above studies, extends 23 miles from El Monte through the Los Angeles central business district, along Wilshire Boulevard in Beverly Hills, and thence to Century City

5 Public Transportation Needs in the Area Served by the Los Angeles Metropolitan Transit Authority, prepared for the Authority by Coverdale and Colpitts, May, 1959.

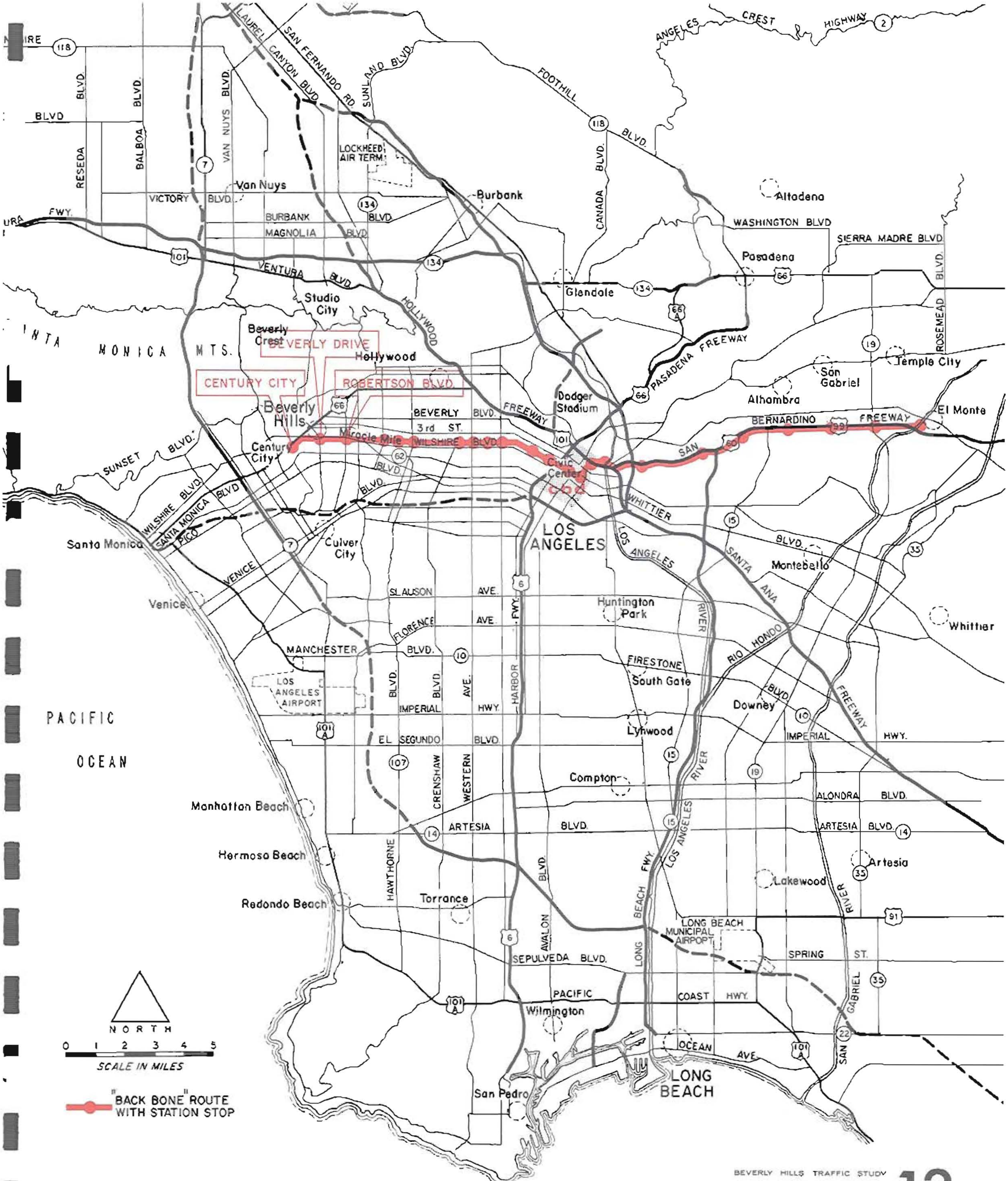
6 A Comparative Analysis of Rapid Transit System Equipment and Routes, prepared for the Los Angeles Metropolitan Transit Authority by Daniel, Mann, Johnson and Mendenhall, August, 1960.

7 By Daniel, Mann, Johnson and Mendenhall, and by Kaiser Engineers.

along Santa Monica Boulevard as shown in Figure 13. At the present time consideration is being given a westerly extension to San Vicente Boulevard (west of the San Diego Freeway). The portion of the route from the Los Angeles CBD to its western terminus is presently envisaged as underground. Stations would be located on average spacings of 1 mile with several closer spacings to serve the more significant concentrations of activity.

Typical rapid transit scheduled station-to-station travel times, as projected, are 18 minutes from downtown Los Angeles (Broadway and Sixth St.) to Beverly Drive, and another 2 minutes to Century City, including time for 20-second station stops along the way. Tentative fares projected for these particular trips would be 45 and 50 cents respectively. Peak-hour travel times, via auto (including allowance for parking and walking between parking space and destination), are estimated by Coverdale and Colpitts at 37 minutes from downtown Los Angeles to the Beverly Drive transit station. The Downtown Business Mens Association made studies of off-peak hour driving times in 1960, and indicated a value of 30 minutes to the intersection of Santa Monica at Wilshire, or about 28 minutes to Beverly at Wilshire, without allowance for parking etc. Thus it is evident that the rapid transit schedule time would provide a net saving of at least 10 minutes - probably more - as compared with auto travel time.

Parking spaces are planned at the terminal stations and others



RAPID TRANSIT PLAN

which may be located on streets leading to important passenger centers, to accommodate patrons who are expected to transfer from private auto to rapid transit. In addition, the numerous MTA lines in the area tributary to the Backbone Route are anticipated to serve as feeder routes transfering passengers to and from the transit stations.

Of particular significance to Beverly Hills would be the transit stations located near Century City, Beverly Drive, and Robertson Boulevard. The aforementioned feasibility study report of the Backbone Route contains estimates of the numbers of passengers expected to board the rapid transit trains at the various stations. Most significant in regard to these considerations of the proposed Beverly Hills Freeway is the estimated diversion of auto users to rapid transit.

The numbers who would be so diverted at the Beverly Hills area stations are shown in Table 9 and compared with the total number of passengers estimated for each station.

Table 9

NUMBER OF PASSENGERS BOARDING RAPID TRANSIT
AT BEVERLY HILLS STATIONS
AND DIVERTED FROM AUTOS
Average 1968 Weekday

STATION	TOTAL	DIVERTED FROM AUTO	PERCENT OF TOTAL
Robertson Blvd.	4,190	2,212	53
Beverly Drive	3,589	2,180	61
Century City	9,888	6,680	68
	17,667	11,072	63

Source: Coverdale and Colpitts, op. cit.

According to the feasibility study, approximately 11,000 passengers traveling east from these three stations are expected to be diverted from automobiles during an average weekday in 1968. Of this total, about 73 percent or 8,000 would board during the peak periods, a significant contrast to the current 27 percent of total auto traffic occurring during the same hours on nearby arterial streets (see Table 2). The number of eastbound passengers diverted from autos and boarding at these Beverly Hills locations during the peak 20-minute period is estimated in the feasibility report at 1,600, notwithstanding possible passenger-to-seat ratios of 1.5 during this time. At an average occupancy of 1.4 persons per car, this represents an auto volume in 1968 of about 1,140 cars in 20 minutes, equivalent to the capacity of two eastbound freeway lanes. However, since only 63 percent will be diverted from autos (the remainder from buses), the rapid transit line can be said to subtract a volume of automobiles that would require the capacity of two eastbound major arterial lanes, or a 4-lane highway, considering both directions of flow. The overall patronage of the Backbone Route is estimated to increase approximately 7 percent by 1980 and 12 percent by 1990. Thus by 1990 the 20-minute rate of 1,280 vehicles is equivalent to two and a half eastbound arterial lanes (at 1,500 vehicles per lane per hour).

On the basis of these figures, the rapid transit line, with its capacity equivalent of a 4- to 6-lane freeway during the morning and evening peak hours in the direction of heaviest flow, would provide welcome relief to freeway users. These estimates of patronage describe in measurable terms and emphasize the complementary characteristics of rapid transit and freeways. Neither mode should be expected to serve all travel desires. Both systems, working in balance, will serve the overall requirements of personal transport.

Chapter IV

TRAFFIC DESIRES

Perhaps the most important part of this study is the determination of the relationship of the City of Beverly Hills and its environs from the transportation standpoint. Two main factors are to be considered in this respect. The first is related to the geographical location of Beverly Hills within the Los Angeles urban area. No matter what takes place within Beverly Hills, heavy through traffic desire lines will cross its bounds as a direct consequence of its location and activities that take place outside its limits. The second factor concerns the Beverly Hills community, the transportation requirements of its residents, and the traffic attraction of its commercial, industrial, institutional, and recreational facilities.

Traffic generated by the various land uses are directly related to the community socio-economic life and its relationship to the entire urban complex. Existing characteristics and magnitudes of different trip categories have been analyzed to gain a clear picture of the actual transportation patterns within and near Beverly Hills. The study of existing travel patterns is the subject of the following sections and forms the basis of consideration in developing traffic projections for a future year.

Traffic Characteristics and Study Area Definition

Traffic that may be observed on the street network of Beverly Hills is composed of trips having a great number of different origins, destinations and purposes. Therefore, it is necessary to segregate traffic in the various categories that are more easily studied, analyzed and expanded.

Trips taking place in the study area may be classified under three headings: through trips which have no origin or destination within the study area, internal trips which have both ends within the Beverly Hills area, and external trips that have one end inside the study area and the other outside the study area limits. External trips may be further divided into trips by residents having a destination outside Beverly Hills and trips by non-residents coming to Beverly Hills for work, shopping, business, or other purposes.

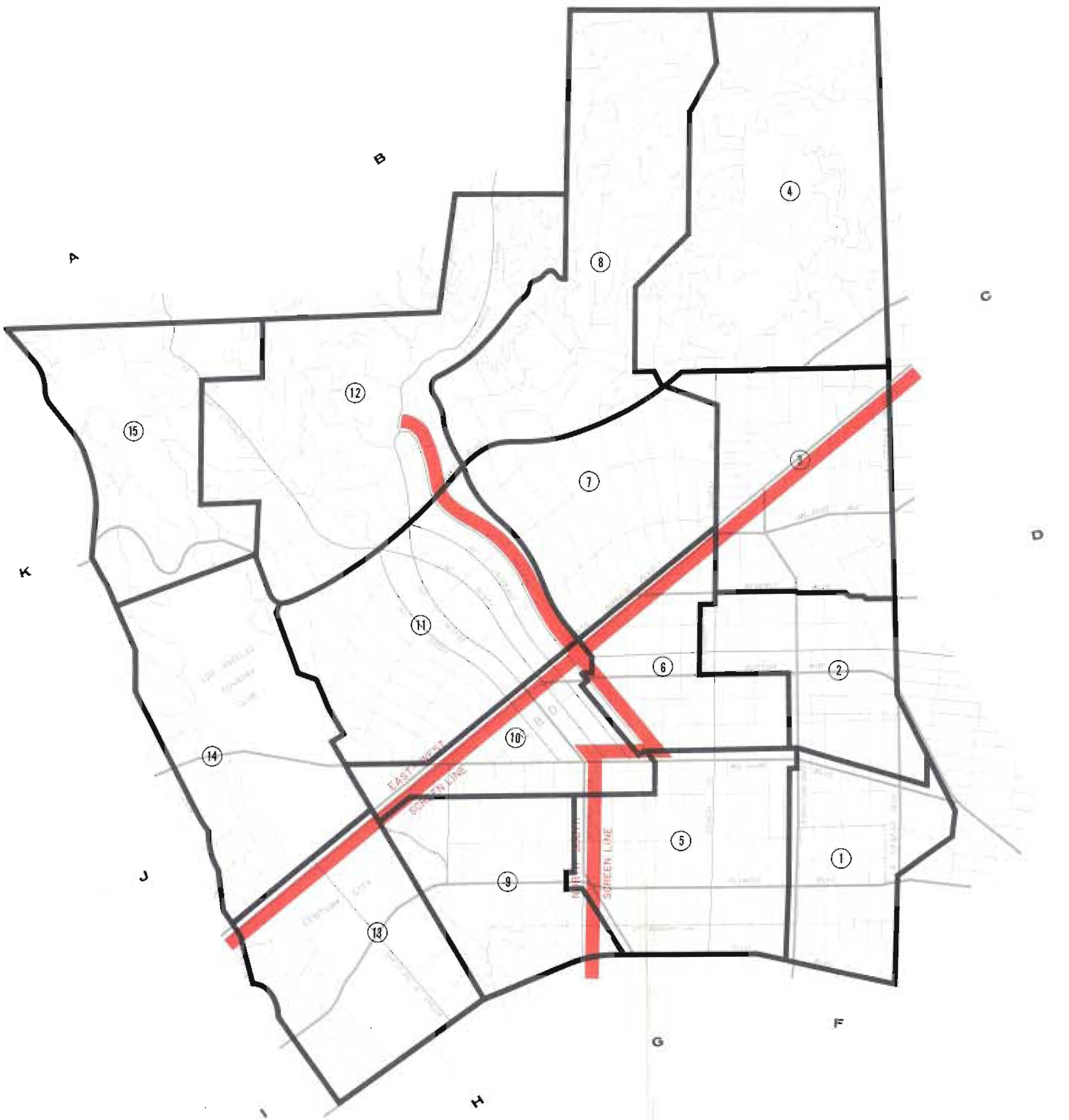
To analyze these different categories of trips, a study area has been defined and divided into 15 traffic zones. The study area limits or cordon line follows generally Beverly Glen Boulevard on the west, Pico Boulevard on the south, La Cienega Boulevard on the east and approximately the city limit on the north. Zones 1, 5, 9 and 13 are located south of Wilshire Boulevard, zones 4, 8 12 and 15 comprise most of the hillside, while the other zones cover the entire area between Sunset Boulevard and Wilshire Boulevard. Zone 10 contains the area known as the "Triangle" and is in fact the central business district of Beverly Hills. All access routes to Beverly Hills have been grouped in 11 external stations. Stations A and B designate the northern access roadways of the Santa Monica Mountains, stations C, D and E represent all arteries crossing the eastern study area limit, stations F, G, and H are on the south side while I, J and K cross the cordon line on the Westwood and West Los Angeles side of Beverly Hills. (See Figure 14.)

Magnitude of Existing Travel

Traffic crossing the cordon line (study area) has been counted by different public agencies as part of regular area-wide traffic counts. Counts in the vicinity of Beverly Hills have been made by the Beverly Hills Department of Public Works, the Los Angeles Department of Traffic and the Los Angeles County Road Department. The total average daily traffic crossing the cordon in 1962-1963 amounted to about 573,000 vehicles.

Through Traffic

Part of the traffic crossing the cordon has no destination inside Beverly Hills and recrosses the study area boundary (through traffic). The determination of the amount of through traffic is of importance in this study and special care was given to it. In December, 1963 a through traffic study was conducted by the Beverly Hills Public Works Department. About 10 percent of all license plates were recorded as vehicles entered and left Beverly Hills on Sunset, Santa Monica, Wilshire and Olympic Boulevards and on Burton Way. More than 3,200 license plates were recorded and matched to determine for each of the 4 hour study (1:45 P.M. to 4:45 P.M.) periods the amount of through traffic. A summary of this study is given in



14

TRAFFIC ZONES, STATIONS AND SCREEN LINES

LEGEND

ZONE BOUNDARY
(2) ZONE NUMBER
D EXTERNAL STATION
SCREEN LINE

NORTH

0 1000 2000 3000 4000
MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY
Wilbur Smith and Associates

Table 10. On the average all four boulevards studied show through traffic percentages of less than 30 percent with an overall two-way average of 24 percent. Surprisingly during the P.M. peak hour when through traffic might be expected to be the highest, the license check on the four boulevards evidenced consistently lower through traffic ratios. This can be attributed to a surge of Beverly Hills residents returning home, and local employees, shoppers etc. returning to their homes outside Beverly Hills.

However higher through traffic ratios were used in the traffic model to take into account three basic factors that have an impact on the through traffic survey results. The first factor is due to the inevitable errors of recording and transcription that are inherent in license plate surveys and which occurrence tends always to diminish the apparent amount of through traffic. The second condition deals with the fact that the survey was conducted during the afternoon hours and 24-hour total through traffic may be higher because of greater through movements at other times of the day, especially immediately after the close of the business day. A third factor that would reasonably indicate a need for increase of the through traffic ratios is the fact that Olympic and Sunset Boulevard observations were not cross checked with each other or with Wilshire and Santa Monica Boulevards. For example, eastbound traffic entering on Sunset and leaving Beverly Hills on Santa Monica would not be counted as through traffic. The matching of license numbers to reveal through trips applied only to traffic entering and leaving on Olympic or on Sunset, or on or between

Table 10

SUMMARY OF THROUGH TRAFFIC STUDY
ON EAST-WEST ARTERIALS
Beverly Hills, California

ROUTE		PERCENT THROUGH TRAFFIC
Sunset Boulevard	Eastbound	32
	Westbound	18
	2-Way	24
Santa Monica Boulevard	Eastbound	28
	Westbound	29
	2-Way	29
Wilshire Boulevard	Eastbound	21
	Westbound	11
	2-Way	16
Olympic Boulevard	Eastbound	34
	Westbound	25
	2-Way	29
All	Eastbound	28
	Westbound	21
	2-Way	24

Source: City of Beverly Hills normal weekday checks in Dec., 1963,
1:45 P.M. - 5:45 P.M.

Wilshire and Santa Monica Boulevards.

Through traffic on other roadways crossing the cordon line has been estimated based on location and relation to the rest of the traffic carriers and their through traffic ratios. A total of about 105,000 through trips a day is estimated to represent all traffic that has no destination in the area but that uses part of the Beverly Hills road network.

External Trips

Considering that 573,000 is the total number of daily cordon crossings and that 210,000 is the total daily through trips crossings (double the 105,000 through trips) the balance of 363,000 represents the total volume of external trips. Through trip cordon crossings therefore amount to about 36.7 percent of all cordon crossings. External trips (363,000 ADT) represent 63.3 percent of crossings, or 77.6 percent of the total of external and through trips combined (468,000 ADT).

Internal Trips

After having determined external and through trip volumes, only internal trips remain to be estimated. Internal traffic represents the difference between the total trip ends and the external trip ends in each zone. To establish the magnitude of trip ends in each zone, land use has been analyzed and broken into seven categories: residential, commercial, industrial, office buildings, hotels, services, and others. The traffic generation of each land use category has been estimated for each zone and the total trip ends have been determined for each of the 15 areas, based on trip generation indices obtained from studies of other comparable urban areas.

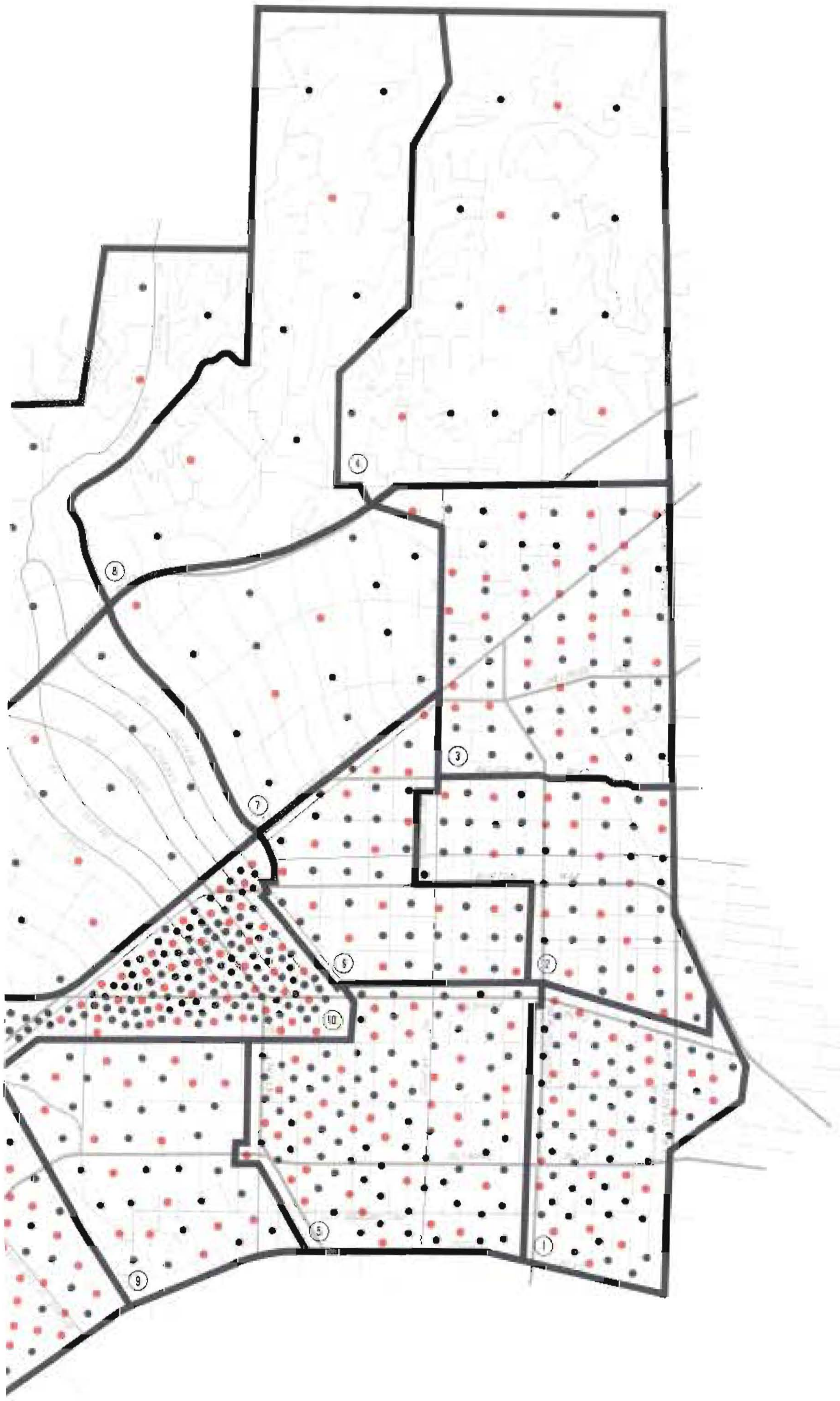
The 15 traffic zones together generate an estimated 490,000 vehicle trips daily. About 200,000 of these trips are related to residential land uses. 90,000 are generated by both commercial and office buildings, and 110,000 attracted by industrial, hotel, services, and other land uses. The total number of trip ends in each zone is obtained by multiplying each land use component by the appropriate traffic generation ratio and by adding all trip ends together. Table 11 contains a summary of trip ends and land use data employed in their derivation.

A wide range of trip ends is attributed to the zones depending on the type and intensity of land use. Figure 15 presents an illustration of the trip end distribution. Zone 10, known as the triangle, has the highest traffic generation with about 121,000 trips per day. Zones 1 and 5 are the next highest generators while zones 2, 3, 6, 9 and 13 all attract about 30,000 trips a day.

As indicated previously 363,000 external trips cross the cordon line and have one end inside the Beverly Hills study area. The difference between the total number of trip ends and the external trips comprises the internal trips. The balance of 127,000 trip ends yields 63,500 internal trips. Internal trips are composed of intrazonal trips and of interzonal trips. Both categories are trips that have both ends in the study area, but the distinction arises from the fact that intrazonal trips have both ends

15

1963 VEHICLE TRIP ENDS IN STUDY AREA



LEGEND

- ZONE BOUNDARY LINE
- (3) ZONE NUMBER
- ● 1000 TRIP ENDS IN 1963
- ● 1000 TRIP ENDS ADDED BY 1980

NORTH

0 1000 2000 3000 4000
MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

Table 11

LAND USE ELEMENTS AND
ESTIMATED TRIP ENDS PER ZONE - 1963
Beverly Hills Study Area

ZONE	LAND USE ELEMENTS							DAILY MOTOR VEHICLE TRIP ENDS
	Number of Dwelling Units	Retail Floor Area (1000 sq.ft.)	Office Floor Area (1000 sq.ft.)	Hotel Floor Area (1000 sq.ft.)	Services Floor Area (1000 sq.ft.)	Industrial Jobs	Retail Jobs	
1	2,220	222	1,140	0	764		295	55,000
2	3,220	32	145	0	357		64	35,000
3	4,600	27	147	0	229		54	43,000
4	560	27	125	100	50		54	12,000
5	4,010	204	1,319	71	937		275	74,000
6	2,930	26	43	0	45	2,250	52	30,000
7	830	0	0	0	0			12,000
8	410	0	0	0	0			6,000
9	2,970	31	125	0	32		62	27,000
10	1,230	1,435	2,937	836	614		1,915	121,000
11	930	0	0	0	0			13,000
12	660	0	0	104	0			10,000
13	1,250	64	300	1,000 rms.				36,000
14	660	0	0	(C-Club)	0			11,000
15	390	0	0	0	0			5,000
	26,870	2,068	6,281	2,111	3,028	2,250	2,771	490,000

in the same zone and that interzonal trips have ends in different zones. The magnitude of intrazonal trips depends on the mix of land uses in each zone and of the zone size. They are estimated to total about 6,500, leaving 57,000 interzonal trips. Intrazonal trips will not be considered in further steps of this study due to their negligible effect on the main arteries of the roadway system.

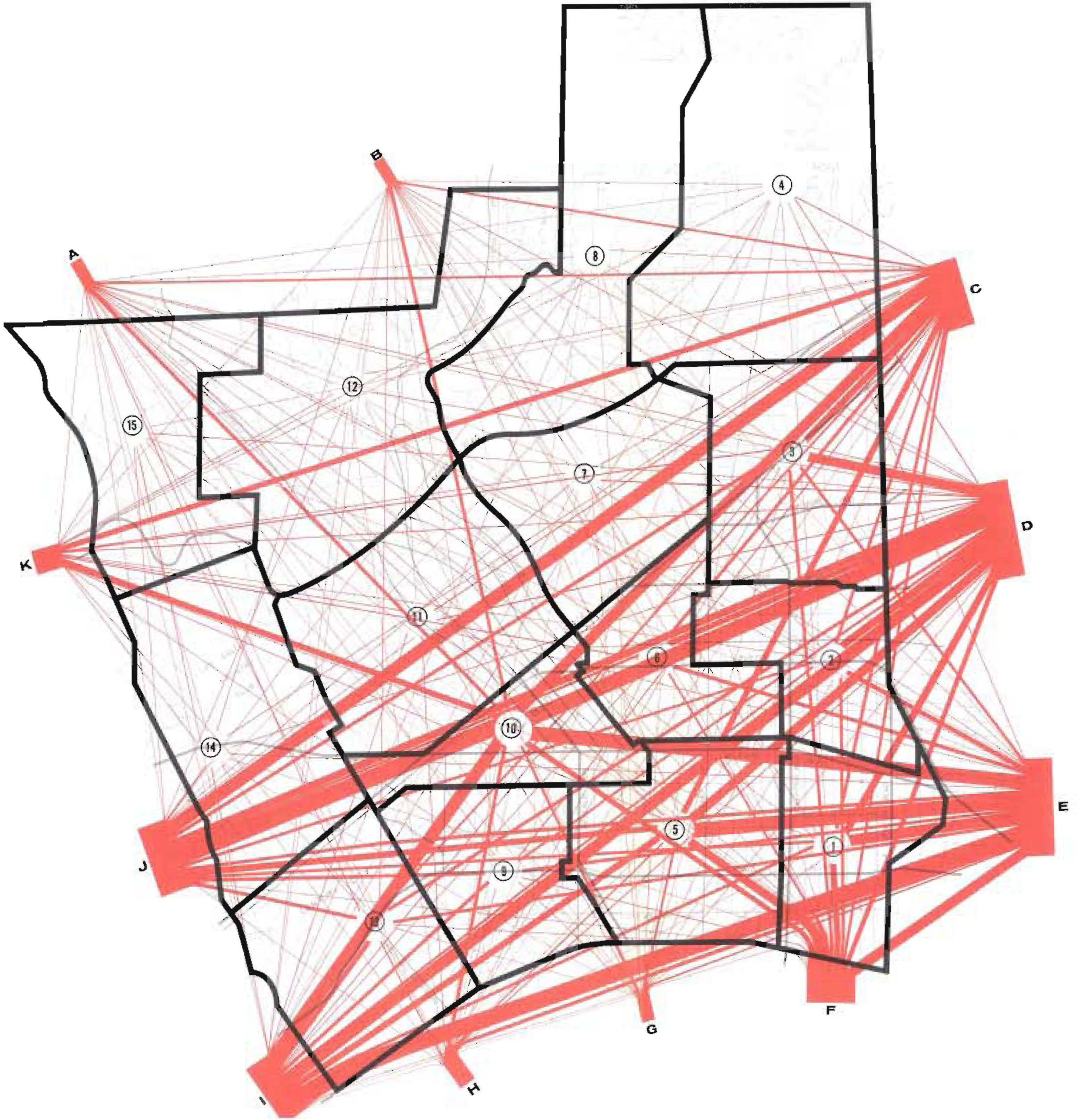
Origin-Destination Pattern - 1963

The preceding analysis established the quantities of trip ends of study area zones. Next, the various trip ends were connected, to form a pattern of trip origins and destinations, required for route assignments.

Because existing origin-destination data obtained by home interviews and roadside driver interviews are not available, a mathematical model was developed and used to estimate trip patterns. The purpose of the model is to simulate all the movements that take place on an average day within, through, to, and from the study area. Once the model is completed, its validity must be checked against the actual traffic volumes obtained by field counts. If too much difference is revealed, adjustment of the model is required.

The pattern of through traffic was derived directly from the through traffic survey and is shown in Table 12 and Figure 16. Once through traffic is subtracted from the total external station crossings, the magnitude of external traffic is revealed.

The external traffic model is basically related to three major ele-



1963
EXTERNAL AND THROUGH TRAFFIC DESIRES

TRAFFIC SCALE

40 30 20 10 5

THOUSANDS OF VEHICLES

LEGEND

ZONE BOUNDARY
(2) ZONE NUMBER
D EXTERNAL STATION

NORTH

0 1000 2000 3000 4000
MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY
Wilbur Smith and Associates

Table 12

1963 AVERAGE DAILY TRAVEL DESIRES
THROUGH TRIPS CROSSING STUDY AREA
Beverly Hills Study Area

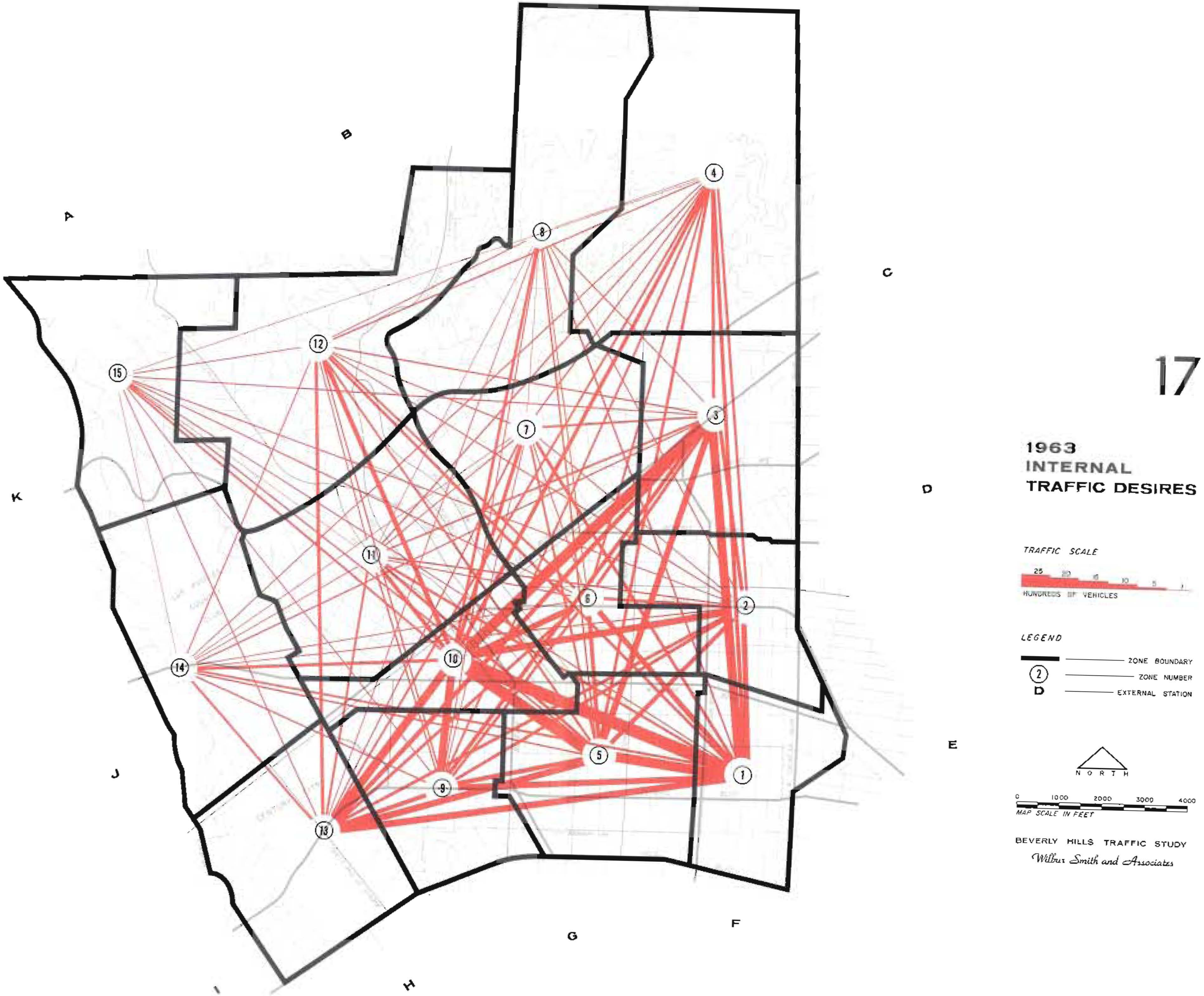
STATION OF ORIGIN OR DESTINATION	A	B	C	D	E	F	G	H	I	J	K
A			2,500	1,000	500	500	100	150	100	150	400
B			2,500	1,000	500	250	30	70	100	150	400
C						2,590	370	740		14,000	5,600
D						4,900	700	1,400	12,200	8,000	2,600
E						11,770	2,230	4,000	17,800	3,400	
F									770	420	
G									110	60	
H									220	120	
I											
J											
K											
Station Volume	5,400	5,000	28,300	31,800	40,200	21,200	3,600	6,700	31,300	26,300	9,000

ments: external trip volumes at the external stations, external trip ends in the 15 traffic zones, and a decreasing attraction rate with increasing travel time between zone and station. An origin-destination tabulation of the 363,000 movements between the 15 zones to each external station is presented in Table 13 and Figure 16. Heaviest traffic desire lines take place between zones of high traffic attraction such as 1, 3, 5 and 10 and busy external stations such as C, D, E, F, J and I. Specific movements may be as high as 15,000 to 18,000 ADT.

The distribution of the 57,000 interzonal trips was based on a gravity model. The total internal trips emanating from a zone were distributed to each other zone directly in proportion to the other zone's attraction and inversely in proportion to the travel time between them.[1] Estimated numbers of work, shopping, and other types of trips were distributed separately. Attraction relates to the appropriate measure of attraction for a trip purpose. For example, the number of jobs in a zone would be a measure of the attraction for work trips; commercial floor area for shopping trips, etc. Table 14 and Figure 17 illustrate the zone to zone movements within the study area. Again, the heaviest traffic desires take place between zones which have substantial concentration of trip ends; namely 1, 3, 5, 10 and 13.

---

1 This method of estimating trip origin-destination distributions is commonly referred to as the "gravity model" and is widely used by planning agencies. It has been proven to be reliable in numerous research studies.



17

1963
INTERNAL
TRAFFIC DESIRES

Table 15

TRIP END GROWTH FACTORS
AND ESTIMATED TRIP ENDS PER ZONE - 1990

Beverly Hills Study Area

ZONE	TRIP END GROWTH FACTORS				DAILY MOTOR VEHICLE TRIP ENDS	
	Residential		Commercial Activity	Employment	Total	Net Growth Index
	Dwelling Units	Trip Ends per D.U.				
1	1.30	1.28	1.38	1.33	79,800	1.46
2	1.30	1.28	1.38	1.00	53,900	1.56
3	1.30	1.28	1.38	1.00	69,200	1.59
4	1.20	1.20	1.38	1.00	16,600	1.37
5	1.30	1.28	1.38	1.40	110,200	1.49
6	1.30	1.28	1.39	1.09	45,900	1.53
7	1.11	1.20	-	-	14,900	1.28
8	1.20	1.20	-	-	7,900	1.39
9	1.30	1.28	1.37	1.00	43,500	1.59
10	1.30	1.28	1.38	1.37	169,300	1.40
11	1.10	1.20	-	-	16,200	1.25
12	1.20	1.20	1.40	-	13,400	1.38
13	5.27	0.76	1.90	1.38	86,100	2.40
14	1.20	1.20	1.40	-	15,500	1.38
15	1.20	1.20	-	-	7,500	1.36
Study Area	1.27	1.08	1.43	1.26	749,900	1.53

to station movements by the average growth factor method. This growth factor is a composite of the external and internal zone growth representing ends of trips passing through a given station. (Locations of outside ends were estimated on the basis of assumed average trip lengths.) Projected land use and traffic growth outside the study area, have been estimated by Wilbur Smith and Associates on the basis of Regional Planning Commission data.

Future internal traffic was determined by applying the gravity model to future trip ends in each zone, as derived from projected land use data.

Origin-Destination Pattern - 1990

Projected through trips for the year 1990, obtained as explained in the preceding paragraph, amount to a total of 207,000. This total amount of traffic represents the total daily traffic desire through the area (see Table 16 and Figure 18).

External traffic desires for 1990 are expected to amount to about 532,000 daily movements. Heaviest traffic will take place between zones with high trip end densities and stations with large volumes, as shown in Table 17 and Figure 18. Movements between zones 1, 3, 5, 10 and 13, and external stations C, D, E, F, I and J will range from 5,000 to 23,000 for each specific movement.

Internal trip desires of 1990, presented in Table 18 and Figure 19, are expected to reach about 94,000 movements a day. Heaviest traffic

Table 13

1963 AVERAGE DAILY TRAVEL DESIRES
TRIPS CROSSING STUDY AREA BOUNDARY
Beverly Hills Study Area

ZONE OF ORIGIN OR DESTINATION	STATION OF ORIGIN OR DESTINATION A	B	C	D	E	F	G	H	I	J	K	TOTAL
1	600	500	3,400	7,300	11,500	6,400	900	600	3,100	3,200	900	38,400
2	200	200	3,300	7,900	4,300	3,300	700	400	2,100	3,100	600	26,100
3	200	200	6,900	9,800	3,700	3,100	600	500	1,300	3,900	1,400	31,600
4	100	100	1,500	1,600	1,000	300	200	100	300	700	400	6,300
5	700	600	6,900	9,800	15,400	8,700	2,200	1,600	6,300	6,600	1,200	60,000
6	200	200	3,800	5,400	3,800	2,100	800	600	1,700	2,600	1,000	22,200
7	100	100	1,500	2,100	1,000	600	200	100	300	1,100	600	7,700
8	100	-	800	700	500	200	100	100	200	200	300	3,200
9	400	300	1,600	2,400	3,400	1,200	900	900	3,100	3,200	800	18,200
10	3,800	3,700	11,500	16,300	15,200	5,600	2,900	3,800	13,800	18,000	5,900	100,500
11	100	100	1,300	1,900	1,000	300	300	300	1,100	1,500	800	8,700
12	100	100	600	900	300	200	100	100	600	1,000	700	4,700
13	1,200	1,200	2,300	3,200	3,000	800	500	1,900	5,100	4,300	1,200	24,700
14	200	200	800	1,100	1,000	300	100	500	1,300	1,700	500	7,700
15	-	-	400	500	300	200	100	200	500	500	400	3,100
TOTAL	8,000	7,500	46,600	70,900	65,400	33,300	10,600	11,700	40,800	51,600	16,700	363,100

Table 14

1963 AVERAGE DAILY TRAVEL DESIRES
TRIPS BETWEEN STUDY AREA ZONES
Beverly Hills Study Area

ZONE OF ORIGIN OR DESTINATION	ZONE OF ORIGIN OR DESTINATION															
ZONES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	-	1,100	1,800	700	2,000	1,000	600	300	1,200	2,500	500	500	1,300	400	200	14,100
2		-	700	500	900	500	200	200	600	1,300	300	200	600	200	200	6,400
3			-	600	1,300	600	400	200	700	2,100	400	300	900	300	200	8,000
4				-	600	400	300	100	400	700	300	300	400	200	100	3,800
5					-	800	400	300	900	2,300	500	400	1,300	300	300	7,500
6						-	200	200	500	1,200	200	400	600	200	200	3,700
7							-	100	200	700	200	200	300	100	-	1,800
8								-	200	500	100	200	200	-	-	1,200
9									-	1,600	300	300	900	300	200	3,600
10										-	800	900	1,700	600	400	4,400
11											-	200	400	200	100	900
12												-	600	200	200	1,000
13													-	400	200	600
14														-	100	100
15															-	-
TOTAL	-	1,100	2,500	1,800	4,800	3,300	2,100	1,400	4,700	12,900	3,600	3,900	9,200	3,400	2,400	57,100

To check the model, all trips crossing a north-south screen line located just east of Rexford Drive (see Figure 14) were determined from actual ground counts and compared to the combined internal, external, and through trips estimated by the model to be crossing the same screen line. This check indicated that the estimated volumes were within 6 percent of the actual ground counts. Thus the accuracy of the traffic model was verified.

Basis for Projection

Projected land use for each zone of the study area, prepared by Real Estate Research Corporation and Eisner-Stewart and Associates (both acting as consultants to the city), supplemented by data from the City Planning Department, provided the basis for future motor vehicle trip generation estimates for each traffic zone. Table 15 summarizes 1990 land use growth indices and corresponding motor vehicle trip generation totals per zone.

Projected through trips have been determined by expanding existing through trips by growth indices varying according to estimated locations of trip origins and destinations. The future population growth predicted by the Los Angeles Regional Planning Commission for each of the zones of origin and destination for a particular through trip component were averaged and applied to the current corresponding volume. Combining all components, the future through traffic was derived.

External traffic was estimated by expansion of the existing zone

1990 EXTERNAL AND THROUGH TRAFFIC DESIRES

TRAFFIC SCALE

40 30 20 10 5

THOUSANDS OF VEHICLES

LEGEND

ZONE BOUNDARY

2 ZONE NUMBER

D EXTERNAL STATION

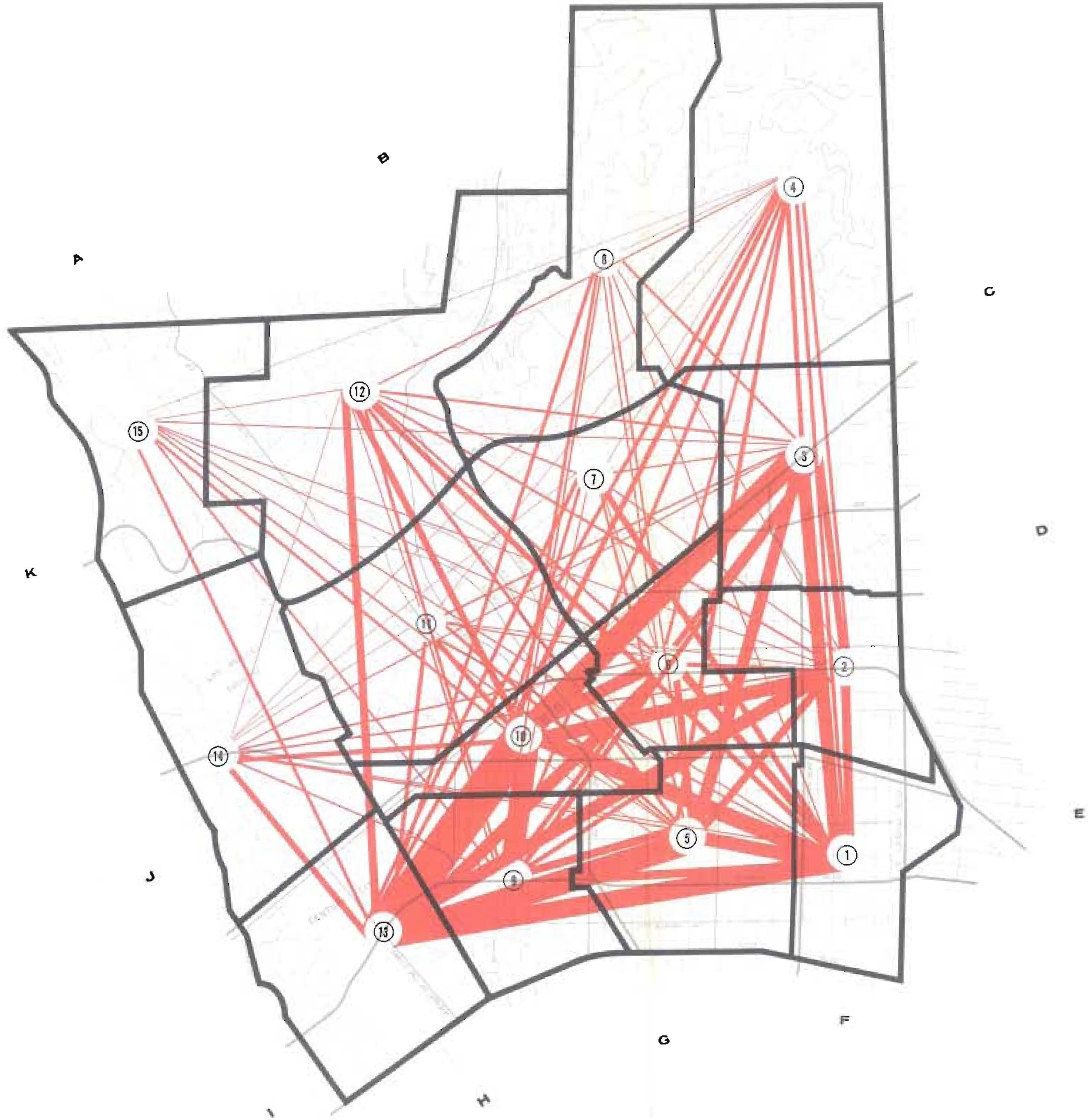
NORTH

0 1000 2000 3000 4000

MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates



1990 INTERNAL TRAFFIC DESIRES

TRAFFIC SCALE

25 20 15 10 5 1

HUNDREDS OF VEHICLES

LEGEND

ZONE BOUNDARY

(2) ZONE NUMBER

D EXTERNAL STATION

NORTH

0 1000 2000 3000 4000

MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

Table 16

1990 AVERAGE DAILY TRAVEL DESIRES
THROUGH TRIPS CROSSING STUDY AREA
Beverly Hills Study Area

STATION OF ORIGIN OR DESTINATION	STATION OF ORIGIN OR DESTINATION										
	A	B	C	D	E	F	G	H	I	J	K
A			4,900	1,640	820	740	250	410	170	330	740
B			4,935	1,640	820	330	165	80	160	330	740
C						8,535	1,230	2,460	1,640	23,000	7,600
D						11,500	1,640	3,280	21,700	16,600	7,700
E						23,800	3,310	5,750	37,300	8,200	
F									1,200	595	
G									200	75	
H									330	170	
I											
J											
K											
Station Totals	10,000	9,200	54,300	65,700	80,000	46,700	6,870	12,480	62,700	49,300	16,780

Table 17

1990 AVERAGE DAILY TRAVEL DESIRES
TRIPS CROSSING STUDY AREA BOUNDARY
Beverly Hills Study Area

ZONE OF ORIGIN OR DESTINATION	STATION OF ORIGIN OR DESTINATION											TOTAL
	A	B	C	D	E	F	G	H	I	J	K	
1	1,200	1,000	5,000	10,800	17,100	8,600	1,300	800	4,800	4,900	1,400	56,900
2	400	400	5,000	12,100	6,600	4,600	1,000	500	3,300	4,900	900	39,700
3	400	400	10,500	15,000	5,700	4,300	800	700	2,100	6,100	2,200	48,200
4	200	200	2,200	2,300	1,400	400	300	100	400	1,100	600	9,200
5	1,400	1,200	10,300	14,600	22,900	11,700	3,000	2,200	9,600	10,100	1,800	88,800
6	400	400	5,700	8,000	5,700	2,900	1,100	800	2,600	4,000	1,500	33,100
7	200	200	2,100	3,000	1,400	700	300	100	400	1,600	900	10,900
8	200	-	1,200	1,000	700	300	100	100	300	300	400	4,600
9	800	600	2,400	3,700	5,200	1,700	1,300	1,300	4,900	5,000	1,300	28,200
10	6,400	6,200	14,700	20,900	19,400	6,500	3,400	4,400	18,200	23,800	7,800	131,700
11	200	200	1,800	2,500	1,400	400	400	400	1,500	2,100	1,100	12,000
12	200	200	100	1,300	400	300	100	100	900	1,400	1,100	6,100
13	2,800	2,800	4,300	6,000	5,700	1,400	900	3,300	9,900	8,300	2,300	47,700
14	400	400	1,200	1,600	1,400	400	100	600	1,900	2,500	700	11,200
15	-	-	500	700	400	300	100	300	700	700	600	4,300
TOTAL	15,200	14,200	67,000	103,500	95,400	44,500	14,200	15,700	61,500	76,800	24,600	532,600

Table 18

1990 AVERAGE DAILY TRAVEL DESIRES
TRIPS BETWEEN STUDY AREA ZONES
Beverly Hills Study Area

	ZONE OF ORIGIN OR DESTINATION															
ZONES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
ZONE OF ORIGIN OR DESTINATION 1	-	1,600	2,500	600	2,400	1,300	500	300	1,600	4,100	400	500	3,700	300	200	20,000
2		-	1,100	600	1,400	700	200	200	800	2,500	200	400	2,400	200	200	10,900
3			-	800	2,200	1,000	400	300	900	4,200	400	500	3,500	300	200	14,700
4				-	700	500	100	100	500	900	100	300	900	100	100	4,300
5					-	1,200	400	300	1,400	3,100	400	600	4,400	300	300	12,400
6						-	200	200	700	2,300	200	400	2,100	300	200	6,600
7							-	-	200	700	-	200	600	100	-	1,800
8								-	200	600	-	-	600	-	-	1,400
9									-	2,900	300	500	3,100	300	200	7,300
10										-	800	1,300	7,100	800	500	10,500
11											-	200	800	100	-	1,100
12												-	1,500	100	100	1,700
13													-	1,000	600	1,600
14														-	-	-
15															-	-
TOTAL	-	1,600	3,600	2,000	6,700	4,700	1,800	1,400	6,300	21,300	2,800	4,900	30,700	3,900	2,600	94,300

movements will take place between zones 1, 3, 5, 10 and 13.

Daily trip ends in all 15 zones together will reach a total of 720,000 in 1990. This is a 47 percent growth over the 1963 total of 490,000.

Table 19 summarizes the trip estimates.

Table 19

SUMMARY OF PRESENT AND FUTURE
DAILY MOTOR VEHICLE TRIP ESTIMATES
Beverly Hills Survey Area

	1963	1990	GROWTH
Study Area Trip Ends	490,000	720,000	47%
Beverly Hills Triangle Trip Ends	121,000	169,000	40%
Century City Trip Ends	36,000	86,000	140%
Through Trips	105,000	207,000	97%
External Trips	363,000	532,000	46%
Internal Trips	63,500	94,000	48%
Cordon Crossings	573,000	946,000	65%

Century City

Covering over 250 acres in zone 13 of the study area, the Century City development (now under construction) comprises a major part of that zone and, when finally developed, will constitute a major traffic generator in the area, with trip ends equal to 50 percent of those generated by Beverly Hills central business district (in 1990). It is situated between Santa Monica Blvd. and Pico Blvd., directly west of the Beverly Hills City Limits. Ultimate development calls for approximately three million square feet of office space, a major retail shopping center, a hotel and over 10,000 residential apartment units, a large theater, and a motel.

Based on the planned ultimate development of Century City, it can be anticipated that over 31,000 automobiles will visit the site daily.[2] Approximately 23,000 parking spaces will be required, with about one-third of these serving apartment areas.

The heaviest traffic movements will occur during the afternoon peak, and should be expected to coincide with the highway peaks in the area. Most of this heavy traffic will be created by the office buildings in the Century City project, augmented by residents returning to the apartment areas. It should be noted that the traffic estimates have assumed a 2-hour period for dispersing the office building employees and approximately 40 percent transit patronage by these people (approximately 2,000 passengers).

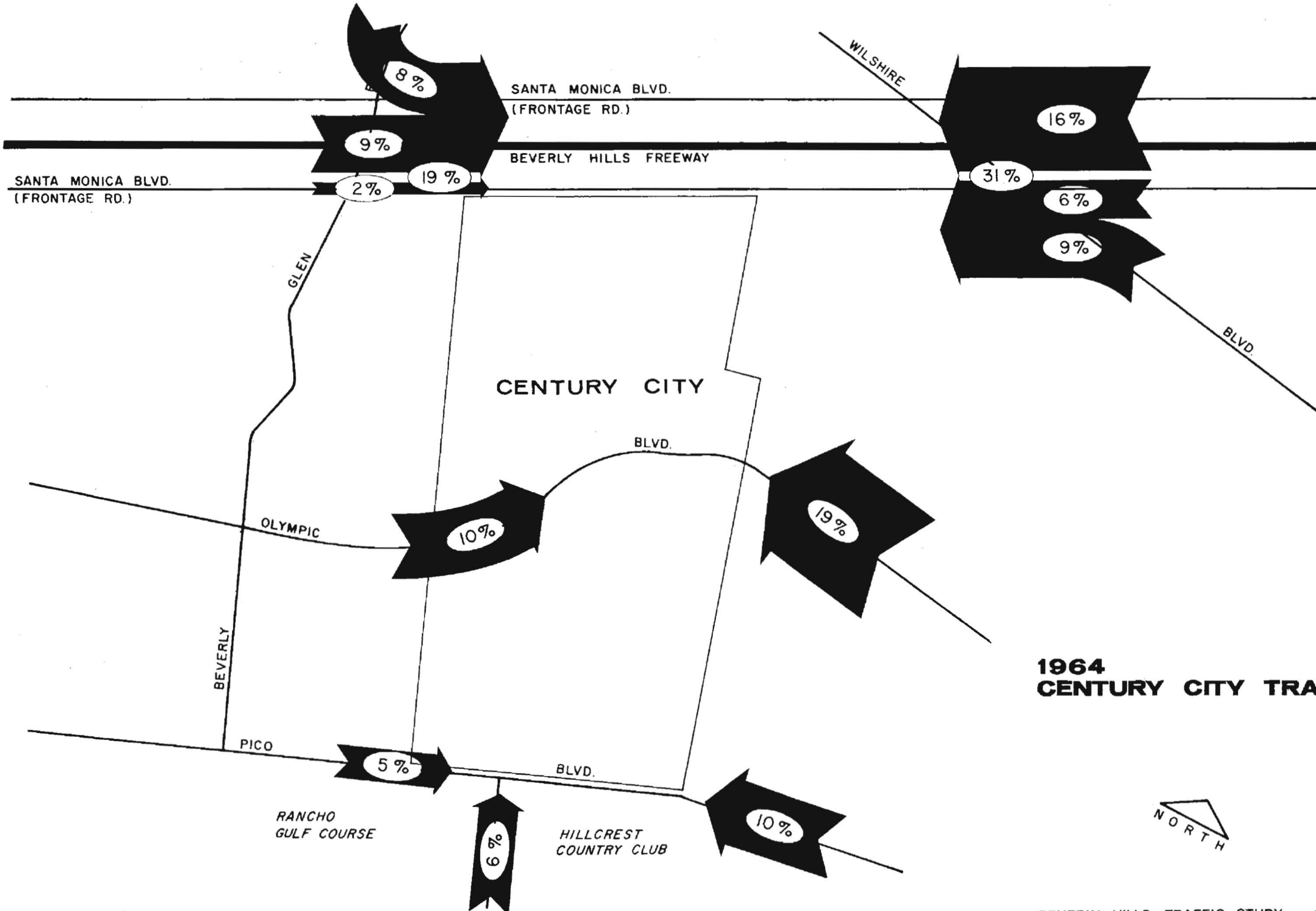
During the initial stages of development, it is anticipated that about half of all site-bound traffic will traverse Beverly Hills, via Santa Monica Boulevard (22 percent), Wilshire Boulevard (9 percent), and

2 Traffic Plan For Century City, 1960, prepared for Webb and Knapp, Inc., by Wilbur Smith and Associates.

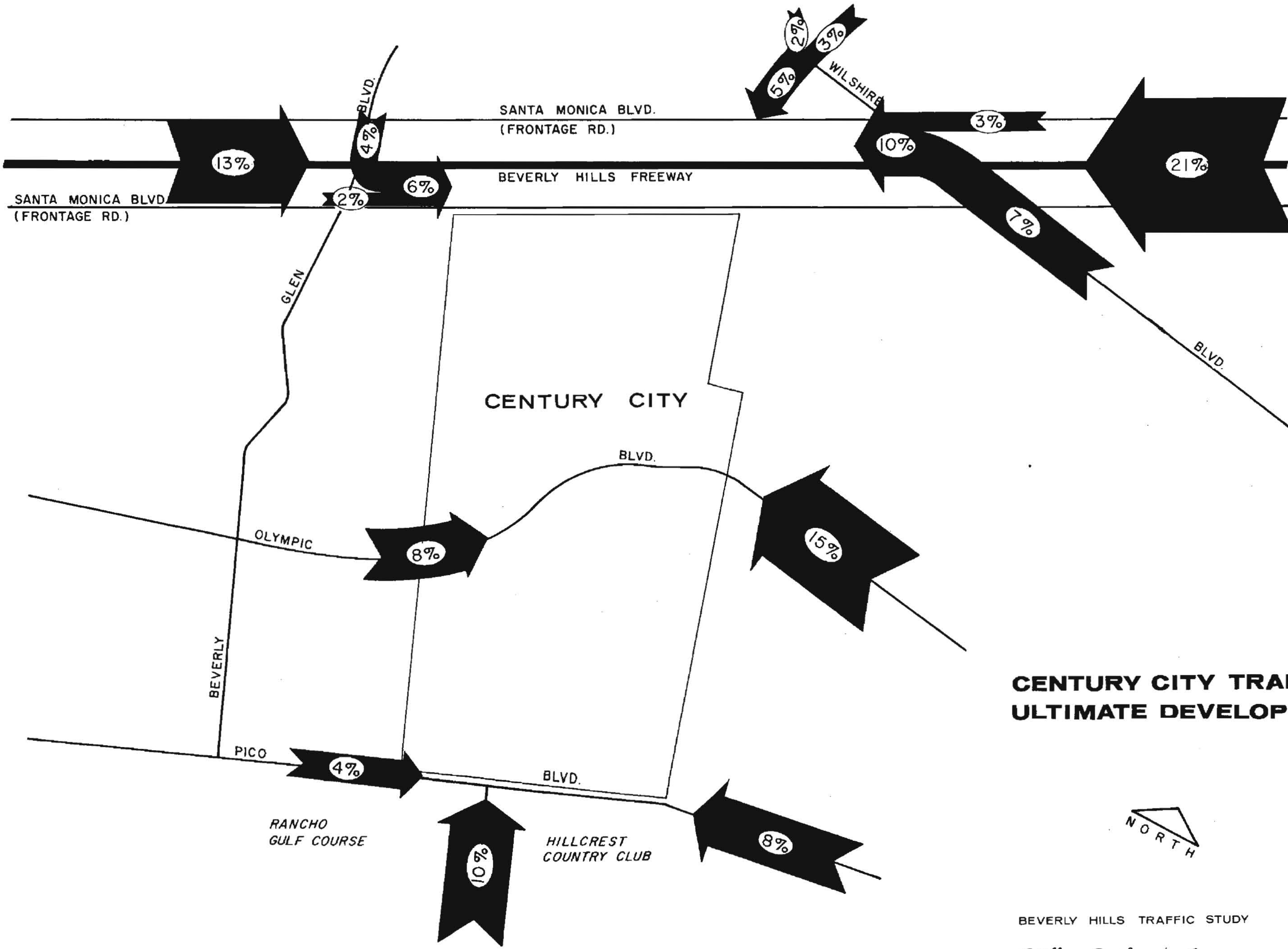
Olympic Boulevard (19 percent). Approximately 29 percent will approach from the west via Santa Monica, Beverly Glen, and Olympic Boulevards, and 21 percent via Pico Boulevard, as shown in Figure 20.

The future distribution of traffic in the Century City zone, of course, will be influenced by the development of freeways in the western Los Angeles area. The traffic distribution developed by Wilbur Smith and Associates as part of the traffic plan for Century City, was based on the assumption that the Beverly Hills Freeway would exist on the Santa Monica Boulevard alignment in this area. The diagram of future Century City traffic distribution, reproduced in Figure 21, demonstrates the continued significance of the heavy traffic to the east of this location.

With the ultimate development of Century City, a significant portion of the anticipated peak hour traffic volumes on the study area street system will be Century City traffic. During the afternoon peak hour, approximately 8,500 vehicles will leave the site, and over 4,800 will enter. Santa Monica Blvd. and the Beverly Hills Freeway will be called on to carry almost 2,000 vehicles eastbound, approximately 25 percent of the total eastbound load anticipated on these two arteries in Beverly Hills. Olympic Blvd. will carry about 1,300 eastbound from Century City, perhaps half of the total directional load on this artery in Beverly Hills. The anticipated traffic volumes on approach roadways during other hours will be less, but will constitute a substantial portion of total study area traffic.



1964 CENTURY CITY TRAFFIC



CENTURY CITY TRAFFIC
ULTIMATE DEVELOPMENT

Chapter V

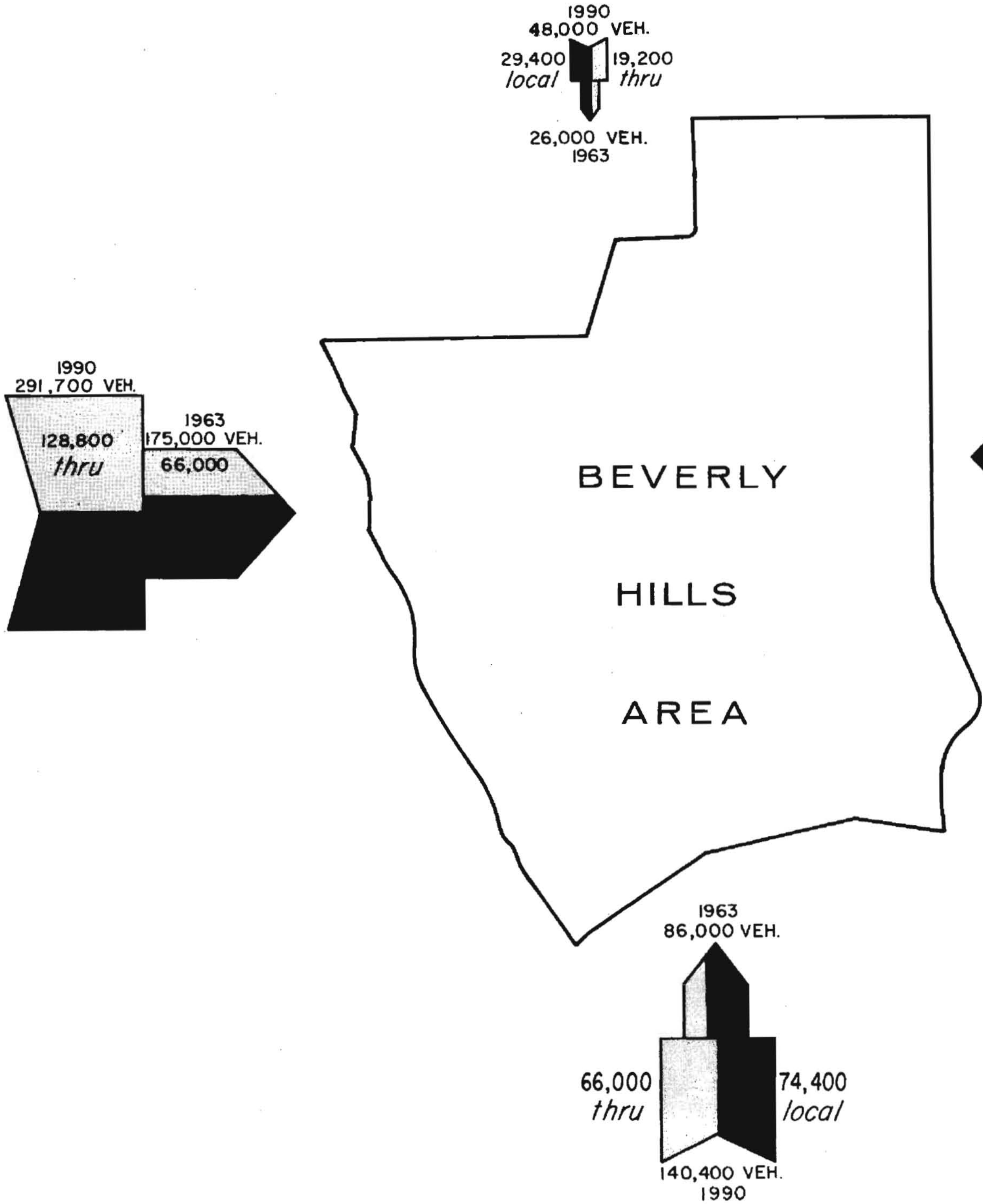
NEED FOR BEVERLY HILLS FREEWAY

Projections of future traffic volumes and patterns of origin and destination definitely establish the need for an east-west freeway through Beverly Hills, as brought out in this chapter.

Corridor Needs

The Beverly Hills east-west traffic corridor may be defined generally as bounded by the mountains on the north and Pico Boulevard on the south. The east-west corridor to the south of this will be served by the Santa Monica Freeway now under construction, and planned to extend west to the Pacific Ocean at Santa Monica (see Figure 2).

A projection of travel desires in the Beverly Hills traffic corridor, illustrated by Table 20 and Figures 8 and 22, shows the need for a considerable increase in traffic capacity in the future. East-west arterials are now loaded to a level that is within the range between practical and possible capacity, meaning that in a very few years the maximum level will be reached, and what is now congestion and driver delay will become stagnation. Through east-west traffic alone will grow from a current estimated volume of 64,000 to 124,000 by 1990. The traffic assigned to the proposed freeway in 1990 (Table 20) would hopelessly overload existing



DAILY TRAFFIC APPROACHING AND LEAVING THE BEVERLY HILLS TRAFFIC STUDY AREA

Table 20

AVERAGE DAILY EAST-WEST TWO-WAY TRAFFIC IN BEVERLY HILLS
AT SCREEN LINE EAST OF REXFORD DRIVE

Route	TRAFFIC TREND 1947 ADT[a]	1953 ADT[b]	1963 ADT[b]	TRAFFIC CAPACITY Pract.[c]	Poss.[d]	ESTIMATED 1990 AVG. DAILY TRAFFIC Sunset Rte.	S.M.Rte.
Sunset Blvd.	22,300	24,000	30,000	19,500	40,000	20,000	30,000
Santa Monica Blvd.(N)	32,500	35,000	46,500	30,500	55,000	55,000	43,000
Burton Way	18,000	17,000	27,100	23,000	42,000	42,000	25,000
Wilshire Blvd.	35,000	35,000	35,000	30,500	55,000	55,000	40,000
Olympic Blvd.	30,000	34,000	40,000	30,500	55,000	45,000	45,000
Local Streets	10,000	10,000	11,000	21,000	30,000	15,000	15,000
Beverly Hills Fwy.				100,000	200,000	84,000	127,000
Diverted to Santa Monica Freeway	-	-	-	-	-	29,000	20,000
Total East-West	147,800	155,000	189,600	255,000	477,000	345,000	345,000
Growth Index	1.00	1.05	1.28	-	-	2.33	2.33

[a] Summer counts reported in A Report Upon Streets, Parking, Zoning, City of Beverly Hills, by Harland Bartholomew and Associates, St. Louis, Mo., 1948.

[b] Counts supplied by City of Beverly Hills.

[c] The practical capacity is defined as the greatest number of vehicles that can pass a given point on a roadway or in a designated lane without the traffic density being so great as to cause unreasonable delay or restriction to drivers' freedom to maneuver under prevailing roadway and traffic conditions.

[d] The possible capacity is the maximum number of vehicles that actually can be accommodated under the prevailing conditions and there will be a continual backlog of waiting vehicles.

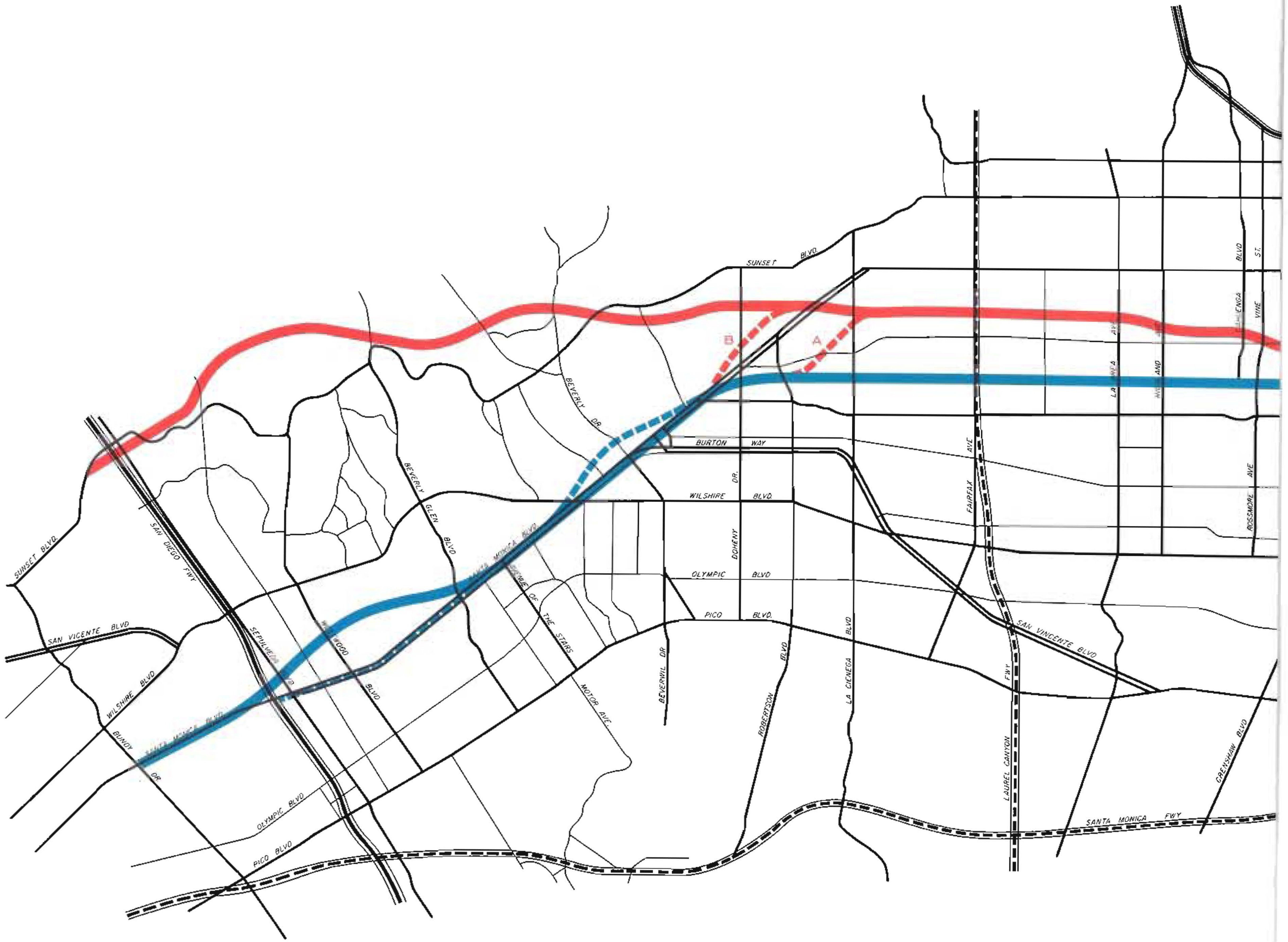
streets without the freeway.

Table 20 illustrates a projection of total corridor volumes crossing a north-south screen line east of Rexford Drive, based on the travel projections discussed in Chapter IV, and assignments to all east-west routes.

Figure 22 illustrates the current and future volume and character of traffic approaching and leaving the Beverly Hills traffic study area (see also Table 21). A 65 percent growth at the eastern edge of the study area is anticipated between 1963 and 1990, the through traffic growing by 95 percent and local traffic (beginning or ending within the Beverly Hills study area) growing by a lesser amount, 45 percent. A similar growth on the western edge is anticipated from 175,400 vehicles, now, to 291,700 in 1990. Growth at the north and south edges will be 88 and 53 percent, respectively.

Alternate Freeway Locations vs. Trip Ends

Figure 23 illustrates alternate freeway route locations now under consideration. Figure 24 illustrates their relationship to locations of estimated current and future trip ends. It is evident that the southern-most routes are most advantageously located with respect to trip origins and destinations, concentrated south of Santa Monica Blvd. Each dot in the figure represents 1,000 motor vehicle trip origins or destinations. The closer the freeway and its access points can be located to these



SUNSET BLVD.
BURTON WAY
WILSHIRE BLVD.
DOHENY DR.
OLYMPIC BLVD
PICO BLVD.
BEVERLY DR.
BEVERLY GLEN BLVD
SANTA MONICA BLVD
AVENUE OF THE STARS
MOTOR AVE.
BEVERWIL DR
ROBERTSON BLVD
LA CIENEGA BLVD
FAIRFAX AVE
LAUREL CANYON FWY
SAN VICENTE BLVD
ROSSMORE AVE
VINE ST.
CRENSHAW BLVD
SANTA MONICA FWY
SAN DIEGO FWY
SEPULVEDA
WESTWOOD BLVD
WILSHIRE BLVD
BUNDY DR
OLYMPIC BLVD
PICO BLVD
A
B

23

PROPOSED BEVERLY HILLS FREEWAY

ALTERNATE ROUTE LOCATIONS

LEGEND

- MAJOR ARTERIAL
- EXISTING FREEWAY
- FUTURE FREEWAY
- BASIC ALTERNATE ROUTE
- BASIC ALTERNATE ROUTE
- BLUE ROUTE VARIATION
- ALT CONNECTIONS OF BASIC ROUTES

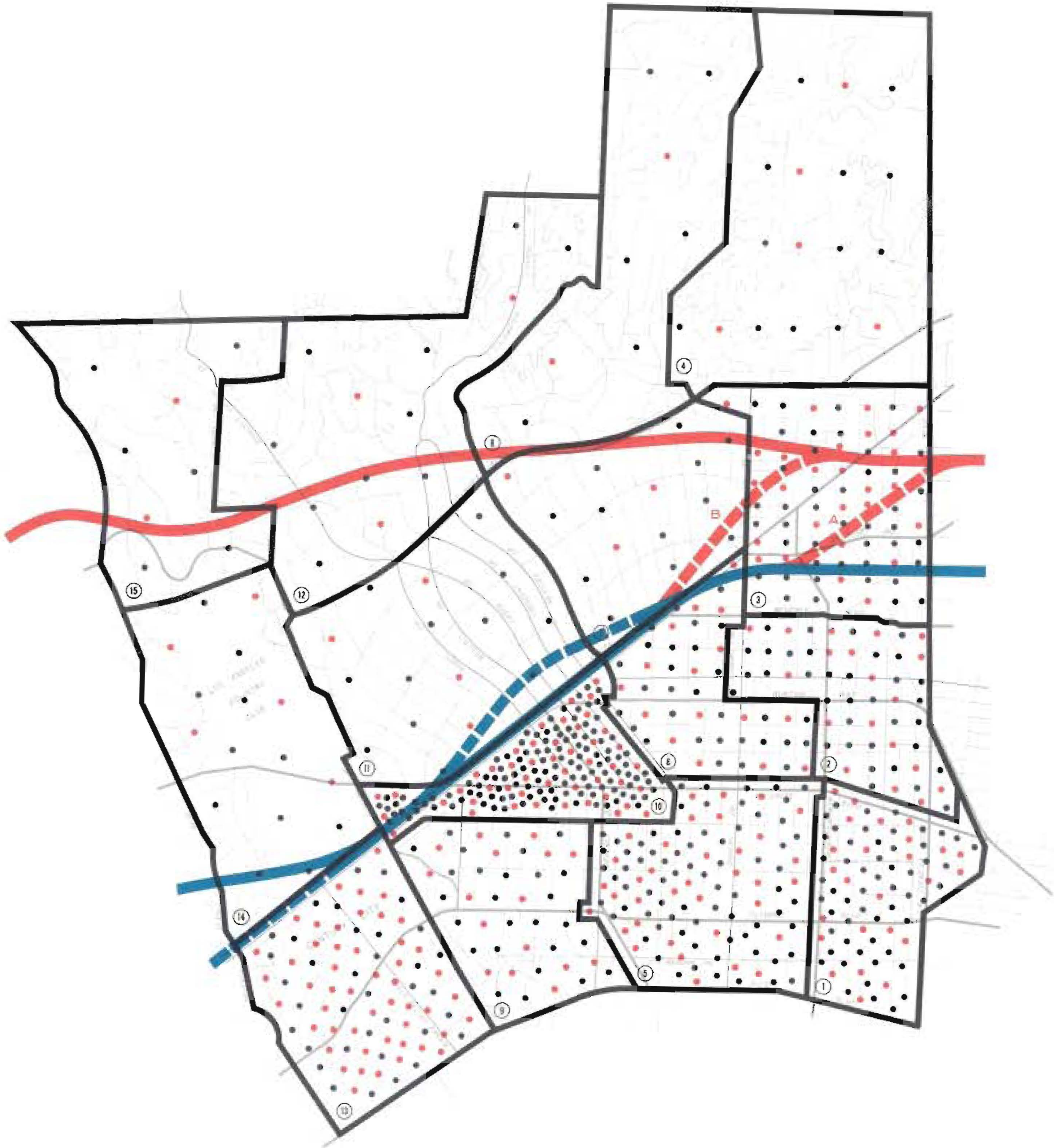
NORTH

0 1 2 3 4 5 6 7

MAP SCALE IN THOUSANDS OF FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates



ALTERNATE FREEWAYS RELATED TO TRIP ENDS

LEGEND

- BASIC ALTERNATE ROUTE
- BASIC ALTERNATE ROUTE
- BLUE ROUTE VARIATIONS
- ALT CONNECTIONS OF BASIC ROUTES
- ZONE BOUNDARY LINE
- (3) ZONE NUMBER
- 1000 TRIP ENDS IN 1963
- 1000 TRIP ENDS ADDED BY 1980

NORTH

0 1000 2000 3000 4000

MAP SCALE IN FEET

BEVERLY HILLS TRAFFIC STUDY

Wilbur Smith and Associates

Table 21

AVERAGE DAILY TWO-WAY TRAFFIC AT BEVERLY HILLS STUDY AREA CORDON LINE
1963 and 1990

EXTERNAL STATION	1963 VEHICLES			GROWTH FACTOR			1990 VEHICLES		
North Cordon Line	Through	Local	Total	Through	Local	Total	Through	Local	Total
A. Bev. Glen & Benedict	5,400	8,000	13,400	1.85	1.90	1.88	10,000	15,200	25,200
B. Coldwater, Etc.	5,000	7,500	12,500	1.84	1.90	1.87	9,200	14,200	23,400
Subtotal	10,400	15,500	25,900	1.84	1.90	1.88	19,200	29,400	48,600
East Cordon Line									
C. Sunset & Sta. Monica	28,300	46,600	74,900	1.92	1.44	1.62	54,300	67,000	121,300
D. Melrose, Beverly, 3rd & S. Vinc.	31,800	70,900	102,700	2.06	1.47	1.65	65,700	103,500	169,200
E. Wilshire, Olympic & Pico	40,200	65,400	105,600	2.00	1.46	1.66	80,000	95,400	175,400
Subtotal	100,300	182,900	283,200	1.95	1.45	1.65	200,000	265,900	465,900
South Cordon Line									
F. LaCienega & Robertson	21,200	33,300	53,700	2.20	1.34	1.70	46,700	44,500	91,200
G. Beverly	3,600	10,600	14,200	1.82	1.34	1.48	6,870	14,200	21,070
H. Beverwil & Motor	6,700	11,700	18,400	1.86	1.34	1.53	12,480	15,700	28,180
Subtotal	31,500	55,600	86,300	2.08	1.34	1.53	66,050	74,400	140,400
West Cordon Line									
I. Pico & Olympic	31,300	40,800	71,800	2.00	1.50	1.73	62,700	61,500	124,200
J. Sta. Monica & Wilshire	26,300	51,600	77,900	1.87	1.49	1.62	49,300	76,800	126,100
K. Sunset	9,000	16,700	25,700	1.87	1.47	1.61	16,780	24,600	41,380
Subtotal	66,600	109,100	175,400	1.98	1.49	1.66	128,780	162,900	291,680
Total	208,800	363,100	570,500	1.98	1.47	1.66	414,030	532,600	946,580

points, the greater service it can be to these trips.

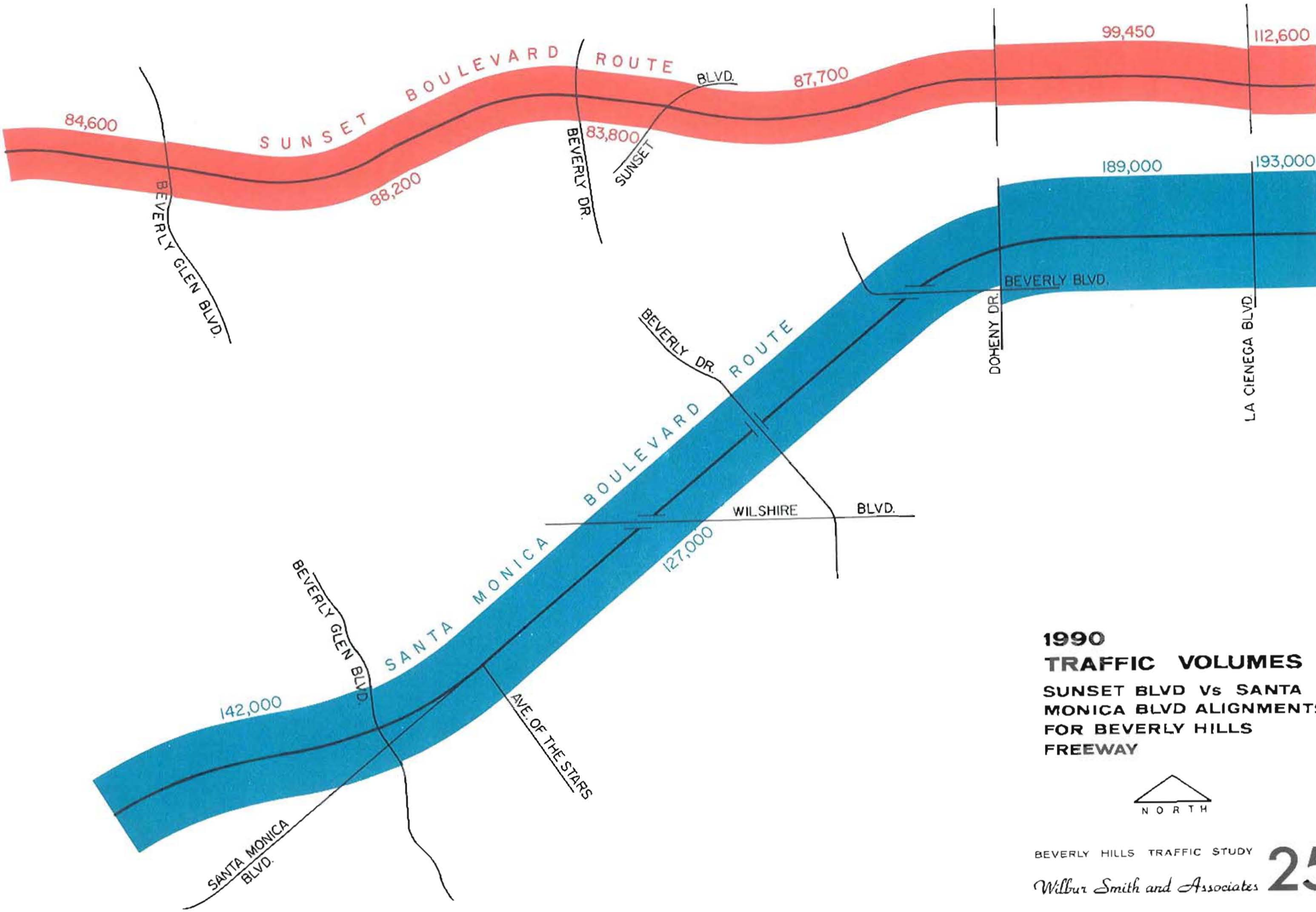
Comparative Traffic Assignments

All trips shown in Tables 16 through 18, which represent the estimated future travel desires within Beverly Hills, have been manually assigned arterial streets and to the alternate freeway routes, taking into account both time and distance for alternate possible travel routes between each zone or station of origin and destination. The resulting traffic volumes on the freeways are shown in Figure 25.

The Sunset Blvd. route would serve considerably less traffic than the Santa Monica Blvd. route, due to the "out of way" location of the northern route with relation to trip desires. Thus, the Sunset route daily volumes would average 84,000 to 88,000 in the City of Beverly Hills, depending on location. However the Santa Monica Blvd. route location would average 127,000 vehicles per day.

Table 20 illustrates anticipated traffic loadings of other arterials near Rexford. All will be carrying capacity traffic loadings. Congestion will be much worse with the Sunset Route as compared with the Santa Monica Boulevard route in view of the lesser diversion of through traffic provided by the former route. It is estimated to carry 65,000 east-west through trips per day, as compared to 87,000 for the more southerly route.

The preferred location will divert about 34,000 more vehicles per day from parallel surface streets than the northerly route, providing a



1990
TRAFFIC VOLUMES
SUNSET BLVD Vs SANTA MONICA BLVD ALIGNMENTS FOR BEVERLY HILLS FREEWAY

much needed relief to Wilshire, Burton Way and Santa Monica Blvd., principally, which would be operating at intolerable levels of traffic congestion otherwise.

Thus the Santa Monica Blvd. routing of the freeway not only benefits its users; it benefits all users of other parallel streets as well as property owners along those streets by relieving traffic congestion along those routes to a greater extent than would be true of the Sunset Blvd. location. Existing east-west streets will be called upon to carry an estimated 232,000 vehicles daily in 1990 if the freeway is located along the Sunset alignment -- but198,000 if it is along the Santa Monica Blvd. alignment, representing a reduction of 34,000 vehicles per day on existing streets -- equivalent to another Wilshire Blvd. in carrying capacity. This would constitute, in effect, a "bonus" of an extra Wilshire Blvd. for Beverly Hills, provided by the preferred alignment but not by the more northerly one.

As shown in Table 20, the Santa Monica location for the freeway will reduce Santa Monica Boulevard to 43,000 ADT in 1990, somewhat less than its present day volume level of 46,500. It would be 55,000 with the Sunset alignment. It will reduce Burton Way from a current 27,100 to 25,000. Burton Way would carry 45,000 with the Sunset alignment. Wilshire will be carrying an estimated 40,000 ADT, slightly more than the 35,000 now being carried, but well below maximum possible capacity. The Sunset route would leave 55,000 on Wilshire -- an intolerable load. Olympic will carry slightly more than at present with either location for the freeway. Both routings are far enough to the north, and the Santa Monica Freeway is close enough on the south to make it immaterial which route is chosen, as far as Olympic is concerned.

The Sunset route would carry only 65,000 east-west through trips per day, as compared to 87,000 for the more southerly route. This is because the Santa Monica Blvd. location is better situated with respect to origins and destinations of through traffic (as well as local traffic).

The effect of the Santa Monica Freeway, now under construction, has been considered as shown by the diversions to this route varying with the alternative locations of the Beverly Hills Freeway. However, the Santa Monica Freeway does not appear to offer much in reducing the traffic load in this corridor. Even if all of the through traffic assigned to the Beverly Hills Freeway (87,000 ADT) were assigned instead to the Santa Monica Freeway, the remaining traffic would still overload the east-west street system, requiring the additional capacity provided by the proposed Beverly Hills Freeway.

Chapter VI

BEVERLY HILLS FREEWAY DESIGN

Cross section design requirements of the proposed freeway will be related to a number of factors, which are discussed in the following sections.

Capacity

The Beverly Hills Freeway will serve in the neighborhood of 100,000 or more trips within the City of Beverly Hills. Thus an 8-lane facility must be provided. It is generally acknowledged that a route of this size can handle 100,000 to 120,000 vehicles per day comfortably and safely without any deterrent to movement or speed, and even higher volumes, if necessary. However, as loads are increased, free flow is affected, resulting in increasing traffic congestion and hazard. Some freeways in the Los Angeles area are now carrying in excess of 200,000 vehicles per day, but only with very undesirable operating conditions at peak periods.

It will be necessary to keep Santa Monica Blvd. open to provide needed capacity in this corridor and to act as a distributor road for the freeway, as indicated by traffic volume assignments discussed in the previous section. This will require the freeway to be depressed or elevated, allowing Santa Monica Blvd. to continue to operate.

Cross Streets

As illustrated in Table 4 and Figure 6, of the 64,900 vehicles approaching Santa Monica Boulevard between Linden and Rexford Drives, from the north and south, 33,100 cross it, representing over half of approaching traffic. Although the 24 lanes available in these cross streets provide ample capacity, enough for 58,000 vehicles daily,[1] by 1990 the north-south movement will have grown by 50 percent to 50,000 ADT, requiring retention of substantially all 24 lanes. (The increase is based on assignments of north-south origin-destination data to an east-west screen line along Santa Monica Boulevard.

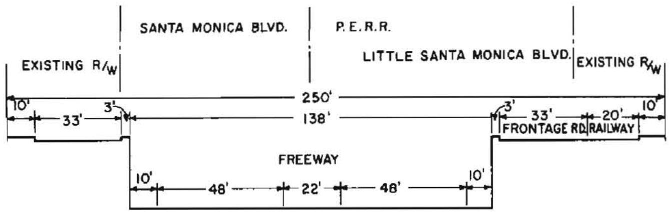
Depressed Section

The freeway must be either depressed or elevated, to permit cross-streets to remain open as well as to permit Santa Monica Blvd. to continue to carry east-west traffic, as discussed previously. It appears to be axiomatic that the freeway be depressed. An elevated freeway would be highly objectionable as a view obstruction and would seriously detract from the residential atmosphere and park-like treatment along Santa Monica Boulevard.

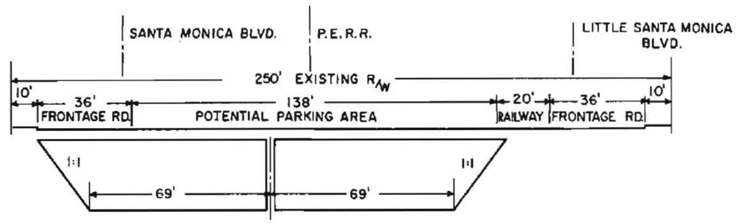
Figure 26 illustrates alternate typical freeway sections that could be provided, and which would meet these requirements.

---

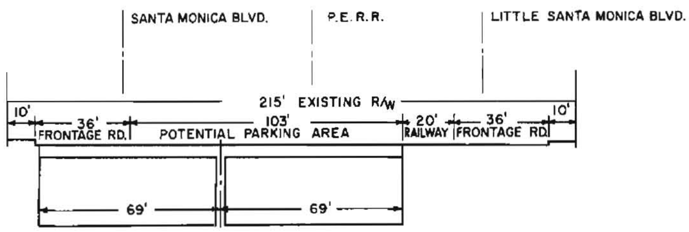
1 Assuming 3 seconds headway, 30 percent "green," 12 percent peak hour factor, and 1.6 directional factor.



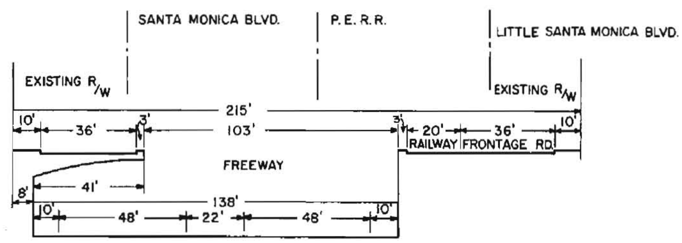
SECTION WEST OF BEVERLY DRIVE



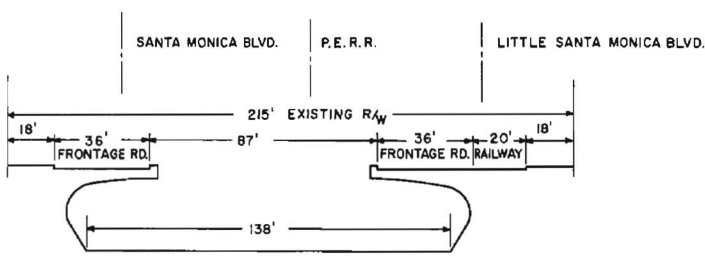
SECTION WEST OF BEVERLY DRIVE
(CUT AND COVER)



SECTION EAST OF BEVERLY DRIVE



SECTION EAST OF BEVERLY DRIVE



SECTION EAST OF BEVERLY DRIVE

TYPICAL FREEWAY SECTIONS

A Covered Freeway is Feasible

The idea of placing major highways completely underground has been considered, discussed, and frequently recommended in various communities as a means of avoiding the taking of property for new routes and for the purpose of burying the sight, sound and smell of the highway. However, there has been little experience with actual construction of this sort. Short sections of freeways or major arterials underground through tunnels, under air fields, etc., and under-water highway tunnels furnish the only experience as to what might be expected with respect to completely covering the Beverly Hills Freeway for a mile or more. A discussion of some of these facilities follows.

Lincoln Tunnel - This facility, operated by the Port of New York Authority, links midtown Manhattan in New York City with Weehawken, New Jersey, and consists of three two-lane tubes under the Hudson River. The center tube is operated one-way in the direction of heavier traffic flow, or as a two-way roadway when flows in both directions are about equal. It is approximately 1.5 miles in length and carried an average daily traffic load of 81,000 in 1962.

Total traffic accidents in the tubes in 1962 averaged 90 per 100 million vehicle miles, reports the Port Authority, about one-third of which involved personal injury. There were no fatalities.

The three tubes were opened in 1937, 1945, and 1957, respectively. For the third tube, ventilation required an initial outlay of about $9 million for equipment and buildings,and electrical power costs average $210,000 annually, 50 percent for ventilation, 50 percent for lighting.

Holland Tunnel - Another New York facility under the Hudson River, this two-tube four-lane highway connects Canal Street in Manhattan with 12th and 14th Streets in Jersey City. It is operated by the Port of New York Authority. It was opened in 1927 and is slightly over 1.5 miles in length. Daily traffic in 1962 averaged 58,500.

Ventilation is accomplished by immense fans housed in four ventilation buildings, two on each side of the river, providing a change of air every 90 seconds.

About 55 accidents per year occur in the tubes, according to the Port Authority, one-third resulting in personal injury and none being fatal, representing a total accident rate of 170 per 100 million vehicle miles.

Baltimore Tunnel-Expressway - A 7,650-foot (portal to portal) twin-tube tunnel under the Baltimore, Md., harbor, is part of 17-mile express throughway. Traffic in 1960 averaged about 35,000 vehicles per day. The tunnel has two 22-foot wide roadway sections with 13-foot maximum overhead clearance. Speed limit is 45 m.p.h. Continuous fluorescent lighting is used. Ventilation is accomplished by 32 fans. An exhaust duct is above and a fresh air duct lies below the tunnel roadway. There are 16 fans (8 exhaust and 8 fresh air blower) in each ventilation building on the second and third floors, providing 38 changes of air per hour. Carbon monoxide analyzers and recorders sample the tunnel air and maintain the CO content below four parts in ten thousand.

Detroit-Windsor Tunnel - This 2-lane underwater roadway, opened in 1930 is approximately one mile in length and carried 10,800 vehicles per day (ADT) in 1963.

Accidents have averaged one per year since its opening, including two fatals in 33 years. No explosive, acid, gasoline or radio-active materials are permitted in the tunnel.

Annual operating cost related to ventilation totals $65,500 ($29,500 salaries, $35,000 heat, water and electricity).

Queens-Midtown Tunnel - This four-lane facility in New York City was opened in 1940 and carried 65,000 ADT in 1962. The 1.2-mile facility cost $46 million to construct. There were 49 accidents in 1962, representing an annual rate of 170 accidents per 100 million vehicle miles.

Brooklyn-Battery Tunnel - Opened in 1950, this 4-lane highway carried 48,100 ADT in 1962. Construction cost was $82.6 million. It is 9,117 feet in length (1.8 miles). Traffic accidents in 1962 totaled 77, a rate of 244 per 100 million vehicle miles.

Cahill Expressway - In Sydney, Australia, a 1,300-foot long four-lane vehicular tunnel has been constructed by the cut and cover method, beneath the Botanic Gardens. The soil over-burden was restored to a minimum depth of 2 feet 6 inches over a reinforced concrete roof and the maximum depth of the roof structure is 5 feet 7 inches. Medians and emergency stopping strips have been provided. Below the expressway is the Metropolitan underground railway (electric).

Associated with the tunnel construction were the problems of providing sufficient ventilation and adequate lighting. For ventilation, two multi-story fan rooms were constructed below ground level, one to serve each half of the tunnel. The southern fan room was built on both sides of the roadway, the division being necessary because of the heavy loading on the electric train tunnels underneath the pavement which would have been imposed by a single large structure. A heavy steel portal frame construction was adopted over the train tunnels to support the fan rooms and the roof system, the footings of the frame being carried down to rail level.

Inside these ventilation rooms four supply and four exhaust fans are located, total capacity amounting to 485 h.p. This system was designed to renew the air supply in the tunnel every 2 1/2 minutes at a circulation rate of 500,000 cubic feet of air a minute. Fresh air is supplied through reinforced concrete ducts below the tunnel pavement feeding into 30 inch diameter pipes with metal outlets about 2 feet above floor level in dwarf walls at the sides of the tunnel. Stale air is exhausted through metal ducts in the ceiling and is drawn between the ceiling and through the diaphragms between and at the end of the beams.

Carbon monoxide detection equipment to be installed comprises two enclosed units located in each of the switchrooms in the northern plant room and the southern plant room (west side). The units will contain a Parson's infra-red gas analyser calibrated to read 0-400 parts per million of carbon monoxide in the air, sequential sampling switch and the necessary solenoid valves and sampling pumps to sample continuously from two sections of the tunnel.

The installation of the carbon monoxide monitoring equipment is considered essential from the safety point of view. In the event of an accident occurring in the tunnel, the traffic build-up would increase the concentration of carbon monoxide, but with the monitoring and recording equipment in operation a check will be made for dangerous concentrations. Without this equipment the fans would be operated manually, most probably for periods in excess of those required to ensure that carbon monoxide concentrations are at safe levels. This would result in an unnecessary increase in power costs.

In lining the tunnel the designers faced problems of fireproofing, rot and corrosion resistance, ease of cleaning, and selection of lightweight materials which would not impose a high dead-load on the roof beams. These requirements were adequately met by the use of aluminum sheeting for the ceiling and ceramic tiles for the wall lining.

The ceiling in the tunnel consists of 18-gauge structural aluminum sheeting attached to aluminum clamps at 8-ft. centers bearing against the bottom flanges of the prestressed concrete girders. This construction is light in weight (less than the specified 20 lb. per square foot) and of pleasing appearance. It will support a live load of 800 lbs. per square foot, in addition to the light fittings and metal exhaust ducts. In overcoming the problem of light reflectivity of the ceiling, for excessive reflection would be a danger to motorists, the aluminum sheeting was given a shot-blasted finish. This was followed by a stucco embossing which breaks the sheet face into a non-reflecting surface. A total quantity of 65 tons of aluminum sheeting, clamps and various extruded sections was used in the ceiling.

The tunnel is lighted by 4,050 fluorescent tubes placed in specially fabricated luminaires in the ceiling. Lighting concentration is heavy at both entrances and reduces to uniform density between the fan rooms. The system was designed by the Sydney County Council acting as consultants to the City Council. The technical information on which the design was based was supplied by the Street Lighting Advisory Committee. In the event of a major power failure affecting the system an emergency plant has been installed to come into operation immediately and to provide sufficient lighting for traffic to use the tunnel without danger. The main system has been designed with regard to the anticipated traffic speed on the Expressway and the time required for a driver's eyes to become accustomed to the changed conditions on entering the tunnel. For night operation the light concentration is reduced.

The tunnel walls are tiled with 6 inch square, white, matt-finish, glazed ceramic tiles, these being the type recommended by the Street Lighting Advisory Committee as most suitable for lighting conditions.

The only maintenance required on the walls will be an occasional wash to remove the exhaust deposits from motor vehicles.

If a fire occurs in the tunnel a flashing yellow signal operates from the fire alarm system at the tunnel's two portals for 3 seconds followed by a red signal and a neon sign indicating "STOP." An automatic sprinkler system has been provided as well as a large capacity fire main with hydrants placed at 200-ft. intervals. Vehicles carrying explosives or inflammable liquids are not permitted to use the tunnel but must detour via Macquarie Street to avoid the possibility of being the accidental cause of a fire in the tunnel.

<u>Safety</u>

Traffic operation in tunnels appears to be as safe as that on conventional freeways and considerably safer than that on conventional city streets according to accident records, as illustrated in Table 22. It is reasonable to believe there would be a better chance of accident reporting in tunnels where attendants are on duty to collect tolls or maintain and supervise lighting and ventilation equipment. This fact would tend to strengthen the relative safety of tunnels, based on reported accident data. Safety factors probably stem from the unusual nature of tunnels, putting the driver "on his guard," as well as the surveillance by tunnel operating personnel.

<u>Parking Over the Freeway</u>

If the proposed Beverly Hills Freeway is constructed as an under-

Table 22

COMPARISON OF TRAFFIC ACCIDENT RATES
Tunnels, Freeways, and Arterials

FACILITY	ADT	YEAR	100 MILLION VEHICLE MILES	TOTAL ACC.	FATAL ACC.	RATE PER 100 M.V.M. Total	RATE PER 100 M.V.M. Fatal
Detroit-Windsor Tunnel	10,800	1963	0.039	NA[1]	NA	NA	NA
Queens-Midtown Tunnel	65,000	1962	0.286	49	NA	170	NA
Brooklyn-Battery Tunnel	48,100	1962	0.317	77	NA	244	NA
Holland Tunnel	58,500	1962	0.320	55	0	170	0
Lincoln Tunnel	81,000	1962	0.444	40	0	90	0
Posey Tube	31,100	1963	0.078	13	0	166	0
Caldecott Tunnel	47,700	1963	0.125	22	0	176	0
Urban Freeways in U.S.						186	2
Urban Arterials in U.S.						526	4
Urban Freeways in California						154	2
Urban Arterials in California						523	3

[1] NA: Not available.

Note: U.S. rates reported in Future Highways and Urban Growth, Wilbur Smith and Associates.

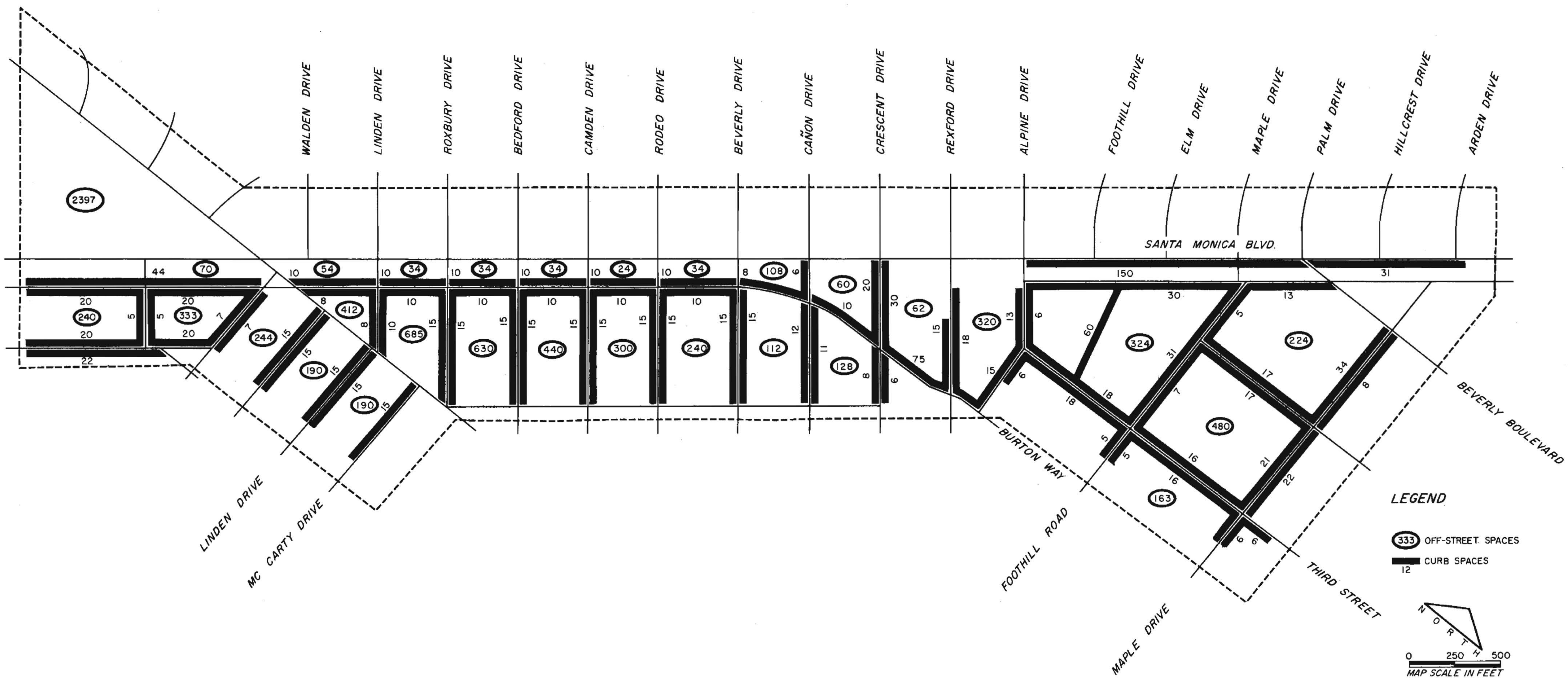
ground facility, it would be possible to provide automobile parking spaces over the freeway and between the two one-way roadways of reconstructed Santa Monica Boulevard.

An investigation of the need for such parking spaces was made, and a summary of the findings and conclusions follows.

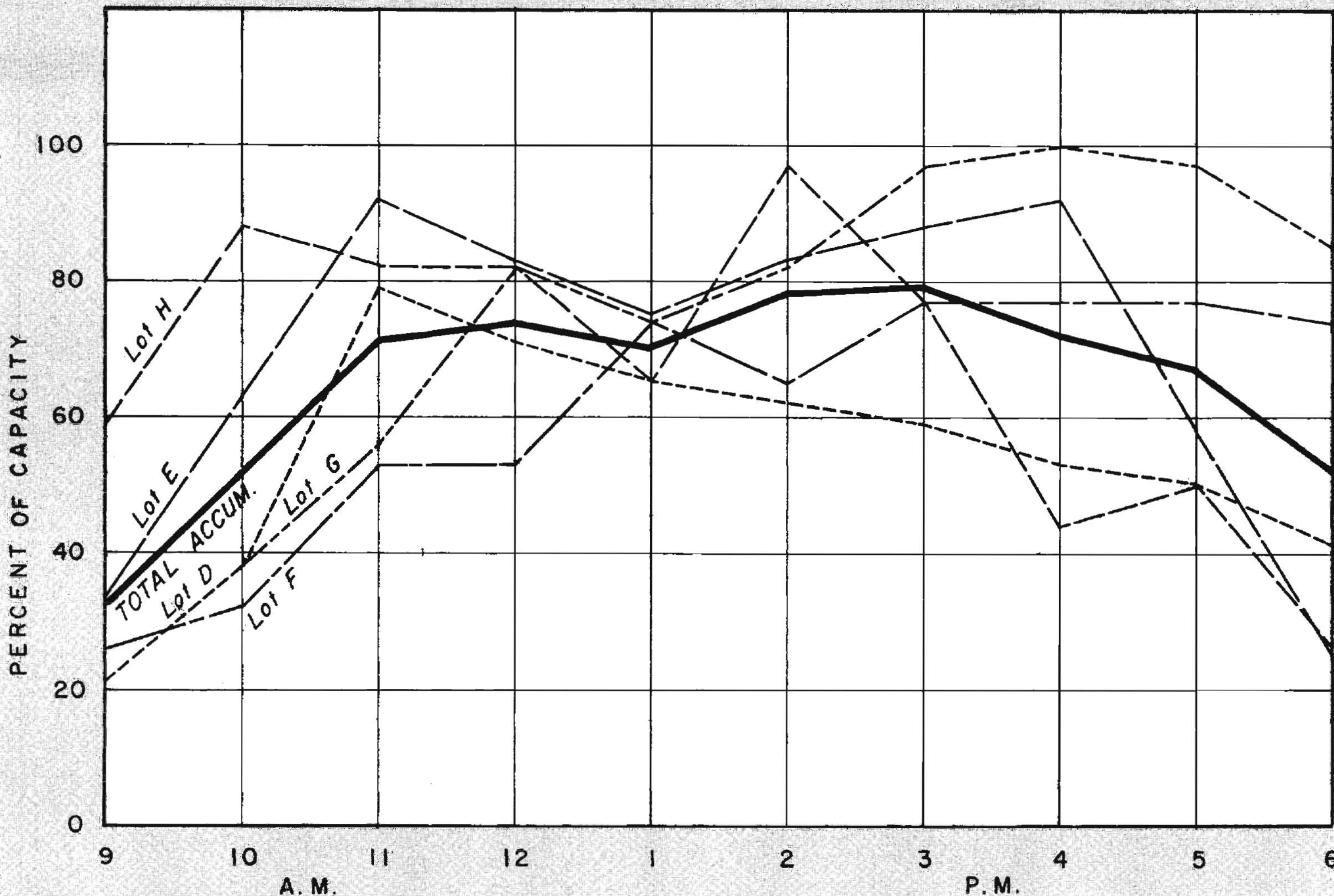
Inventory - The influence area of the proposed Beverly Hills Freeway, from the standpoint of properties within a reasonable walking distance of parking space over the freeway, is shown by Figure 27. The survey area's western part is mostly commercial; the eastern part is industrial.

The current supply of parking is 8,155 spaces in the commercial area and 1,740 spaces in the industrial zone (Table 23).

Parking Accumulations in the Commercial Area - A special check of parking accumulations was made by the city on Tuesday, August 27, 1963, in the five public parking lots located between the north and south Santa Monica Roadways adjacent to the Pacific Electric tracks between Linden Drive and Beverly Drive. The results of this check are tabulated in Table 24 and illustrated in Figure 28. Practical saturation (over 85 percent) is indicated during peak periods in three out of the five lots. (85 percent peak occupancy is considered as practical capacity for the average parking lot catering to short-term parkers.)



CURB AND OFF - STREET PARKING INVENTORY



HOURLY PARKING ACCUMULATION

P.E. Railroad Parking Lots - August 1963

BEVERLY HILLS TRAFFIC STUDY
Wilbur Smith and Associates

Table 23

1963 PARKING SPACE INVENTORY
PROPOSED BEVERLY HILLS FREEWAY VICINITY

LOCATION	TYPE DISTRICT	TYPE PARKING	SPACES
West of Alpine Drive	Commercial	Curb	780
		Off-Street	7,375
		Subtotal	8,155
East of Alpine Drive	Industrial	Curb, 10-Hr. Meters	415
		Curb, 2-Hr. Meters	134
		Off-Street	1,191
		Subtotal	1,740
Total Area		Total Curb	1,329
		Total Off-Street	8,566
		Total	9,895

Table 24

HOURLY PARKING ACCUMULATION AND PERCENT OF CAPACITY
PE RAILROAD PARKING LOTS, TUESDAY, AUG. 27, 1963
Beverly Hills, California

TIME	BETWEEN LINDEN AND ROXBURY 34 Spaces		BETWEEN ROXBURY AND BEDFORD 34 Spaces		BETWEEN BEDFORD AND CAMDEN 34 Spaces	
	Accum.	Pct.	Accum.	Pct.	Accum.	Pct.
9:00 A.M.	20	59	7	21	9	26
10:00	30	88	13	38	11	32
11:00	28	82	19	56	18	53
12:00	28	82	28	82	18	53
1:00 P.M.	22	65	25	74	25	74
2:00	33	97	28	82	22	65
3:00	26	77	33	97	26	77
4:00	15	44	34	100	26	77
5:00	17	50	33	97	26	77
6:00	9	26	29	85	25	74

TIME	BETWEEN CAMDEN AND RODEO 24 Spaces		BETWEEN RODEO AND BEVERLY 34 Spaces		TOTAL 160 Spaces	
	Accum.	Pct.	Accum.	Pct.	Accum.	Pct.
9:00 A.M.	8	33	7	21	51	32
10:00	15	63	13	38	82	51
11:00	22	92	27	79	114	71
12:00	20	83	24	71	118	74
1:00 P.M.	18	75	22	65	112	70
2:00	20	83	21	62	124	78
3:00	21	88	20	59	126	79
4:00	22	92	18	53	115	72
5:00	14	58	17	50	107	67
6:00	6	25	14	41	83	52

Overall, the peak occurred about 3:00 P.M. when 126 cars were observed, filling 79 percent of the spaces.

Table 25 illustrates a count of parked vehicles observed from aerial photographs taken in November, 1963, in certain of the parking lots visible from the air. East of Wilshire Blvd. (in the triangle) the spaces were filled to practical capacity, 87 percent. The five lots adjacent to the P.E. tracks were at 92 percent, higher than in the August check.

Parking Accumulations in the Industrial Area - Checks in this area were made by Wilbur Smith and Associates on Monday, February 17, and Friday, February 21, 1964. The 10-hour spaces along Santa Monica Boulevard South showed 97 percent average occupancy whereas the 2-hour spaces were only 40 percent occupied.

Demand - The 1963 parking demand for the commercial area was estimated on the basis of the building floor areas reported by Eisner-Stewart and Associates (planning consultants to City of Beverly Hills). As shown in Table 26, a current demand for 8,089 spaces is estimated, at the rate of 3 spaces required per 1,000 square feet of building floor area. (This ratio has been observed in numerous studies by Wilbur Smith and Associates.)

Demand for the industrial area in 1963 is calculated to be 1,800 spaces. This number is based on an estimated 2,000 people employed in this zone and a demand of 0.9 parking spaces per employee.

Table 25

OFF-STREET PARKING ACCUMULATIONS SOUTH OF SANTA MONICA BOULEVARD
BASED ON AFTERNOON AERIAL PHOTOS, NOVEMBER, 1963
PROPOSED BEVERLY HILLS FREEWAY VICINITY

LOCATION OF LOTS[a]	VEHICLE ACCUMULATION	PARKING SPACES CAPACITY	ACCUMULATION PERCENT OF CAPACITY
A. West of Wilshire Blvd.			
City limits to Roxbury Dr.	465	724	64
B. East of Wilshire Blvd.			
Roxbury Dr. to Bedford Dr.	174	193	90
Bedford Dr. to Camden Dr.	205	271	76
Camden Dr. to Rodeo Dr.	215	247	87
Rodeo Dr. to Beverly Dr.	299	331	90
Beverly Dr. to Canon Dr.	205	234	88
Canon Dr. to Crescent Dr.	127	153	83
Crescent Dr. to Rexford Dr.	394	440	90
Subtotal	1,619	1,869	87
P.E. Parking Lots Between Two Santa Monica Roadways	147	160	92

[a] Includes only the area covered in photographs.

Table 26

ESTIMATED 1963 PARKING DEMANDS IN COMMERCIAL AREA
BEVERLY HILLS FREEWAY VICINITY

TYPE BUILDING		DEMAND (spaces)
Commercial	(1,346,000 sq. ft. floor area)	4,038
Office	(1,241,000 sq. ft. floor area)	3,723
Residential	(164 Dwelling units)	328
	Total	8,089

Factors: 3 spaces/ 1,000 sq. ft.
2 spaces/ Dwelling unit

Demand for the commercial area in 1990 is based on a 1.40 growth factor (see Chapter IV). It follows that at that time 11,330 spaces will be needed. The 1990 demand for the industrial area was obtained by using a 1.1 growth factor as proposed by Eisner-Stewart and Associates, yielding a figure of 1,980 spaces.

A comparison of supply and demand is made in Table 27. According to the estimates summarized in this table, it may be concluded that current parking supply is in approximate balance with demand. This conclusion is supported by the near-capacity accumulations measured in accumulation studies discussed previously.

It is estimated that in 1990 there will be a substantially increased parking demand. The future demand is not predicated upon the growth of the City of Beverly Hills alone. Of prime importance is the estimated growth of the commercial area, predicted at 40 percent, re-

Table 27

ESTIMATED PRESENT AND FUTURE PARKING SPACE
SUPPLY, DEMAND, SURPLUSES AND DEFICIENCIES
BEVERLY HILLS FREEWAY VICINITY

LOCATION	1963 SUPPLY	1963 DEMAND	DIFFERENCE	1990[b] SUPPLY	1990 DEMAND	1990 DEFICIENCY
Commercial Area	8,155	8,089	66 Surplus[a]	7,765	11,330	3,565
Industrial Area	1,740	1,800	60 Deficiency	1,515	1,980	465

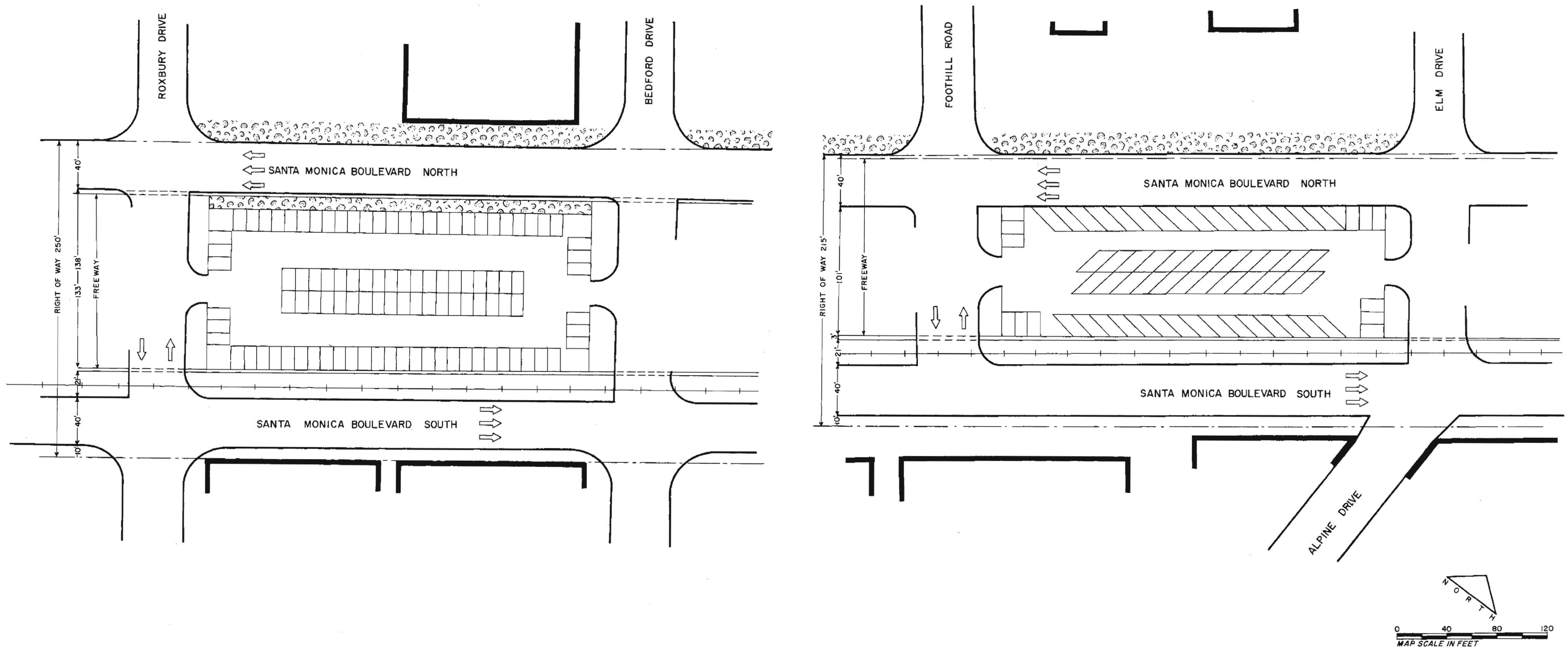
[a] Assuming completion of the 412-space garage at Linden and Wilshire Blvd.
[b] It is assumed that half the existing curb spaces will have been lost by 1980.

sulting in a future deficiency of 3,565 spaces (Table 27).

This deficiency is based on an assumed 50 percent loss in curb spaces due to traffic needs, and no increase in off-street capacity. Obviously it must be anticipated that additional off-street spaces may be provided by private or public enterprise in this area. A good portion of this will probably be constructed as an integral part of new building construction (city building codes now require provision of about 4 spaces per 1,000 square feet in connection with new construction). However the loss of curb spaces, the loss of spaces due to freeway construction, and the need for new spaces due to increased patronage of existing buildings are important deficiencies to be considered. Curb space loss in the commercial area will aggregate in the neighborhood of 400 stalls, it is estimated.

A freeway along Santa Monica Blvd. would eliminate about 400 parking stalls between Wilshire Boulevard and Alpine Drive. However it would also eliminate several buildings with a total square footage of 66,000 and estimated 200-space demand generated by these buildings, thus resulting in a need to replace only a net 200 space loss. Combining this 200 with the anticipated 400 curb space loss in the commercial area immediately adjacent indicates a need for 600 additional spaces without taking account of increased demand in existing buildings, and assuming all new buildings would have integral parking capacity to take care of their added demands.

Parking over a "cut and cover" freeway could provide approximately 704 new spaces, or 304 more than existing today in the total right-of-way of Santa Monica Blvd. adjacent to the commercial area, thus satisfying the 600-space shortage. Figure 29 illustrates possible layout patterns for such facilities, which would be conveniently located with respect to the Santa Monica Blvd. access roadways and would cost very little to provide, assuming the freeway is covered. Such parking space would be located advantageously for the users from the standpoint of both vehicular access and proximity to the commercial area. The walking distance to the center of the survey area is 450 feet, a distance now being walked by approximately 30 percent of the Beverly



PARKING LAYOUT OVER FREEWAY

Hills parkers[2], and much of the area, of course, will be closer to the proposed parking facilities.

Parking over the freeway adjacent to the industrial area would seem to be advantageous, also, in view of a 465-space deficiency predicted for 1990, assuming a 10 percent increase in employee parking demand here. Area over the freeway could provide approximately 150 spaces on one level (Table 28).

Eventual development of these facilities as parking structures may be warranted, if the parking demand justifies.

Table 28

EFFECT OF BEVERLY HILLS FREEWAY ON PARKING SPACE SUPPLY ASSUMING PARKING PROVIDED OVER FREEWAY

COMMERCIAL AREA	INDUSTRIAL AREA	TOTAL
Freeway Construction Eliminates 400 spaces + 200 demand,[a] a net 200 space loss	Freeway Construction Eliminates 150 Spaces	350 space loss
Possible to Add Over Freeway On one level - 704 spaces	Possible to Add Over Freeway On one level - 300 spaces	1,004 space gain
Gain - 304 spaces, or 504 effective spaces	Gain - 150 spaces	Total - 654 space gain

a Buildings to be demolished now generate 200-space demand which will be lost.

2 Wilbur Smith and Associates, A Parking Study for Beverly Hills, 1956

Chapter VII

LIGHTING, VENTILATION, AND ACOUSTICS OF COVERED FREEWAYS

Discussed in this chapter are the physical problems related to use and operation of a possible covered freeway or tunnel section in Beverly Hills. Safe and efficient use of such a facility would be closely correlated with the provision of lighting and ventilation adequate to meet the varying needs of traffic and the changing conditions related to season, climate, and time of day.

Lighting Requirements

One of the principal technical problems in the successful illumination of a tunnel in this sunny clime will be the entrance and exit illumination. Passage from the bright light of open skies to the artificially illuminated tunnel and then back to the natural light can present a serious visual problem to the users of the facility if sufficient compensation is not provided by means of varying luminous intensities commensurate with the existing atmospheric conditions and location in the tunnel. It is not sufficient to provide only a brightly lighted interior. The physiological requirements of the human eye in its response to changes in lighting levels must be taken into account. Automatic switching arrangements controlled by light sensors have been used together with related entrance and exit louvered skylights to solve this problem in certain existing tunnels. Sufficient knowledge exists to make it possible to illuminate a tunnel in this location in such a manner as to offer the barest minimum of problems, related to human sight, as a result of the need for artificial interior lighting.

The Illuminating Engineering Society describes the tunnel lighting problem as follows[1]:

"Underpasses and Tunnels - Underpasses and tunnels may require special treatment, depending on length of roadway and local conditions. Lighting may be needed for day as well as night use of long tunnels. In general the night illumination should be at least 50 percent greater than that recommended for the connecting street or highway, or for a roadway carrying the same volume of traffic. For day-time operation the entrances should have a supplementary lighting system. The purpose of supplementary lighting is to avoid an abrupt change between the several thousand footcandles of daylight and the few footcandles in the tunnel. Such an abrupt change temporarily reduces the motorist's ability to see, until his eyes have become adapted.

In general, vehicular tunnels involve many special design features not common to streets and highways. For this reason, lighting

1 American Standard Practice for Street and Highway Lighting, 1953, Illuminating Engineering Society, New York.

by the conventional street lighting methods and equipment is not satisfactory; and the services of an experienced street lighting engineer will be advisable in arriving at an effective solution."

According to standards of the Institute of Traffic Engineers, Illuminating Engineering Society, and American Standards Association, Table 29 presents the minimum average footcandles of illumination which should be provided at a tunnel entrance (assuming 70 percent reflectance of walls and ceiling). The eye adaptation time relates to the travel time when entering the tunnel.

Table 29

DAYTIME LIGHTING REQUIREMENTS AT TUNNEL ENTRANCE
AT 60 M.P.H. TRAFFIC SPEED

EYE ADAPTATION TIME	EXTENT OF SUPPLEMENTAL LIGHTING FOR	MINIMUM AVERAGE MAINTAINED FOOTCANDLES
First 5 seconds	0 - 450 ft.	75
Second 5 seconds	450 - 900 ft.	50
Third 5 seconds	900 - 1,350 ft.	30

Source: See Text.

An illumination level of 5 footcandles is the recommended standard for the remainder of the tunnel. During night-time, the tunnel entrance brightness can be reduced, and an average of 5 footcandles is recommended for the entire tunnel. The change in level of illumination can be accomplished by automatic means.

Ventilation Requirements

Adequate tunnel ventilation is an obvious and absolute requirement. A tunnel of such length as being considered here will require mechanical ventilation capable of purging the tunnel of the products of combustion exhausted by the stream of vehicles. Although lengths of 500 to 600 feet could be considered possible in terms of self-ventilation, the proposed Beverly Hills Freeway may be many times that length, thus requiring special ventilating equipment. Even with the shorter unventilated sections it would be mandatory to have stand-by equipment "on the line" to provide mechanical ventilation at such times as traffic might be moving very slowly or be stopped for any reason. As with lighting, automatic controls governed by sensing devices are indicated. Such sensors are now commonly used in atmospheric test and control installations and are capable of response to present levels of contamination considerably below those which might be considered dangerous or injurious. Ventilation, in terms of public health, will likely be governed by the concentration of carbon monoxide, one of the principal automotive exhaust products; however, there is a possibility that visibility standards might also be established. Control of the carbon monoxide should come close to controlling odors and the general appearance of smoke in the tunnel; but not completely. It should also be noted that the danger from exposure to carbon monoxide is related not only to the concentration level but also to the overall time of exposure. Therefore the sensing devices could very well be paralleled with vehicle surveillance equipment measuring vehicle speeds and placement. Physiological tests on exhaust gas show that the maximum allowable concentration of carbon monoxide in air for one hour exposure is 4 parts in 10,000[2].

---

[2] Fieldner, A.C.; Henderson, Yandell; Paul, J.W.; et. al. Ventilation of Vehicular Tunnels, Report of U.S. Bureau of Mines to New York State Bridge and Tunnel Commission and New Jersey Interstate Bridge and Tunnel Commission (New York, 1957)

Because of the length of the tunnel being considered it would seem most practical to provide separate zones of ventilation with individual machinery spaces located in underground structures along the route. It is entirely within reason that the required purging in one part of the tunnel could be considerably different than that of others due to the characteristic changes in vehicle movement. Provision should also be made in the ventilation design for filtration or precipitation of particulate matter prior to exhausting to the atmosphere.

Freeway Noise

Of the many problems facing the highway engineer in the location and design of a highway in a populous area, probably the most intangible and the one causing the greatest irritation to the most people is noise. To most people sound becomes noise when sound is no longer pleasant to the person who hears it.

Many studies of highway noise have been made and it appears more have been made in California than in any other local area. Yet, with all these studies, very little is really known about highway noise. Noise, in itself, is of no consequence until people hear it and then it becomes an item of prime importance. The problem is further aggravated by the fact that the same tone is heard differently by different people and tones that may be pleasant or non-irritating to some are unpleasant or very irritating to others. The problem is further complicated by the background noises, some of which one might wish to hear, and by the time of day when the noise or certain sounds occur. That the problem of highway noise is serious is evidenced by the constant demand that a law be passed to stop it.

Since highway noise is a summation of nearly all the audible frequencies and since it is recognized that motor vehicles cannot be operated without creating noise, most studies have concerned themselves with attempting to determine which sounds were the most irritating and what was their source or cause. It is the general concensus of opinion, as a result of these studies, that the most irritating noise was from the vehicle exhaust and the usual cause is acceleration.

It is possible, at the present time, to reduce the exhaust noise through the use of better mufflers. To do this would increase vehicle costs slightly and possibly reduce the operating efficiency of the engine. While this reduction in exhaust noise would be beneficial it would be far from solving the problem of highway noise. The next approach would be design, wherein acceleration noise would be largely reduced and other noise would be contained within the facility or dissipated, so as to create the minimum of irritation.

Studies made to date have been made on freeway facilities of standard design and, except for the covered section, there appears to be little difference between them. The information available does not indicate that any specific attempt has been made to design an uncovered facility that would either largely contain the noise or dissipate it with the minimum of anticipated irritation.

At the present time the American Association of State Highway Officials in a joint effort with the Highway Research Board are beginning to research the subject, but it is unlikely that any specific suggestions on highway acoustic control will be available in less than 5 years.

Of the many studies available on highway noise which have been analyzed the one that seems to be the most pertinent in this instance is one prepared by Finch and Partridge[3] dealing with freeway and expressway sections. The following is an excerpt from that report (table numbers only have been changed).

"Any large group of data such as collected in this study affords the possibility of a great number of analyses. The analyses submitted herewith were limited to those considered to be most significant to the freeway problem. The complete data are tabulated at the end of the report for any additional studies that may be desired.

"The measured levels of the noises of vehicles passing the test location depend to some degree upon the background level. Therefore, the background levels existing at the time of the tests are considered first. By way of explanation, the background level is that noise measured by the meters which exists because of the nature of the surrounding area and the activity taking place therein. This includes traffic noise which is not due to the vehicle or vehicles specifically under test. If the background level is sufficiently high, the noise of a passing vehicle may not increase the meter reading by a measurable amount.

---

[3] Finch, D.M.; Partridge, W.A.; Research Report No. 15. Noise Measurements on Expressway-Type Facilities. The Institute of Transportation and Traffic Engineering, University of California.

"The background level also plays a large part in the relative annoyance of vehicles. For example, if the background level is relatively low, traffic noise may seem louder to the ear than it would seem if masked by a relatively high background level. The average background level of all 15 freeway test sections, as measured on the C scale of the meter (flat response) at a distance of 50 feet, was 69 db.[4] The corresponding averages at distances of 150 and 300 feet were 68 and 66 db respectively. (Table 30) These are normal values for daytime conditions and are higher than would be measured in the very early morning hours (3 A.M.).

"The general pattern showed that the difference between auto noise and background levels decreased with distance from the highway. See Table 31. This pattern appeared on all meter scales. The differences at any one type of freeway section were largest on the A scale, less on the B scale, and least on the C scale. This is to be expected because of the weighting networks used in the instruments and is further substantiation of the known fact that the high frequencies are more rapidly attenuated than the lower frequencies. The largest differences occurred under conditions of (1) maximum power on an inclined freeway section, (2) acceleration from a stop at an intersection, and (3) high speed on a level freeway section.

<u>Automobile Noise</u>

"Automobile traffic (exclusive of trucks and commercial vehicles) is the most common source of noise on the highways, although it is not the loudest. The following outlines some important results of the study concerning automobile traffic alone.

"The average noise level due to autos was computed separately for each test site at each location. At every location and at all three distances from the highway, the average noise generated by autos was generally loudest during acceleration from a stop (intersection). The loudest average auto noise, as recorded on the C scale was 84 db at the 50-ft. test distance. At 300 ft., the highest average was 73 db. It must be kept in mind that the loudest average noise does not mean the loudest single reading obtained, but rather, the loudest group of

---

[4] The decibel is a relative-power unit. A change of one db. in the power or sound level is just detectable as a change in loudness under ideal conditions. Decibels equal 10 times the logarithm of the power ratio.

Table 30

AVERAGE BACKGROUND NOISE LEVELS

TYPE OF LOCATION	TEST DISTANCE (feet)	DECIBELS A Scale	B Scale	C Scale
1. Inclined	50	50	59	69
	150	48	58	62
2. Intersection	50	57	67*	76*
	150	52	64*	73*
	300	52*	63*	69*
3. Level	50	48	56	65
	150	46	56	72
	300	43	55	66
4. Elevated	50	59*	65	72
	150	53*	56	63
	300	50	55	64
5. Cut	50	59*	65	72
	150	52	60	68
	300	46	58	64
Averages for all locations	50	52	60	69
	150	50	58	68
	300	48	58	66

* The highest average for this type of location.
Note: Figures represent the average readings in decibels of all background level readings taken. Averages include the results from several test sites, except where noted.

Table 31

AVERAGE DIFFERENCE BETWEEN AUTO NOISE AND BACKGROUND LEVEL

TEST DISTANCE (feet)	TYPE OF LOCATION	DECIBELS A Scale	B Scale	C Scale
	1. Inclined	11	8	9
	2. Intersection	5	8	6
50	3. Level (high speed)	11	10	7
	4. Elevated	8	6	5
	5. Cut	6	4	3
	1. Inclined	10	4	9
	2. Intersection	7	7	3
150	3. Level (high speed)	8	6	2
	4. Elevated	4	4	5
	5. Cut	5	6	7
	1. Inclined	-	-	-
	2. Intersection	3	2	0
300	3. Level (high speed)	6	2	7
	4. Elevated	4	3	2
	5. Cut	9	1	5

readings obtained at various test sites at the same distance from the highway and same type of freeway section (i.e. cut, fill, intersection, etc.). The loudest single reading would be considerably greater than the average.

"For all types of freeway sections, the average auto noise ranged from 75 db at 50 ft. to 69 db at 300 ft., as measured on the C scale. B and A scale readings were on the average, 9 and 15 db lower than the C scale readings, respectively. In the over-all average for all distances at all locations, auto traffic noise was louder than the background level by 7 db on the A scale, and 5 db on the B and C scales.

"At locations where the background level was high, many cases arose in which the noise generated by light auto traffic was not discernable from the background level, except at the 50 ft. distance (see Table 31). One incident arose in which the meter readings on auto traffic were lower than the average background level. This was due to the fact that background level measurements were taken at times when there was no traffic in the immediate vicinity of the test location, but heavy traffic at a distance. This condition caused higher meter readings than that due to a few slow moving autos in the test area, when there was no heavy traffic in the background. This condition may exist at an intersection when traffic is traveling in platoons between signals. Either heavy traffic is approaching the intersection from some distance away, or is stopped at the intersection and there is traffic at a distance.

Truck Noise

"As was expected, trucks were found to be a more intense source of highway noise than autos. (See Tables 32, 33, 34, and 35.) On an over-all average, the truck noise level was 6 db above that for autos. This figure is small and is due to the grouping of all trucks together, there being many more light trucks than heavy ones. The number of readings on the various types of vehicles comprising the test samples were reasonably proportional to the frequency with which each type of vehicle passed the test location. Since there were greater numbers of two-axle trucks than other types, more meter readings were taken on this type of truck. Due to the fact that the noise generated by these light trucks is, on the average, not much greater than that of an auto, the average of all trucks combined was reduced.

"Average readings on each type of truck at various test distances and on various types of freeway sections may be found in Table 34 and in the Summary Data Sheets in Appendix F. Average truck noise was found to exceed that of autos in all locations and at all distances.

Table 32

AVERAGE NOISE LEVELS OF TRUCKS, AUTOS, AND BACKGROUND

SECTION AND VEHICLE	DISTANCE	DECIBELS		
		A Scale	B Scale	C Scale
	(feet)			
1. Inclined				
Trucks	50	73	79	86
Autos	50	61	67	78
Background	50	50	59	69
Trucks	150	66	76	80
Autos	150	54	61	67
Background	150	48	58	62
2. Intersection				
Trucks	50	77	84	91
Autos	50	64	75	84
Background	50	57	67	76
Trucks	150	66	77	84
Autos	150	58	71	79
Background	150	52	64	73
Trucks	300	62	70	78
Autos	300	57	67	73
Background	300	52	63	69
3. Level				
Trucks	50	69	79	83
Autos	50	59	66	72
Background	50	48	56	65
Trucks	150	65	72	77
Autos	150	54	62	73
Background	150	46	56	72
Trucks	300	53	60	71
Autos	300	47	53	69
Background	300	43	55	66

Table 32 (Cont'd.)

SECTION AND VEHICLE	DISTANCE	DECIBELS		
		A Scale	B Scale	C Scale
	(feet)			
4. Elevated				
Trucks	50	60	70	80
Autos	50	55	59	66
Background	50	48	55	62
Trucks	150	58	66	72
Autos	150	54	58	67
Background	150	53	53	63
Trucks	300	55	60	70
Autos	300	54	58	66
Background	300	50	55	64
5. Cut				
Trucks	50	69	72	77
Autos	50	65	69	75
Background	50	59	65	72
Trucks	150	58	65	74
Autos	150	55	61	70
Background	150	52	60	68
Trucks	300	56	65	72
Autos	300	51	59	69
Background	300	46	58	64

Note: Averages are given for each test distance and type of freeway section.

Table 33

AVERAGE AMOUNT BY WHICH TRUCK NOISE EXCEEDED AUTO NOISE

TYPE OF LOCATION	TEST DISTANCE (feet)	DECIBELS A Scale	B Scale	C Scale
1. Inclined	50	13	12	8
	150	11	14	10
	50	13	9	11
2. Intersection	150	7	6	4
	300	4	3	6
	50	9	7	10
3. Level	150	12	6	4
	300	5	4	1
	50	2	4	3
4. Elevated	150	2	4	3
	300	1	1	3
	50	4	5	3
5. Cut	150	3	4	4
	300	7	5	4

Note: Difference between the averages of truck noise and auto noise for each distance and type of freeway section.

Table 34

AVERAGE NOISE LEVELS FOR VARIOUS TYPES OF TRUCKS

TYPE OF LOCATION	TEST DISTANCE (feet)	C SCALE -- DECIBELS Light Gasoline-Powered Trucks	Heavy Gasoline-Powered Trucks	Diesel Trucks
1. Inclined	50	82	85	89
	150	73	79	82
	50	91	92	91
2. Intersection	150	82	82	86
	300	76	79	81
	50	78	85	89
3. Level	150	71	83	84
	300	73	74	76
	50	71	82	83
4. Elevated	150	70	76	79
	300	69	74	76
	50	79	81	81
5. Cut	150	72	71	74
	300	71	71	73

Note: Averages for each distance and type of freeway section.

Table 35

SUMMARY OF RESULTS

ITEM	TEST DISTANCE (feet)	DECIBELS A Scale	B Scale	C Scale
Highest Average Truck Noise	50	77 Intersection	84 Intersection	91 Intersection
	150	66 Intersection	77 Intersection	84 Intersection
	300	62 Intersection	70 Intersection	78 Intersection
Loudest Single Truck Noise	50	90 Intersection	97 Intersection	102 Intersection
	150	81 Inclined	88 Inclined and Intersection	93 Inclined, Intersection and Level
	300	77 Elevated	84 Elevated	87 Elevated
Average Truck Noise	50	70	77	83
	150	63	71	77
	300	57	64	73
Average Auto Noise	50	61	67	75
	150	55	63	71
	300	52	59	69

Note: Where the loudest readings obtained are reported, the type of freeway section or sections upon which the loudest readings were obtained are noted beneath the reading.

(See Table 33). The difference between truck and auto noise at a single distance and location ranged from 1 to 13 db on the A scale, 1 to 14 db on the B scale, and 1 to 11 db on the C scale. The greatest difference occurred under the condition of maximum power on an inclined freeway section, where the average truck noise exceeded that of autos by 11 db on the A scale, 14 db on the B scale, and 10 db on the C scale. The least difference was noted on elevated freeway sections.

"The loudest single truck noise was noted during acceleration from a stop at an intersection. The maximum noise registered on each of the three scales was as follows:

"C scale, 102 db; B scale, 97 db; A scale, 90 db. These readings were taken at a distance of 50 ft.

"The average truck noise was computed for all trucks at each individual test site. (See Table 32). The highest average was found to occur at an intersection under the condition of acceleration. The averages for the other conditions may be found in Tables 32, 33, 34 and 35 on the preceding pages.

"An analysis was made to determine the difference in decibel readings between the averages of light gasoline-powered two and three axle trucks, heavy gasoline-powered trucks, and diesel-powered trucks, at each distance and each location. (See Table 34). Only the C scale readings were used. In general, the results show that heavy gasoline-powered trucks were louder than light trucks. In some cases the heavy trucks were several times as loud, whereas the difference between heavy gasoline-powered trucks and diesel-powered trucks averaged only about 2 db for all sites. The surprisingly small difference between the latter two types of trucks should not be used to infer that diesel-powered trucks were not the worst offenders. In almost every case, the diesel trucks were both louder, as shown by the meter readings, and more annoying, as judged by the members of the test staff.

Accuracy of the Data

"The principal source of error was the effect of the wind on the meter readings. The wind occasionally caused large deviations in meter readings. These conditions were noted and the particular data was deleted. Several layers of silk cloth were used over the microphones to minimize the effect of the wind. The meters were read only to the nearest decibel, which required almost no estimation or interpolation. Cable losses were taken into account. The averages were rounded off to the nearest decibel. The medians shown on the Summary

Data Sheets were determined by counting the number of readings from the lowest one upward until one-half of the total number of readings was reached. In the case of the one-half point falling at the boundary of a group, the median was generally affected in such a way as to place it in the lower of the two adjacent groups. This accounts for the fact that many of the medians were reported as being 1 db lower than the corresponding average. For the most part, the averages and medians were within 1 db of each other, showing that the test samples of the various types of vehicles had a reasonably balanced distribution about the median.

Conclusions

"The results present the existing noise levels on the five major characteristic expressway and freeway sections. In addition to this, they point up the average levels of noise produced by the various types of vehicles passing over these sections. The results make possible the estimation of the extent of the area affected by the noise.

"The results showed that acceleration from a stop was the condition involving the highest noise levels; therefore, it is apparent from a noise standpoint that stops should be kept to a minimum in populated areas.

"The results show that auto traffic is in every case a less significant source of noise than truck traffic.

"The results show that a cut is not entirely satisfactory in reducing the noise transmitted to the surrounding area. At close distances there is little or no difference between the noise adjacent to the cut and that of a level terrain. At greater distances from the edge of the cut, there is some evidence that noise drops off more rapidly than in the case of level terrain. Whether or not the higher frequency noises are more attenuated than the low ones due to the side walls of the cut as might be expected, remains to be determined from the results of the frequency analyses of the tape recordings. At this time, this effect can only be anticipated.

"The results of tests at elevated freeway sections show that the noise levels at the 50-ft. test distance are lower than those at other test sections for the same distance. It appears that the noise field is distorted and is not uniform near the elevated structure. The elevation seems to have a shielding effect at close distances."

On the basis of available acoustic control data and present concepts of highway design, it can be concluded that the only positive approach to the control of highway noise would appear to be through use of the covered section.

Covered vs. Open Freeway Costs

Preliminary investigations and first order cost estimates show that an 8-lane freeway tunnel along the existing Santa Monica Boulevard alignment and extending from Wilshire Boulevard to Doheny Drive (about 8,100 feet portal to portal) would cost approximately $23,300,000 more than the conventional open cut design. The major elements of this differential cost are summarized in Table 36.

Table 36

ADDITIONAL COSTS FOR COVERED VS. OPEN DEPRESSED FREEWAY UNDER SANTA MONICA BLVD. BETWEEN WILSHIRE BLVD. AND DOHENY DRIVE
Beverly Hills, California

ITEM	COST
Tunnel Structure	$ 12,330,000
Ceiling, Finish and Miscellaneous	3,930,000
Ventilation Buildings	2,500,000
Ventilation Vans and Dampers	1,040,000
Lighting	2,370,000
Miscellaneous Electrical Equipment[a]	1,130,000
TOTAL	$ 23,300,000

[a] Includes telephone, fan control, power distribution system, signs, TV monitor, building services in vent buildings, and central control system.

These costs are based on an assumed 140-foot wide cross section with vertical walls and an 8-lane freeway 25 feet below ground level. The ceiling would be 10 feet below ground level, leaving a 15-foot roadway clearance. The two 4-lane roadways would be separated by a 20-foot wide (15 foot high) fresh air duct between ceiling and ground level and the available space above the ceiling would serve as an exhaust air duct. The item "tunnel structure" covers the cost of the structural cover (prestressed concrete beams) and the vertical walls of the fresh air duct which would act as supports for the roof. A suspended ceiling, which is a portion of the second cost item shown, would enclose the exhaust air duct. A credit of $1,200,000 has been allowed for 12 overpasses, assumed to be required whether the freeway is open or covered.

Amortization of the capital cost of the structure differential at 4 percent over a period of 50 years would amount to about $1,085,000 annually.

The estimated cost of operation of lighting and ventilating systems of the facility would be $90,000 and $170,000 per year more than required for the open cut respectively, or $260,000 per year. Additional tunnel maintenance would aggregate about $130,000 annually. Thus the total annual operation cost of the complete freeway tunnel would be approximately $390,000 more than the open cut freeway section of equal length.

Total annual cost of amortizing capital investment plus operation would approximate $1,475,000.

An alternative scheme utilizing alternate sections of open cut and minimum length tunnels -- assumed to be every other city block -- has been investigated for purposes of an "order of magnitude cost estimate." This would provide tunnel sections varying from about 250 to 580 feet in length and ten open cut sections of 220 to 380 feet lengths. Including in the estimate provisions for ventilation to be used when traffic on either roadway is at a standstill, the estimate of cost is about $12,300,000 more than for an open cut. This amount could be amortized at 4 percent for about $572,000 per year over a period of 50 years. Together with an estimated operating cost differential of $125,000, the annual cost for this alternative design would be approximately $697,000 per year more than for the open cut.

The cost of a third alternative, combining a fully ventilated tunnel for a specific portion of the route and open cut for the remainder would fall somewhere between those of the two schemes described above.