REPORT

TO

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

ON

A MONORAIL RAPID TRANSIT LINE

FOR

LOS ANGELES

JANUARY 15, 1954

COVERDALE & COLPITTS
CONSULTING ENGINEERS
NEW YORK

RUSCARDON ENGINEERS
LOS ANGELES

GIBBS & HILL, INC.
NEW YORK — LOS ANGELES

LOS ANGELES METROPOLITAN
TRANSIT AUTHORITY
2233 BEVERLY BOULEVARD
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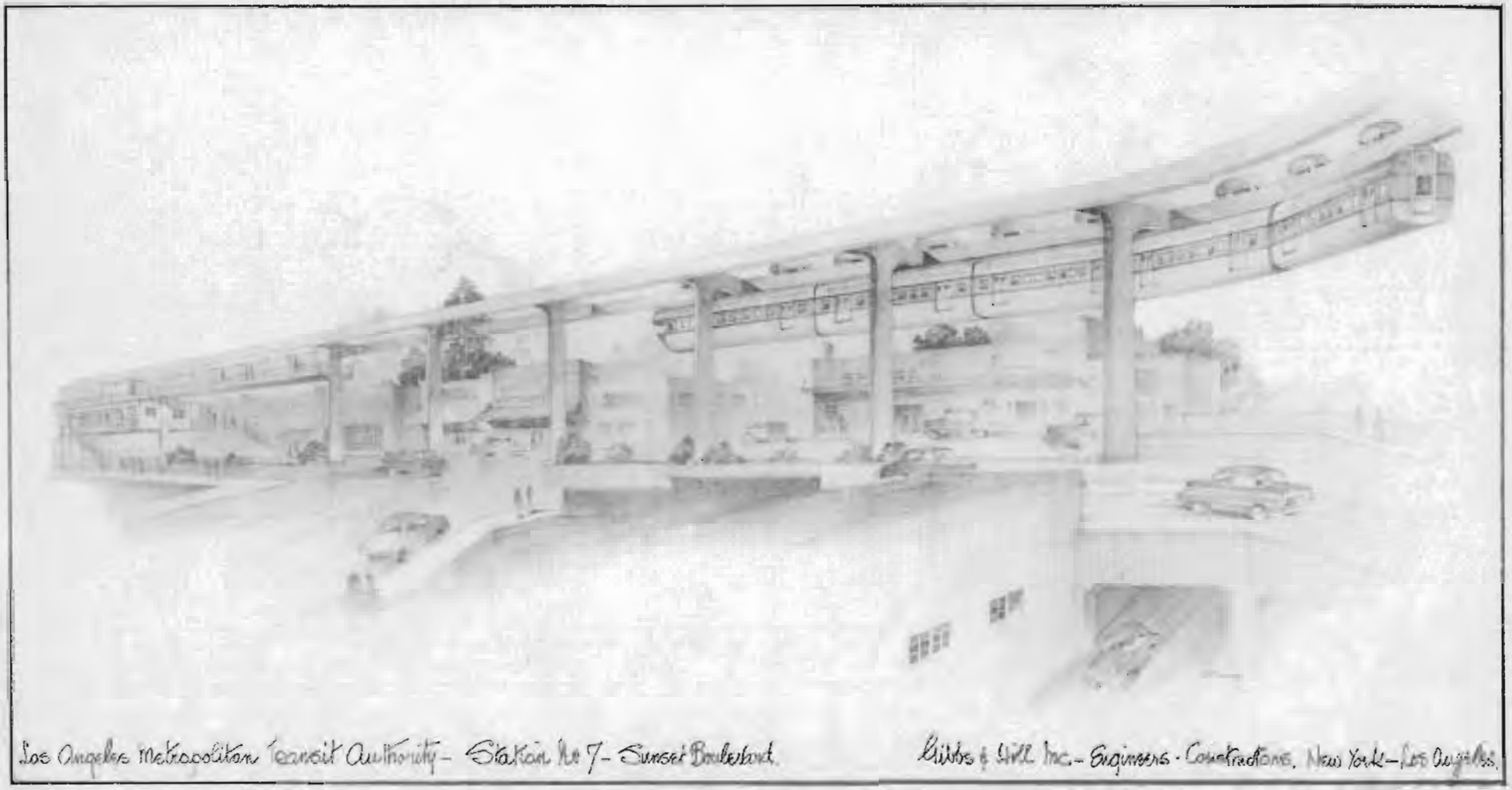

Los Angeles Metropolitan Transit Authority - Station No 7 - Sunset Boulevard.

Gibbs & Hill Inc. - Engineers - Constructors. New York - Los Angeles.

SUMMARY OF CONCLUSIONS
ECONOMIC ENGINEERING REPORT
of
COVERDALE & COLPITTS
for
LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

FIRST:

This report is made to the Los Angeles Metropolitan Transit Authority pursuant to the declared policy of the State of California to develop interurban rapid transit systems in various metropolitan areas of the State for the benefit of the people. (Chapter 1668, Legislative Session 1951, Chapter I, Section 1.1)

The characteristics of Los Angeles as one of the great cities of the United States are different from those of any other city in the combination of its extent of area, the low density of its population, the high degree of automobile ownership and the lack of any system of surface-free mass rapid transit.

SECOND:

The monorail rapid transit route as proposed in this report and located within the area described in the act creating the Authority would, if adopted, be a proper beginning of mass rapid transit throughout Los Angeles County.

THIRD:

Monorail as an interurban railroad, rather than an urban distribution facility, can be integrated appropriately with any future plan of rapid transit that may be adopted for the metropolitan area of Los Angeles County.

FOURTH:

Economic and engineering features of a modern elevated rapid transit system should be given comparative study.

FIFTH:

Action should be undertaken at this time by appropriate agencies exempting the Los Angeles Metropolitan Transit Authority from control by the California State Public Utilities Commission and exempting the property as well as the bonds of the Authority from taxation to conform with the established policy of the State in order to accomplish public acceptability of the revenue bonds proposed to be issued for the financing of the transit system under study.

SIXTH:

Appropriations should be made by the appropriate agencies of State or County for the further steps in engineering, financing and administration which necessarily must supplement the accompanying Feasibility Report.

SEVENTH:

Provided appropriate legislative action is taken and further reports are completed as required, the development of a mass rapid transit system by monorail for Los Angeles as herein described appears to be feasible.

QUALIFICATIONS OF ENGINEERING FIRMS EMPLOYED BY LOS ANGELES METROPOLITAN TRANSIT AUTHORITY IN PREPARATION OF ECONOMIC ENGINEERING STUDY OF MASS RAPID TRANSIT

Coverdale & Colpitts: A partnership, of 120 Wall Street, New York, is a company now celebrating its Fiftieth Anniversary with extensive engineering experience in the field of transportation, railroads, air lines, toll roads, bridges and tunnels. It has been consultant for bankers and industry in connection with the sale of securities, appraisals and management of corporations in the field of economic engineering.

Coverdale & Colpitts was one of the firms recommended to the Board of Supervisors by the University Presidents Report of 1950. This firm has been the Consulting Engineers of the Department of Public Works of the State of California for 17 years. They are at present Consulting Engineers for fifteen States on highway, bridge or transit problems and are also retained by many private and public agencies throughout the nation.

Gibbs & Hill: A firm founded in 1911 as a partnership and incorporated in 1923. Since its foundation, this firm has rendered service to more than 30 railroads and to more than 20 authorities and commissions dealing with transit and transportation matters. The firm has designed power plants throughout the world of a total cost of more than one billion dollars. It has electrified railroads, designed airports, factories and industrial plants. The organization has been actively making engineering analyses of monorail and other modern transportation systems for the past 15 years, including studies of car and motor power in the adaptation of this modern form of transportation to large metropolitan areas. Gibbs & Hill has maintained a fully staffed office in Los Angeles for the past five years.

Ruscardon Engineers is a co-partnership consisting of Rush T. Sill and Donald M. Baker of Los Angeles, represented in this contract by Donald M. Baker, specialist in the field of hydrology, traffic engineering and engineering economics. Mr. Baker is a past president of the Los Angeles City Planning Commission, the Los Angeles Engineering Council and the California State Board of Registration for Civil Engineers. Mr. Baker's first study on transit in Los Angeles was made 20 years ago and still stands as the most thorough analysis of transit problems yet made. Since that time, Mr. Baker has been closely associated with all transit studies made in this area.

Authority: The contract with Engineers provides that the Administrative Staff of the Authority shall upon request of Engineers advise upon matters of public policy, legality of proposed plans and shall make contacts with State, County and City Officers and with industry, for making available to the Engineers information pertinent to the Survey. The Authority has continuously participated in the coordinating activities of all participants in this contract. In the Report the Engineers acknowledge the value of the services rendered by the General Manager and Secretary of the Authority.

REPORT

TO

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

ON

A MONORAIL RAPID TRANSIT LINE

FOR

LOS ANGELES

January 15, 1954

COVERDALE & COLPITTS
CONSULTING ENGINEERS
NEW YORK

RUSCARDON ENGINEERS
LOS ANGELES

GIBBS & HILL, INC.
NEW YORK - LOS ANGELES

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TO

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

ON

A MONORAIL RAPID TRANSIT LINE

FOR

LOS ANGELES

PART 1

ECONOMIC FEASIBILITY OF THE MONORAIL SYSTEM

January 15, 1954

COVERDALE & COLPITTS
CONSULTING ENGINEERS
120 WALL STREET
NEW YORK 5, N. Y.

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ECONOMIC FEASIBILITY OF THE MONORAIL SYSTEM

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W. H. COVERDALE (1904-1949)
W. W. COLPITTS (1913-1951)

January 15, 1954

The Los Angeles Metropolitan Transit Authority
2233 Beverly Boulevard
Los Angeles, California

Dear Sirs:

Complying with your request as expressed in our agreement of April 15, 1953, we have made a study of the economic feasibility of the construction, maintenance and operation of a monorail rapid transit line between the San Fernando Valley and Long Beach and herewith transmit our report.

For the purpose of this study we have associated with ourselves, with your approval, Ruscardon Engineers of Los Angeles and Gibbs & Hill, Inc., Engineers and Constructors, of New York; the former to study origins and destinations of persons within the study area, other traffic matters, population and economic statistics; the latter to estimate the cost of construction and of operation of the proposed monorail system.

The report, therefore, is presented in three parts as follows:

Part I - Economic Feasibility of the Monorail System - Coverdale & Colpitts

Part II - Traffic, Population and Economic Data - Ruscardon Engineers

Part III - Monorail System Design, Estimates of Construction Costs and of Operating Expenses - Gibbs & Hill, Inc.

A mass of information has been accumulated and, although a small part only is reproduced in this report, it is all available for the use of the Authority.

I - INTRODUCTION

The Los Angeles Metropolitan Transit Authority was created by an Act of the California Legislature of 1951 as an instrumentality to carry out the State policy of developing interurban rapid-transit systems in the various metropolitan areas for the benefit of the people.

Under the Act the Authority has engaged engineers and instructed them to make an economic study of the feasibility of the construction, maintenance and operation of a mass rapid-transit system by means of monorail located within the limits prescribed by Section 2.7 of said Act, viz.: ".... the entire San Fernando Valley west of the west boundary of the City of Glendale, and within four (4) miles on each side of the main channel of the Los Angeles River from San Fernando Valley to the mouth of the river at Long Beach....".

The Authority, supported by funds appropriated by the Los Angeles County Board of Supervisors, on April 15, 1953 engaged Coverdale & Colpitts to act as the Consulting Engineers to the Authority and to make a study as described below.

SCOPE OF THE ENGAGEMENT

Under the agreement of April 15, 1953 with the Authority, the scope of the work to be performed by the Engineers is to determine:

"A. Whether the monorail rapid transit route within the operating area described in the Act creating the Authority, would, if adopted, be a proper beginning for the development of rapid transit throughout Los Angeles County, and whether or not such a monorail line will integrate appropriately with any other future plan of rapid transit for the metropolitan area of Los Angeles County.

"B. What the traffic potential is for the monorail route, to be selected by Engineers within the area generally described in the recitals hereof, in terms of payload and revenue, and a determination of the needed stations, speeds of operation and other operating factors.

"C. The development of engineering design and costs for monorail installation on the route; this, however, to be limited to the designs and estimates essential for an economic study, and not to be carried up to the point of design for construction.

"D. Engineers are to:

(a) Select route within the limits specified which seems most appropriate for purposes of this study;

(b) Estimate the probable number of passengers to be carried on each section of the line;

(c) Estimate the reasonable fares to be charged section to section;

(d) Determine optimum location of stations;

(e) Estimate the extent and cost of providing auxiliary or feeder bus service directly supplementary to the route;

(f) Evaluate the proposed line relative to competitive facilities; trolley cars, trolley buses, motor buses and automobiles on streets and on the highway system (including freeways);

(g) Estimate probable annual revenue, operating expenses and amount available for debt service;

(h) Estimate probable amount of revenue bonds that could be supported from this operation at the present and in the future;

(i) Prepare a complete report on the project combining the report of Ruscardon Engineers and Gibbs & Hill and their own studies in one volume and furnish 100 copies thereof to the Authority.

"If in the course of the study by Engineers it becomes obvious that there is some other means of transportation likely to be more economical than the monorail system, said Engineers agree to so advise Authority.

"In the survey and report, due consideration is to be given by Engineers to the relationship of this specific project to the present and prospective development of mass transportation facilities in the County and in the City of Los Angeles."

The Consulting Engineers, with the approval of the Authority, engaged the services of Gibbs & Hill, Inc., Engineers, of New York, experts in the field of monorail systems and electric traction generally, to make preliminary designs and estimates of construction cost and maintenance and operating expenses of a monorail rapid-transit system for Los Angeles; and the services of Ruscardon Engineers of Los Angeles to collect the data necessary for a determination of the potential number of prospective passengers for such a rapid-transit system, including origin and destination information; travel patterns by bus, street car and private automobiles; population trends; parking locations and cost; use of freeways, land use, and other pertinent economic factors.

The work by these associated engineering firms has all been carried out under the supervision of and in collaboration with the Consulting Engineers.

The report which follows is divided into three parts, each one presenting the findings and opinions of the respective associated engineering firms:

Part I - "Economic Feasibility of the Monorail System" was prepared by Coverdale & Colpitts.

Part II - "Traffic, Population and Economic Data" was prepared by Ruscardon Engineers.

Part III - "Monorail System Design, Estimates of Cost and of Operating Expenses" was prepared by Gibbs & Hill, Inc.

GENERAL CONSIDERATIONS

In studying the problem of rapid mass transportation in the Los Angeles metropolitan area it is essential to take into consideration the fact that transportationwise and in relation of city layout to transportation facilities, Los Angeles of the great cities of the United States is in a class by itself. At the present time, Los Angeles and Philadelphia metropolitan districts may be said to be in a tie for third and fourth places,

being exceeded in size only by New York and Chicago. New York, Chicago and Philadelphia have mass rapid transit consisting of systems of subways and elevated railways. The City of Boston, which has a population in its metropolitan district of 2,233,448, also has a subway and elevated system. The rapid-transit development in these four cities commenced in the last quarter of the last century and culminated, except as to the Chicago subway, in the first quarter of the present century. Of all these large cities, Los Angeles is the only one in which the major part of its population development has occurred since the advent of the automobile as the primary means of transportation in America. Possibly, as a result of the availability of the automobile and the resulting convenience of individual transportation, Los Angeles has been developed as a city of individual homes, rather than one of great areas of apartment houses.

As indicated in Part II, page 4, of this report the inhabitable part of metropolitan Los Angeles as of 1953 had a population density of 4,650 persons per square mile. Population, area and density of the whole County and of other urban counties in the United States are shown below:

1950 Census

County	Population (000)	Area (Square Miles)	Density (Persons per Square Mile)	Related City
Los Angeles, Calif.	4,152	4,071	1,020	Los Angeles
Bronx, Kings, New York and Queens counties combined	7,700	254	30,591(Avg.)	New York
Cook, Ill.	4,509	954	4,726	Chicago
Philadelphia, Pa.	2,072	127	16,312	Philadelphia
Wayne, Mich.	2,435	607	4,012	Detroit
Suffolk, Mass.	896	55	16,302	Boston

The population of Los Angeles County has grown over the past four decades as shown in Table 2, Part II, and abstracted below:

Year	Population
1910	504,000
1920	936,000
1930	2,208,000
1940	2,786,000
1950	4,152,000

If we take 1920 as the beginning of the common use of automobiles, the increase in population of Los Angeles County from 1920 to 1950 is 343 per cent.

The use of individual automobiles for transportation was encouraged by the construction of an extensive boulevard system throughout the County. These boulevards were the predecessors of the freeways. Their existence enabled a wide dispersion of residences and hence led to the low density to which reference has just been made.

Los Angeles, however, was not without a suburban transit system which was provided by the construction in the first decade of this century of Pacific Electric Railway. Operation into the station at Main and Sixth streets commenced with rail lines and is still carried on by some lines up until the present, while certain bus lines also terminate there. Most of the railway lines which reach Los Angeles at this station, such as the line to Pasadena and that to San Bernardino and Riverside, have been discontinued and an application is now before the Public Utilities Commission of the State of California to permit discontinuance of the lines between Long Beach and San Pedro and Los Angeles.

The Pacific Electric Railway Lines west and north of Los Angeles to Santa Monica, Van Nuys, Glendale and Burbank reached the city at the subway

terminal at Hill Street between Fourth and Fifth streets. These lines were in operation by 1912 and have been gradually discontinued by the authority of the Department of Public Utilities so that at the present time the only operating lines are those to Glendale and Burbank and one on Santa Monica Avenue to Beverly Hills.

A tabulation of the total number of passengers carried by the Pacific Electric Railway is shown on page 9. It will be observed that the most recent peak movement was 177,823,000 bus and rail passengers in 1945, during a period of great war activity in Los Angeles and while the use of motor fuel was restricted for the greater part of the year. Since 1945, the passengers carried by these lines have been greatly reduced. Buses were substituted for most of the rail lines as rail service was discontinued, but the passengers carried by the buses do not approach in number those that were carried by the railway lines in earlier years. The loss of passengers by this suburban transit facility is not an unusual phenomenon. It has been a common experience in most cities in the United States both east and west.

Urban transportation has been furnished by Los Angeles Transit Lines operating both rail facilities and bus lines widely distributed throughout the City. Los Angeles Transit Lines reached its peak of passenger traffic in 1947. The decline in riding on both the Pacific Electric Railway Lines and the Los Angeles Transit Lines seems to have been caused by the increasing use of passenger automobiles, stimulated by the provision of an extensive system of boulevards and freeways. Other bus companies are operating in other parts of the district carrying smaller numbers of passengers. In 1921 there was one automobile in Los Angeles County to each 6.4 persons; in 1953, one to every 2.4 persons. In automobile ownership in proportion to population, no city in the world compares with Los Angeles (Part II, page 47).

The Pacific Electric Railway at the peak of its activities was operating 1,105 miles of passenger railway trackage. As of 1952 it was operating 366 miles of railway lines.

Total Revenue Passengers
(Fare and Transfer) Rail and Bus

Year	Pacific Electric Railway	Los Angeles Transit Lines
	(000)	
1936	80,573	271,040
1937	84,890	291,844
1938	78,265	292,412
1939	75,465	259,713
1940	79,840	241,767
1941	77,766	251,045
1942	99,166	282,368
1943	137,405	310,976
1944	168,427	321,193
1945	177,823	325,661
1946	174,083	359,128
1947	163,408	439,812
1948	143,921	397,879
1949	125,698	368,004
1950	109,321	317,749
1951	100,517	283,005
1952	92,475	256,947

In 1952 vehicle mileage for various types of service was as follows:

Pacific Electric Railway Company

Type of Service	Vehicle Mileage
Interurban rail lines	2,066,169
Local rail lines	3,524,105
Total rail lines	5,590,274
Interurban coach lines	12,466,010
Local motor coach lines	9,864,146
Total motor coach lines	22,330,156
Total all lines	27,920,430

In March 1953 the sale of the passenger service of the Pacific Electric Railway Company to Metropolitan Coach Lines was announced.

The Los Angeles Transit Lines at the height of its activity was operating a total of about 650 miles of single track and bus lines. As of the end of 1952, it had 238 total miles of single track, 246 miles of bus lines and 23 miles of coach lines.

Los Angeles has in process probably the most extensive system of freeway construction planned by any city in the United States. The freeways in use, under construction, planned and contemplated are shown by the map, Figure 18, Part II. The first freeway to be constructed was the Arroyo Seco between Los Angeles and Pasadena, the first section of which was opened in 1940. This was followed by the Hollywood Freeway now in use between its connection with Santa Ana Freeway and Hollywood Boulevard. Early in 1954 it will be completed through Cahuenga Pass to Ventura Boulevard. The Harbor Freeway which eventually will extend to San Pedro is under construction and has been completed between a junction with Arroyo Seco and Hollywood Boulevard, and Sixth Street, Los Angeles. The Los Angeles River Freeway is under construction and has been completed a short distance northward from the Pacific Coast Highway. The Ramona Freeway is under construction and is now completed between the Santa Ana Freeway and Atlantic Avenue. The Santa Ana Freeway is completed between Spring Street (Civic Center) and Lakewood Boulevard. The freeways that have been constructed are all in use to a high percentage of their capacity and are even now occasionally subject to congestion at peak hours. When those that are now projected, as shown on the map above referred to, are completed, they in turn will soon attract additional traffic and it will not be many years before they also will become congested.

The population of Los Angeles County is estimated to increase from 4,650,000 in 1953 to 5,500,000 by 1960, an increase of 18 per cent. In the following twenty years it is estimated to increase so that by 1980 it will be 7,500,000, or 61 per cent more than in 1953 (Part II, page 20). Moreover, the population in the more thinly settled portions of the County is expected to increase at an even faster rate. In 1950 approximately 55 per cent of the population in a circle of 20 miles radius from the center of Los Angeles lived in the area between the 8-mile and the 20-mile circle. The population in this area is expected by 1960 to constitute 60 per cent of that within the 20-mile circle. The population within the 20-mile circle roughly corresponds to that of the County (Part II, page 33). / Thus a greatly increasing load will be placed on the freeway system. It will be increasingly expensive to build freeways within the built-up parts of Los Angeles. Thus the use of the automobile will become less convenient than at present. It will be essential for the metropolitan area to have some form of rapid mass transportation which will relieve the city streets and highways of strangling congestion. The capacity of even a 6-lane freeway is limited and, if its traffic is restricted to passenger automobiles alone, cannot carry in individual automobiles, without a high degree of congestion, more than between 6,000 and 7,000 passengers in the direction of heaviest travel in the peak hour. This capacity can be increased materially by the use of buses but the use of buses on the freeways, even with turnouts at stops, will reduce the capacity for individual automobiles. >

In view of this background it is obvious that a mass rapid-transit system that would be successful must handle passengers in comfort at a high rate of speed and not at 20 to 24 miles an hour and with 100 per cent or greater overload, as is common in certain cities in the East. Hence the monorail operation discussed herein is designed to have an over-all speed of

upwards of 40 miles per hour including the stops and a sufficient number of cars to keep the percentage of standees, even at the most crowded hours, at not over 50 per cent of the seating capacity. Further, the fares must be not greater than the presently prevailing rates.

The requirements of comfortable and speedy travel apply to any system of mass rapid transit that may eventually be developed in Los Angeles.

II - BRIEF DESCRIPTION OF THE PROJECT

LOCATION

The projected monorail rapid-transit line is located between the San Fernando Valley and Long Beach through Los Angeles, within the area previously defined (hereinafter referred to as the Study Area). A number of different routes within this area were studied. A route along the Los Angeles River appeared to have the advantage as to capital cost, but was inferior as to access to traffic centers. A mass rapid-transit line, to be most useful, must serve the maximum number of potential riders and carry them along the routes they desire to travel.

The route selected is shown on the map, Plate I. The northern terminus of the line is at or near Pancrama in the San Fernando Valley. It extends along Van Nuys Boulevard to Chandler Boulevard, along Chandler to Vineland Avenue, south on Vineland, Cahuenga Pass Freeway to Highland Avenue, using for the most part up to this point the right-of-way formerly used by the Pacific Electric Line. It then extends southerly on Highland Avenue to Sunset Boulevard, east on Sunset to Hill Street, reaching Hill Street by crossing above Hollywood Freeway and using some private right-of-way along Hill (in subway) to Washington Boulevard, thence on private right-of-way, on elevated structure to Broadway near 22nd Street and along Broadway to Main Street at 35th Street; along Main to Florence Avenue, east on Florence to Pacific Boulevard, south on Pacific Boulevard and Long Beach Boulevard (American Avenue) to Long Beach, the southern terminus.

The study contemplates an elevated monorail line along the whole route, except on Hill Street between Temple Street and Washington Boulevard where it would be underground in subway.

The study area traversed by this location as pointed out in Part II of this report presently contains more than half of the population of the County

with an average density of 7,500 per square mile, which is 60.0 per cent greater than in the metropolitan area as a whole. The population of the study area is expected to increase ratably with the balance of the County with a slightly greater proportion of the County's population in 1980 than at present. (See Part II, pages 28-31).

Because of these factors, it is evident that an interurban rapid-transit line connecting San Fernando Valley, North Hollywood, Hollywood, downtown Los Angeles, the industrial area southeast of the Central Business District, Compton and Long Beach is in a position to serve the area well and, particularly in combination with existing surface transportation systems, can perform a most useful transportation service. The projected monorail is definitely an interurban or suburban rather than an urban mass transit facility and as a transportation facility is to be compared with Pacific Electric Lines and automobile transportation on the freeways and highways as a means of access to the business and manufacturing districts of Los Angeles from the residential areas rather than with an urban mass distribution system such as we find in the rapid-transit systems of the larger cities of the East. It is essential that any interurban or suburban railway system be so designed as to integrate fully with distribution facilities within the cities which it serves. The projected monorail system, as will be shown later, is able, through the use of the existing bus and rail lines, to distribute to their ultimate destinations passengers reaching the central areas of Los Angeles by monorail from the north and the south. This is particularly true in the industrial centers of Vernon, Southgate, Maywood and Bell, where Los Angeles Transit Lines facilities are available to permit the transfer of passengers between monorail and surface lines serving the manufacturing plants. On the north the communities of Glendale and Burbank may be reached from Glendale Boulevard Station either by existing motor-bus lines or by private automobile. As other rapid-transit lines may be developed in Los Angeles either to carry

suburban or urban traffic, such facilities could be integrated with the projected monorail system. The method of transfer, if the trip were not continuous, would depend on the type of system eventually developed.

There is not now in any city in the world any suburban or interurban service operating at the over-all speed contemplated for this line. All of the various elements entering into the design have been tried and tested. The only thing that could be considered an innovation is the assembly of all of these particular features in this type of operation. The monorail system contemplated herein is not at all comparable with the one that has been operating in Germany for many years.

THE MONORAIL STRUCTURE

In the monorail system that has been studied, the cars are suspended from a single rail which is carried on a girder supported at intervals by transverse bents, generally in the form of a T with the columns centrally located in the streets, so as to interfere as little as possible with street traffic. A more detailed description of the monorail line is to be found in the accompanying report of Gibbs & Hill, Inc., Part III of this report. A perspective of the system as it would appear from near Glendale Boulevard is shown in the frontispiece.

STATIONS

The stations on the overhead portion of the line are generally over the streets, with mezzanines below the train platforms, and stairways or escalators for access either on sidewalks or on private property. Several stations, where the tracks curve from one street to another at right angles, are on the private property over which the structure is to be built.

Seventeen stations are proposed, including the two termini, as follows:

	Distance from Panorama (miles)	Distance from Each Station to the Next (miles)
PANORAMA, at Roscoe Boulevard	0	1.9
VAN NUYS, at Van Owen Street	1.9	2.8
CHANDLER BOULEVARD, at Woodman Avenue	4.7	3.2
NORTH HOLLYWOOD, Chandler at Tujunga Avenue	7.9	2.2
VINELAND AVENUE, at Ventura Boulevard	10.1	4.1
HOLLYWOOD, Highland Avenue at Sunset Blvd.	14.2	5.3
GLENDALE BOULEVARD and Sunset Boulevard	19.5	2.2
CIVIC CENTER (Subway) Hill Street at Temple	21.7	0.9
SEVENTH STREET (Subway) at Hill Street	22.6	2.4
BROADWAY PLACE and 35th Street	25.0	3.0
MAIN STREET, at Florence Avenue	28.0	2.9
PACIFIC BOULEVARD and Florence Avenue	30.9	3.2
IMPERIAL HIGHWAY	34.1	2.4
COMPTON	36.5	4.5
SAN ANTONIO DRIVE	41.0	3.1
PACIFIC COAST HIGHWAY	44.1	1.6
LONG BEACH, American Avenue at Broadway	45.7	-

These stations are tentative and subject to change if final study indicates the desirability thereof. For a typical layout see Part III.

The total length of the line from Panorama to Long Beach is 45.7 miles; the seventeen stations average 2.8 miles apart.

CARS

The cars proposed are of modern design, all-metal construction, and seat 67 passengers each. The station platforms are to accommodate trains of six cars, with the structure so designed as to permit readily lengthening to accommodate eight-car trains. A diagram of the car is shown in Part III.

SPEED

With high rates of acceleration and deceleration, and with the stations averaging 2.8 miles apart, a maximum speed between stations of 60 miles per hour can be reached, and an average over-all speed, including an allowance of 20 seconds for each station stop, of approximately 41 miles per hour, maintained.

MILEAGES AND TIME BETWEEN STATIONS

The following tables show: first, the distance in miles between stations, and, second, the running times between stations, including a 20-second stop at each station.

MILES BETWEEN STATIONS

	Panorama	Van Nuys	Chandler at Woodman	North Hollywood	Ventura	Hollywood	Glendale Boulevard	Civic Center	Hill and 7th	Broadway Place	Main and Florence	Florence and Pacific	Imperial Highway	Compton	San Antonio Drive	Pacific Coast
Van Nuys	1.9															
Chandler at Woodman	4.7	2.8														
North Hollywood	7.9	6.0	3.2													
Ventura	10.1	8.2	5.4	2.2												
Hollywood	14.2	12.3	9.5	6.3	4.1											
Glendale Boulevard	19.5	17.6	14.8	11.6	9.4	5.3										
Civic Center	21.7	19.8	17.0	13.8	11.6	7.5	2.2									
Hill and 7th	22.6	20.7	17.9	14.7	12.5	8.4	3.1	0.9								
Broadway Place	25.0	23.1	20.3	17.1	14.9	10.8	5.5	3.3	2.4							
Main and Florence	28.0	26.1	23.3	20.1	17.9	13.8	8.5	6.3	5.4	3.0						
Florence and Pacific	30.9	29.0	26.2	23.0	20.8	16.7	11.4	9.2	8.3	5.9	2.9					
Imperial Highway	34.1	32.2	29.4	26.2	24.0	19.9	14.6	12.4	11.5	9.1	6.1	3.2				
Compton	36.5	34.6	31.8	28.6	26.4	22.3	17.0	14.8	13.9	11.5	8.5	5.6	2.4			
San Antonio Drive	41.0	39.1	36.3	33.1	30.9	26.8	21.5	19.3	18.4	16.0	13.0	10.1	6.9	4.5		
Pacific Coast	44.1	42.2	39.4	36.2	34.0	29.9	24.6	22.4	21.5	19.1	16.1	13.2	10.0	7.6	3.1	
Long Beach	45.7	43.8	41.0	37.8	35.6	31.5	26.2	24.0	23.1	20.7	17.7	14.8	11.6	9.2	4.7	1.6

RUNNING TIME BETWEEN STATIONS - MINUTES

	Panorama	Van Nuys	Chandler at Woodman	North Hollywood	Ventura	Hollywood	Glendale Boulevard	Civic Center	Hill and 7th	Broadway Place	Main and Florence	Florence and Pacific	Imperial Highway	Compton	San Antonio Drive	Pacific Coast
Van Nuys	3															
Chandler at Woodman	7	4														
North Hollywood	12	9	5													
Ventura	15	12	8	3												
Hollywood	21	18	14	9	6											
Glendale Boulevard	29	26	22	17	14	8										
Civic Center	32	29	25	20	17	11	3									
Hill and 7th	34	31	27	22	19	13	5	2								
Broadway Place	37.5	34.5	30.5	25.5	22.5	16.5	8.5	5.5	3.5							
Main and Florence	41.5	38.5	34.5	29.5	26.5	20.5	12.5	9.5	7.5	4						
Florence and Pacific	45.5	42.5	38.5	33.5	30.5	24.5	16.5	13.5	11.5	8	4					
Imperial Highway	50.5	47.5	43.5	38.5	35.5	29.5	21.5	18.5	16.5	13	9	5				
Compton	54	51	47	42	39	33	25	22	20	16.5	12.5	8.5	3.5			
San Antonio Drive	60.5	57.5	53.5	48.5	45.5	39.5	31.5	28.5	26.5	23	19	15	10	6.5		
Pacific Coast	65	62	58	53	50	44	36	33	31	27.5	23.5	19.5	14.5	11	4.5	
Long Beach	67	64	60	55	52	46	38	35	33	29.5	25.5	21.5	16.5	13	6.5	2

The running time in minutes from the center of Los Angeles to various points by Monorail as compared with Pacific Electric Rail and Bus Lines is shown below:

Stations	Monorail (From 7th and Hill streets)*	Pacific Electric (From 6th and Main Street Terminal)
South		
Broadway Place	4	12
Main Street	8	27
Pacific Boulevard	12	28
Imperial Highway	17	30
Compton	20	30
Pacific Coast Highway	31	52
Long Beach	33	60
		(From 4th and Hill Street Subway Terminal)
North		
Glendale Boulevard	5	6
Hollywood	13	23
North Hollywood	22	45
Van Nuys	31	65
Panorama	34	78

* Two minutes longer from Civic Center to stations on the South and two minutes less to stations on the North.

Thus it appears that to those located near the stations Long Beach is brought almost as close to the business center of Los Angeles in respect of time as Compton is at present; and, on the north, North Hollywood is brought closer than Hollywood.

PARKING LOTS

At all the stations, except the two in the central business district and the one at the southern terminus, large parking lots will be maintained, as shown on the following page, where prospective passengers may park their cars at a nominal fee for the day and take the rapid transit to their destination, thus avoiding the necessity to drive through traffic congestion; and saving time,

cost, parking difficulties, and wear and tear on the nerves. The availability of such parking space in connection with rapid transit has proven useful in other localities as a means of widening the area served by interurban rapid transit.

Stations	Parking Lot Capacity - Number of Cars that Can Be Parked
PANORAMA, at Roscoe Boulevard	400
VAN NUYS BOULEVARD, at Van Owen Street	300
CHANDLER BOULEVARD, at Woodman Avenue	324
NORTH HOLLYWOOD, - Chandler at Tujunga Avenue	255
VINELAND AVENUE, at Ventura Boulevard	369
HOLLYWOOD, Highland Avenue at Sunset Boulevard	297
GLENDALE BOULEVARD and Sunset Boulevard	311
CIVIC CENTER - Hill Street at Temple (subway)	-
SEVENTH STREET (subway) at Hill Street	-
BROADWAY PLACE and Thirty-fifth Street	255
MAIN STREET at Florence Avenue	351
PACIFIC BOULEVARD and Florence Avenue	324
IMPERIAL HIGHWAY	311
COMPTON	447
SAN ANTONIO DRIVE	324
PACIFIC COAST HIGHWAY	257
LONG BEACH - American Avenue at Broadway	-

TRAIN OPERATION

From the riding habits of potential riders that have been studied, it is believed that most of the traffic will be from the northern and southern portions of the line to and from the business and civic centers, with access to

the industrial areas obtained in part by transfer to existing surface lines. There is also a substantial movement between North Hollywood and Hollywood, and between Hollywood and downtown Los Angeles.

The line has been divided for operation into the Northern and Southern Divisions.

The Northern Division would be between Panorama and Washington Boulevard, where the trains operating on this Division would turn back. The Southern Division would be between Long Beach and Civic Center or possibly Glendale Boulevard, where these trains would turn back. It is contemplated that trains on both divisions would operate during peak periods on a three-minute headway.

The portion of the line between Civic Center and Washington Boulevard would be common to the two divisions. On this common portion, in the peak periods, unless the volume of traffic on the two divisions is in balance, there might be a train every one and one-half minutes to provide a three-minute headway for trains on each division beyond the common portion of the line.

Turning the trains that are limited to operation on one division only will require turn-back loops, one north of Civic Center (or Glendale) and one at Washington Boulevard.

As the densest traffic appears to be potential to the part of the line between North Hollywood and Compton, turn-back loops are provided, one west of North Hollywood and one south of Compton. These loops permit of adjusting train operation to passenger load by providing more frequent service on the most heavily traveled part of the line without requiring excessive train mileage over those parts where the demand is less.

SIGNALS

The signal system is designed for a maximum of 40 trains per hour in one direction on a single track, or a train interval of one and one-half minutes.

The signal system is the most modern yet designed and the most nearly "foolproof". It includes cab signal indication so that the motorman is given notice of signal aspects ahead, thus avoiding any possible confusion with background colored lights. It is equipped to stop trains automatically should a motorman inadvertently fail to obey a stop signal.

INSPECTION FACILITIES, SHOPS AND STORAGE YARDS

The principal shops for heavy repairs are planned at a point about 2.5 miles west of the North Hollywood Station. At this location there will also be a storage yard and inspection facilities, as well as a turnaround loop, these chiefly for the Northern Division.

For the Southern Division a storage yard, inspection facilities, and a turnaround loop are to be at a location about two miles south of the station at Compton. For heavy repairs the cars of this Division will be taken to the shops west of North Hollywood.

A more complete description of these facilities with drawings appears in Part III in the report of Gibbs & Hill, Inc.

ALTERNATE FORM OF RAPID TRANSIT

The type of transportation service described above could be carried out equally well by another form of surface-free transportation; substituting for the monorail a modern elevated railroad. The location of the line and of the stations would be identical with the monorail. Such a railroad would be elevated in the same location in which the monorail is elevated; would be in subway along Hill Street, and, at the northerly end, on the part of the route

formerly private right-of-way of Pacific Electric, this line might be at grade, on embankment, or depressed with grade crossings eliminated. It would be possible to build an elevated railroad with solid ballasted floors reducing the noise ordinarily caused by the passage of trains along such a railroad. The cars would be modern, light-weight, comfortable cars so designed as to eliminate all possible noise. Such an elevated railroad is far different from those now operating in New York, Boston, Philadelphia and Chicago, and would be far less objectionable to abutting property owners than the elevated railroads in the cities mentioned, but in that respect would be substantially more objectionable than the proposed monorail. This form of rapid transit has the advantage of having been thoroughly tested in practice, and is probably more flexible than monorail as to the provision of branch lines and interconnections with rail lines in subways if such form of urban mass transit should eventually be adopted in Los Angeles. The cost of construction of such a system would be greater where built as elevated railroad on the streets but less as to the portion on private right-of-way north of Cahuenga Pass and less in the subway section. The cost of operation would differ only as to track maintenance which would probably be greater than the maintenance of the monorail structure.

III - SOURCES OF TRAFFIC FOR THE PROJECT

Sources of traffic for the project are basically the long-haul passengers of the present transit systems, rail, bus and trolley coach, and persons now moving by private automobile on the streets and freeways.

In 1952 the Pacific Electric Railway Company carried a total of 92,475,000 revenue, including transfer, passengers. On the basis of the first nine months we estimate that 88,483,000 were carried in 1953 or a decline of about four per cent. Assuming 251 weekdays per year and 35 per cent additional for Saturdays, Sundays and holidays, it appears that the 1953 average weekday total for Pacific Electric was about 261,000 passengers.

On Wednesday, April 15, 1953, Pacific Electric made a 24-hour check on passengers entering and leaving downtown Los Angeles and found a total of 160,185. Assuming Wednesday, April 15, 1953, to be an average weekday, this indicated that about 60 per cent of total riders entered or left downtown Los Angeles.

The above figures represent the total passengers carried by the Pacific Electric Railway Company, only part of which, however, came from sections within the Monorail study area, and, therefore, represent the number which can be considered potential to Monorail. Listed on the following page are the Pacific Electric lines which now operate in the Monorail study area. The northern and southern divisions conform with the method of study of the potential Monorail traffic, described hereinafter. These are separated into the lines operating between the Subway Terminal Building and points to the north and west, referred to herein as the Northern Division, and those operating between the station at Main and Sixth streets and points to the south and southeast, referred to herein as the Southern Division.

Line	Passengers Entering Downtown Los Angeles Wed., April 15, 1953	Total Traffic for Lines - Estimated Average Weekday 1952
Northern Division		
No. 28 - West Hollywood	2,790	5,540
No. 32 - Hollywood Blvd.- Beverly Hills	8,368	22,300
No. 83 - Sunset Blvd.	14,077	20,200
No. 86 - Van Nuys via Riverside Drive	3,794	4,600
No. 91 - Echo Park Ave.- Vermont Ave.	11,144	16,700
No. 93 - San Fernando Valley	5,243 (1)	10,300 (2)
Total Northern Division	45,416	79,640
Southern Division		
No. 6 - Long Beach	6,948	8,850
No. 7 - San Pedro	4,639	7,350
No. 11 - Bellflower	2,486	2,610
No. 25 - Watts	6,435	10,000
Total Southern Division	20,508	28,810
Grand Total	65,924	108,450

(1) Line 93 - Bus Line - replaced Line 33.
(2) Line 33 - Rail Line - discontinued December 27, 1952, replaced by Line 93.

As indicated above, about 60 per cent of the above passengers enter the downtown business district.

In the past, the Pacific Electric Railway Company from time to time made origin and destination studies on its various lines and this information was made available to us through the courtesy of the Company. These origin and destination studies of passengers were made for the purpose of studying the traffic flow characteristics of each particular line, and zones were used which would provide the type of information desired; for instance, on November 8, 1951 the Pacific Electric Railway Company made an origin and destination study on the San Fernando line, route No. 33, the results of which study were summarized on

the basis of 28 zones, beginning with a zone for the subway terminal on Hill Street near Fourth Street and extending to a zone for the section of the line from Victory Boulevard to Sherman Way. These 28 zones divided the route into a large number of small sections which provided much detailed information as to passenger riding. We did not require information in such detail and we, therefore, consolidated these 28 zones into 8 larger zones suitable for study relative to the proposed location of Monorail stations. The Pacific Electric Railway origin and destination count was consolidated into these larger zones and therefore, provided us with information which was indicative of the manner in which traffic could be expected to move on the Monorail system.

In our analysis, a number of such origin and destination counts were used both for the northern division and the southern division; the lines in the northern division being the Hollywood Boulevard line, the San Fernando Valley line, Riverside Drive line and the Sunset Boulevard line. These figures indicated that about 70 per cent of all traffic in the Monrail area entered the downtown business section including the Civic Center and that of the total traffic moving in the area, about 43 per cent came from the Hollywood section and about 22 per cent from the vicinity of the Glendale Boulevard station.

In the southern division origin and destination counts were available for the Long Beach line, the San Pedro line, the Watts line, and the Bellflower line. These origin and destination counts by Pacific Electric had been analyzed in detail similar to the northern lines and we, therefore, in turn consolidated these small zones into a lesser number of large zones related to our proposed Monorail location stations. In the case of the southern division it appeared that 65 per cent of the total passengers moving along the line had origins or destinations in the downtown business section, and, furthermore, that about 33 per cent of the total traffic moved from the downtown section to the Lynwood-Compton area.

While the above figures are not completely reconcilable in part because the data were taken in different years, considered together they indicate that 60-70 per cent of transit riders enter the downtown business section.

In the case of the Los Angeles transit lines there were no such origin and destination surveys available, but we did have information of passengers carried by each line. From a study of this information we estimated the number of passengers potential to the Monorail as shown below:

Line	1952 Total (000)	Estimated Percentage Potential to the Monorail	Estimated 1952 Potential to the Monorail (000)	Estimated Average Weekday Potential Traffic 1952
Northern Division				
Melrose Ave. W. Olympic Blvd.	11,690	33	3,897	11,500
W. Adams Blvd. Temple St.	12,690	33	4,233	12,500
Beverly Blvd.	6,814	33	2,271	6,700
Subtotal			10,401	30,700
Southern Division				
S. Vermont and Union Station	6,142	100	6,142	18,100
W. Jefferson and Huntington Park	15,312	33	5,104	15,050
San Pedro and W. Seventh St.	12,072	67	8,048	23,800
S. Broadway and Civic Center	6,937	100	6,937	20,500
W. 54th St. and N. Main St.	5,421	33	1,807	5,300
W. 48th St. and Lincoln Park	4,623	33	1,541	4,500
Maple and S. Figueroa St.	9,934	100	9,934	29,400
Subtotal			39,513	116,650
Grand Total			49,914	147,350

In the year 1952 the Los Angeles Transit Lines, as a whole, carried 256,946,000 revenue passengers including transfers. The above, therefore, indicates that approximately 20 per cent of total passengers on the Los Angeles Transit Lines would be potential to the Monorail system.

The second basic source of traffic for the Monorail system will be the persons now moving by private automobile on the streets and freeways. The freeway system in Los Angeles has been under construction for a number of years; the Arroyo Seco Freeway to Pasadena being the first, a section of which was opened in 1940. See Part II, Figure 18. The first section of the Hollywood Freeway followed shortly thereafter and construction has continued, subject to interruption during World War II, to the present date. Early this year, 1954, it is expected that the Hollywood Freeway will be open to traffic from Spring Street in downtown Los Angeles through Cahuenga Pass and to its connection with Ventura Boulevard at Vineland Avenue.

At Spring Street, proceeding easterly, the name changes to the Santa Ana Freeway which crosses the Los Angeles River and proceeds in an easterly and southeasterly direction, and is currently completed about as far as Whittier. The Arroyo Seco Freeway now connects with the Hollywood Freeway near the Civic Center by means of a four-level intersection, and the freeway system continues south from this point under the name of the Harbor Freeway which is presently open to about Wilshire Boulevard. Continuation of the Harbor Freeway farther south is under construction, and will eventually extend as far as San Pedro.

The Los Angeles River Freeway which will ultimately connect the Santa Ana Freeway, from the vicinity of Atlantic Avenue, with Long Beach is also under construction and is opened for a short distance near its southern end. Other elements of the proposed freeway system are either open, under construction or

in various phases of planning and financing, but these briefly described above are the principal ones from which patronage for the Monorail system can be expected to be drawn.

As indicated above, sections of the freeway system have been opened at various times in the very recent past and it is expected that additional lengths will be completed in the near future. For this reason traffic counts quickly decline in value because of the rapidly changing traffic pattern. Furthermore, other traffic counts have been delayed until particular sections of a freeway are opened so that a continuity of comparable traffic data within the city has been lacking.

Among the principal sources of information for traffic which we consider potential to the Monorail system were the cordon counts made by the City of Los Angeles, Department of Traffic Engineering, over a series of years around the central business district. This central business district was defined for the purpose of these counts as being the area bounded on the northeast by Sunset Boulevard, on the northwest by Figueroa Street, on the southwest by Pico Boulevard, and on the southeast generally by Los Angeles Street. A discussion of the trend shown by these cordon counts is presented in Part II of this report, Table 9 and Figure 13. It should be noted that these cordon counts generally covered a 16-hour period from 6:00 A.M. to 10:00 P.M.

Since the last of these cordon counts, important sections of the freeway system have been completed and a readjustment of the normal traffic pattern has taken place. In 1952 the Institute of Transportation and Traffic Engineering of the University of California made a study of the traffic on certain major streets parallel to the Hollywood Freeway northwest of the central business district prior to the opening of the Freeway, and also a study of traffic

on these same major streets and the Hollywood Freeway subsequent to its opening. Results of this study indicated very little change in total traffic moving but that the Freeway was carrying approximately 28 per cent of the total traffic in the band studied. Certain previously major routes showed substantial losses in traffic, such as, Sunset Boulevard, which showed a decline of 40 per cent; Temple Street, which showed a decline of 45 per cent, and First Street which showed a decline of 32 per cent.

Since the total traffic moving did not vary abnormally, we used the 1950 cordon counts as a basis of estimating traffic potential to the Monorail area. We assumed that traffic entering the central business section on the northwest from Sunset Boulevard to Third Street, inclusive, was traffic coming from areas directly potential to the Monorail and also that traffic entering and leaving the central business district on the southwest from Figueroa Street to Los Angeles Street, inclusive, was also directly potential to the Monorail. We adjusted the 16-hour counts to an estimated 24-hour count on the basis of Division of Highways traffic counts on the Hollywood Freeway which indicate that about 87 per cent of total 24-hour traffic moves in the 16-hour period from 6:00 A.M. to 10:00 P.M. We increased this estimated 24-hour traffic by 19 per cent on the basis of Division of Highway traffic counts in the area to arrive at an estimate for 1953. This indicated that about 150,000 vehicles were entering the central business district from the Monorail study area northwest of the central business district, a large portion of which is now using the Hollywood Freeway. This compares with total traffic on the Hollywood Freeway of about 120,000 vehicles per day as indicated by a traffic count made by the Division of Highways 500 feet east of Glendale Boulevard, Friday, July 24, 1953, when 60,254 vehicles were counted in the westbound direction only. From the Monorail area to the south, it appeared that about 198,000 vehicles per day were entering and leaving the central business district.

Traffic volume counts at other locations or routes which may be considered sources of patronage for the Monrail system are as follows. All of these counts were made by the Division of Highways and represent 16 hours of an average weekday in July 1953. We have expanded these counts to an estimated 24-hour period by use of the factor developed above, which indicated that the 16-hour period represented about 87 per cent of the 24-hour period.

Street	Intersection	Leg of Intersection	Estimated 24-Hour Traffic
Hollywood Freeway	Santa Monica	NW	57,200
Hollywood Freeway	Santa Monica	SE	79,300
Cahuenga Pass Freeway	Highland Avenue	S	44,700
Cahuenga Pass Freeway	Highland Avenue	SE	72,500
Ventura Boulevard	Lankershim Boulevard	E	76,600
Figueroa Street	Slauson Avenue	N	36,000
Figueroa Street	Slauson Avenue	S	38,700
Figueroa Street	Manchester Avenue	N	31,000
Figueroa Street	Manchester Avenue	S	29,000
Atlantic Avenue	Firestone Avenue	N	40,500
Atlantic Avenue	Firestone Avenue	S	32,500
Atlantic Avenue	Artesia Avenue	N	21,600
Atlantic Avenue	Artesia Avenue	S	21,800

To the northwest of the central business section traffic arteries other than the Hollywood Freeway still carry substantial volumes and would be major sources of passenger traffic for the System. These would include Glendale Boulevard, Beverly Boulevard, and Third Street as the most important while, undoubtedly, some traffic from as far south as Wilshire Boulevard and possibly Olympic, and as far north as Riverside Drive and San Fernando Road might also be attracted to the use of the System.

In San Fernando Valley, practically all of the traffic moving between areas near or to which Monorail stations would be accessible, and Hollywood and the central business district, represent sources of traffic which the Monorail system could serve beneficially. This traffic now moves into these areas via

Ventura Boulevard, Lankershim Boulevard and Vineland Avenue; another main route is Barham Boulevard, now serving as a means of communication between the upper San Fernando Valley and the Hollywood area. Traffic from the vicinity of San Fernando now using San Fernando Road, if destined for the central business district or areas south or southeast therefrom, might well find use of the Monorail system attractive.

To the south of the central business district there are many important highway routes to the industrial sections, as well as to the Long Beach-San Pedro areas from the center business district. These will be augmented in the near future, undoubtedly before a Monorail system can be completed, by the opening of the Harbor Freeway to San Pedro and the Los Angeles River Freeway to Long Beach. These two freeways will undoubtedly draw interurban traffic from the present arteries, such as, Figueroa Street, Broadway, Main Street, Avalon Boulevard, and Long Beach Boulevard, all of which is a potential source of traffic for the Monorail system but as to which the freeways, on their completion, will be very competitive with the Monorail system on a time basis.

IV - ESTIMATED TRAFFIC AND REVENUE

In developing the potential traffic for the Monorail system, two basically different methods were used. The first method involved a study of present-day rail and bus riding, together with a study of current automobile traffic on the streets and freeways. The second method employed an origin and destination study of industrial employees in the Los Angeles area prepared by Ruscardon Engineers.

In the first method, further use was made of the origin and destination studies of the Pacific Electric Railway Company referred to in Chapter III. We assumed that the travel pattern of the estimated Los Angeles Transit Lines passengers entering the downtown business section was the same as that of the Pacific Electric riders as to origins and destinations outside the central business district and as to complete trips which did not enter the district, and we, therefore, distributed the Los Angeles Transit Lines passengers accordingly. The sum of the Pacific Electric Railway and the Los Angeles Transit Lines riders as developed above is an indication of the present-day riding pattern on the existing transit lines relative to the Monorail system as currently proposed.

Likewise, the automobile traffic estimated as entering the central business district from areas potential to the Monorail system as described in Chapter III was assumed to have the same origin and destination pattern as that of the Pacific Electric Railway, and it was distributed in the same manner.

During the course of this study, Ruscardon Engineers made vehicular volume counts and also made an analysis of the number of persons carried per automobile during the period of such counts. Studies were made at nine different locations in the area on various weekdays in June and July 1953, one of which is shown on Table 12, page 66, Part II. As to the vehicles observed, each vehicle on the average carried about 1.45 persons, including the driver.

The estimated number of automobiles moving from each zone to every other zone was, therefore, multiplied by 1.45 to obtain an estimate of the number of persons moving over the streets and freeways within the area in accordance with this pattern. By combining the zone-to-zone flow of passengers by rail, bus and individual automobiles, we estimated total potential riders for the Monorail system, distributed by zones and related to the proposed Monorail stations.

Considering that the major portion of all potential traffic, both transit and automobile, enters the downtown business section, and since such traffic was used as the base for this estimate, we believe the method of distribution to be reasonable.

The estimate of vehicular riders used above was checked at locations outside the central business district by comparison with available counts. Two such locations were Cahuenga Pass on the north and across a screen line in the vicinity of Imperial Highway between Figueroa Street and Atlantic Avenue on the south. In both cases, the vehicular traffic estimated as potential to the Monorail was less than the actual total traffic at the particular location. This was to be expected because the Monorail traffic does not include strictly local movements. While this process did not result in a precise check, it was felt that the degree of corroboration was satisfactory within the limits of the information available.

These computations produced an estimated total potential for the Monorail system within the study area of 785,000 persons for an average weekday in 1953; of which about 15 per cent were present-day transit riders and about 85 per cent were present riders in individual automobiles on the streets and freeways.

The second basis for estimating potential traffic was the origin and destination survey of employed persons (comprised very largely of industrial

employees) compiled by Ruscardon Engineers and more fully described in Part II of this report. The place of business and home addresses of these employed persons were summarized by postal zones in the Monorail study area. We consolidated origin and destination information obtained by this study by assembling these zones into larger groups which could be compared as to time and distance characteristics relative to present-day transit lines, highway routes and the proposed Monorail route. A summarization of the employed persons in such zones indicated that out of a total of 391,000 (Part II, page 78) in the study area, there were approximately 153,000 employees, the location of whose homes would make them potential users of the Monorail system. (See pages 47 to 50.)

The Ruscardon Engineers study was based largely on employees in manufacturing industries. In certain sections of the area; namely, Hollywood and downtown Los Angeles, that study also included employees in other categories, all as discussed in Part II, page 85 of this report. Ruscardon Engineers estimate that, assuming employees in manufacturing industries are 100 per cent potential to the Monorail, employees in other categories are potential in various degrees as indicated in Part II, page 86 and that, on the average, these other employees are potential to the extent of approximately 50 per cent of those engaged in manufacturing.

Therefore, we increased the potential riders determined from industrial employees for each zone-to-zone movement by 50 per cent.

Since the Ruscardon Engineers origin and destination survey was based entirely on employed persons, it is believed that the potential so indicated represents what would be largely peak-hour traffic, that is, riding from home to work and vice versa. Since a large portion of these people now move by private automobile, as indicated by the relationship between total riders on present-day transit lines and the estimated automobile traffic shown above, page 35, 15 per cent by transit and 85 per cent by automobile, it is believed

that the peak-hour traffic should be expanded to the full twenty-four hours on the basis of daily travel pattern of automobiles on the highways.

Traffic counts made by the California Division of Highways on the Hollywood Freeway, July 24, 1953, indicate that in the three busiest hours of the morning and the three busiest hours of the afternoon, a total of 41.3 per cent of the 24-hour traffic is carried. We have, therefore, assumed that as far as potential traffic is concerned, total employed persons represent 40 per cent of all traffic available. Expansion of these figures indicates, therefore, that there is an average weekday potential to the Monorail of about 1,115,000 passengers developed as shown below:

Total potential workers from Ruscardon Engineers origin and destination study	153,000
Two trips per day per worker; that is, to and from work	306,000
Increase by 50 per cent for estimated potential workers in other categories	460,000
Expand to 24-hour traffic assuming workers represent 40 per cent of total potential rides	1,115,000

This figure of 1,115,000 compares with the estimated 785,000 potential daily rides produced from the study of transit and automobile riding. It is believed that the larger figure is probably more nearly correct because of the general coverage of the survey, and also because the smaller figure represents only an expansion of Pacific Electric origin and destination studies which were made on different dates and for a different purpose, and exclude any allowance for through riders. In any event, both figures are of the same order of magnitude and it appears probable that for the particular location of the Monorail and the proposed station sites, limits of the total potential traffic are established by these totals.

In estimating that portion of the potential Monorail traffic which could be expected to use the proposed facility, consideration was given to relative time, distance and cost of use as compared with the use of alternate means of travel. For such determination we studied the time required to travel between selected common points of each zone to each other zone by three methods; namely, present-day transit riding, highway riding in individual automobiles, and riding by the proposed Monorail. Comparisons of distances traveled were made, but these seemed less important than time. Cost studies were also made, including a relation of the differences in distances where they affected cost of the trip.

As to present transit riding, we estimated the time and cost required to travel from each zone to every other zone by the best present transit facilities available. Where necessary, these times included walking time across downtown Los Angeles from the subway terminal to the Pacific Electric terminal at Sixth and Main streets. No time, however, was included for waiting when transfer between lines was necessary. Costs included cash fares and any transfer costs.

Time and distance studies pertaining to the use of highways, streets and freeways were made by our engineers as the result of many trips over existing routes. We estimated time and distance over future routes on the basis of distances taken from maps and speeds as determined from our experience on existing highways of similar construction. We assumed for purposes of our estimates that at the time of commencement of the Monorail operation, the Harbor Freeway would be completed between Los Angeles and San Pedro, and the Long Beach Freeway between Santa Ana Freeway and Long Beach. Travel time on the freeways was estimated to be at an over-all average of 45 miles per hour. Direct automobile costs were calculated on the basis of three cents per mile for fuel, oil and tires, and in the case of the Hollywood zone and the Central Business District

zones, an average daily parking cost of 50 cents. Vehicular costs were divided by 1.45 (the average persons per automobile) to allow for a theoretical distribution of the total cost of operating the vehicle to individual persons.

In the case of the Monorail, time between stations was calculated on the basis of an average speed of 41 miles per hour including stops and, in addition, five minutes was added for ascent and descent from station platforms and for the waiting time for trains. Where Monorail stations were not at the common points of the zones, it was assumed that either automobile or mass transit facilities would be used to get to the Monorail station and these costs and times were included. Use of private automobiles to get to and from the Monorail stations was restricted to one end of the trip.

For example, we estimate that from Panorama to Hollywood, the time required by existing transit is 56 minutes, by the present highway system 36 minutes, and by the Monorail would be about 25 minutes. From Panorama to 7th and Hill streets by existing transit facilities is 78 minutes, by highway is 50 minutes, and by Monorail would be about 36 minutes. In all of the above cases, estimated cost via Monorail would be the cheapest. From Hollywood to 7th and Hill streets by existing transit is about 35 minutes, by highway system is about 20 minutes, and by Monorail is estimated to be about 25 minutes. In this case, use of the highways represents the best means of travel in relation to time, although as to costs, the existing transit is the cheapest. From 7th and Hill streets to Compton, the estimated time by existing transit is 40 minutes, by highway, 38 minutes, and by Monorail would be about 24 minutes. From 7th and Hill streets to the terminal station in Long Beach, the existing transit schedule is over an hour; by highway the time would be about 55 minutes using the Los Angeles River Freeway, while the Monorail would provide transportation in about 37 minutes. In the cases of both of these last trips, the cost by Monorail is estimated to be the cheapest.

Comparison of time and cost by use of the proposed Monorail system with present mass transit facilities indicated that in almost all cases the Monorail system would provide quicker service than the present facilities at, except in the case of short hauls within about an eight-mile radius circle centered downtown, lower cost. Comparison of the time and cost of the use of the proposed Monorail system with the use of automobiles on the highways and assumed freeway systems indicated that in most cases the Monorail system would be less expensive than use of private automobiles and, while generally somewhat slower, would in many cases be faster depending chiefly on the origin and destination of the trip relative to a Monorail station.

In our opinion, time saving will be the most important measurable factor in diverting automobile users from their present method of transportation to the Monorail. For this reason, we estimated diversions to the Monorail from the highway system on the basis of time saving alone, and on the scale indicated below:

Time Saving of the Monorail vs. Highway System (Minutes)	Estimated Percentage Diversion to the Monorail System
0	20
5	60
10	100

These percentages were applied to the group zone-to-zone potential industrial employee traffic from Ruscardon Engineers and the resultant sum, 46,600, indicates our estimate of the number of industrial employees who would use the Monorail. Since each employee could be assumed to make two trips a day, that is, to and from work, this figure was doubled, 93,200, and is our estimate of the total rides which we would expect for the Monorail from industrial workers. On page 37 above we estimated the corresponding potential at 306,000 and our estimated diverted traffic of 93,200 represents about 30 per cent of this potential.

On page 37 above we discussed the ratio of the potential of manufacturing employees to total employees, and indicated that we believe this ratio should be approximately 50 per cent. Since these other workers, however, may be less restricted as to hours of employment and may have some need of their automobiles, at their places of business, we believe that the estimated rate of diversions for other than industrial employees should be reduced by one-half, and therefore have increased our estimated manufacturing employees by 25 per cent instead of 50 per cent to account for employees in other categories. This process produces estimated diverted peak-hour traffic for all employees, of 116,500 passengers. Compared with the total estimated peak-hour potential of 460,000, this estimated diversion total represents about 25 per cent.

As discussed under potential traffic, peak-hour traffic on the highways in the Los Angeles area represents about 40 per cent of total 24-hour traffic. Experience on the transit lines indicates that their peak-hour traffic is about 50 per cent of total 24-hour traffic, and therefore, we have assumed that the above figure of 116,500 peak-hour passengers would be about 50 per cent of the 24-hour total. On that basis our estimate of average weekday traffic becomes 233,000.

Compared with our estimated 24-hour potential of 1,115,000, our estimated diverted passengers represent about 20 per cent. See table on the following page.

	Potential	Diverted	Per Cent Diverted of Potential
Number of manufacturing employees (from Ruscardon Engineers Survey)	153,000	46,600	
Two trips per day per employee; that is, to and from work	306,000	93,200	30.5
Percentage increase to account for employees in categories other than manufacturing	50%	25%	
Estimated peak-hour total	460,000	116,500	25.3
Estimated per cent peak-hour to 24-hour total	40%	50%	
Total average weekday traffic	1,115,000	233,000	20.3

For the purpose of this study, we have assumed that fares to be paid by passengers would be collected by the turnstile method. We propose at this time that a zone system of fares be adopted. We have tentatively set up a northern zone extending from the northern terminus of the line to and including the Hollywood station, a central zone comprising the Glendale station, the Civic Center station and the 7th and Hill streets station, and a southern zone from the Broadway Place station to the southern terminus of the line. The platforms of the stations and the waiting rooms would be separated by a grill or other partition, except at the three central stations and at the two terminii.

Turnstiles in the three center stations will require a dime either to enter or to leave, so that a passenger going, for example, from 7th and Hill to Glendale Boulevard would deposit a dime upon entering the station and another upon leaving - the total fare being 20 cents.

At the stations south of 7th and Hill, passengers would deposit a quarter upon entering to go north but nothing upon leaving, so that the fare is 25 cents between any of these stations in the northbound direction. If such

passengers, however, ride to any of the three central stations, they deposit a dime upon leaving, so that the total fare to any of these three stations from the south is 35 cents. If they ride further north than Glendale Boulevard, they deposit a quarter upon leaving, making the fare from any station on the Southern Division south of 7th and Hill to any station on the Northern Division north of Glendale Boulevard, 50 cents.

Similarly, in the opposite direction from north to south.

Applying the above fares to the estimated weekday zone-to-zone traffic indicates that from the 233,000 estimated average weekday passengers, a total of $69,321 would be collected, or an average of $0.298 per passenger.

We have also considered the situation where the line would be constructed only from North Hollywood to Compton. In the case of the long line our estimates show passengers boarding at the three stations at either end of the line. In the case of the short line, these three stations, at the ends of the long line, six in all, would be eliminated. We estimate that any passengers using these stations in the case of the long line, to and from the Central Business District or to short line stations beyond, would also be patrons of the short line. To stations nearer than the Central Business District we estimate that 50 per cent of the passengers for the long line would be retained in the case of the short line. Long line traffic between two stations, which would both be eliminated in the case of the short line, was excluded entirely from short line traffic estimates. The zones for fare payments would remain the same and the rate of fare would remain the same.

On the above basis, we estimate that total average weekday traffic would be 205,109 passengers from whom would be collected total revenue of $62,252, or an average of $0.304 per passenger.

We expanded the estimated average weekday totals for the long and short lines to an estimated year as described previously; that is, assuming 251 weekdays

per year and adding 35 per cent for Saturdays, Sundays and holidays, or an equivalent of about 339 weekdays. As a result of this, we estimate that for a full year, results of operation would be as shown in the tables on pages 45 and 46, and summarized below:

	Long Line Panorama-Long Beach	Short Line North Hollywood-Compton
Estimated annual passengers	78,952,000	69,501,000
Estimated annual revenue	$23,489,000	$21,094,000

It should be recognized that the above estimates were arrived at on the basis of an analysis of available information, plus an origin and destination survey of only one category of potential users for such a rapid-transit system. It is believed that these estimates are reasonable for the purpose.

PANORAMA - LONG BEACH

ESTIMATED TOTAL TRAFFIC AND REVENUE

		Average Weekday						Estimated Full Year x 338.85
		Panorama-Woodman	No. Hollywood-Hollywood	Glendale-Downtown	Broadway Place-Compton	San Antonio Drive-Long Beach	Total Panorama-Long Beach	
Panorama-Woodman	Traffic Fare Revenue	820 $0.25 $205	22,485 $0.25 $5,621.25	14,390 $0.35 $5,036.50	3,815 $0.50 $1,907.50	385 $0.50 $192.50	41,895 $12,962.75	
No. Hollywood-Hollywood	Traffic Fare Revenue		25,795 $0.25 $6,448.75	16,725 $0.35 $5,853.75	5,180 $0.50 $2,590	260 $0.50 $130	47,960 $15,022.50	
Glendale-Downtown	Traffic Fare Revenue			20,565 $0.20 $4,113	58,270 $0.35 $20,394.50	7,515 $0.35 $2,630.25	86,350 $27,137.75	
Broadway Place-Compton	Traffic Fare Revenue				33,920 $0.25 $ 8,480	14,865 $0.25 $3,716.25	48,785 $12,196.25	
San Antonio Drive-Long Beach	Traffic Fare Revenue					8,010 $0.25 $2,002.50	8,010 $2,002.50	
Total Panorama-Long Beach	Traffic Revenue	820 $205	48,280 $12,070	51,680 $15,003.25	101,185 $33,372	31,035 $8,671.50	233,000 $69,321.75	78,952,000 $23,489,000
	Average fare						$0.298	

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NO. HOLLYWOOD - COMPTON

ESTIMATED TOTAL TRAFFIC AND REVENUE

		Average Weekday				Estimated Full Year x 338.85
		No.Hollywood-Hollywood	Glendale-Downtown	Broadway Place-Compton	Total No.Hollywood Compton	
No. Hollywood-Hollywood	Traffic	37,037	31,115	9,255	77,407	
	Fare	$0.25	$0.35	$0.50		
	Revenue	$9,259	$10,890	$4,627	$24,776	
Glendale-Downtown	Traffic		20,565	65,785	86,350	
	Fare		$0.20	$0.35		
	Revenue		$ 4,113	$23,025	$27,138	
Broadway Place-Compton	Traffic			41,352	41,352	
	Fare			$0.25		
	Revenue			$10,338	$10,338	
Total N. Hollywood-Compton	Traffic	37,037	51,680	116,392	205,109	69,501,185
	Revenue	$9,259	$15,003	$37,990	$62,252	$21,094,090
	Average fare				30.35¢	

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GROUPS OF POSTAL ZONES FOR STUDY OF TRAFFIC TO AND FROM THE SOUTH OF THE GROUP

Group	Postal Zone	
	Number	Name
100	80	Pacoima
	83	San Fernando
101	69	Chatsworth
	79	Northridge
102	71	Canoga Park
	72	Reseda
	90	Van Nuys
104	86	Sun Valley
105	78	North Hollywood
106	73	Encino
	87	Tarzana
	89	Universal City
	92	Woodland Hills
107	68	Burbank
108	28	Los Angeles
109	38	Los Angeles
110	36	Los Angeles
111	4	Los Angeles
112	5	Los Angeles
113	27	Los Angeles
114	26	Los Angeles
	29	Los Angeles
	39	Los Angeles
115	All	Glendale
116	12	Los Angeles
	31	Los Angeles
	32	Los Angeles
	41	Los Angeles
	42	Los Angeles
	65	Los Angeles

GROUPS OF POSTAL ZONES FOR STUDY OF
TRAFFIC TO AND FROM THE SOUTH OF THE GROUP

Group	Postal Zone	
	Number	Name
117	33	Los Angeles
	63	Los Angeles
119	13	Los Angeles
	14	Los Angeles
	17	Los Angeles
120	6	Los Angeles
	7	Los Angeles
	11	Los Angeles
	15	Los Angeles
	18	Los Angeles
121	1	Los Angeles
	21	Los Angeles
	22	Los Angeles
	23	Los Angeles
	58	Los Angeles
	66	Bell
	75	Huntington Park
	77	Maywood
122	72	Downey
	76	Lynwood
	85	South Gate
123	70	Compton
	81	Paramount
124	67	Bellflower
125		

GROUPS OF POSTAL ZONES FOR STUDY OF
TRAFFIC TO AND FROM THE NORTH OF THE GROUP

Group	Postal Zone	
	Number	Name
200	90	Van Nuys
201		
202	78	North Hollywood
203	89	Universal City
204	5	Los Angeles
	6	Los Angeles
	18	Los Angeles
	28	Los Angeles
	36	Los Angeles
	38	Los Angeles
205	27	Los Angeles
	29	Los Angeles
206	26	Los Angeles
207	39	Los Angeles
208	12	Los Angeles
	22	Los Angeles
	23	Los Angeles
	31	Los Angeles
	32	Los Angeles
	33	Los Angeles
	63	Los Angeles
209	7	Los Angeles
	15	Los Angeles
210	13	Los Angeles
	14	Los Angeles
	21	Los Angeles
211	11	Los Angeles
	58	Los Angeles
212	1	Los Angeles
	2	Los Angeles

GROUPS OF POSTAL ZONES FOR STUDY OF TRAFFIC TO AND FROM THE NORTH OF THE GROUP

Group	Postal Zone	
	Number	Name
213	66	Bell
	72	Downey
	75	Huntington Park
	77	Maywood
	85	South Gate
214	59	Los Angeles
215	76	Lynwood
216	5	Long Beach
	11	Long Beach
	67	Bellflower
	70	Compton
	81	Paramount
217	6	Long Beach
	7	Long Beach
	8	Long Beach
	15	Long Beach
218	10	Long Beach
219	74	San Pedro
	84	Harbor City
220	91	Wilmington
221	3	Long Beach
	4	Long Beach
	12	Long Beach
	13	Long Beach
	14	Long Beach
222	2	Long Beach

V - ESTIMATED COST OF CONSTRUCTION

The cost of construction of the Monorail system described in Chapter II, above, has been estimated by Gibbs & Hill, Inc., Consulting Engineers, and is set forth in some detail in Part III of this report. The following is a condensation thereof. The estimates are based on prices and wages in effect at the end of 1953. The estimates are presented for a line between:

(a) Panorama and Long Beach, and

(b) North Hollywood and Compton

These estimates are set forth below. To the construction costs estimated by Gibbs & Hill, Inc. we have added allowances for the Authority's administration, legal expenses and taxes during construction, working capital, interest during construction, and cost of financing and so have produced an estimate of the amount of financing required. No separate allowance is included for patent rights and royalties other than included in the cost of equipment. Gibbs & Hill, Inc. advise that to the best of their knowledge no such allowance is needed.

BETWEEN PANORAMA AND LONG BEACH - 45.7 MILES

Gibbs & Hill, Inc. estimate the construction cost as follows (pages 15-17, Part III):

The structure, including steel, foundations and stations (except two in subway section)		$ 61,104,175
The equipment, including trolleys, rail, signals and intercommunication system, substations and power distribution, complete except cars		13,830,249
Subway structure, including two stations (under Hill Street)		21,800,000
Repair shops and storage yards, completely equipped		6,081,011
Land acquisition, including parking lots		3,261,030
Cars for beginning of operation,		
131 cars at $80,000	$10,480,000	
Equipment for inspection and maintenance	110,000	10,590,000
Miscellaneous expenses including model testing and development, procurement of equipment and material, field surveys, engineering expense, insurance during construction, and placing equipment into operation and training personnel		10,500,000
Contingencies		10,000,000
Total		$137,166,465
We have added the following item:		
Authority administration and taxes during construction		$ 1,833,535
Total Cost		$139,000,000
Interest during construction (2-1/2 years net at 5 per cent of bond issue)		20,651,000
Cost of financing (at 3 per cent of total bond issue)		4,956,000
Total Capital Cost		$164,607,000
Working Capital		600,000
Total Requirements		$165,207,000

BETWEEN NORTH HOLLYWOOD AND COMPTON - 28.6 MILES

Gibbs & Hill, Inc. estimate the construction cost of this part of the line as follows (pages 18-20, Part III):

Structure, including steel, foundations and stations (except two in subway section)		$ 43,346,855
Equipment, as above		10,022,766
Shops and yards		5,719,011
Subway structure		21,800,000
Land, including parking lots		2,308,900
Miscellaneous expenses including model testing and development, procurement of equipment and material, field surveys, engineering expense, insurance during construction, and placing equipment into operation and training personnel		8,650,000
Cars for beginning of operation, 117 cars at $80,000	$9,360,000	
Equipment for inspection and maintenance	110,000	9,470,000
Contingencies		10,000,000
Total		$111,317,532

We have added the following item:

Authority administration and taxes during construction	$ 1,442,468
Total Cost	$112,760,000
Interest during construction (2-1/2 years net at 5 per cent of bond issue)	16,747,000
Cost of financing (at 3 per cent of total bond issue)	4,019,000
Total Capital Cost	$133,526,000
Working Capital	450,000
Total Requirements	$133,976,000

Experience in cities where elevated railways have been built indicates the possibility of claims of abutting property owners for damages to the value of their real estate. The Monorail location, except where it is in private right-of-way or in subway, is in wide streets, is in general higher, and interferes substantially less with light, air and access than did the elevated railways. The question of whether such damages will be claimed or proved is at present unanswerable and no allowance therefore has been made. Experience generally has been that provision of transportation facilities has increased the assessed valuation of real estate so located as to benefit from the new lines. This is a benefit which would accrue to the municipality involved and not to the line.

We have not included any allowance for acquisition of right-of-way.

VI - ESTIMATED COST OF MAINTENANCE AND OPERATION

The cost of maintenance and operation has been estimated by Gibbs & Hill, Inc. and is set forth in Part III of this report. We have also prepared such estimates including the costs of maintenance of way, maintenance of equipment, operation of trains, power and general overhead. Details of organization have been considered, including the various departments such as the following:

Executive
Transportation
Engineering
Line Equipment
Track and Structures
Car Maintenance
Secretaries
Payroll
Personnel
Accounting
Revenue
Purchase and Stores
Law and Real Estate
Transportation Costs
Medical
Lost Property
Police

A hypothetical budget for these departments was set up and the total expenses, together with the estimated cost of power, indicated for the appropriate number of car-miles required to perform the service, were 33.8 cents per car-mile, which corroborated the estimate of Gibbs & Hill, Inc. (pages 13 and 14, Part III). We have increased this figure somewhat to cover social security and other payroll taxes, workmen's compensation and other insurance. These estimates are based on existing levels of prices and wages.

The operating expenses and the necessary fares required to cover operating expenses and fixed charges have been estimated both for the 45-mile line from Panorama to Long Beach and for the 32-mile line from North Hollywood to Compton, as follows:

Between Panorama and Long Beach

Operating Expenses:	
Maintenance of way and structures	$ 1,220,000
Maintenance of equipment	1,750,000
Operating cars	2,426,000
(This is based on one motorman and one guard per train)	
Power	1,750,000
General administrative expenses	875,000
Total	$ 8,021,000
(This is equivalent to 33.8 cents per car-mile for 23,750,000 car-miles a year)	
Allowance for Social Security, Compensation and other insurance	750,000
Total Operating Expenses	$ 8,771,000
For purposes of computing interest the rate is taken at 5 per cent per year; and for amortization of debt a period of 20 years at 3 per cent per year.	
Interest at 5 per cent and amortization at 3 per cent of the total bond issue	13,216,000
Total Annual Expenses and Charges, except Taxes	$21,987,000

Because of the relatively high cost of the property, the State, City and County taxes, calculated in the manner applied to utilities in Los Angeles, produce a very high figure in proportion to operating expenses. For that reason we have shown the expenses and charges before taxes as well as after taxes.

In the Act creating the Los Angeles Metropolitan Transit Authority, Section 4.21 of Chapter 4 states:

> "The authority shall pay to each public corporation in which property of the authority is situated an amount equal to the amount which would be paid in taxes and assessments on such property if it were privately owned. The amount of such payments shall be computed in the same manner as taxes or assessments on such property would be computed if it were privately owned, except that for this purpose the property of the authority shall be valued at appropriate times by the State Board of Equalization, and its determination thereof shall be final. This section shall not be applicable to bonds issued by the authority."

In accordance with the language of this Act, we have computed taxes on this property at the rates that have been furnished to us by the Authority at 2 per cent of the gross revenue and 6-1/2 per cent on the assessed valuation of the property, which is taken at one half of the cost; in this case, one half of $139,000,000 prior to the addition of items of interest during construction and the cost of financing.

As computed in this way the total taxes payable the first year are less than $5,000,000, which is five eighths of all of the total operating expenses, before taxes. Taxes amount to about 25 per cent of the sum of operating expenses, interest and amortization on investment and taxes.

Total Annual Expenses and Charges, except Taxes (as shown on the preceding page)	$21,987,000
Taxes include a franchise tax of 2 per cent on the gross revenue and a property tax of 6-1/2 per cent on the assessed valuation of the property, which has in this case been taken at half the cost or $69,500,000.	
If taxes are to be paid, the additional amount to be earned is estimated at	4,988,000
Making the total, including taxes, of	$26,975,000
Taking the average passengers at 233,000 per weekday, or 79,000,000 per year, the average fare per passenger needed to earn expenses and interest and amortization is	$0.28
and to earn taxes as well	$0.341

Between North Hollywood and Compton Line - 28.6 Miles (32 miles for operation)

Operating Expenses:	
Maintenance of way and structures	$ 901,556
Maintenance of equipment	1,292,698
Operating cars (This is based on one motorman and one guard per train)	1,792,588
Power	1,290,944
General administrative cost	631,440
Total (This is equivalent for 17,540,000 car-miles per year to 33.7 cents per car-mile)	$ 5,909,226
Allowance for Social Security, Compensation and other insurance	591,000
Total Operating Expenses	$ 6,500,000
Interest at 5 per cent and amortization at 3 per cent on bond issue of $133,976,000	10,718,000
Total Annual Expenses and Charges, before Taxes	$17,218,000
Taxes, two per cent on the gross revenue of $21,000,000 and a property tax of 6-1/2 per cent on the assessed valuation of the property, which in this case has been taken at half the cost or $61,135,000.	
If taxes are to be paid, the additional amount to be earned is estimated at	4,087,000
Making the total, including taxes	$21,305,000
Taking the average passengers per weekday at 205,000 equivalent to 69,500,000 per year, the average fare needed to earn expenses and fixed charges other than taxes is	$0.248
and including taxes	$0.307

No specific allowance has been included above for depreciation. If such an allowance were to be set up it would be in the order of about 8 per cent of gross earnings. This would amount to (a) $1,898,000 in the case of the longer line, and (b) $1,704,000 in the case of the shorter line, as compared with the annual amounts required for amortization of debt of $4,956,000 and $4,019,000, respectively. These latter figures are derived in Chapter VII following. The application to depreciation reserves of funds set aside for amortization is an entirely proper and normal procedure.

VII - CAPITAL REQUIREMENTS AND COMMENTS ON FINANCING

In the following, separate consideration is given to the two cases:

(a) line extending between Panorama and Long Beach

(b) line extending between North Hollywood and Compton

LINE BETWEEN PANORAMA AND LONG BEACH

In Chapter IV, above, the passenger revenue was derived as follows:

Line between Panorama and Long Beach	$23,489,000
To this should be added an allowance for income from advertising privileges, car cards, station posters and other concessions estimated at one per cent of passenger revenue, or	235,000
making gross revenues	$23,724,000
Operating expenses, excluding taxes, were estimated in Chapter VI at	8,771,000
leaving, available for depreciation, taxes and debt service,	$14,953,000
The total bond issue required was derived in Chapter V as $165,207,000.	
Annual interest on this amount at 5 per cent is	$ 8,260,000
and the annual amount necessary to retire the debt in 20 years (3 per cent) is	4,956,000
making total annual charges	$13,216,000
The amount available before taxes shows a coverage over interest alone of	$ 6,693,000
or, the interest is earned	1.81 times
Taxes, as estimated in Chapter VI, are	$ 4,988,000
leaving the total available for depreciation and debt service	$ 9,965,000
This shows a coverage over interest alone of	$ 1,705,000
or, the interest is earned	1.21 times
The "amount available" after taxes to meet debt service of $13,216,000 is deficient by	$ 3,251,000

LINE BETWEEN NORTH HOLLYWOOD AND COMPTON

Similarly, in Chapter IV:

Passenger revenue was derived as	$21,094,000
To this is added an allowance for advertising privileges, etc., of one per cent	211,000
making gross revenues	$21,305,000
Operating expenses, excluding taxes, were estimated in Chapter VI at	6,500,000
leaving, available for depreciation, taxes and debt service,	$14,805,000

The total bond issue required was, from Chapter V, $133,976,000.

Annual interest charges at 5 per cent are	$ 6,699,000
and the annual amount necessary to retire the debt in 20 years (3 per cent) is	4,019,000
making total annual charges	$10,718,000
The amount available before taxes shows a coverage over interest alone of	$ 8,106,000
or, the interest is earned	2.21 times
Taxes, as estimated in Chapter VI, are	$ 4,087,000
leaving the total available for depreciation and debt service	$10,718,000
This shows a coverage over interest alone of	$ 4,019,000
or, the interest is earned	1.60 times
There is just sufficient earnings after taxes to cover total annual requirements for debt service amounting to	$10,718,000

From the above it appears that for both conditions there is a margin before taxes over and above the amounts needed to pay interest at 5 per cent and retire the debt in 20 years. After taxes there is a deficiency of $3,371,000 in the case of the longer line and just sufficient in the case of the shorter.

No allowance has been made for increase in traffic although the projected population of Los Angeles County in 1960, which is only two years after

the earliest year in which the system could be put in operation, is 5,500,000 or approximately 25 per cent greater than in 1953 (see Part II, page 19) and the growth in the area farthest from the center of Los Angeles and therefore most likely to use the Monorail is projected at a much more rapid rate than the areas nearer to the center of the City (see Table 4, page 28, Part II). We are of opinion that such growth will increase the earnings over and above those which we have estimated as of the present year.

The annual charges for amortization are several times the amount needed as provision for depreciation. If an allowance were to be set up it would be in the order of about eight per cent of gross revenue; $1,898,000 in the case of the longer line, and $1,704,000 in the case of the shorter as compared with annual amortization requirements of $4,956,000 and $4,019,000, respectively.

If the test of economic feasibility of a project is the ability to pay interest on and pay off the debt within a reasonable period, say 20 years, then the Monorail system herein described would be feasible in the case of the line between Panorama and Long Beach only with substantial relief in the matter of taxes. In the case of the initial construction between North Hollywood and Compton, the result is more favorable even after taxes estimated on the conventional basis. In the latter case the estimated earnings after taxes would be sufficient to pay interest and retire the debt in 20 years. This indicates economic feasibility subject to determination of the matter of damages for use of city streets, to approval by Public Utilities Commission and successful financing.

As to whether or not this project could be financed by an issue of revenue bonds is another matter. The only revenue bonds secured solely by earnings of a traction property that we know of are Chicago Transit Authority. In

that case the Authority has complete and undisputed authority over service and rates and, in fact, is required to maintain rates at a level sufficient to produce certain reserves and interest and amortization requirements. The many issues of revenue bonds on highway facilities secured by tolls, such as the bonds issued by California Toll Bridge Authority, are based on the Authority's right and obligation to fix toll rates at levels sufficient to meet all bond requirements.

The Chicago Transit Authority, as of December 31, 1952, had outstanding $128,000,000 of revenue bonds, of which $105,000,000 carried interest at various rates, 3-1/4 per cent to 3-3/4 per cent, depending on year of maturity, but $65,000,000 of them maturing in 1978 bear interest at 3-3/4 per cent. $23,000,000 issued in 1952 mature in 1982 and bear interest at 4-1/2 per cent. In addition, there are $15,000,000 of equipment trust certificates authorized, but they are secured directly by the equipment.

For the year 1952 gross earnings of Chicago Transit Authority were $117,122,567 and the amount available for depreciation, reserves and debt service was $16,406,427, as compared with charges of $4,810,892, a coverage of 3.4 times. The amount available after depreciation and rental is $6,650,092, a coverage of 1.38 times.

In the instant case, the Act creating the authority provides that the Authority "shall be subject to the same regulations, restrictions and restraints as if it were a privately owned and operated carrier and shall be subject to the jurisdiction of the Public Utilities Commission and all other laws applicable to privately owned and operated carriers" (Chapter 3, Section 3.2). Furthermore, the question of the amount of damages, if any, payable to property owners abutting on the streets used by the Monorail is indeterminate.

We are of opinion that these restrictions would make it very difficult, if not impossible, to sell revenue bonds on any project. In this project the margin should be greater than normal because the general investing public would consider a Monorail system as an innovation not yet proven in practice, and in an industry which has ceased to have a strong appeal to the investor.

VIII - CONCLUSIONS

As a result of the combined study described above, in which there were associated with us the firms of Ruscardon Engineers and Gibbs & Hill, Inc., and in conformity with the contract we have reached the conclusions as set forth below.

FIRST:

Los Angeles in respect of transportation requirements is of all the great cities in the United States in a class by itself. The density of population of the portion of the County south of the mountains is estimated at 4,650 per square mile, which is a fraction of the density in either New York, Philadelphia or Boston. Of all the cities in the United States, Los Angeles is the one which has attained the greatest part of its growth since the advent of the automobile. The population has increased 343 per cent between 1920 and 1950. In 1921 there was one automobile for every 6.4 persons; in 1953 one to every 2.4 persons. In automobile ownership in proportion to population, no city in the world compares with Los Angeles. The use of the automobile has been fostered by boulevard and freeway construction, both that completed and that which is now in progress and planned. With the great increase in the number of automobiles and the facilities provided for their use, the use of mass transit has rapidly declined.

The estimated population of the County of Los Angeles in 1953 is 4,650,000 persons. It is estimated that by 1960 it will have increased to 5,500,000, a growth of 18 per cent, and by 1980, 26 years from now, to 7,500,000, an increase over 1953 of 61 per cent. Moreover, it is estimated that the major part of the growth will occur in the suburbs. This is the section of the County where the density at the present time is lowest. In the light of these circumstances where the population of Los Angeles has been largely dependent for

transportation on the individual automobile, it is apparent that any rapid-transit system, to be effective, must carry passengers at high speed and in comfort.

SECOND:

A Monorail rapid-transit route as proposed in this report, located within the area described in the Act creating the Authority would, if adopted, be a proper beginning for the development of rapid transit throughout Los Angeles County.

This route connects the important San Fernando Valley with Hollywood, Los Angeles, including the downtown central business area, the industrial areas of Vernon, Southgate, Maywood, Huntington Park and Lynwood (some of these latter reached in conjunction with Los Angeles Transit Lines by means of transfer), Compton and Long Beach. The area studied, which was that defined by the Act creating the Authority, contains more than half of the population of Los Angeles County. Residential developments predominate at both ends of the line, business and manufacturing establishments at the center. This line would bring the area in San Fernando Valley as close to the business center of Los Angeles measured by time of transit as Hollywood now is by present means of mass transportation. Whether or not the number of people entering the Central Business District decline in the future or continue in approximately the same volume as at present, the growing congestion of the highways - even of the freeways - will induce people to use rapid-transit lines insofar as they are available, particularly those that compete reasonably well in time with transportation by individual automobile.

The ability of this system to transport passengers from Panorama and Van Nuys on the north to the Central Business District in less than the time required for a trip by existing public transit facilities from Hollywood, and,

on the south, from Long Beach in less time than required by existing public transit facilities from Compton to the Central Business District will insure a substantial passenger load largely obtained by diversion of passengers from automobiles.

Such a system can be constructed for far less cost than additional freeways for automobiles and can carry with comfort more people than a six-lane freeway.

THIRD:

Considering that the Monorail system is an interurban railroad rather than an urban distribution facility, it can be integrated appropriately with any future plan of rapid transit that may be adopted for the metropolitan area of Los Angeles County. At the present time no such plan exists. If the Monorail system is built in the general location shown, future interurban lines can be so located as to provide for convenient interchange of passengers and the same statement may be made as to local distribution facilities.

FOURTH:

A Monorail system, such as proposed, will furnish a faster service than any other interurban railroad in the country.

The length of the line between Panorama City in San Fernando Valley and Long Beach is slightly more than 45 miles. A through train will traverse this distance, making all stops, in 67 minutes. Seventeen stations are provided averaging 2.8 miles apart. The cars are designed to seat 67 people; may operate in peak hours in 6-car trains at 3-minute intervals, with the number of passengers limited to 100 per car. The average over-all speed including stops is 41 miles per hour. The system will be equipped with the most modern and "fool-proof" signal system to prevent any possible train operating accidents. Since no Monorail system of this type is in operation anywhere (that in Germany is not

comparable) we recommend that prior to placing this system in operation a test section be constructed of sufficient size to enable study of the operating features of the system including the riding characteristics of curves, the operation of signals, the accessibility of electric distribution system and running rails for inspection, and the acceleration and braking of cars.

FIFTH:

The same type of service could be performed by another form of surface-free transportation such as a modern elevated railroad, following the identical route suggested for the Monorail. Such type of facility should be considered.

SIXTH:

The route selected by the engineers and shown on Plate I is presented for public discussion, subject to reasonable adjustment, and is the one that will produce the most traffic and be the least costly to build within the prescribed area.

SEVENTH:

If the construction of the Monorail system were to be authorized at the present time, it would be possible to have it in operation by 1960 and at that time the estimated annual number of passengers that would be carried on a line extending from Panorama on the north to Long Beach on the south would be 79,000,000. If the length of the line were to be curtailed so that the northern terminus would be at North Hollywood and the southern terminus at Compton, the number of passengers is estimated at 69,500,000. Considering the increase in population forecast for the San Fernando Valley and for the section of the County south and southeast of Compton, there is every reason to expect a future substantial growth in passengers.

We estimate that these passengers will be distributed as follows:

	Long Line	Short Line
On the northern end of the line	27,200,000	23,095,000
On the southern end of the line	41,554,000	36,300,000
Within center zone	6,976,000	6,971,000
Through riders	3,270,000	3,134,000
Total	79,000,000	69,500,000

EIGHTH:

We have predicated our conclusions as to traffic and revenues on a base fare of 25 cents for each of the northern and southern zones and a fare of 20 cents in the central zone, with a 35-cent fare from either the northern or southern zone to the central zone, and 50 cents for through riders, that is, from the northern zone to the southern zone, or the reverse. These fares are, for the longer rides, substantially less than those charged by existing forms of mass transportation. For shorter rides they are somewhat greater, but carry the passengers with greater speed, and with more comfort. These rates were set up tentatively for purposes of computation and not necessarily as a recommendation for adoption at this time.

NINTH:

The matter of the provision of feeder bus service supplementary to the route may best be obtained by co-ordination with the existing transportation lines. On the north end of the line there is an opportunity for joint service from Glendale Boulevard station to Burbank and Glendale and from Van Nuys or Panorama to San Fernando and the northerly and westerly parts of the valley; and from Hollywood station to Santa Monica. On the south end of the line there is an opportunity for joint service from the stations at Broadway Place and Main Street, in particular, and the industrial area lying east of these stations.

TENTH:

Automobile parking spaces are provided at most of the stations, particularly those at the extremities of the line. Such facilities have proved to be of substantial value in attracting traffic.

ELEVENTH:

We estimate that to construct and equip a monorail system, as described:

(a) between Panorama City and Long Beach will require a bond issue of $165,207,000

(b) if the portion of the line between North Hollywood and Compton be built initially, we estimate such construction and equipment will require a bond issue of $133,976,000

TWELFTH:

We showed the estimated results of operation of the Monorail system in Chapter VII. For the Panorama-Long Beach line, it is apparent that the interest coverage before taxes and depreciation is 1.81. After taxes it is 1.21; but there is a deficiency after taxes as to complete debt service of $3,251,000. This deficiency might be reduced or eliminated with growth of traffic in future years, for which we have not made specific allowance. Without such increase in earnings the amount available to amortize the debt after payment of interest would be $1,705,000, which would require about 36 years to retire the $165,207,000 of bonds. Moreover, depreciation would ordinarily be figured at 8 per cent of gross revenues, or $1,898,000 a year. The amount required for amortization may be used in building up a depreciation reserve, but in this case the balance of $1,705,000 after taxes and interest is insufficient for annual depreciation.

The Los Angeles Transit Authority by the terms of the Act of 1951 is subject to regulation by the Public Utilities Commission of the State of California and subject to the payment of taxes.

Regulation by the Public Utilities Commission relates to routes, service and rates, as well as to other operating matters. This is in marked distinction to the characteristics of other revenue bonds, of which many million dollars are outstanding on toll highway, bridges and other facilities. For instance, the bonds issued by California Toll Bridge Authority secured by tolls are based on the Authority's right and obligation to fix toll rates at levels sufficient to meet all bond requirements. This is the normal requirement of any public revenue bond issue. Tax exemptions are granted to the California Toll Bridge Authority, the Chicago Transit Authority, and substantial tax relief is allowed the New York Port Authority. The combination of novelty of design, of high taxes shown in this report, subjection of the Authority to the Public Utilities Commission and the uncertainty of assessment of damages for the structure in city streets would, in our opinion, impose a handicap to the sale of these bonds as public revenue bonds. As to this matter the advice of a financial advisor should be sought.

REPORT

TO

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

ON

A MONORAIL RAPID TRANSIT LINE

FOR

LOS ANGELES

PART II

TRAFFIC, POPULATION AND ECONOMIC DATA

JANUARY 1954

RUSCARDON ENGINEERS

LOS ANGELES CALIFORNIA

RUSCARDON ENGINEERS
ENGINEERING - MANAGEMENT
448 SOUTH HILL STREET
LOS ANGELES 13, CALIFORNIA
MUTUAL 5809

RUSH T. SILL, A.I.M.E. - A.S.C.E.
DONALD M. BAKER, M.AM.SOC.C.E.

CABLE ADDRESS:
"RUSCARDON"
ALL CODES

January 15, 1954

Coverdale and Colpitts,
Consulting Engineers,
120 Wall Street,
New York 5, New York

Gentlemen:

We are pleased to transmit herewith our Report, covering certain matters assigned to us in our Agreement of April 15, 1953, in connection with the study, made for the Los Angeles Metropolitan Transit Authority, as to the economic feasibility of a monorail rapid transit line from the San Fernando Valley to Long Beach.

May we herewith express our pleasure in this association with you in this study, and in the cooperation which we received therein from your staff.

With kind regards, we are

Very truly yours,

RUSCARDON ENGINEERS

By Donald M. Baker
Donald M. Baker

DMB:el

RUSCARDON ENGINEERS — LOS ANGELES — CALIFORNIA

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Population of Metropolitan Los Angeles as of April 1953

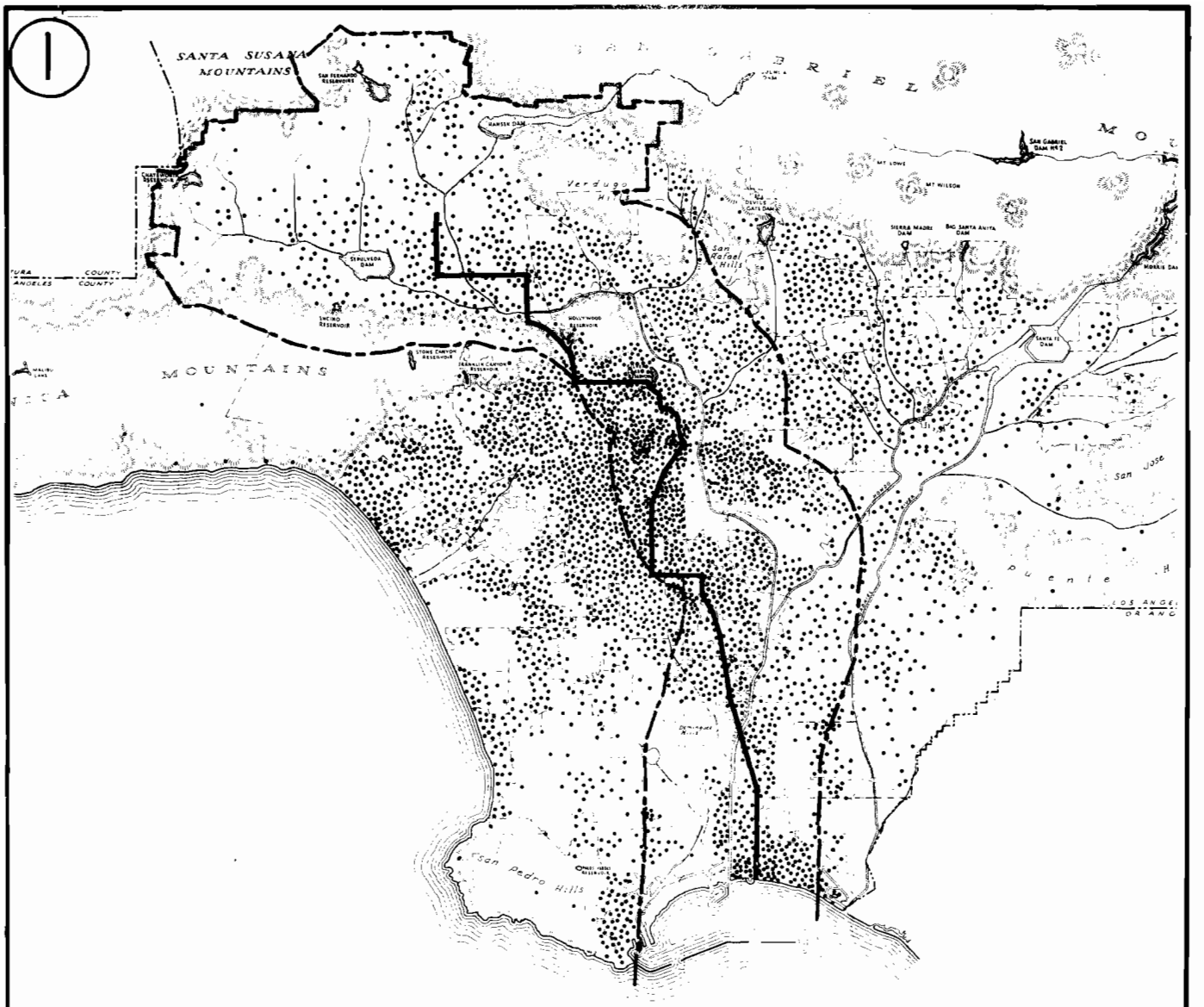
Los Angeles City	2,100,000
Other 43 Incorporated Cities	1,475,000
Remainder of Area	1,038,000
Total	4 613,000
Balance of Los Angeles County	37,000
Total - Los Angeles County	4,650,000

Source - Research Department, Los Angeles Chamber of Commerce

Los Angeles City was founded in 1781 as a Spanish Pueblo, and was incorporated in 1850, or 69 years later, with a population of 1600 persons. By 1880, The City population had increased to 11,183 persons and that of the County to 20,000; in 1900-50 years after its incorporation-the City of Los Angeles had a population of 102,489 and the County a population of 170,298 persons; in 1950-100 years after the incorporation of the City-its population was 1,970,318 and that of the County was 4,151,683 persons. A recent Federal Census made in the Fall of 1953 found the City with a population of 2 104,663, with an estimate of County population at this date, made by the Los Angeles Regional Planning Commission of 4,750,000. Until 1940, County population has ranged from 1.6 to 2.0 times that of the City of Los Angeles. In 1950, however, County population was 2.1 times that of the City and in 1953 it was nearly 2.3 times that of the City.

The City of Los Angeles has added greatly to its area as well as to its population in the past century, and is now reputed to be the largest City in point of area-in the world.

This rate of population increase-almost doubling every decade with the exception of that of 1930-1940-has created a dynamic economy in the area, which could naturally be expected to affect the pattern and structure of any large community, but the period during which large numerical increases



KEY

STUDY AREA BOUNDARY

MONORAIL ROUTE

• 1000 PERSONS

NORTH

MILES 0 5 10

SOURCES
L A COUNTY REGIONAL PLANNING COMMISSION

DISTRIBUTION OF POPULATION

COUNTY OF LOS ANGELES
JANUARY, 1951

RUSCARDON ENGINEERS 1953

FIGURE NO. 1

DISTRIBUTION OF POPULATION IN
METROPOLITAN LOS ANGELES - 1950

This Figure shows the distribution of population in Metropolitan Los Angeles as of 1950, the boundary of the Study Area - discussed hereafter- and the route of the proposed Monorail line.

The "ellipse" of heavy population density, extending from Hollywood southeasterly to Compton, is served at either end by the proposed route. The latter swerves easterly to pass through the Central Business District of Los Angeles, a focal point of a large amount of travel, thence southerly for some distance, from where it passes easterly to the industrialized area, and again southerly therefrom to Long Beach.

TABLE NO.. 1

AREA AND POPULATION
CITY OF LOS ANGELES
1850 - 1953

YEAR (Dec.31)	AREA ADDED Sq. Mi. (1)	TOTAL AREA Sq. Mi. (2)	CITY POPULATION (3)	PERSONS PER Sq. Mi. (4)
1850	**28.01	28.01	*1610	57
1859	1.20	29.21	4385	150
1895	1.41	30.62	50395	1640
1896	10.18	40.80	50395	1230
1899	2.46	43.26	102479	2370
1906	18.64	61.90	240000	3880
1909	23.26	85.16	307322	3520
1910	15.66	100.72	*319198	3160
1912	6.90	107.62	427000	3980
1915	180.59	288.21	475367	1650
1916	49.71	337.92	500000	1480
1917	13.18	351.11	533535	1515
1918	12.76	360.46	550000	1525
1919	3.41	363.87	563000	1550
1920	0.50	364.37	*576673	1585
1922	5.82	370.19	736963	1990
1923	29.73	399.92	802358	2002
1924	9.30	409.22	850143	2085
1925	5.90	415.12	1014622	2443
1926	19.14	434.26	1056983	2438
1927	6.88	441.14	1079789	2462
1928	0.15	441.29	1152806	2605
1930	0.45	441.74	*1238048	2800
1931	0.09	441.83	1255829	2840
1932	8.70	450.53	1283859	2850
1933	0.13	450.66	1281266	2842
1935	0.12	450.78	1294600	2870
1941	0.42	451.20	1544000	3380
1944	0.68	451.88	1697000	3760
1947	0.84	452.72	1840835	4025
1949	0.75	453.47	1920595	4250
1953	0.27	453.75	2100000	4650

* U.S. Census ** City Incorporated

Notes: Column 1 - City Incorporated 1850 Area - City of Los Angeles

Column 3 -*Federal Census - Other Years - Research Dept. L.A. Chamber of Commerce

the entire County of 170,000, mass transportation requirements in the city were adequately served by two electric transit systems, which later merged. During the 1900-1910 decade Henry E. Huntington built the Pacific Electric Interurban System, connecting the City of Los Angeles with all of the outlying population centers in the County and the San Fernando Valley, and extending eastward and southeasterward to San Bernardino, Riverside and Orange Counties. This system likewise served to collect and distribute freight throughout this four-county area.

By 1910 the City of Los Angeles had a population of 319,000 and a County population of 504,000. Trackage and service rendered by both local and interurban transit companies were still adequate to serve transit needs of the community. Ten years later, however, by 1920, when the City reached a population of 577,000 and the County of 936,000, rising construction and operating costs, with a continuation of pre-World War I fares made capital investment in expansion of rail transit facilities more or less unattractive. Buses were then in the development stage and provision of new facilities did not keep up with increased population and developed area. Travel distances had increased with increases in developed area, and travel time had lengthened.

By this date, however, the motor vehicle had appeared. In 1921 there was one passenger automobile for every 6.4 inhabitants of Los Angeles County. Local residents found that it was not necessary for them to live within a half mile of a transit line in order to secure adequate transportation service in their daily movements between where they lived and where they worked, shopped and played. They could use their automobile - because of local climatic conditions - for 365 days a year, and they started to do so. Settlement advanced beyond the end of rail transit lines and it was

not until the end of the 1920-1930 decade that bus service was to any degree serving these outlying areas. The increasing number of motor vehicles created congestion, slowed down schedules of transit vehicles-rail and bus-transit riders took to using their own cars, and the spiral had commenced.

Had the advent of the motor vehicle in this country occurred fifty years earlier, other large cities in the United States would undoubtedly have commenced this current trend towards sub-urbanization far earlier, and population densities therein would not be what they are today. On the other hand, had it occurred fifty years later than it did, Metropolitan Los Angeles would today have had a far higher average population density, a much smaller developed area and undoubtedly a smaller population. Occurring at the time that it did, the motor vehicle encouraged low density and widespread distribution of local population.

Cause of Local Population Growth

From a long local residence and a study of factors which have been responsible for the dynamic growth in population in Metropolitan Los Angeles, the writer is of the opinion that it is not the local climate but rather the type and kind of living which such climate allows-single family homes, with front and back yards, flowers and fruit trees, a barbecue, a two-car garage, and in many homes two cars-and proximity to ocean, mountain, desert and recreational areas-practically year around outdoor living that has caused this growth. This widespread occupancy of single family homes has created in this area what is probably the highest standard of living the world has ever seen.

Travel distances resulting from a City population of 300,000 and a County population of 500,000 did not create very serious problems of daily

movement, even with low population densities, but when the Los Angeles City population reached 1,000,000 or more, and County population double this figure, the built up area of the community had become extremely large. The problems of congestion and slower rates of movement began to be acutely felt.

So far, however, this condition has not resulted in a cessation of population growth, as is evidenced by an increase in population in Los Angeles County during the past $3\frac{1}{2}$ years of around 600,000 persons, but it has resulted in far more time being spent in daily movement between place of residence and place of work.

Retail stores have moved out to the people, as is evidenced by the widespread distribution of substantial shopping centers in the material shown herein. Industry, however, has not to any extent changed its general location, and the time required for people, particularly those employed in industry, to travel from where they live to where they work, has increased substantially.

Freeways as a Solution of Transportation Needs

Much talk has occurred over the past ten or fifteen years as to the advisability of constructing a system of freeways throughout Metropolitan Los Angeles to provide a means of movement within the area, but progress in this construction has been very slow. The Arroyo Seco Freeway connecting Pasadena with Downtown Los Angeles was completed in the latter part of the 1930-1940 decade, and it is expected that the Hollywood Freeway connecting the San Fernando Valley to Downtown Los Angeles will be open to through traffic early in 1954. The Ramona and Santa Ana Freeway should be completed within the next two or three years. However, these Freeways will not in any way serve the entire transportation needs of the community, as

they already are now approaching congestion in the sections where they have already been opened to travel.

The method of financing the construction of freeways in this area by the State Highway Commission s on a "Pay as You Go" basis, which depends upon the annual allocation from gasoline taxes, by the State, for their construction. This method of financing cannot, because of inadequacy of funds, provide any adequate or extensive system of freeways in this area short of the next 25 or more years. Unless some other method of financing is developed, it is not believed that freeway construction will begin to keep pace with increasing population and resultant motor vehicle registration.

Factors Necessary to Maintain Future Growth of Population and Present Living Standards

To maintain anything approaching past rates of population growth in the area-until a point of saturation occurs-two things are necessary, (a) the single family residential characteristic of local living must be maintained, by the shortening of the time of daily travel between place of residence and place of work to a reasonable figure, and (b), local residents must have the opportunity to earn their living when residing here.

The first requirement will be served, at least within a portion of the area, should the proposed monorail facility be constructed. As to the opportunity to earn a living, this in the last analysis depends upon the availibility of jobs in industry. The existence of such jobs, also in the last analysis, depends upon the existence of markets for local products-agricultural, mineral and industrial.

Los Angeles County is today, and has been for many years, the leading agricultural County in the United States in value of its agricultural products, largely because of the high priced citrus, nuts and field crops raised here. In time, with land use changes from agricultural to residential and industrial purposes, this present ranking will probably be lost, but for many years it can be expected to continue at a high level since land which produces agricultural crops of highest unit value per acre will be the last to change to use for other purposes.

Petroleum is the principle local mineral product, although there is an increasing production of non-metallic minerals in the desert back country. On-shore petroleum production in the area has probably passed its peak. Recent investigations indicate, however, the possibility of larger off-shore reserves available for production equal in volume to the original reserves in the Los Angeles Basin. The Tidelands Oil controversy has so far limited off-shore activities to study and investigation, but if and when this controversy is settled, it is expected that an active drilling campaign would be initiated to develop this off-shore oil.

Industrial employment depends essentially upon markets for the products of local industry, and to support a substantial amount of such industry, distant as well as local markets must exist. Metropolitan Los Angeles, located at a considerable distance from the center of population in the United States, is itself a rapidly growing market as are the Pacific Coast and Southwestern States. Areas rapidly growing in population absorb considerably more industrial products per capita than are absorbed in more stable areas.

also large resources of fuel and power, and an efficient labor force. It

can be expected that, as soon as conditions settle down in the Orient, even if this requires several decades to occur, large demands will be made upon this local area for its industrial products.

Available Data

Probably in no other large community in this country has more data been assembled or collected, for a wide variety of purposes, than in Metropolitan Los Angeles. Were it not for the availability of such data, this Report could not have been made within the time available.

While all data utilized was of recent date, not all of it was as of a single date. Also, coming from numerous sources, it was found that in some instances data on the same subject varied slightly. In no instance, however, was this slight difference of sufficient magnitude to effect conclusions reached.

The rapidly growing population of the area resulted in the greatest differences in basic data. The county population increased some 600,000, or 14.5 per cent between the 1950 Federal Census, taken in April of that year, and the most recent estimate was made by the County Regional Planning Commission, as of the Fall of 1953. Consequently, certain derived data based upon 1950 Census figures may be somewhat low. Wherever it was possible however, to make reasonable estimates of quantities as of 1953, this was done.

Acknowledgements

To name separately every agency or firm that cooperated in this study, particularly those who assisted in furnishing information upon which the Origin and Destination Study was made, would require pages. The following agencies and their staffs, however, deserve special acknowledge-

ment for large volumes of data and information furnished and cooperation rendered - Federal Bureau of the Census, Federal Superintendent of Buildings, Assistant Postmaster, Los Angeles County Regional Planning Commission, Los Angeles City Civil Service Commission, Los Angeles City Planning Commission, Los Angeles City Engineer's Office, Research Department of the Los Angeles Chamber of Commerce, Research Department of the Security First National Bank of Los Angeles, State Highway Commission, County Road Department, County Administrator's Office, Automobile Club of Southern California, Los Angeles Metropolitan Traffic Association, Downtown Business Men's Association, Building Owners and Managers Association, Pacific Electric Railway, Pacific Telephone and Telegraph Company, Los Angeles Transit Lines, California Public Utilities Commission, Los Angeles Department of Public Utilities and Transportation, and the Los Angeles Metropolitan Transit Authority.

II

THE STUDY AREA

Under the Enabling Statute creating the Los Angeles Metropolitan Transit Authority, the latter was authorized to construct a monorail line extending from the San Fernando Valley to the Pacific Ocean, the location of this line being limited, on the Coastal Plain, to within a radius of 4 miles on either side of the Los Angeles River. The Authority was likewise authorized, under certain conditions, to operate buses within the above area. Hence, it became necessary to determine an area whose population, workers and shoppers would be served by the proposed facility and such feeder buses or private automobiles as would be used by potential riders.

Area Selected

An area was selected which embraced the San Fernando Valley, including the Cities of Burbank, Glendale and San Fernando, and which extended somewhat outside of the 4 mile radius specified in the Enabling Act, when it reached the Coastal Plain. This area included population, present and future, which it was felt would be reasonably served by the proposed facility and feeder bus lines. It totalled 330,011 acres-515.6 square miles-or 46.9 per cent of the area designated as Metropolitan Los Angeles.

In outlining the Study Area, as it is termed herein, boundaries of Postal Zones or Post Office Delivery Areas (described hereafter) were used as exterior boundaries. In establishing these latter, there was taken into consideration present daily movement of population, by transit facilities, and by private automobiles on competing highways, whereby people travelled from their place of residence to work and shop. The boundary of the Study Area was limited to an area outside of which people would probably use

other means of transportation than the proposed monorail line.

The boundaries of this Study Area are shown on Plate III. Its population, discussed later in this Report, and the relation of such population to that of the County of Los Angeles, are shown in the following tabulation:

Census of	Population		% of Population
	Los Angeles County	Study Area	in Study Area, of County Population
1930	2,208,492	1,334,100	60.4
1940	2,785,643	1,626,937	58.4
1950	4,151,687	2,284,363	55.0
1953*	4,650,000	2,473,329	53.3

* Estimate of Los Angeles County Regional Planning Commission for April 1953

This Study Area has contained, at least since 1930, more than one-half of the population in Los Angeles County, although the relative proportion of such population to that of the County has decreased slightly since 1930. It is believed that the provision of better transportation within the Area will increase this ratio somewhat in forthcoming years.

Postal Zones

In the 1940 and 1950 Federal Censuses Los Angeles County was divided into a series of "Census Tracts", these tracts being areas which had a population which ranged, in 1940, from 3000 up to 6000 or 7000. There were 580 of these tracts in the 1940 Census. Increase in population in various sections of the County has caused the sub-division of many of these tracts, and in the 1950 Census they numbered somewhat in excess of 700.

Various reports issued by the Bureau of Census for its 1940 and 1950 Censuses contain statistical information-in addition to population-pertaining

to each of these Census Tracts. This information has proved to be very valuable in the present Study.

Shortly after 1940, the Research Committee of the Los Angeles Chamber of Commerce embarked upon a project to determine and segregate the population in the 1930 Census to Census Tracts as they existed in 1940. This was accomplished, and at the present time there are available "Tracted" population figures for the County for the three Census years, 1930, 1940 and 1950. There has been some slight shifting of Census Tract boundaries in the 1950 Census from those of the 1940 Census, but for all practical purposes such tract boundaries may be considered comparable for all three Censuses.

In the Origin and Destination Study (discussed hereafter) it was found necessary to allocate places of work and places of residences in accordance with information available to both employers and employees. Few people in the County know the number of the Census Tract in which they live, but practically every employer and employed person is familiar with his Postal Zone or Post Office Delivery District. As a result, it was determined to use these latter two Units (hereinafter referred to "Postal Zones") as a basis for studies of population and of travel patterns described in this Report.

The City of Los Angeles is divided into Postal Zones south of the Santa Monica Mountains, and the Cities of Glendale and Long Beach are likewise zoned. The San Fernando Valley and the remainder of the Study Area is not so sub-divided, but is divided into areas which are tributary to local Post Offices and which are known as Post Office Distribution Districts. In certain of the smaller Cities on the Coastal Plain, the City itself was considered as a Postal Zone.

This study resulted in the development of 80 Postal Zones distributed throughout the Study Area. Data pertaining to past and present population,

to location of industrial establishments, and other employing agencies, and to place of residence of employees, has been distributed amongst these 80 Postal Zones. These Zones are also shown on Plate III.

III

POPULATION

Los Angeles County

The Federal Census of 1880 found a population of 33,381 in Los Angeles County. Seventy years later, the 1950 Census found a County population of 4,151,687, or 124.5 times the population 70 years previous. The Regional Planning Commission estimates the County population-as of the Fall of 1953-to be 4,750,000, or 142.5 times the 1880 population.

To forecast future population in an area which has for so long been functioning under a dynamic economy is a far more difficult task than to forecast future population in more stabilized communities in the United States. Table No. 2 and Figure No. 2 show Census population of Los Angeles County from 1880 to 1950, and in Figure No. 2 the County population has been projected to the year 1980.

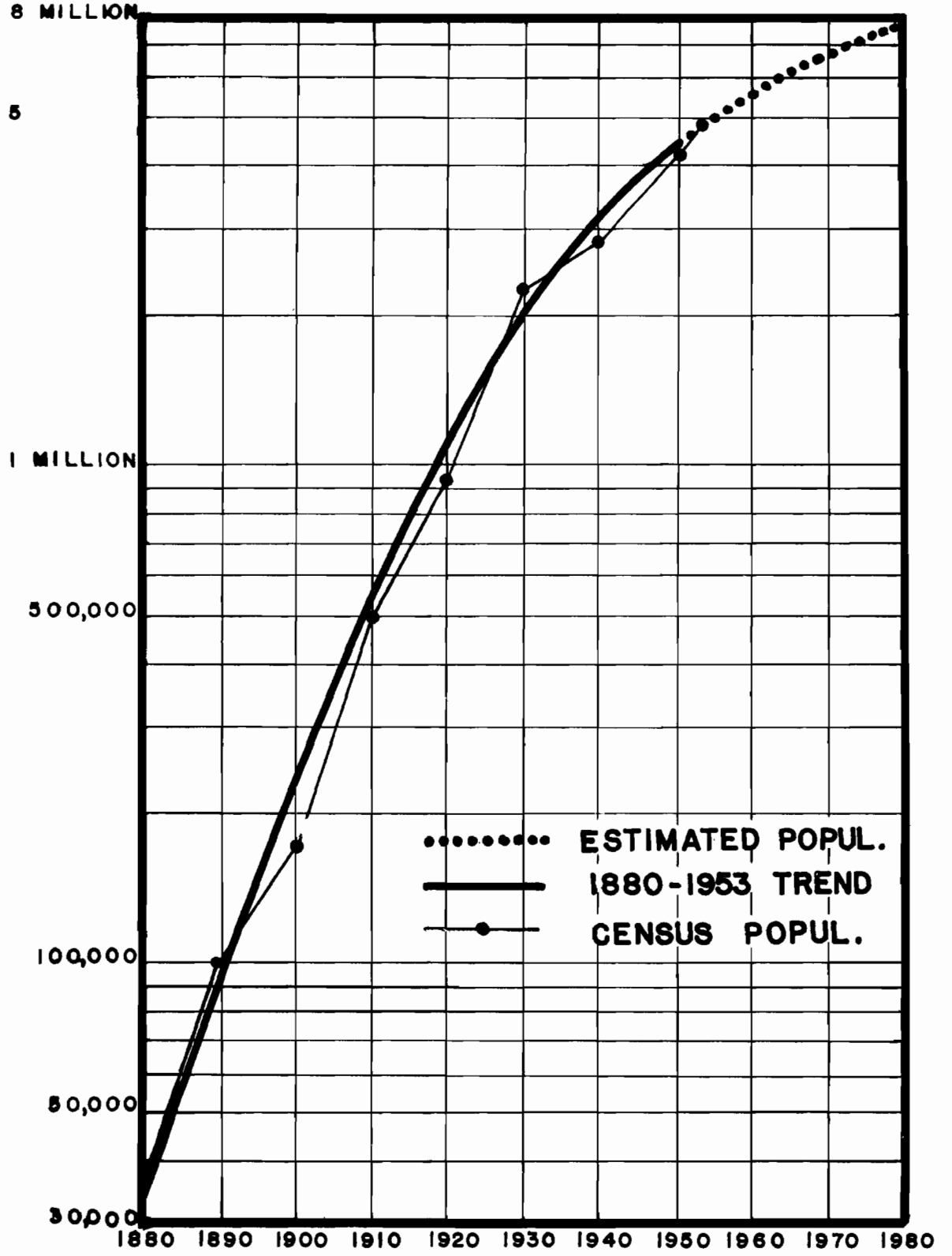
Past and Present Population of Postal Zones

The boundaries of the various Postal Zones within the Study Area were not coterminous with boundaries of Census Tracts, and in practically every case, except where the smaller incorporated Cities were involved, Postal Zone boundaries cut across Census Tract boundaries. In these Census Tracts estimates were made of the proportionate area of each Census Tract within such Postal Zone, and the area and population of the Census Tract within such Zone for the 1930-1940 and 1950 Censuses were estimated. From these the total area of the Postal Zone and its total population for the above three dates was estimated.

The entire Study Area was then divided into 13 Groups of Postal Zones, all of which, from local knowledge, had more or less similar characteristics as to population densities and rates of population increase.

(2)

PAST AND ESTIMATED FUTURE POPULATION OF LOS ANGELES COUNTY, CALIFORNIA



RUSCARDON ENGINEERS 1953

FIGURE NO. 2

PAST AND ESTIMATED FUTURE POPULATION
LOS ANGELES COUNTY-1880 TO 1980

The writer has found, in numerous studies of population in Southern California, that the percentage rate of population increase each decade alternates, a decade with a percentage rate greater than the general trend being followed by one with a rate less than such trend.

It will be noted that the rate of increase, indicated by the slope of the line connecting points showing Census population, has this characteristic. Rate of increase for the decade 1880-1890 is greater than the rate of trend increase, that for the decade 1890-1900 is less, etc., etc. The smallest percentage rate of population increase occurred during the 1930-1940 decade, the Depression years.

As with population increases in all large Metropolitan areas, the trend curve from 1880 to 1950 has a decreasing rate of increase with every decade. Projected to the year 1980, the following are estimates of future County population -

Census of 1960	5,500,000
1970	6,600,000
1980	7,500,000

These are believed to be reasonable figures, provided that the present single family residential living characteristic can be maintained, by provision of adequate mass rapid transit facilities and that no serious economic disturbance nr international conflict occurs within this future period.

If the above trend curve were continued for another two decades, to the year 2000, a County population of the order of 8,300,000 might be expected in 1990 and of the order of 9,000,000 by the year 2000. This, however, in the opinion of the writer is too far in the future to estimate, with any degree of assurance, the population of a dynamic community such as is Metropolitan Los Angeles. See Table No. 2

TABLE NO. 2

PAST AND ESTIMATED FUTURE
POPULATION - LOS ANGELES COUNTY

CENSUS DATE	POPULATION	INCREASE DECADE NO.	IN %
1860	11333		
		3976	35.1
1870	15309		
		18072	118.0
1880	33381		
		68063	203.9
1890	101454		
		68844	67.9
1900	170298		
		333842	196.0
1910	504131		
		432324	85.8
1920	936455		
		1272037	135.8
1930	2208492		
		577151	26.1
1940	2785643		
		1366044	49.0
1950	4151687		
		1348313	32.5
1960	5500000		
		1100000	20.0
1970	6600000		
		900000	13.6
1980	7500000		

Table No. 3 presents the area in acres, population for the Census years, 1930, 1940 and 1950, and the estimated population derived from figures of the Los Angeles Regional Planning Commission for the Spring of 1953, as well as the density of population for each of the 80 Postal Zones and the average density for the 13 Groups of Postal Zones.

Future Population of Postal Zones

It is believed that the ratio of population of the Study Area to that of the County will increase somewhat in the future, and the following estimates of future population were made -

Date	County Population	Ratio Population of Study Area to County Population	Population of Study Area
1953*	4,650,000	53.3%	2,473,329
1960	5,500,000	53.4	2,937,999
1970	6,600,000	53.4	3,528,400
1980	7,500,000	56.4	4,139,000

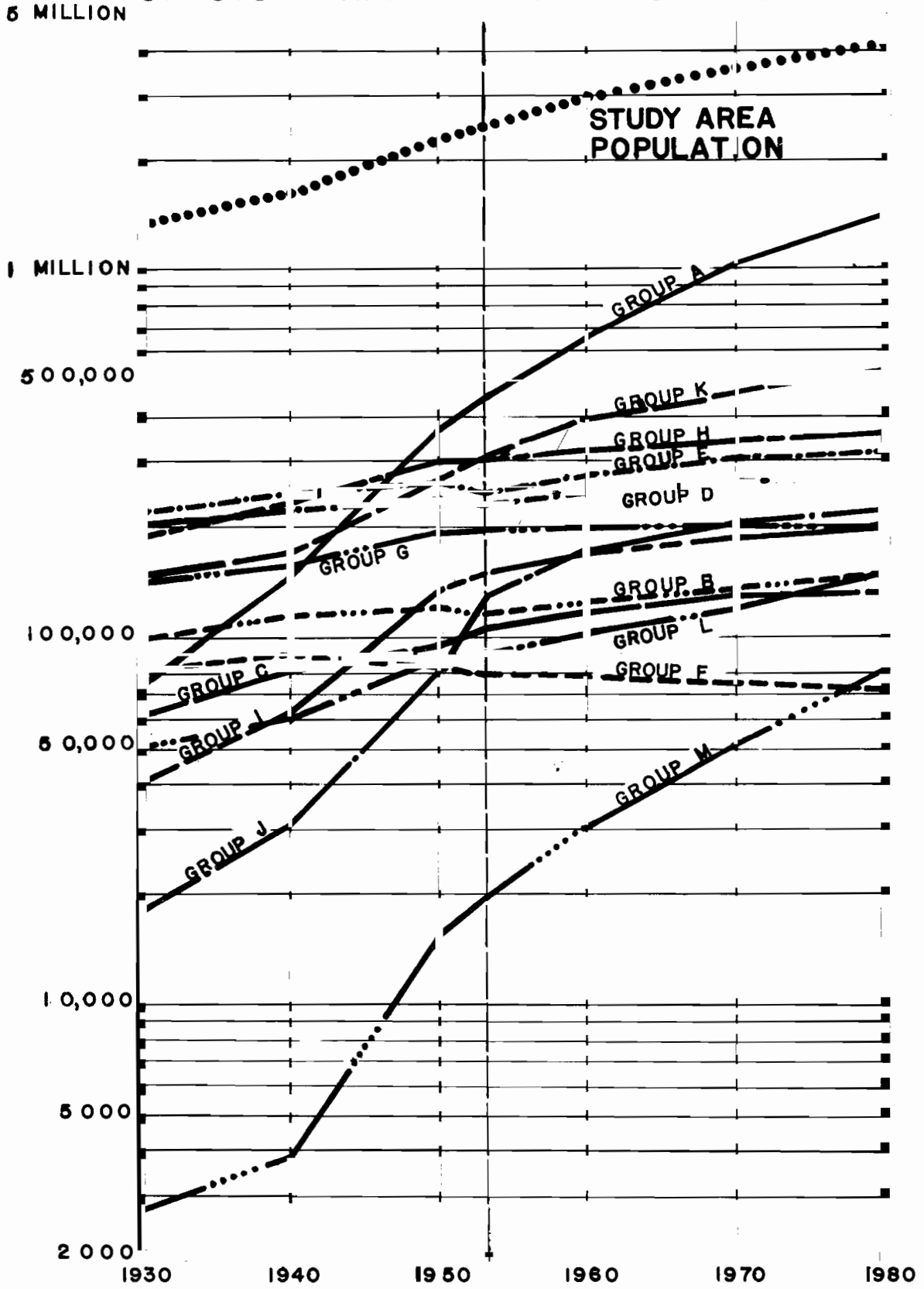
Population for each of the Zone Groups was then estimated, taking into consideration past rates of population increases for each Zone Group, present and ultimate probable densities and general personal knowledge of the areas. Population of each Zone was then adjusted to total Zone Group population. Similar procedure was followed in estimating population of each Zone in each Zone Group. Results for each Zone and Zone Group are shown in Table No. 4.

Decentralization of Population

One of the most interesting facts encountered in this study resulted from an analysis of population increase within a 20-mile radius of Downtown Los Angeles between 1940 and 1950. Total population within this 20-mile radius in 1950 was 4,051,903 persons or 97.8 per cent of the County population as of that date. The area within this radius was divided into four quadrants

(3)

PAST AND ESTIMATED FUTURE POPULATION OF STUDY AREA BY P.O. ZONE GROUPS



RUSCARDON ENGINEERS 1953

FIGURE NO. 3

PAST AND ESTIMATED FUTURE POPULATION OF THE STUDY AREA
1930 to 1980 - BY GROUPS OF POSTAL ZONES

The locations of the groups of Postal Zones designated alphabetically on this Figure are ahown on Plate III. The slope of each curve showing population is proportionate to the percentage rate of population increase during each decade. Up until 1953, Groups A, I, J and M had the greatest rate of Population increase. Following 1953, rates, except for those of Groups A and M tend to more or less stabilize. Group F includes the Central Business District of Los Angeles, which has shown a declining population since 1940.

Percentage rate of increase for the 1940-1950 decade was as follows:

Group	1950 Population in % of 1940 Population
A	261.2
B	105.4
C	115.9
D	106.4
E	109.1
F	93.7
G	122.4
H	131.9
I	219.7
J	268.9
K	157.9
L	143.3
M	397.4
Study Area	140.4

See Tables Nos. 3 and 4

TABLE NO. 3

PAST AND PRESENT POPULATION OF
STUDY AREA - 1930 - 1953

	AREA ACRES (1)	1930 POPULTN NO. (2)	1930 DEN-SITY (3)	1940 POPULTN NO. (4)	1940 DEN-SITY (5)	1950 POPULTN NO. (6)	1950 DEN-SITY (7)	1953 POPULTN NO. (8)	1953 DEN-SITY (9)
GROUP A									
Burbank	10704	16667	1.6	34356	3.2	78577	7.3	84591	7.9
Chatsworth	7286	735	0.1	1462	0.2	3258	0.4	4250	0.6
Canoga Park	11037	3569	0.3	5000	0.5	9509	0.9	12252	1.2
Encino	6208	980	0.2	1769	0.3	11133	1.8	14734	2.4
No. Hollywood	13968	15767	1.1	39201	2.8	91133	6.5	101287	7.3
Northridge	4503	885	0.2	1230	0.3	3152	0.7	4166	0.9
Pacoima	6813	3148	0.5	5440	0.8	19253	2.8	25661	3.8
Reseda	5390	1623	0.3	3725	0.7	14810	2.8	19365	3.6
San Fernando	26686	12756	0.5	17574	0.7	40752	1.5	51760	1.9
Sun Valley	5732	1964	0.3	4393	0.8	18687	3.3	20640	3.6
Tarzana	4170	884	0.2	1821	0.4	4390	1.1	5814	1.4
Universal City	290	51	0.2	11	0.04	7	0.02	7	0.02
Van Nuys	20124	14059	0.7	28268	1.4	79973	4.0	105214	5.2
Woodland Hills	7402	609	0.1	1025	0.1	4774	0.6	6127	0.8
Total	130313	73697	0.6	145275	1.1	379408	2.9	455868	3.5
GROUP B									
L.A Zone 27	5269	29128	5.5	34798	6.6	40311	7.7	39305	7.5
28	6047	30522	5.0	36306	6.0	39257	6.5	37952	6.3
29	835	19498	23.4	21300	25.5	20866	25.0	19869	23.8
38	1058	20246	19.2	22255	21.0	20500	19.4	19328	18.3
Total	13209	99394	7.5	114659	8.7	120934	9.2	116454	8.8
GROUP C									
Glendale 1	1524	7624	5.0	11464	7.5	15148	9.9	17457	11.5
2	1368	8054	5.9	12299	9.0	13918	10.2	16017	11.7
3	517	6194	12.0	7172	13.9	7653	14.8	8810	17.0
4	631	8350	13.2	9695	15.4	9980	15.8	11397	18.0
5	1262	15242	12.1	17840	14.1	18837	14.9	21688	17.2
6	3077	10383	3.4	13041	4.3	15948	5.2	18350	6.0
7	2939	4465	1.5	6019	2.0	6785	2.3	7806	2.7
8	1003	2017	2.0	4599	4.6	6986	7.0	7954	7.9
Total	12321	62329	5.1	82129	6.7	95255	7.7	109479	8.9

TABLE NO. 3 - CONTINUED

		AREA	1930 POPULTN		1940 POPULTN		1950 POPULTN		1953 POPULTN	
		ACRES	NO.	DEN-SITY	NO.	DEN-SITY	NO.	DEN-SITY	NO.	DEN-SITY
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GROUP D										
L.A.Zone	4	2132	37581	17.6	40761	19.4	40858	19.1	39362	18.4
	5	1978	40873	20.7	48786	24.7	50075	25.7	48906	24.8
	6	1066	29249	27.5	33018	31.0	33438	33.4	32118	30.1
	7	1684	39024	23.2	42283	25.4	43589	25.9	41625	24.8
	18	1942	36634	17.3	39171	20.2	44136	22.7	43267	22.4
	36	2319	17201	7.4	23308	10.1	29708	12.8	30091	13.0
Total		11121	200562	18.0	227327	20.4	241804	21.7	235369	21.2
GROUP E										
L.A.Zone	12	2065	41845	20.2	42632	20.6	39751	19.2	38000	18.4
	26	2798	48729	17.4	54469	19.4	56244	20.1	53323	19.0
	31	2410	32645	13.6	34053	14.1	35391	14.7	35456	14.7
	37	3160	13734	4.3	17669	5.6	25780	8.2	25862	8.2
	39	2806	16814	6.0	21875	7.8	27892	9.9	28322	10.1
	41	2276	15297	6.7	17633	7.7	19808	8.7	20137	8.8
	42	2770	30142	10.9	33193	12.0	35372	12.8	35307	12.8
	65	2811	21764	7.7	24487	8.7	28261	10.0	28712	10.2
Total		21096	220970	10.5	246011	11.6	268499	12.7	265119	12.6
GROUP F										
L.A.Zone	13	459	9496	20.7	9779	21.3	10485	22.8	9808	21.4
	14	258	6866	26.6	6704	26.0	6414	24.9	6728	26.0
	15	1072	28015	26.2	32042	29.9	29473	27.5	27608	25.8
	17	531	24541	46.2	27680	52.2	24699	46.5	23181	43.6
	21	1048	14944	14.2	14989	14.3	14391	13.7	13934	13.3
Total		3368	83862	24.9	91194	27.0	85462	25.4	81259	24.1
GROUP G										
L.A.Zone	22	7139	29973	4.2	39420	5.5	61475	8.6	61131	8.6
	23	3287	33956	10.3	36989	11.2	43785	13.3	43743	13.3
	33	1779	39790	22.4	40571	22.8	44432	24.9	44574	25.1
	63	2515	40896	16.2	44677	17.8	48255	19.2	48071	19.1
Total		14720	144615	9.8	161657	11.0	197947	13.4	197519	13.4

TABLE NO. 3 - CONTINUED

		AREA ACRES (1)	1930 POPULTN NO. (2)	1930 POPULTN DENSITY (3)	1940 POPULTN NO. (4)	1940 POPULTN DENSITY (5)	1950 POPULTN NO. (6)	1950 POPULTN DENSITY (7)	1953 POPULTN NO. (8)	1953 POPULTN DENSITY (9)
GROUP H										
L.A.Zone	1	2282	31875	14.0	35655	15.6	39341	17.2	39589	17.3
	2	2273	20653	9.1	24773	10.9	40251	17.7	40773	18.0
	11	2736	63849	23.3	69892	25.6	79134	29.0	78366	28.6
	58	3929	8902	2.3	9060	2.3	10643	2.7	10663	2.7
Bell		4141	11315	2.7	25171	6.1	41527	10.0	41218	10.0
Huntington Pk.		1792	25994	14.5	29985	16.7	30598	17.1	30804	17.2
South Gate		4475	19632	4.3	26945	6.0	51116	11.4	51473	11.4
Maywood		639	6794	10.6	9097	14.2	11684	18.3	12236	19.1
Total		22267	189014	8.5	230578	10.4	304294	13.6	305122	13.7
GROUP I										
L.A.Zone	59	2244	13471	6.0	18874	8.4	31371	14.0	31709	14.1
Compton		8361	19764	2.4	31689	3.8	75742	9.0	86197	10.3
Lynwood		3069	7489	2.4	11594	3.8	29456	9.6	31875	10.4
Total		13674	40724	3.0	62157	4.6	136569	10.0	149782	11.0
GROUP J										
Bellflower		6037	6996	1.2	11774	2.0	37892	6.3	62964	10.4
Downey		8141	8004	1.0	12538	1.5	28402	3.5	41929	5.2
Paramount		2602	3145	1.2	6320	2.4	16088	6.2	23548	9.0
Total		16780	18145	1.1	30632	1.8	82382	4.9	128441	7.7
GROUP K										
Long Beach	2	536	12592	23.5	12133	22.6	14080	26.3	14378	26.8
	3	2031	15787	7.8	18739	9.2	24937	12.3	25444	12.5
	4	3745	16888	4.5	18069	4.8	23596	6.3	29476	7.9
	5	4885	12611	2.6	21247	4.4	46908	9.6	52202	10.7
	6	3061	15826	5.2	18449	6.0	29446	9.6	30396	9.9
	7	2061	2713	1.3	5649	2.7	10404	5.0	10628	5.2
	8	5313	1623	0.3	3562	0.7	18375	3.5	20088	3.8
	10	2158	3916	1.8	7983	3.7	23690	11.0	24269	11.3
	11	2351	0	0.0	0	0.0	2638	1.1	5964	2.5
	12	613	18483	30.2	18176	29.6	17005	27.8	17370	28.3
	13	3467	33414	9.6	33043	9.5	38553	11.1	39538	11.4
	14	944	11873	12.6	12344	13.1	11643	12.3	11873	12.6
	15	5458	646	0.1	674	0.1	7295	1.3	11172	3.4
Total		36623	146372	4.0	170068	4.6	268570	7.3	318468	8.7

TABLE NO. 3 - CONTINUED

	AREA ACRES	1930 POPULTN NO.	1930 POPULTN DENSITY	1940 POPULTN NO.	1940 POPULTN DENSITY	1950 POPULTN NO.	1950 POPULTN DENSITY	1953 POPULTN NO.	1953 POPULTN DENSITY
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GROUP L									
Harbor City	1714	1608	0.9	2121	1.2	6192	3.6	6729	3.9
San Pedro	13289	36363	2.7	44086	3.3	56496	4.3	57480	4.3
Wilmington	6796	13665	2.0	15205	2.2	25300	3.7	27119	4.0
Total	21799	51636	2.4	61412	2.8	87988	4.0	91328	4.2
GROUP M									
Torrance	12720	2780	0.2	3838	0.3	15251	1.2	19121	1.5
Total	12720	2780	0.2	3838	0.3	15251	1.2	19121	1.5
GRAND TOTAL	330011	1334100	4.0	1626937	4.9	2284363	6.9	2473329	7.5
L. A. County Population		2208492		2785643		4151687		4650000	
Study Area Population in % of County Population		60.4		58.4		55.0		53.3	

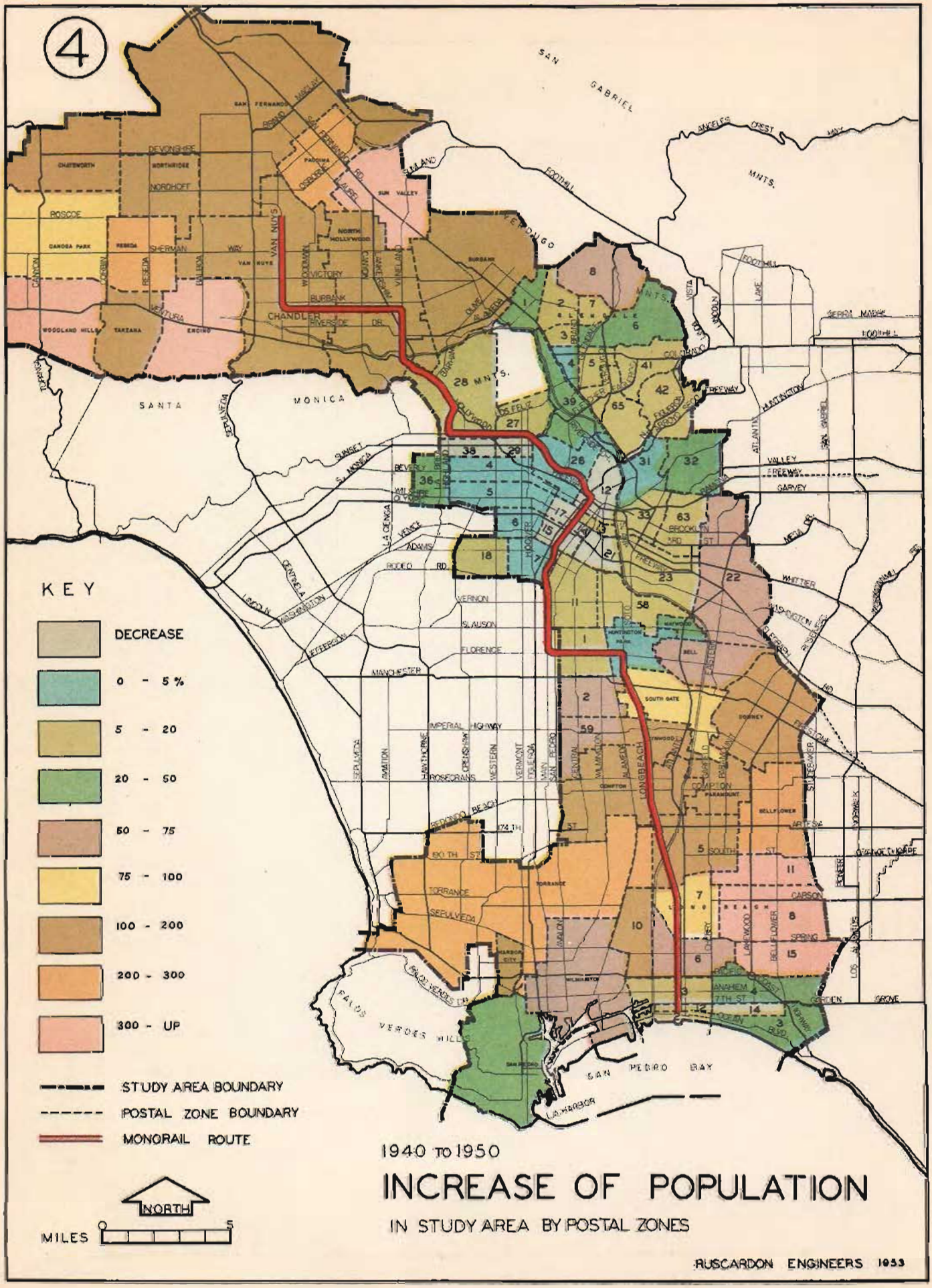

4
KEY
DECREASE
0 - 5 %
5 - 20
20 - 50
50 - 75
75 - 100
100 - 200
200 - 300
300 - UP
STUDY AREA BOUNDARY
POSTAL ZONE BOUNDARY
MONORAIL ROUTE
NORTH
MILES
0
5
1940 TO 1950
INCREASE OF POPULATION
IN STUDY AREA BY POSTAL ZONES
RUSCARDON ENGINEERS 1953

FIGURE NO. 4

PERCENTAGE RATE OF INCREASE
BY POSTAL ZONES
WITHIN STUDY AREA 1940-1950

As would be expected, percentage rates of increase during this decade were the largest in those Postal Zones at either extremity of the Study Area - in the entire San Fernando Valley and in the Zones easterly and southerly of the industrial area from Vernon through Compton, with the exception of the City of Long Beach and Signal Hill.

The "core" area around the Central Business District, and some of Hollywood, showed for the most part moderate rates of increase ranging up to 10-15 per cent, but likewise showed some areas where a slight decrease in population occurred. This decrease was due to commercialization and industrialization-for the most part with light industry-of former residential areas, and also because of the taking for freeway purposes, in recent years, of substantial areas which had a high population density in 1940.

TABLE NO. 4 - CONTINUED

GROUP D		AREA ACRES (1)	1953 POPULTN NO. (2)	1953 POPULTN DENSITY (3)	1960 POPULTN NO. (4)	1960 POPULTN DENSITY (5)	1970 POPULTN NO. (6)	1970 POPULTN DENSITY (7)	1980 POPULTN NO. (8)	1980 POPULTN DENSITY (9)
L. A. Zone	4	2132	39362	18.4	44600	21.0	50200	23.6	55000	25.8
	5	1978	48906	24.8	55800	28.2	63100	31.9	69000	34.9
	6	1066	32118	30.1	33200	31.1	33000	31.0	32000	30.0
	7	1684	41625	24.8	43200	25.7	42900	25.4	42000	24.9
	18	1942	43267	22.4	45700	23.6	46600	24.0	47000	24.2
	36	2319	30091	13.0	31500	13.6	34200	14.7	35000	15.1
Total		11121	235369	21.2	254000	22.8	270000	24.2	280000	25.1
GROUP E										
L.A. Zone	12	2065	38000	18.4	38900	18.8	39900	19.3	41000	19.8
	26	2798	53323	19.0	55900	20.0	59600	21.3	63000	22.5
	31	2410	35456	14.7	35900	14.9	36400	15.1	37000	15.4
	32	3160	25862	8.2	27500	8.7	29800	9.4	32000	10.1
	39	2806	28322	10.1	30700	10.9	33800	12.0	37000	13.2
	41	2276	20137	8.8	21900	9.6	24500	10.8	27000	11.9
	42	2770	35307	12.8	36900	13.3	38900	14.0	41000	14.8
	65	2811	28712	10.2	32300	11.5	37100	13.2	42000	15.0
Total		21096	265119	12.6	280000	13.3	300000	14.2	320000	15.2
GROUP F										
L.A. Zone	13	459	9808	21.4	9300	20.3	8700	19.0	8000	17.5
	14	258	6728	26.0	6300	24.4	5700	22.1	5000	19.4
	15	1072	27608	25.8	27400	25.6	27300	25.5	27000	25.1
	17	531	23181	43.6	23100	43.5	23000	43.3	23000	43.3
	21	1048	13934	13.3	13400	12.8	12700	12.1	12000	11.4
Total		3368	81259	24.1	79700	23.6	77400	23.0	75000	22.3
GROUP G										
L.A. Zone	22	7139	61131	8.6	60000	8.4	58500	8.2	57000	8.0
	23	3287	43743	13.3	42700	13.0	41400	12.6	40000	12.2
	33	1779	44574	25.1	45500	25.6	46800	26.3	48000	27.0
	63	2515	48071	19.1	49800	19.8	52400	20.8	55000	21.9
Total		14720	197519	13.4	199000	13.5	199000	13.5	200000	13.6

TABLE NO. 4 - CONTINUED

GROUP H	AREA ACRES	1953 POPULTN NO.	1953 POPULTN DENSITY	1960 POPULTN NO.	1960 POPULTN DENSITY	1970 POPULTN NO.	1970 POPULTN DENSITY	1980 POPULTN NO.	1980 POPULTN DENSITY
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
L.A. Zone 1	2282	39589	17.3	43000	18.9	43000	18.8	45000	19.7
2	2273	40773	18.0	44700	19.7	46800	20.6	48000	21.1
11	2736	78366	28.6	77600	28.4	76000	27.8	75000	27.4
58	3929	10663	2.7	10900	2.8	10900	2.8	11000	2.8
Bell	4141	41218	10.0	46600	11.3	53000	12.8	55000	13.3
Huntington Pk.	1792	30804	17.2	35600	19.9	41900	23.4	45000	25.1
South Gate	4475	51473	11.4	56600	12.4	62800	14.0	67000	15.0
Maywood	639	12236	19.1	13000	20.4	13600	21.3	14000	21.9
Total	22267	305122	13.7	328000	14.7	348000	15.6	360000	16.2
GROUP I									
L. A. Zone 59	2244	31709	14.1	33000	14.7	35000	15.6	36000	16.0
Compton	8361	86197	10.3	99000	11.8	112000	13.4	118000	14.1
Lynwood	3069	31875	10.4	39000	12.7	43000	14.0	46000	15.0
Total	13674	149782	11.0	171000	12.5	190000	13.9	200000	14.6
GROUP J									
Bellflower	6037	62964	10.4	68000	11.2	71000	11.8	74000	12.3
Downey	8141	41929	5.2	77000	9.5	98000	12.0	115000	14.1
Paramount	2602	23548	9.0	29000	11.1	33000	12.7	36000	13.8
Total	16780	128441	7.7	174000	10.4	202000	12.0	225000	13.4
GROUP K									
Long Beach 2	536	14378	26.8	18500	34.5	18800	35.1	19000	35.5
3	2031	25444	12.5	37500	18.5	51800	25.5	61000	20.0
4	3745	29476	7.9	35700	9.6	43800	11.7	45000	12.0
5	4885	52202	10.7	62400	12.8	67500	13.8	69000	14.1
6	3061	30396	9.9	34400	11.2	36500	11.9	37000	12.1
7	2061	10628	5.2	18300	8.9	19700	9.6	21000	10.2
8	5313	20088	3.8	34400	6.5	49900	9.4	64000	12.0
10	2158	24269	11.3	27400	12.7	27700	12.7	28000	13.0
11	2351	5964	2.5	17600	7.5	26700	11.4	31000	13.2
12	613	17370	28.3	19300	31.5	19700	32.1	20000	32.6
13	3467	39538	11.4	43400	12.5	45500	13.1	47000	13.6
14	944	11873	12.6	12600	13.4	12800	13.6	13000	13.8
15	5458	11172	3.4	35500	6.5	47600	8.7	65000	11.9
Total	36623	318468	8.7	397000	10.8	468000	12.8	520000	14.2

TABLE NO. 4 - CONTINUED

GROUP L	AREA ACRES (1)	1953 POPULTN NO. (2)	1953 POPULTN DEN-SITY (3)	1960 POPULTN NO. (4)	1960 POPULTN DEN-SITY (5)	1970 POPULTN NO. (6)	1970 POPULTN DEN-SITY (7)	1980 POPULTN NO. (8)	1980 POPULTN DEN-SITY (9)
Harbor City	1714	6729	3.9	8300	4.8	12500	7.3	17000	9.9
San Pedro	13289	57480	4.3	63300	4.8	76400	5.8	92000	6.9
Wilmington	6796	27119	4.0	29400	4.3	34100	5.0	41000	6.0
Total	21799	91328	4.2	101000	4.6	123000	5.6	150000	6.9
GROUP M									
Torrance	12720	19121	1.5	32000	2.5	53000	4.3	80000	6.3
Total	12720	19121	1.5	32000	2.5	53000	4.3	80000	6.3
GRAND TOTAL	330011	2473329	7.5	2937700	8.9	3528400	10.7	4139000	12.5
L. A. County Population		4650000		5500000		6600000		7500000	
Study Area Population in % of County Population		53.3		53.4		53.4		56.4	

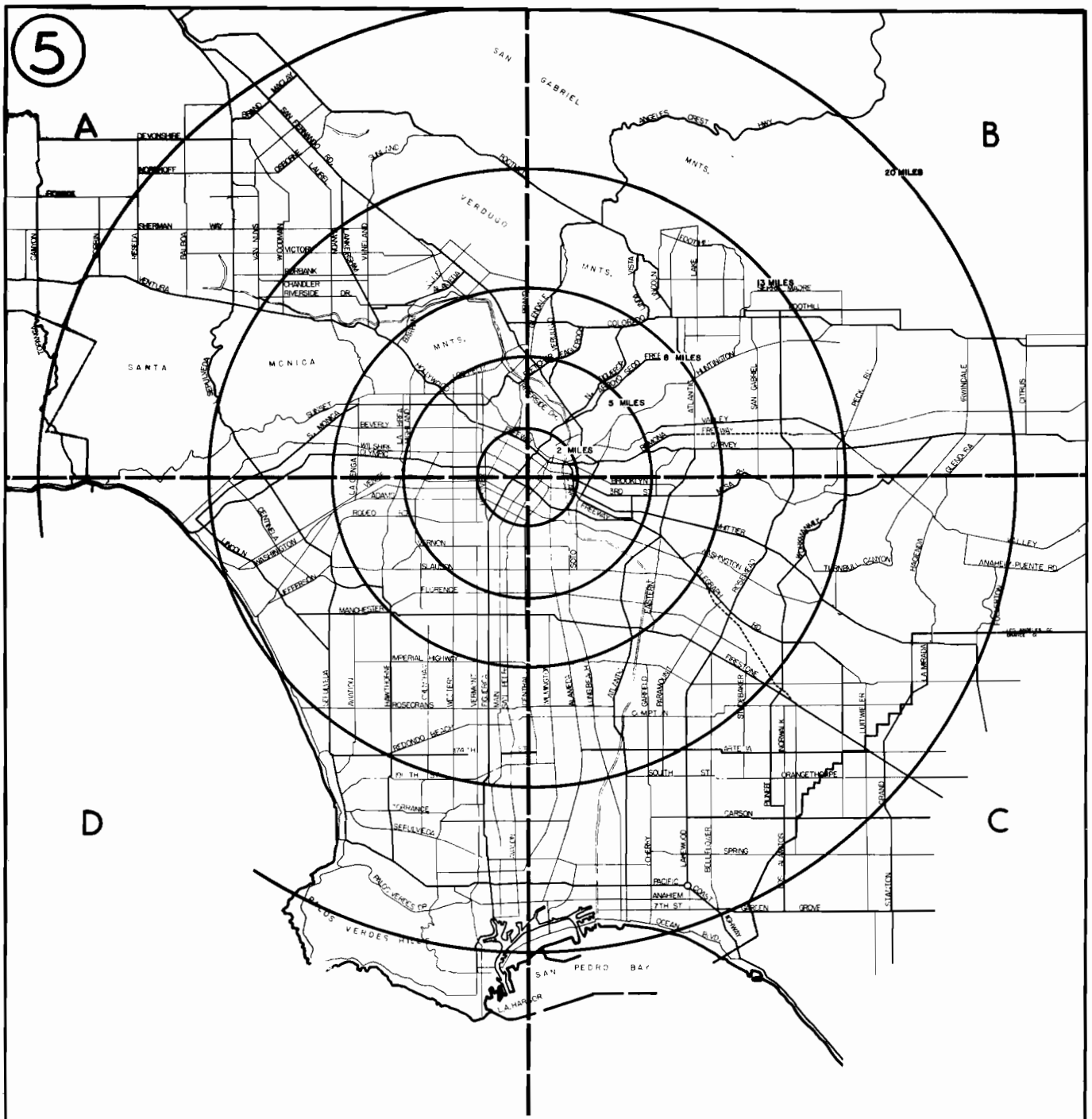
and each quadrant was divided into Zones or Sectors of various radii, 2,5,8,13 and 20 miles, from the center of Downtown Los Angeles. These quadrants and zones are shown on Figure No. 5, with the area and population of each Zone within each quadrant, total area, and also population density in persons per acre for the Census years 1930, 1940 and 1950 are likewise given in Table No. 5.

Densities outside of the 8-mile radius are still very low, and encourage this trend towards single family residential living. That it is continuing is borne out by data collected by the Los Angeles Regional Planning Commission. At the present time 66 per cent of the residential family units in Los Angeles County are single family in character, and of family units constructed between 1950 and the present time, 77 per cent were single family in character.

Population Density

Metropolitan Los Angeles has always been characterized by a low density of population. In the Spring of 1953, with a total County population of 4,650,000 - 98 per cent of which lived within a 20-mile radius of Downtown Los Angeles, the average population density of the area was 6.5 persons per acre. The density of the Study Area was slightly in excess of this figure, being 7.5 persons per acre.

Of the 80 Postal Zones included in the Study Area, 13 had a population density in excess of 20 persons per acre. The total population of these 13 Zones in the Spring of 1953 was 407,798 persons, or 16.5 per cent of the total population of the Area. The highest population density within the Study Area -43.6 persons per acre- occurred in Postal Zone 17, in the City of Los Angeles, as of the Spring of 1953. There was one Postal Zone having a population density in excess of 30 persons per acre at that time, and the



QUADRANT MAP

FOR LOS ANGELES COUNTY

RUSCARDON ENGINEERS 1953

FIGURE NO. 5

QUADRANTS AND SECTORS WITHIN A 20-MILE RADIUS
OF DOWNTOWN LOS ANGELES

This map is to be used in connection with Table No. 5, which presents the changing distribution of population within a 20-mile radius of Downtown Los Angeles as of 1930-1940 and 1950.

Total population as of 1950 was fairly well distributed amongst the four quadrants, ranging from 818,553, or 20.4 per cent of the total population, within the 20-mile radius in the Northeast Quadrant, to 1,114,478 or 27.5 per cent of this total, in the Southwest Quadrant. Population increase during this period was the least in the Northeast Quadrant, being 232,280 or 17.5 per cent of the total increase, and the greatest in the Southeast Quadrant, being 348,746, or 26.3 per cent.

Population densities in 1950 ranged from 4.5 persons per acre in the Northwest Quadrant to 8.4 persons per acre in the Southwest Quadrant. The average density for the entire area within the 20-mile radius was 5.6 persons per acre(areas for which population density was computed included all hill and mountain, as well as valley land within each Quadrant and Sector.)

The most significant facts developed in this study were -

a. In 1930, 63.2 per cent of the total population within the 20-mile radius lived within an 8-mile radius. By 1940, this percentage had dropped to 58.5, and by 1950 it had dropped to 45.1.

b. Of the total population increase between 1940 and 1950 of 1,327,438 within this 20-mile radius, 1,090,666 or 82.2 per cent(practically 5 out of 6) occurred outside of the 8-mile radius.

c. Should this trend in decentralization of population increase during the 1950-1960 decade-and there is every reason to believe that it will-provided adequate transportation is provided, population increase during the coming decade outside of the 8-mile radius can be expected to be somewhat in excess of 1,000,000 persons, and total population outside of this radius by 1960 can be expected to be of the order of 3-$\frac{1}{4}$ million people, or about 60 per cent of total population within the 20-mile radius.

TABLE NO. 5

POPULATION CHANGES BY QUANDRANTS 1930 - 40 - 50
WITHIN VARIOUS RADII FROM CENTER OF CITY OF LOS ANGELES

RADII MILES	AREA ACRES (a)	1930 POPULATION NO.	1930 DENSITY*	INCREASE 1930-40 IN POPULATION NO.	INCREASE 1930-40 %	1940 POPULATION NO.	1940 DENSITY*	INCREASE 1940-50 IN POPULATION NO.	INCREASE 1940-50 %	1950 POPULATION NO.	1950 DENSITY*
A. NORTH WEST QUADRANT											
0--2	1969	68698	34.9	9386	13.7	78084	39.7	-2882	-3.7	75202	38.2
2 -5	8423	154996	18.4	22305	14.4	177301	21.0	2865	1.6	180186	21.4
5 -8	20100	170069	8.5	49697	28.2	219766	10.9	22328	10.1	242094	12.1
8 13	49262	86902	1.8	73900	85.0	160802	3.3	125397	78.0	286199	5.8
13-20	153689	51163	0.3	41779	81.6	92942	0.6	173051	186.0	265993	1.7
Total	233443	531828	2.3	197067	37.0	728895	3.1	320759	44.0	1049674	4.5
B. NORTH EAST QUADRANT											
0 2	1935	46092	23.8	989	2.1	47081	24.3	-2860	-6.1	44221	22.8
2--5	10873	109488	10.1	6783	6.2	116271	10.7	15805	13.6	132076	12.2
5--8	21071	140615	6.7	28817	20.4	169432	8.0	40572	24.0	210004	10.0
8-13	59853	149658	2.5	56912	38.0	206570	3.5	121876	59.0	328446	5.5
13-20	48363	36614	0.8	10305	28.2	46919	1.0	56887	121.3	103806	2.2
Total	142095	482467	3.4	103806	21.7	586273	4.1	232280	39.6	818553	5.8
C. SOUTH EAST QUADRANT											
0--2	2377	30222	12.7	-1536	-5.1	28686	12.1	-163	-0.6	28523	12.0
2--5	9615	131215	13.7	10398	7.9	141613	14.7	16234	11.5	157847	16.9
5--8	19684	110453	5.6	39360	35.6	149813	7.6	75596	50.5	225409	11.5
8-13	43796	59209	1.4	31928	54.0	91137	2.1	147243	162.0	238380	5.5
13-20	136294	194199	1.4	38117	19.0	232316	1.7	186743	80.4	419059	3.1
Total	211766	525298	2.5	118267	22.5	643565	3.0	425653	66.2	1069218	5.0

Note: (a) Area given is that of Census Tracts whose outer boundaries most closely follow quadrant and circumference lines.

* - Density in Persons per Acre

TABLE NO. 5 - CONTINUED

RADII MILES	AREA ACRES (a)	1930 POPULATION NO.	1930 DENSITY*	INCREASE 1930-40 IN POPULATION NO.	INCREASE 1930-40 %	1940 POPULATION NO.	1940 DENSITY*	INCREASE 1940-50 IN POPULATION NO.	INCREASE 1940-50 %	1950 POPULATION NO.	1950 DENSITY*
				D. SOUTH WEST QUADRANT							
0--2	1757	40136	22.8	6267	15.6	46403	26.4	-1365	-2.9	45038	25.6
2--5	10085	208532	20.8	17095	8.2	225627	22.5	10369	4.6	235996	23.6
5 -8	20466	151707	7 4"	41605	27.4	193312	9.4	60273	31.2	253585	12.4
8-13	52180	137809	2.6	60001	43.5	197810	3.8	204765	103.5	402575	3.9
13-20	49130	77653	1.6	24927	32.2	102580	2.1	74704	72.9	177284	3.6
Total	133618	615837	4.6	149895	24.4	765732	5.7	1348746	45.5	1114478	8.4
				TOTAL WITHIN 20 MILE RADIUS							
0--2	8038	185148	23.0	15106	8.2	200254	25.0	-7270	-3.6	192984	24.0
2--5	38996	604231	15.5	56581	9.2	660812	17.0	45273	6.8	706105	18.1
5--8	81321	572844	7.0	159479	27.9	732323	9.0	198769	27.2	931092	11.5
8-13	205091	433578	2.1	222741	51.5	656319	3.2	599281	91.2	1255600	6.1
13-20	387476	359629	0.9	115128	32.0	474757	1.2	491385	103.3	966142	2.5
Total	720922	2155430	2.9	569035	26.4	2724465	3.8	1327438	48.6	4051923	5.6

Note:

(a) Area given is that of Census Tracts whose outer bc ndaries most closely follow quadrant and circumference lines.

* - Density in Persons per Area.

TABLE NO. 5 - CONTINUED

SUMMARY - POPULATION INSIDE AND OUTSIDE 8-MILE RADIUS

	AREA	1930 POPULATION		INCREASE 1930-40 IN POPULATION		1940 POPULATION		INCREASE 1940-50 IN POPULATION		1950 POPULATION	
	ACRES (a)	NO.	DENSITY*	NO.	%	NO.	DENSITY*	NO.	%	NO.	DENSITY*
Inside	128355	1362223	10.6	231166	17.0	1593389	12.4	236772	14.9	1830161	14.3
Outside	592567	793207	1.3	337869	42.5	1131076	1.9	1090666	96.5	2221742	3.8
Total 20-Mile Radius	720922	2155430	2.9	569035	26.4	2724465	3.8	1327438	48.6	4051903	5.6

POPULATION OUTSIDE OF 20-MILE RADIUS

	1930 POPULATION		1940 POPULATION		1950 POPULATION	
	NO.	% TOTAL CO.	NO.	% TOTAL CO.	NO.	% TOTAL CO.
Total County Pop.	2208492	100.0	2785643	100.0	4151687	100.0
Total Inside 20-Mile Radius	2155430	97.6	2724465	97.8	4051903	97.8
Total Outside 20-Mile Radius	53062	2.4	61178	2.2	91784	2.2

Note: (a) Area given is that of Census Tracts whose outer boundaries most closely follow quadrant and circumference lines.

* Density in Persons per Acre.

remaining 11 of the above 13 Postal Zones had a population density of between 20 and 30 persons per acre.

A slight loss in population between the time of the 1950 Census and the Spring of 1953, occurred in 19 Postal Zones, these having a total population in 1950 of 721,726. This loss in population amounted to 17,527 persons, or 7.7 per cent of the 1950 population of the Study Area. This loss occurred in the Zones of highest density and was due essentially to (a) the industrialization or commercialization of land use in these Zones of high population density, or (b) the condemnation of a substantial area of land in these Zones for use in construction of freeways.

Location of Areas of Low Population Density

It can be expected that the large population increases numerically as well as percentage-wise would occur in areas having at the present time low population densities. Figure Nos. 6 and 7 present by Postal Zones the population density in persons per acre as of 1953, and estimated population density in persons per acre as of 1980, and Figure 4 shows the percentage increase in population from 1940 to 1950 in Census Tracts. It will be noted in this last Figure that the high rates of population increase during the above decade occurred in the San Fernando Valley and also southerly of Los Angeles, with the exception of the City of Long Beach.

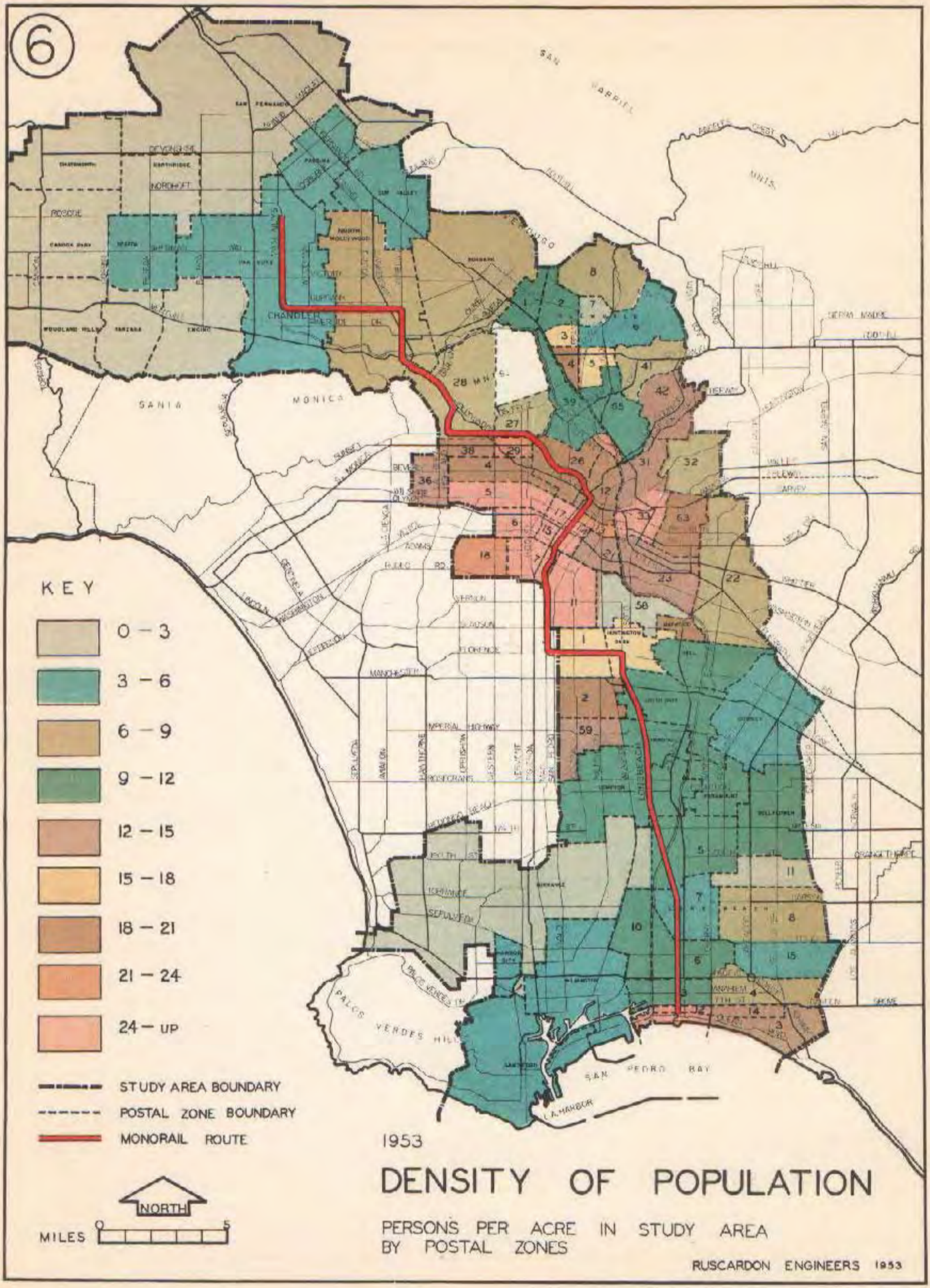

6
KEY
0 – 3
3 – 6
6 – 9
9 – 12
12 – 15
15 – 18
18 – 21
21 – 24
24 – UP
STUDY AREA BOUNDARY
POSTAL ZONE BOUNDARY
MONORAIL ROUTE
NORTH
MILES
0
5
1953
DENSITY OF POPULATION
PERSONS PER ACRE IN STUDY AREA
BY POSTAL ZONES
RUSCARDON ENGINEERS 1953
SAN FERNANDO
SANTA MONICA
CHANDLER
SAN PEDRO BAY
L.A. HARBOR

FIGURE NO. 6

DENSITY OF POPULATION WITHIN STUDY AREA BY POSTAL ZONES - 1953

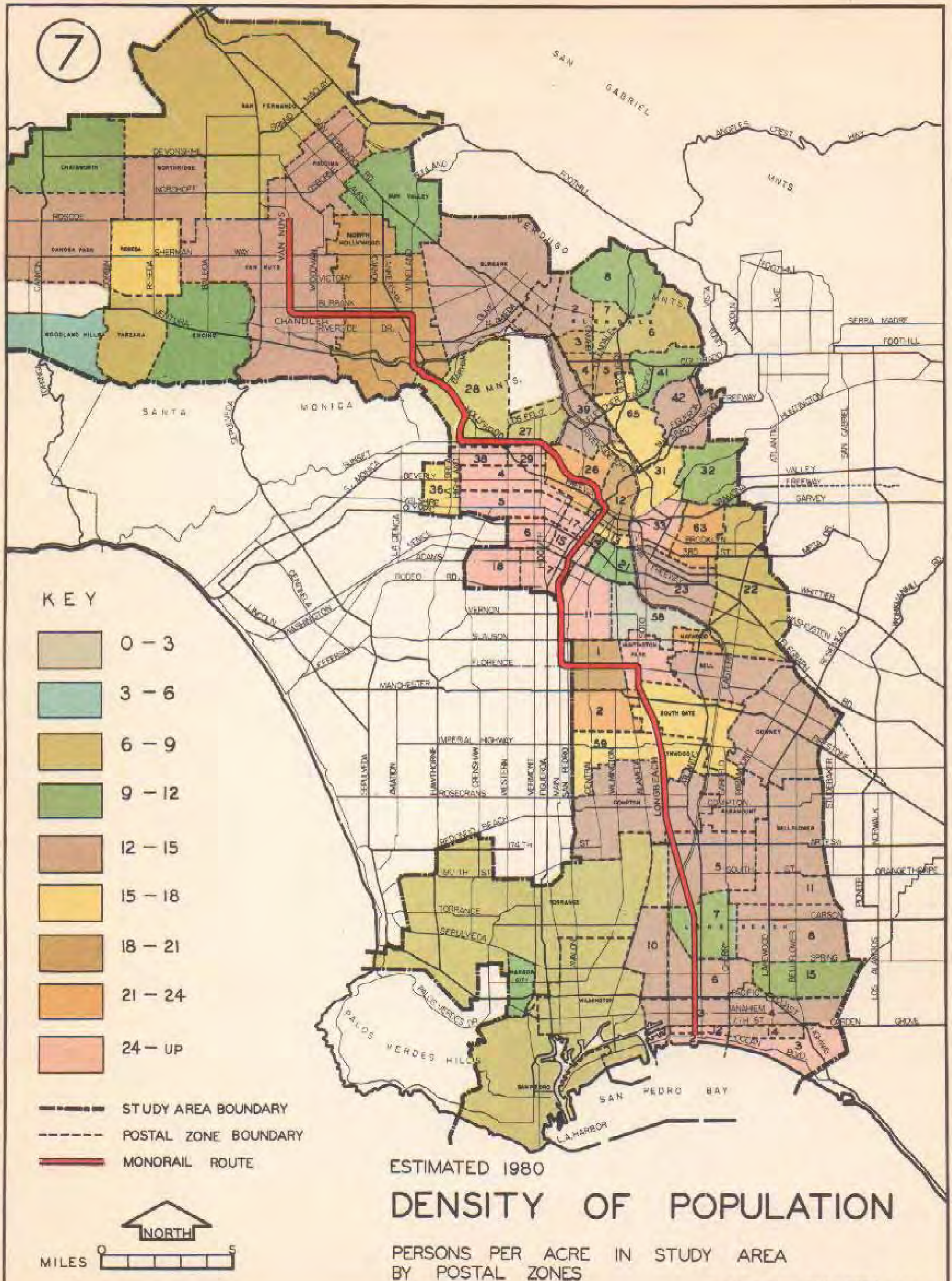
This map shows that, in spite of the fact that the greatest percentage rate of population increase during the 1940-1950 decade occurred at either extremity of the Study Area, population densities at such extremities are still relatively low, and for this reason the large future increases in population-provided that adequate transportation facilities are provided-can be expected to occur in the areas of present and future low population density.

Residential building lots-usually 50' x 150' in dimensions-result in about 5 lots per acre. With 3.3 persons per family, this results in a saturation density of 16 persons per acre for strictly residential areas of this character. Since World War II, however, family size is increasing, and in new subdivisions occupied by the younger population, saturation densities of from 17 to 19 per acre may be reached.

Allowing for local commercial buildings, a few multiple dwellings, schools and parks, saturation densities today of from 15 to 17 per acre may occur when large areas are considered.

This map shows that there are still large areas with densities of much less than these latter figures.

See Table No. 3



ESTIMATED 1980

DENSITY OF POPULATION

PERSONS PER ACRE IN STUDY AREA
BY POSTAL ZONES

RUSCARDON ENGINEERS 1953

FIGURE NO. 7

ESTIMATED FUTURE DENSITY OF POPULATION
WITHIN THE STUDY AREA - AS OF 1980

This map is based upon data in Table No. 5. Average population density in 1980 is estimated as 12.5 persons per acre.

There are still a considerable number of Postal Zones where population density in 1980 is estimated to be considerably below the saturation point for single family residences. Zones in Groups D and F average in excess of 20 persons per acre and in Groups E and H in excess of 15 persons per acre.

Increased use of land for industrial purposes in the area southerly from Vernon to San Pedro Harbor may result in densities as given in Table No. 4, approaching saturation by 1980, but there still will be considerable room for population living in single family residences in those Zone Groups having population densities of less than 12-13 persons per acre, as of that date.

See Table No. 4

IV

ECONOMIC CHARACTERISTICS

While this Report does not deal essentially with economic characteristics of the general area, it was thought advisable to present a small amount of material pertaining to this subject.

Median Value of Owner Occupied Single Family Homes - 1950

Figure No. 8 shows by seven brackets the median value of single family owner occupied homes within the Study Area. As with income, most sections in which the higher value homes occur are located outside of the Study Area.

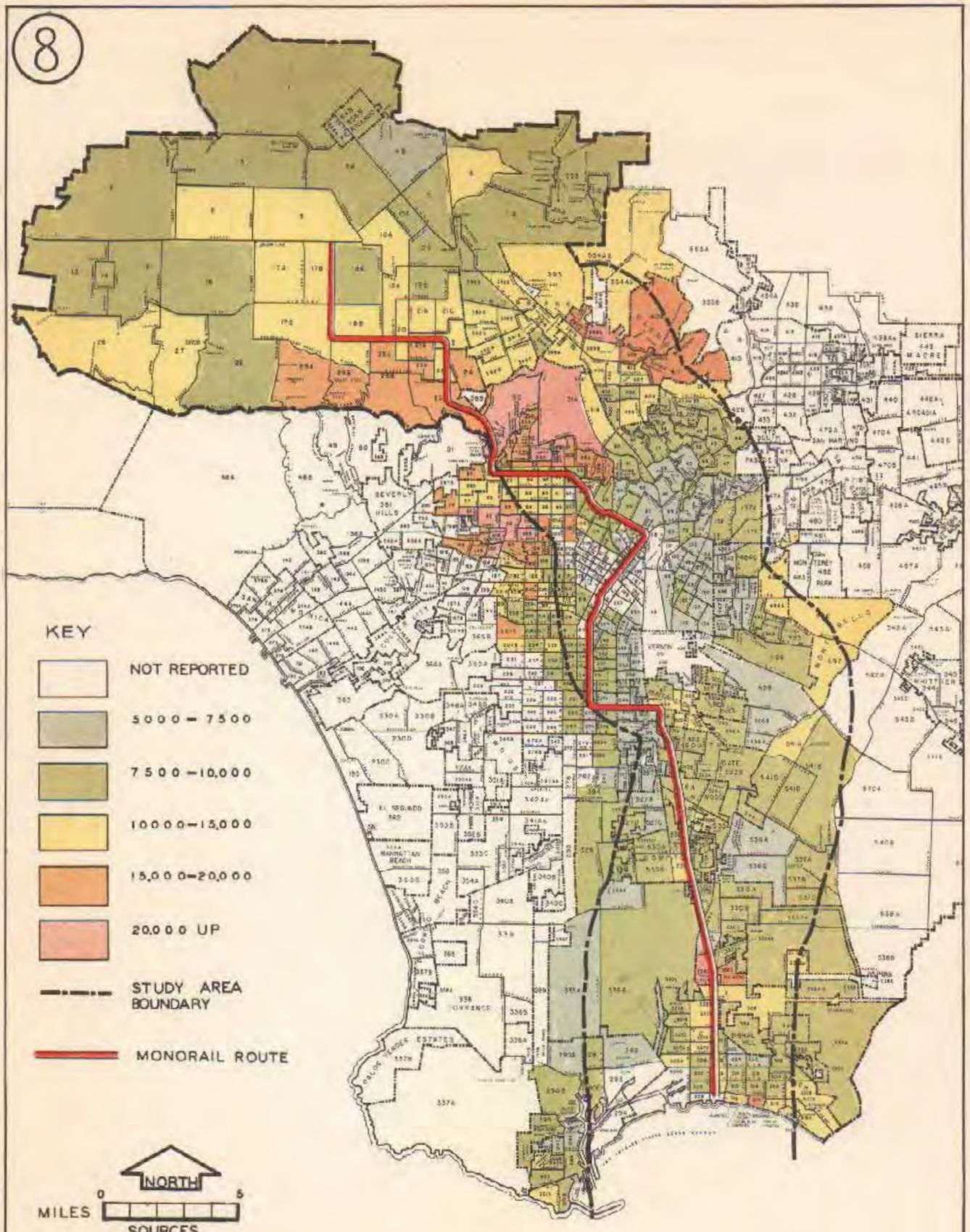
Median Income Per Family - 1950

Figure No. 9 shows the range in family income in six different brackets. Most of the high family income areas are without the Study Area.

Economic Indices

Figure No. 10 and Table No. 6 present certain Indices for the Los Angeles Metropolitan Area over the past three or more decades. Gasoline Sales are for the entire State of California, as such sales in individual Counties of the State are not reported separately.

8



MEDIAN VALUE OF OWNER OCCUPIED DWELLING UNITS IN STUDY AREA BY CENSUS TRACTS

RUSCARDON ENGINEERS 1953

FIGURE NO. 8

MEDIAN VALUE OF OWNER OCCUPIED SINGLE FAMILY HOMES
WITHIN STUDY AREA - 1950

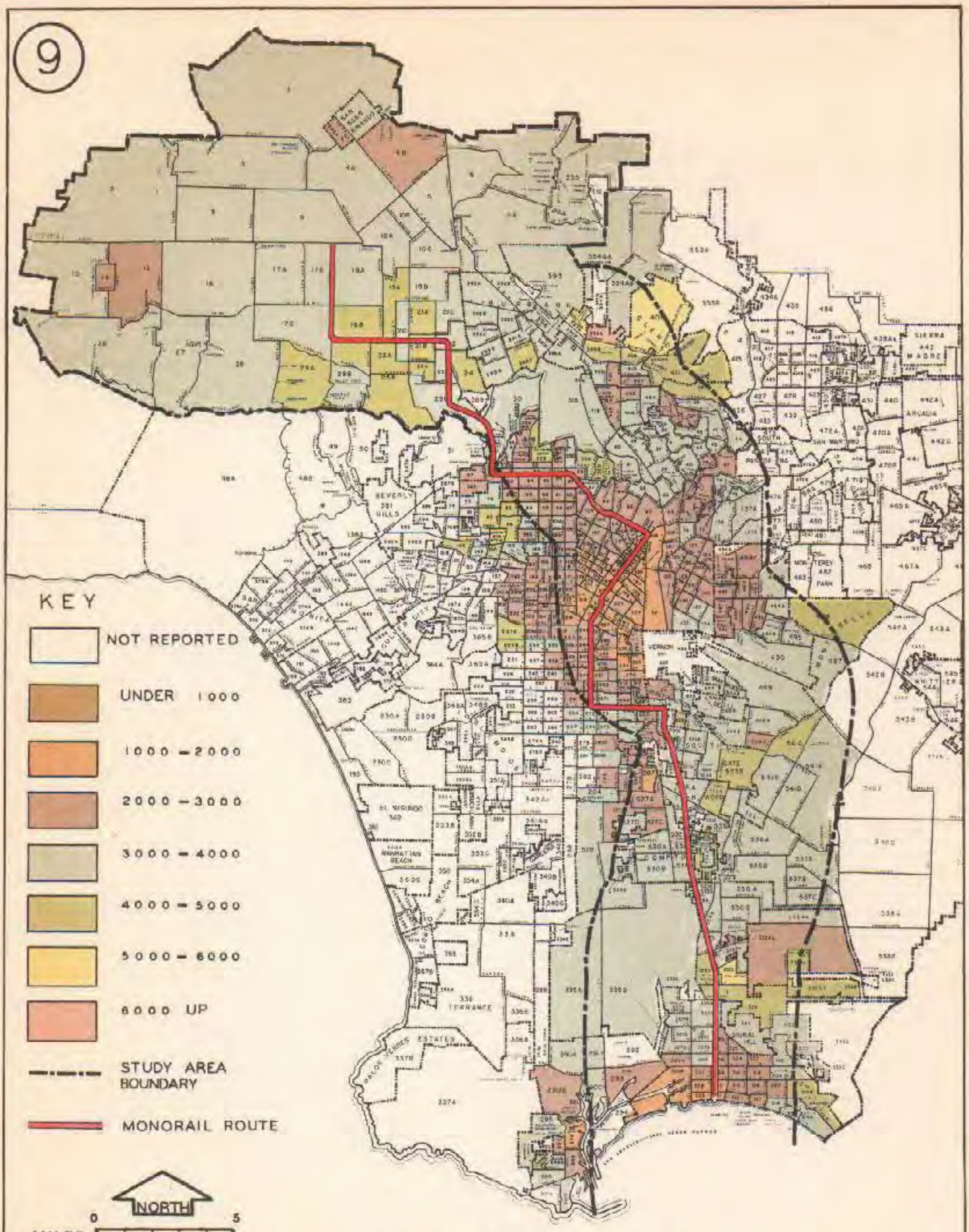
This factor is usually considered to be a very good indicator of the economic status of residents within any area and may be considered to be so in those Census Tracts having relatively low population densities, but a comparison with Figure No. 9, Median Income per Family, will not show very good correlation between Median Value of Homes and Median Family Income, for all Census Tracts, for the following reasons.

In many areas of higher population densities, a considerable number of inhabitants therein live in multiple dwellings, and for the most part, single family homes, while having a high value, house a relatively small proportion of the total population, with residents of multiple dwellings being in a somewhat lower economic bracket. Consequently, high values of single family owner occupied homes do not reflect high income in these Tracts.

High population densities also occur in the older sections of the area, where single family homes were built many years ago before present costs levels existed. Furthermore, the market for such older homes is not great, further resulting in lower values. In most of the areas where median values are in excess of $ 8000, homes have been built in recent years during the era of high construction costs.

In the Census Tracts not colored, no data was given in the Census Reports as to this factor.

9



MEDIAN INCOME IN STUDY AREA
BY CENSUS TRACTS 1950

RUSCARDON ENGINEERS 1953

FIGURE NO. 9

MEDIAN FAMILY INCOME WITHIN THE STUDY AREA - 1950

This map indicates Median Family Income as of 1950, in each Census Tract within the Study Area. In general, such income ranged from $ 2500 to $ 4500 per year, except in a small area in Hollywood, within Downtown Los Angeles and within an area southerly and southwesterly therefrom, in the Watts area westerly of Lynwood, and in a small area along the Ocean in Long Beach, in which areas Median Income ranged from under $ 1500 up to $ 2500 per year.

Areas with Median Income in excess of $ 4500 per year are few in number within the Study Area, as most of such areas in the County occur in Pasadena, Beverly Hills, Westwood, West Los Angeles, the "Malibu" and Palos Verdes, all of which are outside of the Study Area.

Experience in other communities where mass rapid transit facilities exist shows that areas having family incomes within the $ 2500 to $ 4500 per year bracket develop a higher riding habit on such systems than those where incomes are in higher or lower brackets.

In Census Tracts not colored, no data regarding income was given in the Census Reports.

10

ECONOMIC INDICES - METROPOLITAN LOS ANGELES

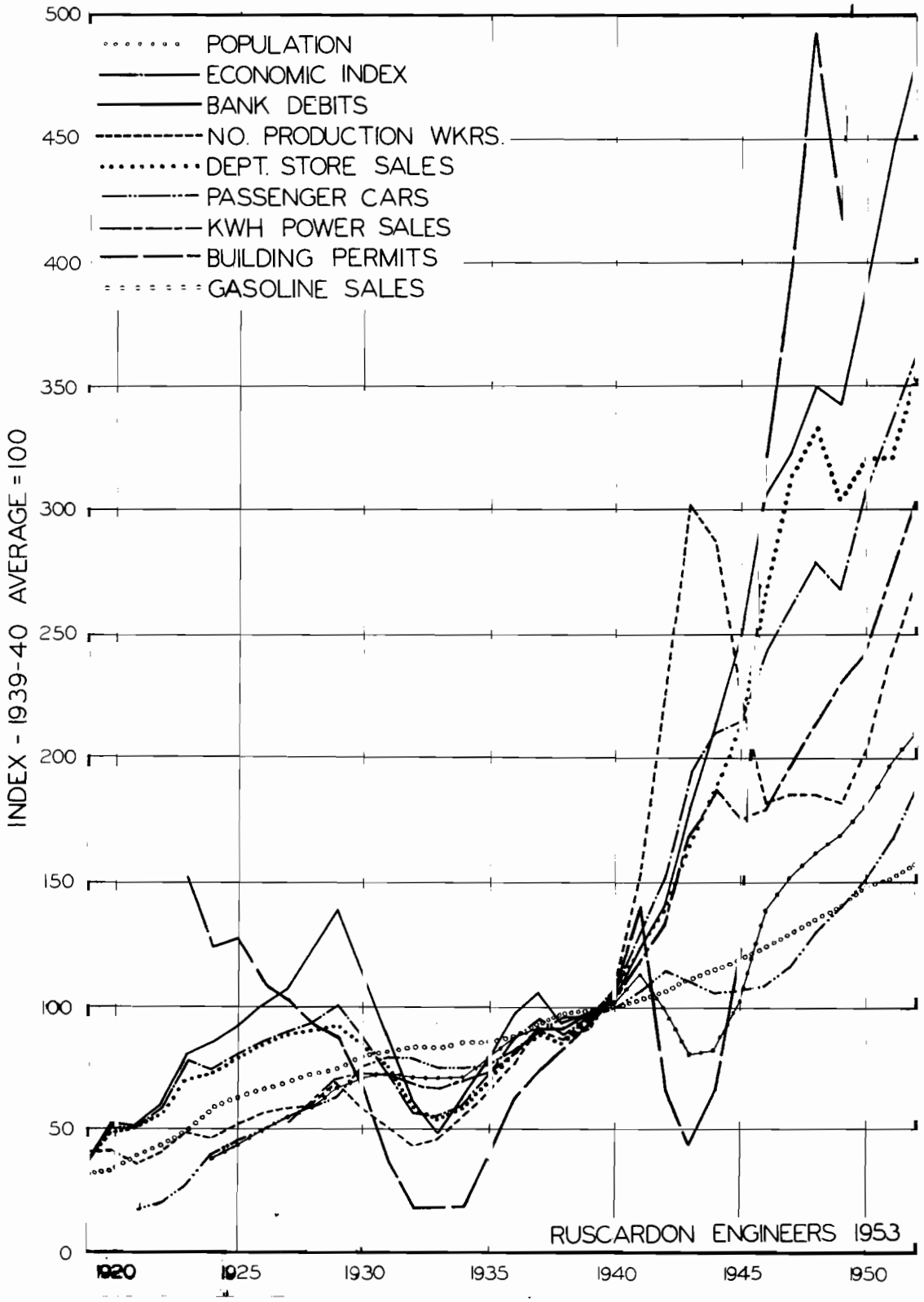


FIGURE NO. 10

ECONOMIC INDICES-METROPOLITAN LOS ANGELES-1920-1953

Various Economic Indices pertaining to Metropolitan Los Angeles are shown on this Figure. They all show an increase from 1920 through 1929, except that the Index for Building Permits declined during the early 1930's and, with the exception of Building Permits and Number of Production Workers in Manufacturing and the Motion Picture Industry, all showed a continued rise following the early 1930's. The general rate of increase in all Indices, except the foregoing, following this 1930-1935 period was considerably in excess of the rate of increase of population.

The initial decline in Building Permits during the 1920's probably indicated that the local population was becoming adequately housed, and that industrial plant construction had slowed down, while the decline in this Index during the 1941-1943 period was due to lack of availability of building materials and of construction labor.

The most significant fact in this graph is that, while the Index for the number of production workers dropped sharply from in excess of 300% in 1943 to well below 200% in 1946, and then continued at around this level for several years, other Indices, the Areal Economic Index and the Indices of Bank Debits, Department Store Sales, KWH Power Sales and Building Permits, did not reflect this decline. This would indicate that production workers, laid off from War Industry, still had money to spend and had found jobs at which to earn such money.

The extremely high rise in Building Permits would indicate that many of these former production workers secured employment in construction, residential and industrial, and the continued rise in KWH Power Sales, after a short drop following 1944, also would indicate that Post-War industrial activity recovered fairly rapidly. See Table No. 6.

TABLE NO. 6

ECONOMIC INDICES - LOS ANGELES AREA
(1939-40 - 100%)

YEAR	POPULATION	ECONOMIC INDEX	BANK DEBITS	DEPT. STORE SALES	NO. OF PRODUCTION WORKERS	KWH POWER SALES	BLDG. PERMIT VALUATION	PASSGR. CAR REGISTRATION	GASOLINE SALES
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1919	32.7	37.0	36.2	36.1	40.9		23.2		
1920	33.6	50.6	52.1	49.3	41.6		46.8		
1921	39.2	50.0	51.7	51.4	36.9		66.2	16.8	
22	44.1	59.2	59.8	56.7	40.8		96.0	20.7	
23	49.0	77.9	80.7	70.3	48.8		151.2	28.3	
24	59.2	74.7	85.1	73.4	47.2		123.1	40.2	38.9
1925	62.4	80.1	91.0	79.9	51.3		126.1	45.6	43.8
1926	66.1	85.7	100.4	85.0	57.2		109.1	49.7	49.3
27	69.0	89.5	107.0	89.0	59.2	54.7	102.3	55.0	55.5
28	72.1	93.9	123.8	90.1	60.7	62.1	91.0	59.0	59.5
29	74.7	100.9	140.3	91.8	68.1	72.1	87.0	64.1	67.0
1930	79.3	88.6	115.8	85.9	59.9	73.5	66.0	76.3	71.2
1931	81.8	73.9	88.7	76.7	51.3	73.5	36.8	79.1	73.0
32	83.8	57.9	62.8	59.1	44.5	68.4	16.2	79.1	71.8
33	83.0	55.5	58.0	55.2	47.1	67.1	17.2	75.8	71.3
34	85.5	60.6	62.1	59.6	57.3	70.0	17.4	75.6	71.3
1935	85.7	71.8	77.6	70.0	66.6	74.9	38.9	76.6	79.8
1936	88.0	86.9	97.5	82.1	78.1	83.8	67.2	82.4	87.1
37	93.6	95.4	105.7	88.8	90.3	91.0	74.6	89.0	92.1
38	97.5	89.4	93.6	85.3	83.6	92.7	83.5	95.8	92.0
39	98.3	95.5	96.4	93.7	92.4	97.4	93.5	96.2	97.8
1940	100.0	104.5	103.6	106.3	107.6	102.6	106.5	100.0	102.2
1941	103.0	130.2	125.0	125.1	155.7	118.1	141.3	107.2	114.7
42	107.1	153.9	141.9	140.7	225.2	135.8	68.9	115.1	98.8
43	111.8	194.5	182.1	167.4	303.6	170.2	45.0	110.8	81.7
44	115.7	211.4	214.4	189.1	288.2	189.6	66.9	106.2	83.5
1945	120.0	215.9	251.7	213.7	225.5	177.3	120.9	107.0	103.1
1946	125.1	243.6	306.4	277.7	183.9	180.8	319.1	108.5	139.5
47	130.3	261.4	323.7	313.7	186.1	198.4	395.6	117.3	152.8
48	136.0	279.8	351.0	334.5	186.2	216.1	493.8	131.0	163.0
49	142.0	269.2	344.9	305.5	183.8	232.0	419.3	140.0	170.0
1950	149.0	308.2	388.0	321.8	204.8	244.2	610.9	151.8	182.0
1951	152.6	334.5	441.4	322.8	243.5	276.5	517.1	168.1	198.0
1952	158.0	361.9	481.2	353.4	271.5	304.0	600.0	178.0	211.3

TABLE NO. 6 - CONTINUED

Notes

All Indices refer to average of 1939-1940 as 100%, except population, which is as of April 1, 1940. Population for 1930-1940-1950 is for April 1st - in other years for January 1st.

Sources

Col. 2 - All years except 1920-1930-1940 and 1950 - Research Dept. L.A. Chamber of Commerce. Other years - U.S. Census.

Cols. 3-4-5-6-8 - Research Department - Security First National Bank of Los Angeles. Col. 6- No. of Production Workers includes only workers engaged in Production and is exclusive of Administrative, Clerical and other employees.

Col. 7 - Research Department - Los Angeles Chamber of Commerce.

Col. 9 - California State Department of Motor Vehicles

Col.10 - Automobile Club of Southern California

100% Averages

Col. 2 - Population 1940 - 2,785,643

4 - Bank Debits 1939 - 1940 - $ 10,424,552,000

6 - No. Production Workers 1939-1940 - Average Monthly - 160,608

7 - KWH Power Sales 1939-1940 - 3,780,573,000

8 - Building Permits 1939-1940 - $ 219,832,500

9 - Passenger Auto Registration 1939-1940 - 1,019,293

10 - Motor Vehicle Fuel Sales - State of California 1939-1940 - 1,698,041,000 gallons

V

PASSENGER AUTOMOBILES

Los Angeles County has the greatest density of passenger automobile registration - expressed as the number of persons per registered automobile - or conversely - as the number of automobiles per 1000 population, of any large metropolitan area in the United States, which means in the World. This fact, the relatively low population density, and the prevalence of single family residential living, are all closely related.

Density of Passenger Automobile Registration in 10 Largest Counties in the United States 1951-1952

As of 1951-1952, there were 2.76 persons per passenger automobile in Los Angeles County, or 363 passenger automobiles per 1000 County population. The Five Boroughs of New York City had 7.03 persons per passenger automobile, or 142 automobiles per 1000 population.

Density of Passenger Automobile Registration - Los Angeles County Past and Estimated Future

In 1953, there were an estimated 1,895,000 passenger automobiles registered in Los Angeles County, or 2.43 persons per automobile-412 per 1000 of County population. This increase in the number of passenger automobiles has been much greater than the increase in population, as is shown on Figure No. 12 and Table No. 8.

Statutory Requirements for Garages in Residential Buildings

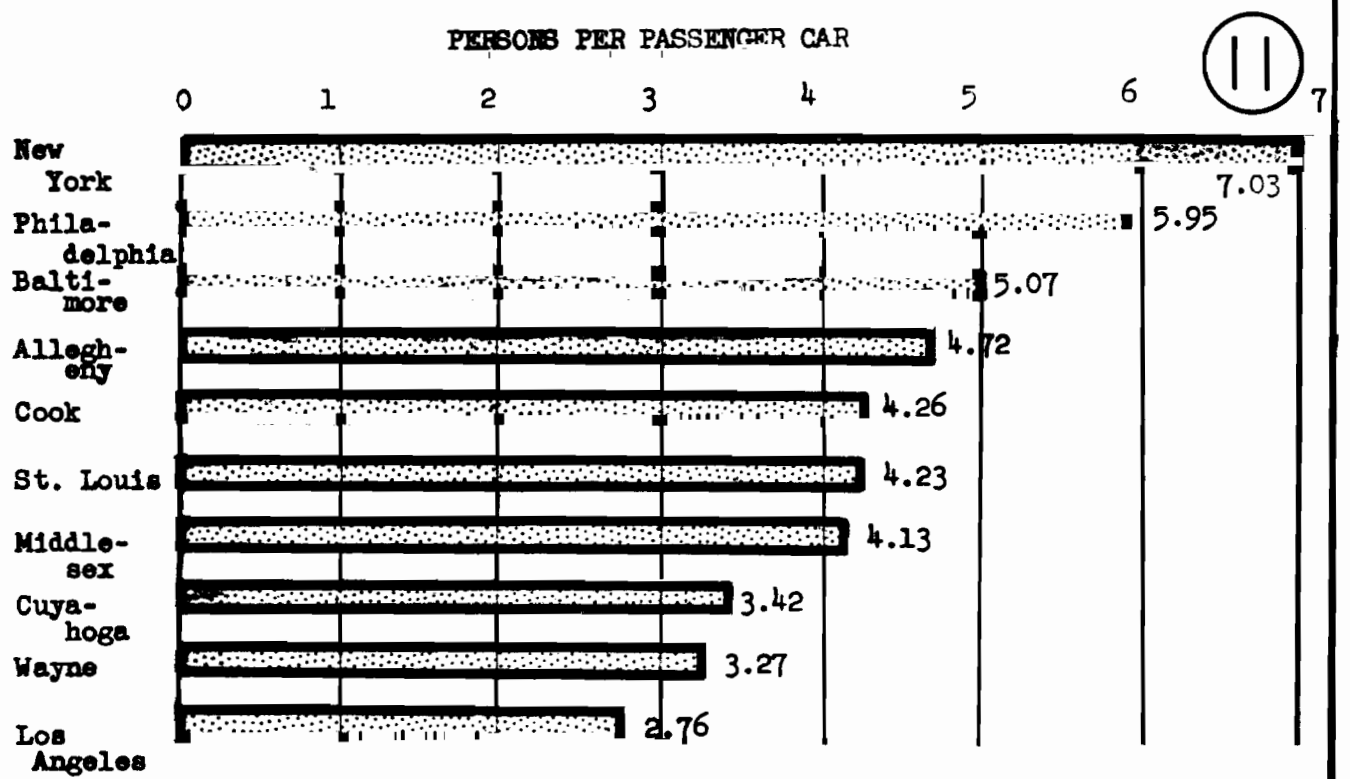
Ever since 1930, the City of Los Angeles has specified by Ordinance that one garage or storage space for an automobile must be provided for every family dwelling unit constructed, whether such unit be a single family or a multiple dwelling. Today no one thinks of building a single family

TABLE NO. 7

DENSITY OF PASSENGER AUTOMOBILES
IN THE 10 LARGEST COUNTIES AS
OF 1951-52

RANK IN DENSITY	COUNTY	PRINCIPAL CITY	PERSONS PER AUTOMOBILE	AUTOS PER 1000 POPULATION
1	Los Angeles	Los Angeles	2.76	363
2	Wayne	Detroit	3.27	306
3	Cuyahoga	Cleveland	3.42	292
4	Middlesex	Lowell	4.13	242
5	St. Louis	St. Louis	4.23	236
6	Cook	Chicago	4.26	232
7	Allegheny	Pittsburg	4.72	212
8	Baltimore	Baltimore	5.07	197
9	Philadelphia	Philadelphia	5.95	168
10	New York	New York	7.03	142

Source - Automobile Facts and Figures - 1953



RUSCARDON ENGINEERS 1953

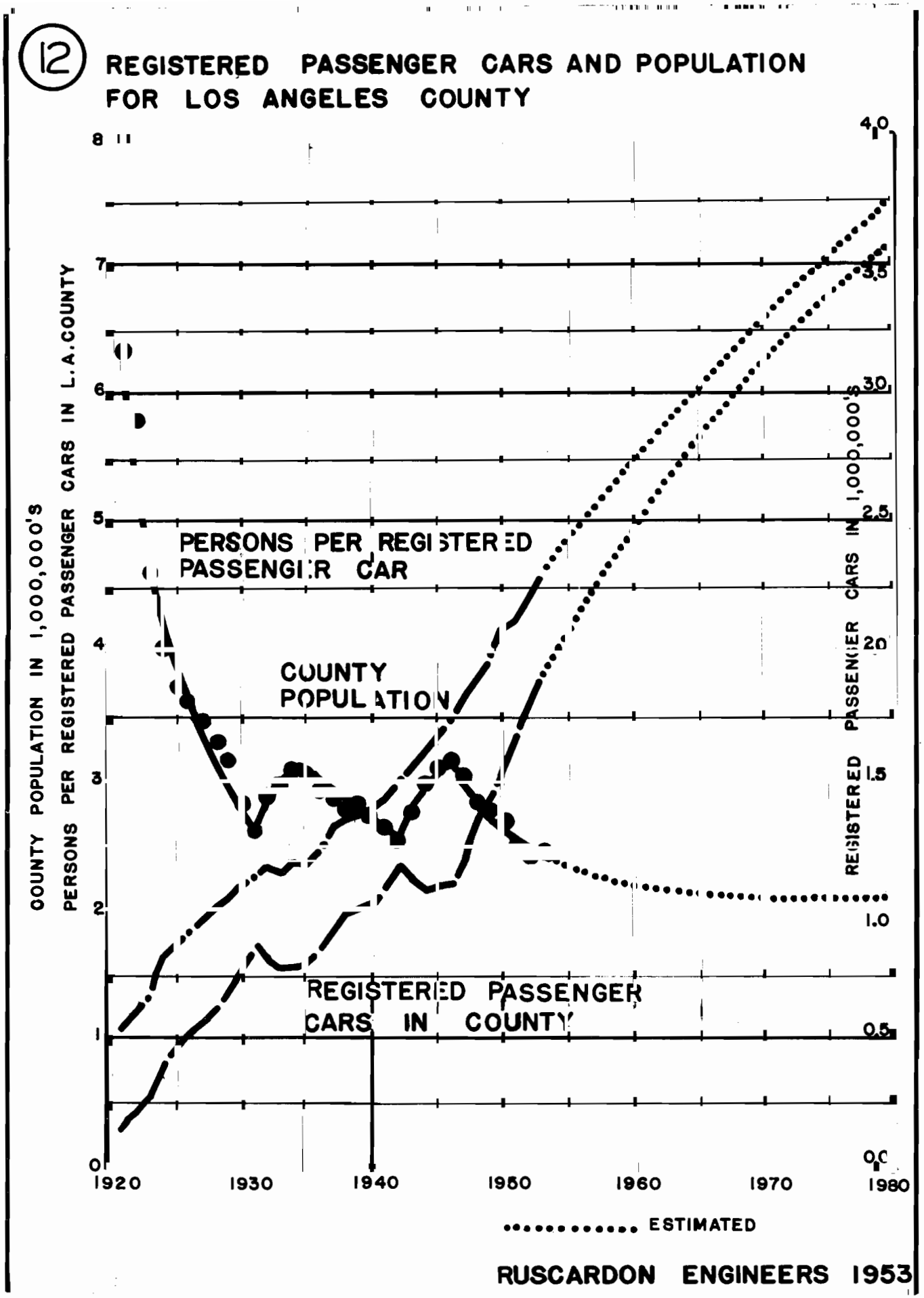

12
REGISTERED PASSENGER CARS AND POPULATION FOR LOS ANGELES COUNTY
COUNTY POPULATION IN 1,000,000'S
PERSONS PER REGISTERED PASSENGER CARS IN L.A.COUNTY
REGISTERED PASSENGER CARS IN 1,000,000'S
PERSONS PER REGISTERED PASSENGER CAR
COUNTY POPULATION
REGISTERED PASSENGER CARS IN COUNTY
0
1
2
3
4
5
6
7
8
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
1920
1930
1940
1950
1960
1970
1980
ESTIMATED
RUSCARDON ENGINEERS 1953

FIGURE NO. 12

PAST, PRESENT AND ESTIMATED FUTURE PASSENGER AUTOMOBILE REGISTRATION IN LOS ANGELES COUNTY 1921 - 1980

Total number of passenger automobiles registered in Los Angeles County have shown a continuous rise since 1921, with the exception of a few years in the early 1930 decade, during the Depression, and also during the early years of World War II, when the number declined slightly.

The number of persons per passenger automobile also continuously declined, except for these two periods, and in 1953 reached a low figure (a high density) of 2.43 persons per car, or 412 passenger automobiles per 1000 County population.

The curve of persons per car, from the trend of the curve following 1946, might have been projected from a high of 3.16 in that year down to around 1.5 in 1980, but it is believed that other factors will come into play, economics, availability of garage accomodations, traffic congestion, which will prevent it from dropping to this low figure. Some reduction can be expected, however, and the curve has been flattened out by 1970 at a figure of 2.1 persons per car. This indicates a total passenger automobile registration of 3,700,000 passenger cars by 1980, about twice the present number.

See Table No. 8

TABLE NO. 8

LOS ANGELES COUNTY PASSENGER CAR REGISTRATION AND POPULATION
1921 - 1953

YEAR	PASSENGER CARS REGISTERED (1)	COUNTY POPULATION (2)	POP'N. PER PASS. CAR (3)	PASSENGER CARS 1000 POP'N. (4)
1921	171624	1092500	6.37	157
22	211000	1229490	5.82	172
23	288000	1336130	4.64	216
24	410000	1648670	4.02	249
1925	465000	1737570	3.74	268
26	506000	1842550	3.64	275
27	560000	1925010	3.43	291
28	601637	2010170	3.34	299
29	654100	2081070	3.18	314
1930	776677	2208492	2.85	352
31	866264	2278580	2.63	381
32	805787	2336060	2.90	345
33	772399	2308870	2.99	334
34	770877	2381080	3.09	324
1935	779915	2389680	3.06	326
36	838983	2453970	2.93	342
37	907223	2609270	2.88	348
38	975392	2718780	2.79	359
39	979974	2738390	2.80	358
1940	1019293	2785643	2.73	366
41	1093290	2866900	2.62	381
42	1174358	2985000	2.54	394
43	1127538	3108100	2.76	362
44	1082809	3221400	2.98	336
1945	1088930	3345900	3.08	326
46	1103914	3486600	3.16	317
47	1196319	3632000	3.04	329
48	1333718	3791900	2.84	352
49	1426073	3954700	2.78	360
1950	1543647	4151687	2.69	372
51	1712545	4250000	2.48	403
52	1816643	4400000	2.42	413
53	e 1895000	4600000	2.43	412

e Estimate

TABLE NO. 8 - CONTINUED

LOS ANGELES COUNTY PASSENGER CAR
REGISTRATION AND POPULATION
1921 - 1953

NOTES:

Col. 1 - Number of Passenger Cars Registered as of January 1st of Year Shown. This figure reflects the total number of Registrations during the previous 12 months period.

Source - California Department of Motor Vehicles

Col. 2 - Estimated County Population as of January 1st of Year Shown, except years of Decennial Census when population is as of April 15th.

Source - Census Years - U. S. Census
Other Years - Research Dept.
Los Angeles Chamber of Commerce

residence without at least a two car garage, as the place would neither be salable nor rentable. Today every sixth family owns two cars, and at the rate that this multiple ownership is increasing, it will not be long before this will be reduced to two cars for every fifth family.

Effect of Improved Transit Facilities upon Density of Passenger Automobile Registration

It is not believed that improved mass rapid transit facilities will have any great effect on this trend in multiple ownership of automobiles. The widespread and increasing decentralization of shopping centers throughout the Metropolitan Area will tend to maintain the trend. Many workers will still use their cars to reach transit stations. Reduction of long distance automobile travel, which the provision of mass rapid transit facilities will tend to encourage, combined with an increase in mileage of freeways, should reduce the present congestion on arterial highways, and encourage their wider use.

Should the family car be left at home, the housewife will find many additional needs for its use. It is the teen-age generation, and those a few years older, however, who are largely responsible for this multiple ownership of cars. These young people have their friends, and the parents have theirs, and the two groups are different and usually live in different localities. Automobiles pass through a number of ownerships today in their total life of 12 to 14 years, and the old age of many of them is spent in the hands of this younger generation.

Week-end travel to recreational areas - mountains, beaches and desert- is very extensive. Seldom do parents and young people go to the same place, and this is a strong argument for the second car in the family.

The strongest argument, however, lies in the fact that passenger

automobile density (expressed as number of such automobiles per 1000 population) varies inversely with population density (expressed as number of residents per acre). As long as this area maintains its low population density, it will maintain its high passenger automobile density.

VI

THE CENTRAL BUSINESS DISTRICT OF LOS ANGELES

Up until about 1920, the Central Business District of Los Angeles, or Downtown Los Angeles, as it is commonly known, was the dominating business center of Metropolitan Los Angeles. Practically all office buildings, all department stores, specialty shops, and other retail stores, except the usual neighborhood stores, were located there.

Such District is normally taken to extend from Sunset Boulevard on the North to Pico Boulevard on the South, and from Figueroa Street on the West to Los Angeles Street on the East, although various other boundaries, closely approximating these, have also been used.

Number of Motor Vehicles Entering Downtown Los Angeles from Past Cordon Counts 1923 - 1950

Table No. 9 presents the results of various cordon counts of motor vehicles entering the Central District, summarized in three groups of Streets on the East and West sides, and into two groups on the North and South sides.

Number of Motor Vehicles Entering Downtown Los Angeles-1950

Figure No. 13 presents in detail the number of motor vehicles entering Downtown Los Angeles in 1950, by streets of entry and departure.

Decentralization in Retail Trade - 1929-1948

In 1920, Los Angeles City had a population of 576,000 and the County of 936,000. By 1930, the City population had increased to 1,238,048 and the County population to 2,208,492. The increase in City population was 662,000 and in County population was 1,272,000. At the same time passenger automobile registration had increased from 171,624 in 1921 to 776,677 in 1930, or by 605,053. No figures are available as to the location of the

TABLE NO. 9

CORDON COUNTS - NUMBER OF MOTOR VEHICLES
ENTERING CENTRAL BUSINESS DISTRICT OF LOS ANGELES

YEAR	NORTH SIDE			EAST SIDE				SOUTH SIDE			WEST SIDE				GRAND
	SEC.1	SEC.2	TOTAL	SEC.3	SEC.4	SEC.5	TOTAL	SEC.6	SEC.7	TOTAL	SEC.8	SEC.9	SEC.10	TOTAL	TOTAL
1923	6414	16051	22465	24622	27188	7608	59418	22640	25906	48540	20468	22559	22756	65823	196246
1929	24200	29780	53980	26600	37696	10595	74891	26760	19200	45960	33286	38195	32800	104281	280112
1931	13193	21163	34356	28917	35386	14510	78803	24997	30467	55464	27302	41542	34749	103593	272216
1936	23250	32603	55853	26550	38787	10703	76040	25664	31350	57014	30384	42104	44200	116688	305595
1939	13190	19080	32270	28780	32970	12750	74500	21890	30937	52827	23513	34470	41500	99483	259080
1941	20527	23556	44083	39154	36904	14308	90726	24471	39042	63513	33752	39714	48542	122008	320330
1947	35783	21451	57184	45673	45894	24615	116182	28372	44628	73000	43304	45878	56976	146158	392524
1950	39234	21720	60954	45893	45035	23323	114251	28630	42878	71508	43354	42922	51848	138179	384892

NOTES:

1923 Count - L.A. Street Traffic Engineering Dept. - Sunset-Pico; Figueroa-Los Angeles

1929 Count - Auto Club of So. Calif. Flower to Los Angeles (W&S sides) Commercial to Pico (E side) Pico to Temple (W side) 16 Hr. Count Figures adjusted to include ommitted streets

1931 Count - L.A. Street Traffic Engineering Dept. Same as 1923 Count

1936 Count - Auto Club of So. Calif. - Same basis as 1929 Count

1939 Count - L.A. Transportation Engineering Board - 12 Hr. Count - 7:00AM - 7:00PM - Same Area as 1923 and 1931 Counts

1941 Count - L.A. County Regional Planning Comm. - 16 Hr. Count - 6:00AM - 10:00PM

1947 Count - L.A. Street Traffic Engineering Dept. - 16 Hr. Count - 6:00AM - 10:00PM

1950 Count - L.A. Street Traffic Engineering Dept. - 16 Hr. Count - 6:00AM - 10:00PM

TABLE NO. 9 - CONTINUED

NOTES:

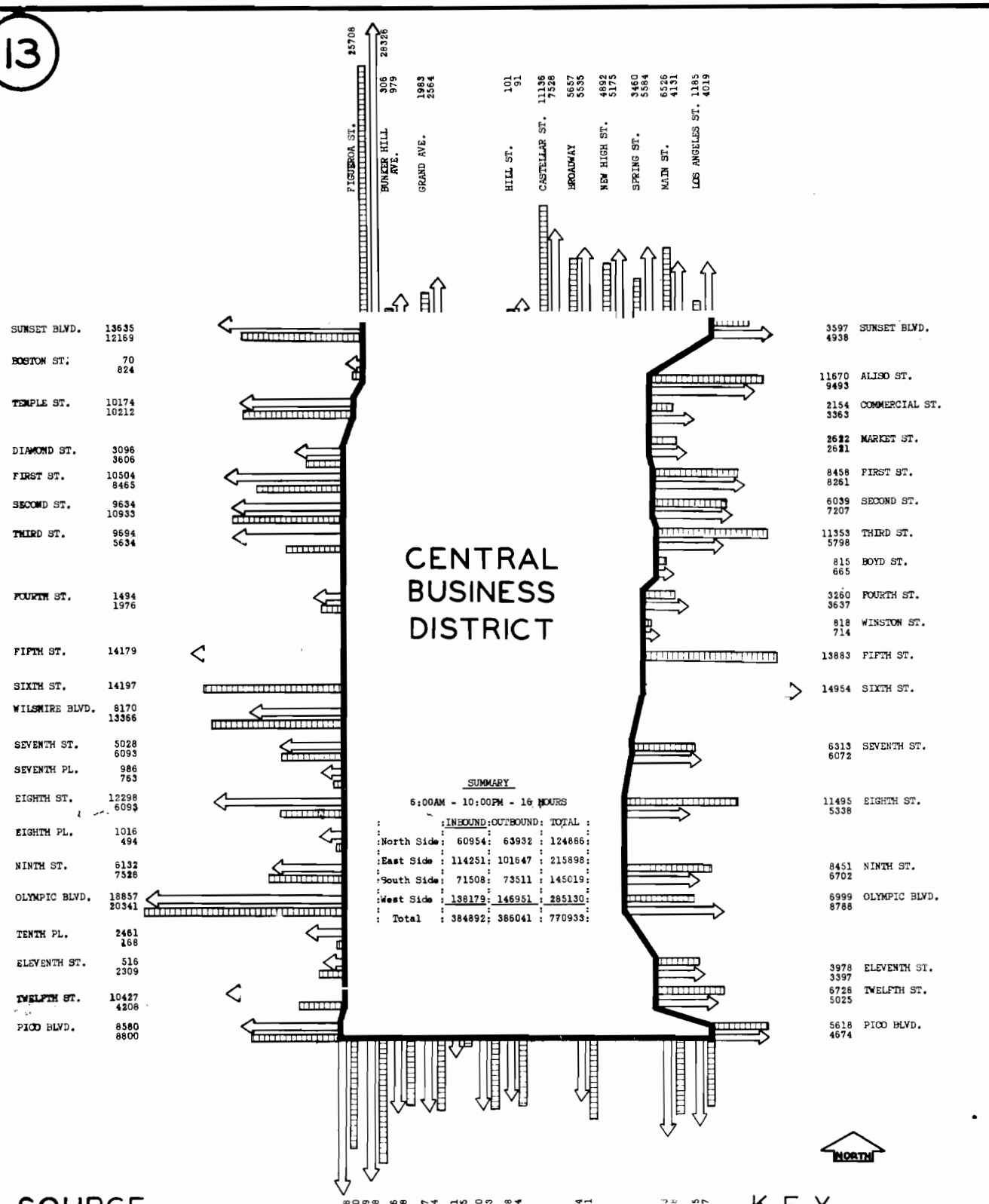
North Side
Section 1 Figueroa through Castelar Street
2 Broadway through Los Angeles Street

East Side
Section 3 Sunset through 3rd Street
4 Boyd through 9th Street
5 Olympic through Pico Street

South Side
Section 6 Los Angeles through Hill Street
7 Olive through Figueroa Street

West Side
Section 8 Pico through 9th Street
9 8th Place through 4th Street
10 3rd through Sunset Boulevard

13



SOURCE

DEPT. OF STREET TRAFFIC ENGINEERING, CITY OF LOS ANGELES

NUMBER OF VEHICLES ENTERING CENTRAL BUSINESS DISTRICT

6:00 A.M. TO 10:00 P.M. ON AVERAGE WEEKDAY - 1950

RUSCARDON ENGINEERS 1953

FIGURE NO. 13

NUMBER OF MOTOR VEHICLES ENTERING THE
CENTRAL BUSINESS DISTRICT OF LOS ANGELES -1950

This is the last complete Cordon Count made of motor vehicles entering the Central Business District of Los Angeles, although some counts have been made on individual streets since 1950. This count was made prior to the opening of the Hollywood or Harbor Freeways to traffic. At the present writing they are not yet open throughout their entire length, but are used to a substantial extent by local traffic. The Hollywood Freeway, since it has been partially opened, has taken a substantial amount of traffic from Sunset Boulevard, Temple, First, Second and even Third Streets.

Figueroa Street carried the largest volume of traffic, both in and outbound, this being essentially traffic from Pasadena and neighboring communities travelling to it over the Arroyo Seco Freeway. Olympic Boulevard carries traffic from Santa Monica and Western Los Angeles directly into the lower part of Downtown Los Angeles. At this date, Fifth and Sixth Streets were one-way streets, and recently Eighth and Ninth Streets have been made one-way.

The heavy traffic along the East and West sides of the area is due not alone to the greater length of these sides, but likewise to the fact that a great deal of through traffic moves in this direction, between residential areas to the West and wholesale and industrial areas to the East of the Central Business District. A study made in 1939 indicated that 35 per cent of the traffic entering the Central Business District in an East and West direction moved directly across it without stopping. Eliminating this percentage of through moving vehicles, from entering and leaving traffic, the number of vehicles entering and leaving across the East and West boundaries, in spite of the far greater length of the latter, is but about 10 per cent greater than those entering and leaving on the North and South sides.

increase in areal population between 1920 and 1930, but it undoubtedly occurred in peripheral areas. Distances had become great, traffic congestion had increased and decentralization of trade was under way.

The trend in this decentralization is shown in Table No. 10, the Major Economic Areas being indicated on Figure No. 14.

Another significant fact in connection with the decentralization of Downtown Los Angeles is the fact that but three office buildings have been constructed in Downtown Los Angeles since 1930, all in recent years, while many older buildings have been torn down to make way for parking facilities.

Number of Persons Entering Downtown Los Angeles
During an Average Week Day 1924 to 1980

From the cordon counts of motor vehicle traffic made between 1924 and 1950, from scattered data as to persons per passenger automobile, and from other scattered traffic counts, as well as from data supplied by the Pacific Electric Railway and the Los Angeles Transit Lines, it has been possible to estimate the number of persons entering Downtown Los Angeles during a 12-hour week day at various times between 1924 and 1953.

When these numbers of persons entering were expressed as the numbers per 1000 County population at each date, a trend curve developed which allowed a projection of the number entering per 1000 County population up to the year 1980.

If present conditions as to transportation and parking facilities continue it can then be assumed that Downtown Los Angeles has become stabilized. Every available vacant parcel of land not occupied by a building is used for a parking lot, and a number of parking garages have been constructed and are heavily used. The only manner by which parking capacity in the area can be increased will be to construct more parking garages, and/or to tear down more existing buildings and convert the area that they occupy to parking lots or garages.

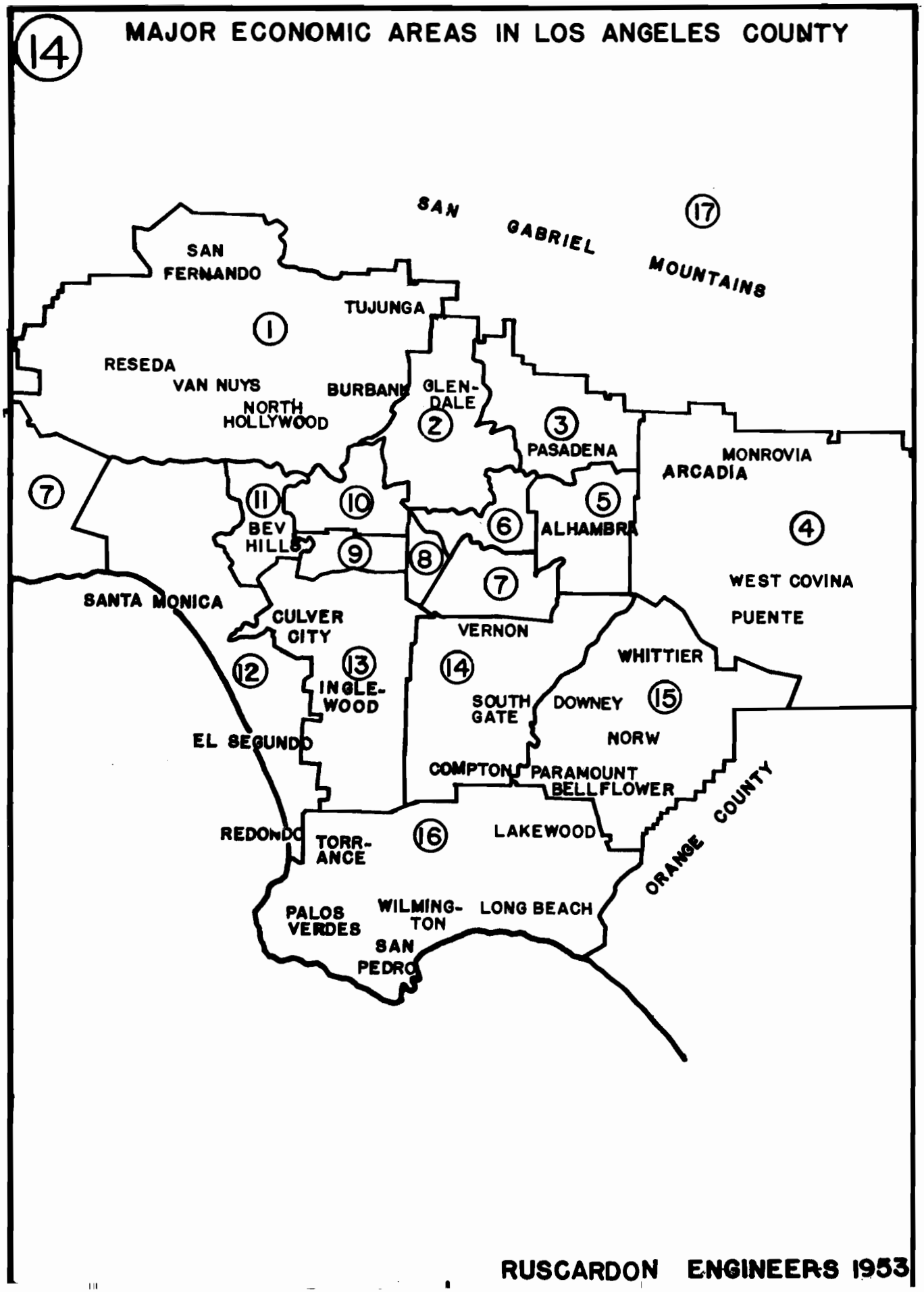

14
MAJOR ECONOMIC AREAS IN LOS ANGELES COUNTY
SAN GABRIEL MOUNTAINS
17
SAN FERNANDO
TUJUNGA
1
RESEDA
VAN NUYS
BURBANK
GLEN-DALE
NORTH HOLLYWOOD
2
3
PASADENA
MONROVIA
ARCADIA
7
11
10
5
BEV HILLS
6
ALHAMBRA
4
9
8
7
WEST COVINA
SANTA MONICA
CULVER CITY
VERNON
PUENTE
12
13
14
WHITTIER
INGLE-WOOD
SOUTH GATE
DOWNEY
15
EL SEGUNDO
NORW
COMPTON
PARAMOUNT
BELLFLOWER
ORANGE COUNTY
REDONDO
TORR-ANCE
16
LAKEWOOD
PALOS VERDES
WILMING-TON
LONG BEACH
SAN PEDRO
RUSCARDON ENGINEERS 1953

FIGURE NO. 14

MAJOR ECONOMIC AREAS - LOS ANGELES COUNTY

This map locates the Major Economic Areas within the County for which volume of Retail Sales are shown in Table No. 10.

Data presented in this Table emphasizes the extent to which decentralization of Retail Trade has taken place since 1929 in Los Angeles County. In that year, out of every $ 1.00 spent in Retail Sales in the County almost 30¢ was spent in Downtown Los Angeles, while in 1948, this 30¢ had dropped to slightly more than 11¢.

The Northeast, East, Central, including Downtown Los Angeles, Hollywood, and the balance of the County, all had lost their relative positions as retail trading centers between 1929 and 1948.

Downtown Los Angeles, as considered in these figures, extends from Temple Street southerly to Jefferson Boulevard, while normally it is considered to extend from Sunset Boulevard southerly to Pico Boulevard. Volume of trade between Temple and Sunset, and between Pico and Jefferson is relatively small.

See Table No. 10

TABLE NO. 10

TOTAL RETAIL SALES - LOS ANGELES COUNTY
BY MAJOR ECONOMIC AREAS

AREA	LOCATION	TOTAL RETAIL SALES $000 OMITTED 1929	1933	1935	1939	1948	% INCR. 1929 48
1	San Fernando Valley	28217	14818	25096	53138	324547	1050
2	Glendale	46463	27426	37692	62927	200891	333
3	Pasadena	60146	28808	45003	59718	211339	234
4	Pomona - Foothill	32845	16519	24000	42737	207850	532
5	Alhambra	23088	12831	21015	34625	123451	434
6	Northeast	40596	24402	37820	39415	106909	163
7	East	76766	34345	41148	86085	247230	223
8	Central	441792	196608	235803	256932	629723	42.5
8a	Downtown Los Angeles	381046	165758	205302	223071	505240	32.7
9	Wilshire	46750	39378	56167	87635	305169	553
10	Hollywood	87315	44802	70061	100142	256140	193
11	Beverly Hills-Westwood	15423	8370	21991	44738	158811	930
12	Santa Monica Bay	42260	21632	33790	54181	225886	435
13	Adams - Inglewood	97835	56778	83452	137556	515923	428
14	Southeast	65029	39771	58893	104273	406055	525
15	Whittier - Norwalk	11882	4426	7534	25481	127012	970
16	South Coast	106305	57225	86632	116278	429592	304
17	Balance of County	64692	31962	56006	8589	35733	-45
	Total Los Angeles Co.	1287304	660101	942103	1314450	4512261	251
	% 1929 Sales	100.0	51.4	73.3	102.0	350.5	

TABLE NO. 10 - CONTINUED

% OF COUNTY TOTAL

AREA	LOCATION	PER CENT OF COUNTY TOTAL 1929	1933	1935	1939	1948
1	San Fernando Valley	2.2	2.2	2.7	4.0	7.2
2	Glendale	3.6	4.2	4.0	4.8	4.5
3	Pasadena	4.7	4.4	4.8	4.5	4.7
4	Pomona - Foothill	2.6	2.5	2.6	3.3	4.6
5	Alhambra	1.8	1.9	2.2	2.6	2.7
6	Northeast	3.2	3.7	4.0	3.0	2.4
7	East	6.0	5.2	4.4	6.5	5.5
8	Central	34.3	29.8	25.0	19.5	14.0
8a	Downtown Los Angeles	29.6	25.1	21.8	17.0	11.2
9	Wilshire	3.6	6.0	6.0	6.7	6.8
10	Hollywood	6.8	6.8	7.4	7.6	5.7
11	Beverly Hills-Westwood	1.2	1.3	2.3	3.4	3.5
12	Santa Monica Bay	3.3	3.3	3.6	4.1	5.0
13	Adams - Inglewood	7.6	8.6	8.9	10.5	11.4
14	Southeast	5.1	6.0	6.3	7.9	9.0
15	Whittier - Norwalk	0.9	0.7	0.8	1.9	2.8
16	South Coast	8.3	8.7	9.2	8.8	9.5
17	Balance of County	5.0	4.8	5.9	0.7	0.8
	Total Los Angeles Co.	100.0	100.0	100.0	100.0	100.0

Source -
Research Department - Security First National Bank of Los Angeles

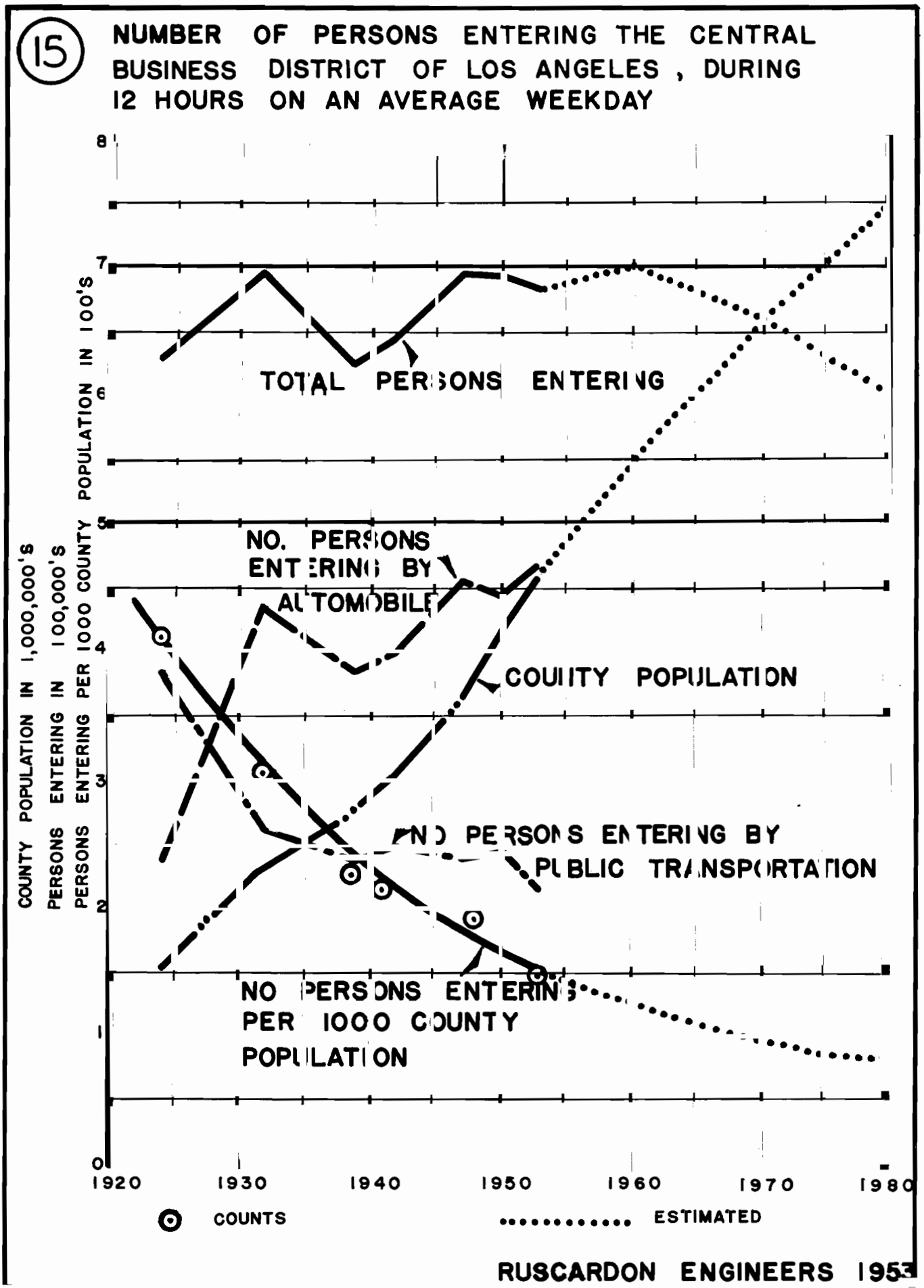

15
NUMBER OF PERSONS ENTERING THE CENTRAL BUSINESS DISTRICT OF LOS ANGELES, DURING 12 HOURS ON AN AVERAGE WEEKDAY
COUNTY POPULATION IN 1,000,000'S
PERSONS ENTERING IN 100,000'S
PERSONS ENTERING PER 1000 COUNTY POPULATION IN 100'S
TOTAL PERSONS ENTERING
NO. PERSONS ENTERING BY AUTOMOBILE
COUNTY POPULATION
NO PERSONS ENTERING BY PUBLIC TRANSPORTATION
NO PERSONS ENTERING PER 1000 COUNTY POPULATION
0
1
2
3
4
5
6
7
8
1920
1930
1940
1950
1960
1970
1980
COUNTS
ESTIMATED
RUSCARDON ENGINEERS 1953

FIGURE NO. 15

NUMBER OF PERSONS ENTERING THE CENTRAL BUSINESS DISTRICT
OF LOS ANGELES DURING 12 HOURS ON AN AVERAGE WEEK DAY
1924 to 1980

This Figure is presented in connection with Table No. 11, which is based upon available cordon counts and other traffic counts adjacent to the Central District, upon data from the Pacific Electric Railway and the Los Angeles Transit Lines, and from a 1944 Report of the Los Angeles County Regional Planning Commission.

The curve expressing total number of persons entering the Central District per 1000 total County population shows a very definite downward trend. In 1924, the number entering was equal to 413 per 1000 County population. At the present time this number has dropped to 152 per 1000, and by 1980 it is estimated that it will be about 80 per 1000. This last figure, naturally, is based upon the assumption that transportation and parking facilities remain at about what they are today.

A further interesting fact, based upon this projection and upon estimated future County population, is that there have not been, nor will there be - up to 1980 - less than 600,000 nor more than 700,000 persons entering the Central District daily, and that in 1980, there will be fewer persons entering such District daily than have entered it since 1924, when County population was slightly in excess of 1,500,000 persons.

See Table No. 11

TABLE NO. 11

NUMBER OF PERSONS ENTERING THE CENTRAL BUSINESS DISTRICT OF LOS ANGELES DURING AN AVERAGE 12 HOUR WEEK DAY

DATE	PERSONS ENTERING			POPULATION LOS ANGELES COUNTY	PERSONS ENTERING PER 1000 POPULATION
	BY AUTO	BY PUBLIC TRANSP'N.	TOTAL ENTERING		
1924 Jan. 1	239855	383145	623000	1509318	413
1931 Dec. 1	434986	262256	697242	2273670	307
1938 Fall	384788	239512	624290	2730900	228
1941 Fall	396493	246440	642933	2995743	214
1947	455000	240500	695500	3632000	192
1950	446000	247450	693450	4151687	167
1953	470000	211300	681300	4600000	148
1960			700000	5500000	128
1970			660000	6600000	100
1980			600000	7500000	80

1960 - 1970 - 1980 - Estimated

Cordon bounded by Sunset Blvd., Los Angeles St., Pico Blvd., Figueroa St.

Figures fo 1924, 1931, 1938 and 1941 - Reports on Business Districts, L.A. County Regional Planning Comm.

Figures for 1947, 1950 and 1953 are estimates, based upon adjusted Motor Vehicle Cordon Counts, and data furnished by Pacific Electric Company and Los Angeles Transit Lines.

All Cordon Counts adjusted to a 12 hour basis

Factor of 1.45 persons per auto used with Cordon Counts to develop number of persons entering by automobile

VII

TRAFFIC

Increase in Motor Vehicle Traffic - 1948 to 1953

Up until the 1930-1940 decade, traffic patterns in the Metropolitan Los Angeles Area were primarily radial in direction, like the spokes of a wheel. Since that time, decentralization of business, extension of the populated area and increased industrialization in outlying sections, particularly since the early 1940's,have resulted in a substantial increase in circumferential traffic.

Many automobile riders who formerly drove through the Central District from one side of the Metropolitan Area to the other now drive around it. Morning and evening peaks made up of industrial workers are creating conditions which are approaching, if not reaching congestion. Plate IV presents the traffic flow-in both directions-on certain State and other highways in the area for the year 1948, and-in a different color,- the increase in such traffic during the five year period 1948 to 1953.

The shortage of passenger automobiles, created by cessation of production during World War II, had not been eliminated by 1948, there being 1,333,718 passenger automobiles registered in Los Angeles County in that year. This number had increased to 1,895,000 or 42.2 per cent by 1953. While population of the County had only increased by 22.5 per cent during this 5-year period. While in future years, the increase in number of passenger automobiles may be expected to follow more closely the increase in population, decentralization of the latter may be expected to cause a substantial increase in this circumferential traffic, unless provision is made to handle a considerable amount of such traffic on mass rapid transit facilities.

Southbound Passenger Automobiles and Passengers
Travelling over Cahuenga Pass - July 1953
From 6:00AM to 10:00PM

This count, made in connection with the annual traffic count of the California Highway Commission, was primarily to determine car riding habits, from which the number of persons leaving the San Fernando Valley during a 16-hour day could be estimateed. Because the Freeway over Cahuenga Pass is not as yet connected with the Hollywood Freeway-although such connection is expected to occur early in 1954-it was not possible to determine the proportion of these passengers coming from the Valley who travelled directly to Downtown Los Angeles, and those who followed a circumferential route around this area to points on the opposite side, or who travelled southerly or westerly from Hollywood.

Distribution of Rail and Vehicular Travel over 24 Hours

Transit riding habits, shown on Figure No. 17, are typical of those in large Metropolitan Areas in this Country, except that morning and evening peaks are sharper and mid-day and evening traffic is smaller, these characteristics being undoubtedly due to the high passenger automobile registration and decentralization of retail trade.

Freeway Construction Program

Figure No. 18 shows the present state of Freeway development in Metropolitan Los Angeles, and probable rate of future Freeway construction under present methods of financing. The present system of financing highways, based upon State collected gasoline and user taxes, with some Federal allocations, with these revenues being allocated to Cities, Counties and the State system according to a formula, has been in effect for three decades.

This system operated very well while the number of registered motor vehicles was relatively small, but today, when freeway construction is

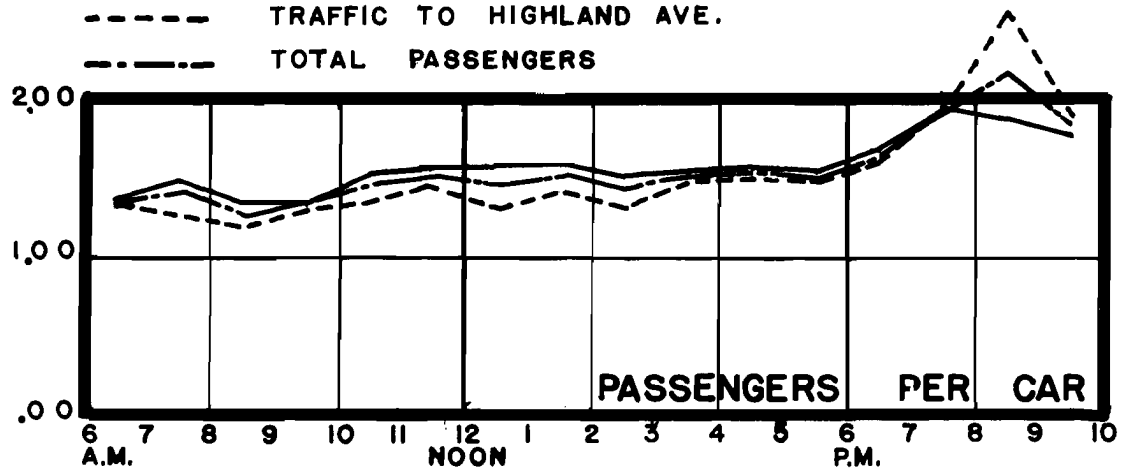
16

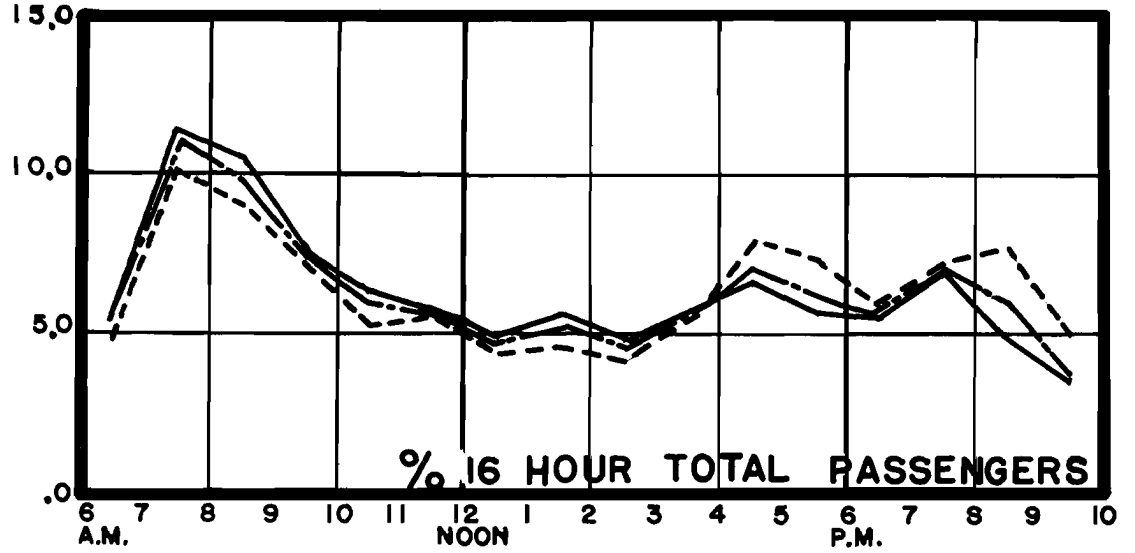
SOUTH BOUND PASSENGERS AND PASSENGER CARS OVER CAHUENGA PASS

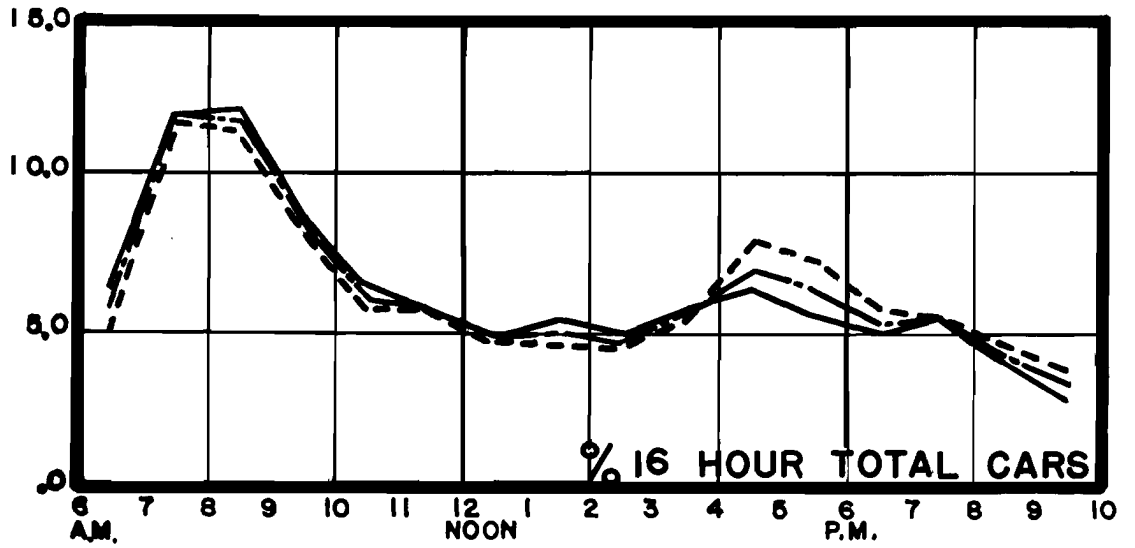
TRAFFIC TO CAHUENGA

TRAFFIC TO HIGHLAND AVE.

TOTAL PASSENGERS







RUSCARDON ENGINEERS 1953

FIGURE NO. 16

DATA PERTAINING TO SOUTHBOUND PASSENGER CARS AND PASSENGERS TRAVELLING OVER CAHUENGA PASS DURING THE PERIOD 6:00AM to 10:00PM, JULY 1953

This Figure presents some of the data given in Table No. 12. A portion of the passenger automobiles travelling southbound over Cahuenga Pass continue directly down Highland Avenue to and through Hollywood, while the remainder travel easterly to the eastern section of Hollywood and beyond, via Cahuenga Boulevard. The Hollywwod Freeway is not yet connected to the Freeway through the Pass

Of a total of 47,658 passenger cars travelling southbound over the Pass, 29,289, or 61.5 per cent, travelled via Cahuenga Boulevard, and 18,369, or 38.5 per cent, passed down Highland Avenue. Of the total of 70,797 passengers, 44,434 or 62.8 per cent travelled via Cahuenga Boulevard, and 26,363, or 37.2 per cent, travelled down Highland Avenue.

Passengers per car started out at slightly over 1.3 in early morning hours, and gradually increased to around 1.5 by 6:00PM, and then increased fairly rapidly until 9:00PM, after which time they dropped off in number. Between 7:00 and 9:00AM, 20.9 per cent of the total passengers moved, and between 7:00 AM and 10:00AM, this proportion was 29.7 per cent, or a total of 50.6 per cent of the total 16 hour traffic in these 5 hours. The slight evening peak, between 4:00 and 6:00PM, is apparently made up of persons working in the San Fernando Valley and living south of the Pass, while the later peak between 7:00 and 9:00PM, is probably made up of pleasure seekers coming to Hollywood, and of persons travelling to Los Angeles from distant points in the northern or central part of the State.

See Table No. 12

TABLE NO. 12

SOUTHBOUND PASSENGER CARS AND PASSENGERS OVER CAHUENGA PASS

PERICD	TO CAHUENGA AVENUE					TO HIGHLAND AVENUE					TOTAL SOUTHBOUND TRAFFIC				
	PASS. CARS		PASSENGERS		PASS.	PASS. CARS		PASSENGERS		PASS.	PASS. CARS		PASSENGERS		PASS.
	NO.	% TOTAL	NO.	% TOTAL	PER CAR	NO.	% TOTAL	NO.	% TOTAL	PER CAR	NO.	% TOTAL	NO.	% TOTAL	PER CAR
6-7AM	1868	6.4	2510	5.6	1.34	943	5.1	1221	4.6	1.30	2811	5.9	3731	5.3	1.33
7-8AM	3498	11.9	5081	11.4	1.45	2133	11.6	2670	10.1	1.25	5631	11.8	7751	11.0	1.38
8- 9AM	3510	12.0	4609	10.4	1.31	2072	11.3	2406	9.1	1.16	5582	11.7	7015	9.9	1.26
9-10AM	2489	8.5	3323	7.5	1.33	1494	8.1	1891	7.2	1.27	3983	8.2	5214	7.4	1.31
10-11AM	1863	6.4	2792	6.3	1.50	1025	5.6	1350	5.1	1.32	2888	6.1	4142	5.9	1.43
11-12AM	1648	5.6	2545	5.7	1.54	1021	5.6	1437	5.4	1.41	2669	5.6	3982	5.6	1.49
12-1PM	1429	4.9	2186	4.9	1.53	868	4.7	1094	4.2	1.26	2297	4.8	3280	4.6	1.43
1-2PM	1538	5.2	2439	5.5	1.58	830	4.5	1165	4.4	1.40	2368	5.0	3604	5.1	1.52
2-3PM	1412	4.8	2098	4.7	1.49	820	4.4	1054	4.0	1.29	2232	4.7	3152	4.5	1.41
3-4PM	1630	5.6	2486	5.6	1.52	986	5.4	1418	5.4	1.44	2616	5.5	3904	5.5	1.49
4-5PM	1827	6.2	2871	6.5	1.57	1411	7.7	2067	7.9	1.46	3238	6.8	4938	7.0	1.52
5-6PM	1594	5.4	2445	5.5	1.53	1292	7.0	1894	7.2	1.47	2886	6.1	4339	6.1	1.50
6-7PM	1422	4.9	2384	5.4	1.68	1019	5.6	1531	5.8	1.50	2441	5.1	3915	5.5	1.61
7-8PM	1598	5.5	3073	6.9	1.92	986	5.4	1857	7.1	1.88	2584	5.4	4930	7.0	1.90
8-9PM	1137	3.9	2142	4.8	1.88	784	4.3	2011	7.6	2.57	1921	4.1	4153	5.9	2.16
9-10PM	826	2.8	1450	3.3	1.75	685	3.7	1297	4.9	1.89	1511	3.2	2747	3.7	1.82
Totals	29289	100.0	44434	100.0	1.46	18369	100.0	26363	100.0	1.44	47658	100.0	70797	100.0	1.49

TABLE NO. 12 CONTINUED

S U M M A R Y

PERIOD	TO CAHUENGA AVENUE					TO HIGHLAND AVENUE					TOTAL SOUTHBOUND TRAFFIC				
	PASS. CARS		PASSENGERS		PASS.	PASS. CARS		PASSENGERS		PASS.	PASS. CARS		PASSINGERS		PASS.
	NO.	% TOTAL	NO.	% TOTAL	PER CAR	NO.	% TOTAL	NO.	% TOTAL	PER CAR	NO.	% TOTAL	NO.	% TOTAL	PER CAR
6-7AM	1868	6.4	2510	5.6	1.34	943	5.1	1221	4.6	1.30	2811	5.9	3731	5.3	1.33
7-9AM	7008	23.9	9690	21.8	1.38	4205	22.9	5076	19.2	1.21	11213	23.5	14766	20.9	1.32
7-10AM	9497	32.4	13013	29.3	1.37	5699	31.0	6967	26.4	1.22	15196	31.7	19980	28.3	1.31
10A-4PM	9520	32.5	14546	32.7	1.53	5550	30.2	7518	28.5	1.35	15070	31.7	22064	31.2	1.47
10A-5PM	11347	38.7	17417	39.2	1.53	6961	39.7	9585	36.4	1.38	18308	38.5	27002	38.2	1.48
4P-8PM	6441	22.0	10773	24.3	1.67	4708	25.7	7349	28.0	1.56	11149	23.4	18122	25.6	1.63
5P-8PM	4614	15.8	7902	17.8	1.71	3297	18.0	5282	20.1	1.60	7911	16.6	13184	18.6	1.85
8P-10PM	1963	6.7	3592	8.1	1.83	1469	8.0	3308	12.5	2.25	3432	7.3	6900	9.6	2.01

NOTES:

Southbound Cars and Passengers to Cahuenga - Monday, July 20, 1953 - 6:00AM to 10:00PM by Ruscardon Eng.

Southbound Passengers to Highland - Monday, July 13, 1953 - 6:00AM to 8:00PM by Ruscardon Engineers

Southbound Passengers and Cars to Highland - Monday August 10, 1953 - 8:00PM to 10:00PM by Ruscardon Engineers

Southbound Cars to Highland - Monday, July 13, 1953 - 6:00AM to 8:00PM by State Highway Department

FIGURE NO. 17

HOURLY DISTRIBUTION OF VEHICULAR AND TRANSIT PASSENGER TRAVEL OVER 24 HOURS

This graph, based upon data given in Table No. 13, shows hourly distribution of passenger and vehicular travel on the lines of the Pacific Electric Railway, the Los Angeles Transit Lines, and on the Hollywood and Arroyo Seco Freeways.

The morning peak transit travel, between 7:00 and 9:00AM, accounts for 23.5 per cent of the total 24 hour passengers on the Pacific Electric Railway, and for 19.3 per cent on the Los Angeles Transit Lines, with the evening peak, between 4:00 and 6:00PM accounting for 25.7 per cent of the total 24 hour passengers on the Pacific Electric Railway, and for 22.5 per cent on the Los Angeles Transit Lines. Thus, these four peak hours account for travel of 49.2 per cent of the total passengers on the Pacific Electric Railway and for 41.8 per cent of the total passengers on the Los Angeles Transit Lines.

Travel during offpeak hours, during the middle of the day and after 6:00PM is heavier on the Los Angeles Transit Lines than on the Pacific Electric Railway, and this accounts, at least to a considerable extent, for the fact that travel peaks on the Pacific Electric Railway are somewhat higher than those on the Los Angeles Transit Lines, when expressed in terms of total 24 hour passenger travel.

TABLE NO. 13

HOURLY DISTRIBUTION OF PASSENGER AND VEHICULAR TRAVEL

TIME	PAC. ELEC. RY. % of TOTAL PASSENGERS		L.A. TRAN. LINES % OF TOTAL PASSENGERS		VEHICLES % OF TOTAL ON FREEWAYS	
	24 Hrs. 6-6AM	16 Hrs. 6A-10PM	24 Hrs. 6-6AM	16 Hrs. 6A-10PM	24 Hrs. 6-6AM	16 Hrs. 6A-10PM
6- 7AM	4.0	4.2	4.0	4.2	3.3	3.7
7- 8AM	13.8	14.4	11.8	12.5	8.4	9.4
8- 9AM	9.7	10.1	7.5	7.9	7.5	8.4
9-10AM	4.7	4.9	4.4	4.7	5.5	6.2
10-11AM	4.2	4.4	4.7	5.0	4.5	5.1
11-12AM	4.0	4.2	5.2	5.5	4.6	5.2
12- 1PM	4.0	4.2	4.8	5.1	4.6	5.2
1- 2PM	3.8	4.0	5.1	5.4	4.5	5.1
2- 3PM	4.1	4.2	5.2	5.5	4.9	5.5
3- 4PM	6.0	6.3	6.0	6.4	6.0	6.7
4- 5PM	11.7	12.2	10.6	11.2	8.3	9.3
5- 6PM	14.0	14.6	11.9	12.6	9.8	11.0
6- 7PM	6.0	6.3	5.5	5.8	6.8	7.6
7- 8PM	2.3	2.4	2.9	3.1	4.2	4.7
8- 9PM	1.8	1.9	2.5	2.7	3.1	3.5
9-10PM	1.6	1.7	2.3	2.4	3.0	3.4
10-11PM	1.3		1.6		3.2	
11-12PM	1.0		1.4		3.4	
12- 1AM	0.7		0.9		1.7	
1- 2AM	0.3		0.3		0.8	
2- 3AM	0.1		0.2		0.4	
3- 4AM	0.1		0.1		0.3	
4- 5AM	0.1		0.2		0.4	
5- 6AM	0.7		0.9		0.8	
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0

Source -
Research Department- Pacific Electric Company -
January 28, 1953

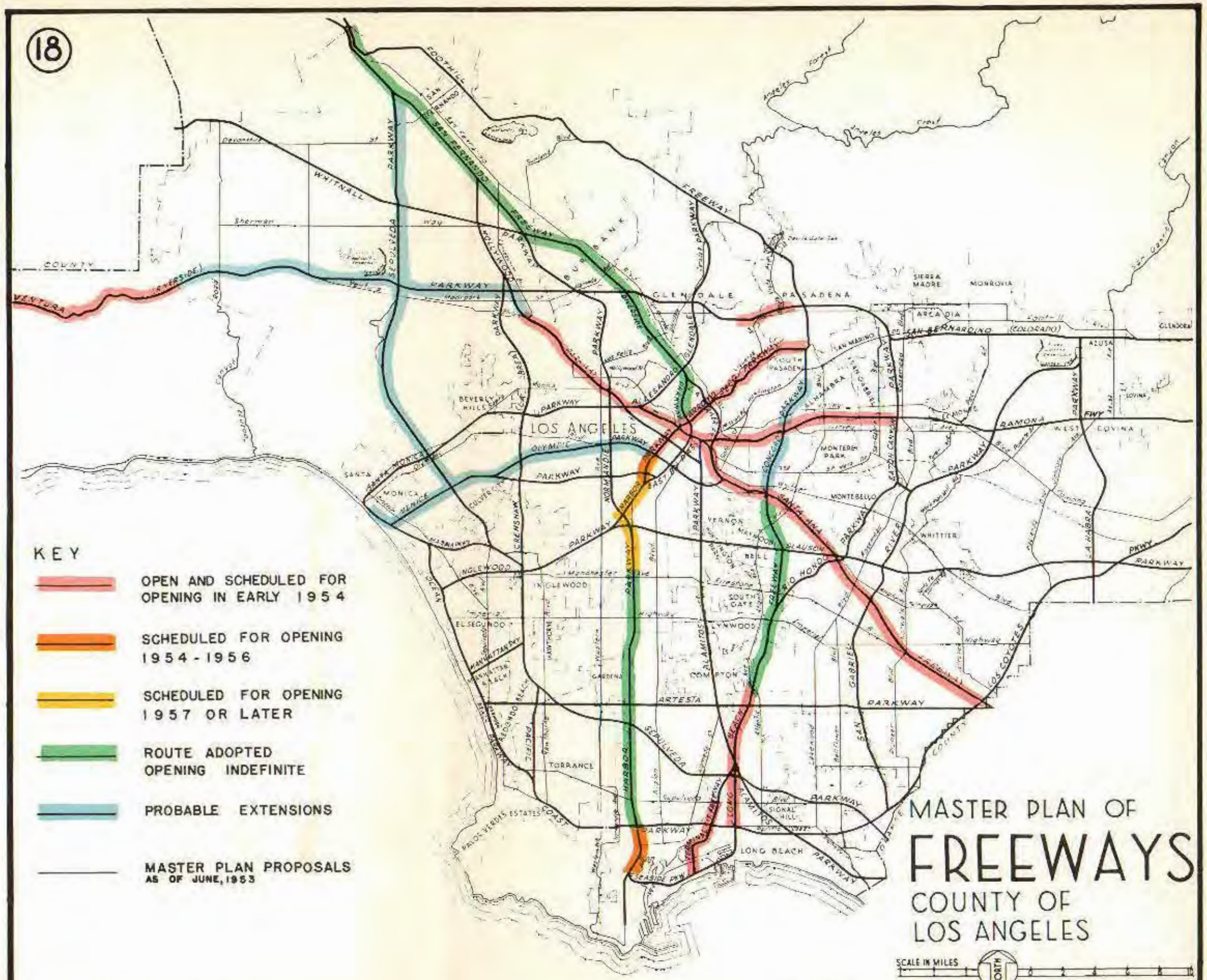
essential, particularly in the Metropolitan Areas of the State, and with the extremely high cost of such Freeways compared with costs of arterial highways, it has not provided sufficient funds annually to allow such freeway construction to keep pace with the increasing demands of motor vehicle traffic for them.

An effort was made in the 1953 State Legislature to provide a large bond issue, debt service upon which would have been met from future gasoline and user taxes, in order to accelerate freeway construction in Metropolitan Areas, as well as to make up deficiencies in other highways, which was not successful. Another bill creating a Freeway Authority for Metropolitan Los Angeles, which would have imposed local gasoline and possibly other taxes, using such revenues for debt service on a large bond issue, to be likewise used for accelerating local Freeway construction, failed of passage.

It is the opinion of the writer, as stated in the Foreword of this Report, that, irrespective of whether the proposed rail facilities are constructed, some method of financing Freeway construction in Metropolitan Los Angeles, which will allow early completion of a Freeway network adequate to care for present traffic and which will allow such a network to keep pace with increasing population and motor vehicle registration, is an urgent necessity.

Such Freeway network will be needed particularly to serve those areas where present population densities are low and travel patterns are not now, nor will be for some time in the future, of a character to provide sufficient revenues to support rail mass rapid transit, until such time as densities and travel patterns in these areas will provide such support.

(18)



KEY

- OPEN AND SCHEDULED FOR OPENING IN EARLY 1954
- SCHEDULED FOR OPENING 1954 - 1956
- SCHEDULED FOR OPENING 1957 OR LATER
- ROUTE ADOPTED OPENING INDEFINITE
- PROBABLE EXTENSIONS
- MASTER PLAN PROPOSALS AS OF JUNE, 1953

MASTER PLAN OF FREEWAYS COUNTY OF LOS ANGELES

SCALE IN MILES

NORTH

RUSCARDON ENGINEERS · 1953

THE REGIONAL PLANNING COMMISSION - COUNTY OF LOS ANGELES

FIGURE NO. 18

PRESENT AND FUTURE STATUS OF FREEWAY DEVELOPMENT

The following indicate briefly the present and future status of Freeway development in Metropolitan Los Angeles, during the next few years.

HARBOR FREEWAY - Now open to Sixth Street. Section from Sixth to Olympic Boulevard scheduled to open in early 1954, Section to 23rd Street under contract, scheduled to open about the middle of 1955. Construction bids to Exposition Boulevard to be advertised early in 1954, with this section to be opened in the middle of 1956. Construction bids to Gage Avenue to be advertised in latter part of 1954, with opening of this section early in 1957. Southern end from Lomita Boulevard to Battery Street, San Pedro, to be advertised for bid in early 1954, and opened for use the latter part of 1956. Right-of-way acquired on all remaining sections. Construction to proceed as funds become available.

LOS ANGELES RIVER FREEWAY - Completed north of 223rd Street. Under construction to south crossing of Atlantic Boulevard. Right-of-way being acquired north to Olympic Boulevard, with section from Washington Boulevard to Olympic Boulevard scheduled for initial construction.

HOLLYWOOD - RAMONA CONNECTION- Aliso-Alameda Street underpass scheduled for opening the end of 1953. Vignes Street separation to be completed about the end of 1954.

HOLLYWOOD FREEWAY - Completion of section through Cahuenga Pass scheduled for completion early in 1954. Extension westerly to Ventura Boulevard probable. Extension north to San Fernando less probable.

GENERAL COMMENTS - Riverside Parkway route adopted, San Fernando to Arroyo Seco. Extension of Riverside Parkway from Arroyo Seco southerly to Ramona and Santa Ana Parkways, with Olympic Freeway, thence westerly to Santa Monica appears likely. Santa Monica Parkway through Beverly Hills appears unlikely. Sepulveda Parkway route adopted but time of initiation of construction indefinite.

VIII

ORIGIN AND DESTINATION STUDY

In an investigation of this character it becomes necessary to secure information as to the location of residence and place of employment of potential passengers who might ride a transit facility to be constructed, and also as to their movement and pattern.

Location of Industry

Plate II shows the location of land now occupied by industry. It will be noted that such industry is located in the area extending from the southeastern portion of Los Angeles in a southerly direction. That this general locational trend will in all probability continue in the future is indicated by the location of land now zoned for industrial purposes. Naturally, some scattering of industrial use may be expected, but the pattern has been set for this continuation, by the location of existing industrial uses and the zoning of land for expansion of these uses.

Other considerations will likewise influence the continuation of this trend, proximity of rail lines and highways, and of the Ports of Long Beach and Los Angeles, available water supply, and, with provision of adequate transportation facilities, an adequate labor supply.

Persons Included in Study

Because of the availability of information, the present study was limited primarily to employees of industry, with the exception of Postal Zones 12, 13, 14, 15 and 17, these being Downtown Los Angeles, and 28, Hollywood. In the aforementioned Zones the employees included those working in the retail stores, hotels, etc., and also occupants of office buildings. All persons covered in this study are employed and therefore constitute the major portion of the potential traffic during the morning and evening peak hours.

Industrial Establishments Included in Study

The Los Angeles Chamber of Commerce in 1952 published a Directory of all industrial establishments in Los Angeles County, employing 25 or more persons, giving the street address and Postal Zone of each industry or plant in the County. These industries were classified-as to number of employees into the following groups-25 to 49 employees; 50 to 99 employees; 100 to 249 employees; 250 to 499 employees; and 500 or more employees. The total industrial employees in each Zone were estimated by taking the average number employed in each group and multiplying such number by the number of plants listed in each Zone in each group. For example, in the group employing between 25 and 49 employees, it was assumed that average number employed was 37. This number was multiplied by the number of plants in the Zone in this group to secure the number of estimated industrial employees in that Zone.

This method is considered statistically sound, as the number of firms in each group was large. The number of employees in those firms employing in excess of 500 persons was in most instances secured directly from the employer, and in the few instances where such information was not available, the number was taken as the average number of employees per firm in the 500 or more group.

Procedure Used in Securing Employee Addresses

Addresses of employees segregated as to Postal Zones were secured by a number of methods - personal solicitation, telephone calls and by mail. In quite a few instances local Chambers of Commerce in smaller communities gave excellent cooperation. In securing this information some employers furnished separate 3" x 5" cards for each employee with their name and residence address, and in most instances, the Postal Zone in which such

employee lived. In a small percentage of cases the employees address card did not give the Postal Zone of his residence.

When the number of addresses lacking Postal Zone identification formed a fairly sizable proportion of the total persons employed at a plant, a 25 to 50 per cent sample of such unzoned addresses was taken, and Postal Zones of such addresses determined from a Street Directory which gave Postal Zones. Where the unzoned addresses constituted a relatively small proportion, they were proportioned between employees who lived in the Study Area and those who lived without it. As was to be expected, a large number of employees were found to live outside of the Study Area. This group was set aside, however, for use in any future studies.

Other employers and groups supplied the data on forms supplied to them, these forms giving the total number of persons employed by them at each plant or business location in each of the 80 Postal Zones.

Expansion Factor

While it was not possible to secure a 100 per cent sample of all employees, the percentage was quite high in the majority of Zones, being in excess of 50 per cent of those employed in industry in the Area, as is shown in Table No. 14.

It then became necessary to expand this sample to include all of these persons employed in industry in each Postal Zone. Inasmuch as the size of the sample was substantial, it was assumed that the residence pattern for all employees in each Zone was the same as that indicated by the sample. To the known number of employees working in a given Zone and living in each of the 80 Postal Zones, an "Expansion Factor" was applied, this being developed as follows.

TABLE NO. 14

SUMMARY OF ORIGIN AND DESTINATION STUDY

POSTAL ZONE		EMPLOY-EES NAMES REC'D.	EST'D. TOTAL EMPLOY-EES	EXPAN-SION FACTOR	NO. IN COL. 1 LIVING IN STUDY AREA	EST'D. NO. IN COL.2 LIV-ING IN STUDY AREA
		(1)	(2)	(3)	(4)	(5)
GROUP A						
Burbank		41804	48652	1.16	32271	37524
Chatsworth		129	129	1.00	103	103
Canoga Park		00	00	00	00	00
Encino		00	00	00	00	00
No. Hollywood		7912	9576	1.21	7059	8575
Northridge		00	00	00	00	00
Pacoima		151	213	1.41	135	191
Reseda		235	288	1.22	146	276
San Fernando		669	946	1.41	622	871
Sun Valley		397	688	1.74	349	606
Tarzana		00	00	00	00	00
Universal City		00	00	00	00	00
Van Nuys		3157	5976	1.89	2974	5615
Woodland Hills		00	00	00	00	00
Total		54454	66462	1.22	43659	53761
GROUP B						
L. A. Zone	27	435	1188	2.73	327	892
	28	3895	24720	*6.18	2621	17781
	29	386	638	1.65	246	399
	38	1720	8326	4.85	1152	5587
Total		6436	34872	5.41	4346	24659
GROUP C						
Glendale	1					
	2					
	3		Glendale zones not			
	4					
	5		Tabulated individually			
	6					
	7					
	8					
Total		5081	9373	1,85	3816	7105

TABLE NO. 14 - CONTINUED

POSTAL ZONE		EMPLOYEES NAMES REC'D.	EST'D. TOTAL EMPLOYEES	EXPANSION FACTOR	NO. IN COL. 1 LIVING IN STUDY AREA	EST'D. NO. IN COL. 2 LIVING IN STUDY AREA
		(1)	(2)	(3)	(4)	(5)
GROUP D						
L. A. Zone	4	1428	2391	1.67	991	1654
	5	3593	3873	1.08	1805	1960
	6	3362	3392	1.00	1657	1657
	7	3088	7501	2.43	1820	4418
	18	169	400	2.37	115	264
	36	2876	5225	1.82	1613	2933
Total		14516	22782	1.57	8001	12886
GROUP E						
L. A. Zone	12	26269	36577	*1.39	17127	24056
	26	72	725	10.10	50	502
	31	6923	11935	1.72	4341	7481
	32	4334	7500	1.73	1874	3245
	39	2786	5286	1.90	2289	4357
	41	69	75	1.09	65	69
	42	161	213	1.32	101	134
	65	3099	5913	1.91	2231	4263
Total		43713	68224	1.56	28078	44107
GROUP F						
L. A. Zone	13	15044	25799	*1.71	9390	16131
	14	30878	58636	*1.80	17510	32563
	15	7234	28852	*4.00	4390	16275
	17	12006	19443	*1.62	6669	10653
	21	4344	15696	3.62	2781	10251
Total		69506	148426	2.14	40740	85873
GROUP G						
L. A. Zone	22	14896	24926	1.67	7534	12620
	23	6428	19259	3.00	3884	11658
	33	1218	2124	1.75	862	1521
	63	140	3193	22.80	83	1895
Total		22682	49502	2.18	12363	27694

TABLE NO. 14 - CONTINUED

POSTAL ZONE	EMPLOY-EES NAMES REC'D.	EST'D. TOTAL EMPLOY-EES	EXPAN-SION FACTOR	NO. IN COL. 1 LIVING IN STUDY AREA	EST'D. NO. IN COL. 2 LIVING IN STUDY AREA
	(1)	(2)	(3)	(4)	(5)
GROUP H					
L. A. Zone 1	2601	11831	4.55	1585	7055
2	3972	6838	1.72	2931	5044
11	2484	10897	4.38	1348	6505
58	31243	51657	1.65	21337	34751
Bell	396	1137	2.87	298	853
Huntington Pk.	2592	4483	1.73	1687	2938
South Gate	7360	12168	1.65	5018	8285
Maywood	313	2235	7.15	218	1546
Total	50961	101246	1.99	34422	66977
GROUP I					
L. A. Zone 59	67	1076	16.08	30	481
Compton	2464	2786	1.13	1709	1964
Lynwood	1838	2080	1.13	1418	1599
Total	4369	5942	1.36	3157	4044
GROUP J					
Bellflower	00	00	00	00	00
Downey	4689	7751	1.66	2441	4056
Paramount	235	388	1.65	201	332
Total	4924	8139	1.65	2642	4388
GROUP K					
Long Beach 2	1156	2294	1.99	1051	2096
3	7342	7755	1.06	6361	6738
4	2170	2583	1.19	1901	2262
5	1351	2137	1.58	1098	1537
6	379	838	2.21	285	620
7	199	538	2.71	154	417
8	13571	17175	1.26	8398	10582
10	24	150	6.25	20	118
11	00	00	00	00	00
12	888	2573	2.90	829	2358
13	275	2003	7.29	252	1764
14	7	288	00	3	3
15	00	00	00	00	00
Total	27362	38334	1.40	20352	28495

TABLE NO. 14 - CONTINUED

POSTAL ZONE	EMPLOYEES NAMES REC'D. (1)	EST'D. TOTAL EMPLOYEES (2)	EXPANSION FACTOR (3)	NO. IN COL. I LIVING IN STUDY AREA (4)	EST'D. NO. IN COL. 2 LIVING IN STUDY AREA (5)
GROUP L					
Harbor City	00	00	00	00	00
San Pedro	4347	10255	2.36	3693	8716
Wilmington	6659	11675	1.75	5527	9679
Total	11006	21930	1.99	9220	18395
GROUP M					
Torrance	5845	21836	3.74	3492	13020
Total	5845	21836	3.74	3492	13020
GRAND TOTAL	320855	597068	1.86	214288	391404

NOTES:

Column (1) Actual No. of Names secured of persons employed in designated Postal Zone

Column (2) Estimated Total No. of persons employed in zone by types of concerns contacted in Study

Column (3) Column (3) equals Column (2) divided by Column (1)

Column (4) Actual No. of Names secured of persons who were employed in zone and lived in Study Area

Column (5) Estimated total number of persons employed in zone by types of concerns contacted who live in Study Area. Column (5) is a summary of the expansion of the distributed names in the designated zone by use of the factor given in Column (3)

*-These zones were expanded by a different procedure explained in Text.

The total figure for employees estimated to be working in the given Postal Zone was divided by the figure for employees whose Postal Zone address was known, the result being considered as the "Expansion Factor". The following hypothetical case illustrates the procedure.

Assume that there were an estimated 2500 persons employed in Zone 35, who lived within the Study Area, and that of these, Zones of residence were available for 1500 employees. The "Expansion Factor" for Zone 35 would therefor be 2500 ÷ 1500, or 1.67. If information was received to the effect that 30 employees who worked in Zone 35 resided in Zone 22, this latter number was expanded by multiplying by the factor 1.67 (30x1.67) and it was estimated that of the total 2500 persons who worked in Zone 35, 50 resided in Zone 22.

Table No. 14 shows that there was a total of 597,068 persons employed in these 80 Zones, that data as to Zone of residence was received from 320,855 persons, making the "Expansion Factor" for the entire Study Area 1.86. This includes the Zones in "Downtown Los Angeles" mentioned above, and also the Hollywood Area.

Because of the preponderance of non-industrial employees in Downtown Los Angeles and in Hollywood, an effort was made to determine Zone addresses of employees of retail stores, hotels, financial concerns and public agencies and occupants of office buildings.

In 1949, the Downtown Business Men's Association made an estimate of the total number of persons who entered and remained in the Central District during the 16 hours, 6:00AM to 10:00PM, using then available sources of information, and this was used as a bases for the Origin and Destination Study in this area, being expanded as described below.

The area included in this Study extended from Sunset Boulevard on the north to Pico Boulevard on the south, and from Figueroa Street on the west to

Los Angeles Street on the east. The five Postal Zones which make up this area cover a considerably larger area than that given above, and it was felt that the Downtown Business Men's Association Study should be expanded to cover the five Postal Zones.

To the 22,343 Governmental employees included in the estimate of the Downtown Business Men's Association estimate, 15 per cent was added, making an estimated total within this employment category of 25,694 employees. City, County and Federal Agencies reported residence addresses of 21,448 employees. This providing an "Expansion Factor" of 1.20 (25694 ÷ 21448). A total of 4821 addresses of industrial employees working in plants in these Zones was received. Total employees estimated to be working in these Zones, based upon the categories in the Chamber of Commerce publication, were 10,993, which gave an "Expansion Factor" of 2.25(10993÷ 4821). No information as to employees in smaller retail stores in this Zone was received from the Downtown Business Men's Association, although those employed by the large department stores were included.

Zone 13 The Downtown Business Men's Association reported addresses of 7053 persons employed in stores in this Zone and an "Expansion Factor" of 1.50 was arbitrarily assumed. It was also found by canvass that 6165 occupants of office buildings in this Zone existed and an "Expansion Factor" of 1.7 was arbitrarily assumed, giving a total of 10,481 occupants of office buildings in this Zone. Replies were received from industrial employers giving the residence addresses of 1826 persons employed in this Zone. The estimate from the Chamber of Commerce Bulletin of total industrial employees therein was 4738 persons, resulting in an "Expansion Factor" of 2.59 for this Zone.

23,000 employees in retail stores in Hollywood. Since the Hollywood retail

no data was available on this point, it was arbitrarily assumed that 75 per cent of these 23,060 persons were employed in Zone 28, or a total of 17,300. Based upon data in adjacent Zones, it was assumed that 10.2 per cent of the 17,300 employees or 12,150, lived in the Study Area and their residential addresses were distributed in the pattern found by occupants of office buildings and industrial workers.

It is realized that the quality of the results of this Study is not as high as is that developed from industrial employees, but it does take in considerably more employees in other categories, and in all probability the final results are of reasonable quality.

Other Potential Passengers

As stated above, all potential passengers, except those in Downtown Los Angeles and in Hollywood, are industrial employees engaged in manufacturing industry. In addition to these employees, however, there are a substantial number of employees in other industrial categories.

In the Community Labor Market Survey of the California State Department of Employment a total of 1,486,000 persons were listed as being employed in 11 employment areas as of July 1952. These employment areas cover very closely the Study Area. The number of employees in each employment area in each category are listed in Table No. 15.

Manufacturing had the greatest number - 436,500 - followed by Wholesale and Retail Trade - 342,900 - and then Service - 248,100. Employees in Manufacturing constitute 29.7 per cent of the total number of employees, and the above three categories include 1,026,000 persons, or 69.0 per cent of the workers in these 11 employment areas.

Table No. 16 was prepared to show the number of employees in each employment area and under each category, per 1000 employees in Manufacturing.

For example, in the Huntington Park area there were 124,500 employees in Manufacturing, and 34,400 in Wholesale and Retail Trade, or 277 per 1000 Manufacturing. For every employee in Manufacturing there were a total, including those in Manufacturing, of 4,056 employees in the 13 employment Zones.

Nearly all of these employees in Manufacturing could be considered as potential users of this transit facility if it is constructed. This is not true, to as great an extent, with employees in other industrial categories due to various reasons, their residence being close to their place of employment, their need to use their own automobile in their daily work and similar reasons.

No information is available on this matter nor as to the location of residence of employees in other than the Manufacturing category. To secure some idea of how many of these employees in other categories would also be potential users in the proposed facility, it becomes necessary to make certain assumptions, these being based largely upon local knowledge of employment characteristics.

The results of these assumptions are Shown in Table No. 17. Under each category an assumption was made as to the total percentage of employees in each employment category who would be potential users of the proposed transit facility. For example, it was assumed that only 5 per cent of those employed in the category of Fishing and Agriculture would be potential users of the proposed facility, 10 per cent of those employed in the Mining category (including oil workers), 7½ per cent in the Construction category, etc. In the Burbank employment area, for example, there were 68 employees in the Fishing and Agriculture category per 1000 employees in Manufacturing. Applying the 5 per cent Factor to this number it developed that but 3 employees per 1000 employees in Manufacturing would be potential users of the

TABLE NO. 16

EMPLOYMENT IN VARIOUS CATEGORIES PER 1000 EMPLOYEES IN MANUFACTURING - IN EMPLOYMENT AREAS ADJACENT TO AND INCLUDING STUDY AREA

EMPLOYMENT AREA	TOTAL	FISHING AGRICULTURE	MINING	CONSTRUCTION	MANUFACTURING	TRANSPN. COMMCTN. UTILIT'S	WHOLESALE RETAIL TRADE	FINANCE INSURANCE REAL EST	SERVICE	GOVERNMENT	OTHER
Burbank	1834	68	4	50	1000	90	153	49	340	30	50
Compton	3333	258	86	432	1000	247	518	62	494	111	123
East Los Angeles	3383	299	0	80	1000	313	955	56	274	10	398
Glendale	3598	378	15	235	1000	182	683	136	568	136	265
Hollywood	6840	216	16	280	1000	320	2000	440	1824	104	640
Huntington Park	1767	10	1	71	1000	44	277	34	180	54	96
Long Beach	3158	68	91	273	1000	117	682	143	431	208	145
Los Angeles	4777	112	5	121	1000	567	1320	372	875	405	0
San Fernando	9000	1650	200	600	1000	500	1600	300	2000	150	1000
San Pedro	3500	767	0	583	1000	250	233	83	150	267	167
Torrance	2827	143	42	327	1000	77	488	95	506	60	89
Van Nuys	5920	228	5	670	1000	107	1563	491	1071	312	473
Wilmington	2818	330	80	136	1000	568	227	34	170	68	205
Average	4056	348	42	297	1000	260	824	176	683	147	281

Source - Data in Table No.

TABLE NO. 17

POTENTIAL USERS IN VARIOUS EMPLOYMENT CATEGORIES
COMPARED WITH POTENTIAL USERS ENGAGED IN MANUFACTURING

% of USE BY EMPLOYEES IN MANUFACTURING		5	10	7½	100	25	25	25	12½	30	15
EMPLOYMENT AREA	TOTAL	FISHING AGRICULTURE	MINING	CONSTRUCTION	MANUFACTURING	TRANSPN. COMMCTN. UTILIT'S	WHOLESALE RETAIL TRADE	FINANCE INSURANCE REALEST.	SERVICE	GOVERNMENT	OTHER
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Burbank	1139	3	0	4	1000	23	38	12	42	9	8
Compton	1374	13	9	32	1000	62	130	15	62	33	18
East Los Angeles	1448	15	0	6	1000	78	238	14	34	3	60
Glendale	1440	19	2	18	1000	45	170	34	71	41	40
Hollywood	2079	11	2	21	1000	80	500	110	228	31	96
Huntington Beach	1146	0	0	5	1000	11	69	9	22	16	14
Long Beach	1405	3	9	20	1000	29	170	36	54	62	22
Los Angeles	1811	6	1	9	1000	141	330	93	110	121	0
San Fernando	2193	83	20	45	1000	125	400	75	250	45	150
San Pedro	1348	38	0	44	1000	63	58	21	19	80	25
Torrance	1295	7	4	25	1000	19	122	24	63	18	13
Van Nuys	1899	11	0	50	1000	27	390	122	134	94	71
Wilmington	1314	16	8	10	1000	142	57	9	21	20	31
Average	1530	17	4	22	1000	65	206	44	86	44	42

REPORT

TO

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

ON

MONORAIL RAPID TRANSIT

FOR

LOS ANGELES

PART III

MONORAIL SYSTEM DESIGN
ESTIMATES OF CONSTRUCTION COSTS
AND OF OPERATING EXPENSES

December 31, 1953

GIBBS & HILL, INC.
ENGINEERS - CONSTRUCTORS
NEW YORK - LOS ANGELES

GIBBS & HILL, INC.
CONSULTING ENGINEERS
DESIGNERS - CONSTRUCTORS

510 WEST SIXTH STREET
LOS ANGELES 14, CAL.

PENNSYLVANIA STATION
NEW YORK 1, N. Y.

December 31, 1953

Coverdale & Colpitts
120 Wall Street
New York 5, New York

Gentlemen:

Transmitted herewith is our report on preliminary design as required for estimating purposes, estimates of construction cost and of maintenance and operating expenses of a monorail rapid-transit installation over both the longer and shorter routes in Los Angeles specified by you.

Attention is called to the fact that unit costs of operation and maintenance are favorable due to the high intensity of use resulting from the schedules proposed. High scheduled speed combined with dense train service over a long main line run results in low costs per train mile and per track mile. The figures given in the report have been derived from the records of similar and successful rapid transit operation adjusted for inherent differences in the two services.

While some structural modifications should be considered in case final design is undertaken the first cost figures based upon the preliminary design are adequate for the present economic study.

A few of the preliminary drawings have been included in the report for illustrative purposes and to indicate the care with which the estimates were prepared. The entire file of drawings is available to you at any time you wish.

We wish to express our appreciation of the wholehearted cooperation received from all members of your staff and the officials of the Metropolitan Transit Authority.

Very truly yours,

GIBBS & HILL, Inc.

J B Saxe

J. B. Saxe
Vice President and
Chief Engineer

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SCOPE

Under a contract consummated April 15, 1953 Gibbs & Hill, Inc. has prepared the following estimates of a Monorail installation to provide mass rapid transit in Los Angeles, California:

1. The estimated cost of construction of a Monorail line along a route location furnished by Coverdale & Colpitts;

2. The estimated cost of equipment and appurtenances, stations, shops and inspection facilities, yards, power supply, power transmission and distribution system, signals and cars;

3. The estimated cost of maintaining and operating the system based on desired overall speeds, frequency of service and passenger loads from information furnished by Coverdale & Colpitts.

SUMMARY

The study required has developed the following First Cost and Annual Maintenance and Operating Cost figures:

1. For full length of line, Panorama to Long Beach:

a.	Estimated First Cost of Line	$82,904,175
b.	Estimated First Cost of Equipment, etc.	44,262,290
c.	Contingency	10,000,000
d.	Estimated Annual Cost of Maintenance and Operation involving 23,750,000 car miles/year	8,021,000

2. For the shorter line, North Hollywood to Compton:

a.	Estimated First Cost of Line	65,146,855
b.	Estimated First Cost of Equipment, etc.	36,170,677
c.	Contingency	10,000,000
d.	Estimated Annual Cost of Maintenance and Operation involving 17,540,000 car miles/year	5,928,520

INTRODUCTION

Monorail rapid transit was devised as a promising answer to the need, evident in many communities, of providing mass rapid transit in face of existing surface-traffic congestion and of the high costs of alternate forms of rapid transit, notably the subway. In most instances, high speed movement of true mass-transportation vehicles on the surface is impossible because of interference from other traffic using the same arteries. The cost usually involved for suitable private rights-of-way on the surface would be prohibitive. A subway, of course, provides the private right-of-way and eliminates the hindrance of movement from competing traffic. It is, therefore, an admirable solution in all respects, except that of cost. Very few, if any communities can support this burden even when the population served is very dense and riding relatively uniform throughout a large part of the day.

When both surface and sub-surface solutions are unavailable, the only resort is to go above the surface. In the past this has involved the "elevated", an air-less, light-less, near-tunnel over a street cluttered by two or more rows of supporting structures and surrounded by a din of noise. The elevated did provide the desired private right-of-way and as a form of transportation could be satisfactory. Its cost was, relative to the subway, a step in the right direction.

Starting from the elevated, the problem is to strip away its objectionable features and improve its better ones with the aid of modern technical progress. Monorail is the resulting answer.

The more or less conventional roadbed of the elevated, its ties, and rails, are reduced to a single longitudinal supporting member of strength and stiffness adequate to support the equipment, and within this limitation, of

the smallest dimensions possible. This member, being placed above the car, the normal clearance above the ground surface is increased ten or twelve feet. This relationship in combination with the small amount of light cut off, even by a "two track" line, restores the space below it to the out-of-doors without increasing appreciably the usual street noise. Both the single and double track arrangements of members require only a single row of columns presenting a limited surface obstruction. In fact, whatever obstruction is involved becomes almost negligible when columns are placed in the center division provided in most important new highways.

GENERAL DESCRIPTION OF LOS ANGELES PROJECT

The route for which cost studies have been prepared extends approximately 45 miles from a terminal station at the north end of Van Nuys Boulevard near Roscoe Boulevard to a similar station at the southern end on American Boulevard at Broadway in Long Beach. Short turn-around, loop facilities extend beyond both terminal stations. The entire operation is above ground except for a short tunnel, slightly over two miles in length, under Hill Street in downtown Los Angeles. Turn-around facilities are also provided at either end of the tunnel section, and adjacent to North Hollywood and Compton.

Along Van Nuys Boulevard, the structures occupy the center of the wide thoroughfare, from which a turn is made onto private right-of-way in the center of Chandler Boulevard. Leaving the latter boulevard, the line runs along Vineland Avenue to a second section of private right-of-way in the center of Cahuenga Pass Freeway. It leaves this right-of-way at a point where freeway construction interferes and passes via Highland Avenue to Sunset Boulevard. Located along the previous two track street car route, the line follows Sunset Boulevard to the vicinity of the old Hill Street intersection. At this point

the route swings across the Hollywood Freeway and into a tunnel extending under Hill Street to Washington Boulevard. Thence it cuts across to Broadway, running eventually into Main Street which is followed until the route turns onto Florence Avenue, across which it runs east to Pacific Boulevard. Running south on this thoroughfare, the line moves over to Long Beach Boulevard, which together with American Avenue provides the route into Long Beach.

STRUCTURES

The structure is, in general, supported by a single row of columns located in the center of private right-of-way where available or alternately in the middle of streets. Each column, resting on a concrete foundation adequate to withstand the overturning moments imposed upon it, terminates at the upper end in a transverse double bracket member, supporting two longitudinal girders. Each longitudinal girder, provided with expansion joints at suitable intervals, forms a continuous rail support from one end of the line to the other.

A single running rail, for the form of monorail used as the basis for cost estimates, is fastened on top of the longitudinal girder, resting upon a resilient, sound-deadening material. At expansion joints in the supporting girder, mitre-joints in the rail are provided to preserve a smooth-running surface, free of usual rail-joint clicking. When actual design is undertaken certain alternate forms of construction should be examined. One of these, constituting a change in physical form, is to arrange the trucks and supporting girders so that the truck runs inside the girder, possibly on pneumatic tires. While this arrangement would probably increase the cost of supporting structures and girders approximately 15 per cent, it presents offsetting advantages in cost of subway installation and more convenient switching. Further investigation of the feasibility and economy of pre-stressed concrete structures is

also warranted.

Each of the two trucks supporting each car is provided with two double-flanged wheels. All propulsion motors and equipment are mounted in the trucks, which ride above the running rail surface. The car body runs below the supporting girder and is supported by a hanger-arm from each truck in such a way that the center of gravity of the unit of rolling stock is directly below the rail.

Side clearances are provided to permit sway of the car body in passing around curves or due to transverse wind-loading. In the former case, the car assumes a position of equilibrium between centrifugal and gravitational forces leading to the easiest passage around curves and to greater passenger comfort. The maximum sway provided for, results from the extreme condition of a steady transverse wind loading on the side of the car equivalent to a sustained wind velocity of 70 miles per hour. Under this condition, the displacement of the car is 12° 40' from the vertical. Speed restrictions on curves are established, and enforced by automatic speed control, to keep the sway on curves within this same limit of displacement.

All parts of the structure are designed to withstand earthquake shock of an acceleration equal to 0.2g, or 20 per cent of the rate of acceleration due to gravity.

Due to the presence of the hanger arms between trucks and car bodies, track switches necessarily differ from conventional rail-line switches. For straight-through movement space between the tangent girder and that for the turn-off, must be provided for passage of the hanger arms. This is very simply accomplished by arranging a length of the girder support as a 180 degree rotating block turning around a longitudinal axis. In one position it places a

tangent rail in alignment with adjacent straight-through rails. When rotated over, a curved rail on the opposite surface matches with one adjacent tangent rail and with the curved turnout rail, so bridging the gap between stationary supporting members. Movement is provided by dual motor driving mechanisms, so allowing for remote control analogous to conventional switch machines.

The vertical dimensions of the supporting structure provide 16 feet clear between the bottom of cars and the surface of streets or ground below. The under surface of the supporting girders are approximately ten and a half feet above the 16 foot clearance line or slightly over 26 feet above a road surface. Being at such height and of relatively small dimensions, the girders cannot approach the effect of a nearly solid roadbed at a sixteen foot clear height in obstructing air and light above the street and in reflecting traffic noises, nor do they come nearly as close to structures on abutting property.

A number of varying station arrangements are possible, some of them making use of property adjacent to the street. Such solutions are, however, special cases, generally applicable in only a few locations. Since the line runs in general down the center of a street or private right-of-way, the least complication is involved by placing the stations in the same location.

Each station must provide space for a change booth, turnstiles and other general facilities, with convenient access to and from the street level and the train platform. In the case of ten stations, the latter is placed between the inbound and outbound routes by somewhat spreading the space between supporting girders. The fare collecting facilities are placed below the platform level as this arrangement avoids restricting space for free passenger movement on the platform and permits access to the platform by stairways leading outward toward the ends of the platform so resulting in convenient

passenger distribution. This mezzanine level can be supported on the same row of columns as the main structure, by increasing the usual girder height sufficiently to preserve the standard 16 foot clearance from the mezzanine to the street.

It appears undesirable to provide access to the mezzanine level from the center of the street due to the traffic hazard of concentrating pedestrian travel to and from sidewalks in the vicinity of stations. Instead, foot-bridges across the street at both ends of the mezzanine level and four stairways to sidewalk level are provided. Two of these stairways are equipped with moving stairs.

It is considered that both the profile and downtown traffic conditions, under which even a single row of supporting columns would be undesirable, indicate a tunnel under approximately two miles of Hill Street. This tunnel section includes two stations, one serving the Civic Center and one at Seventh Street. In these stations passenger platforms are provided outside the two-track area in order to facilitate convenient stairways to the surface without forcing the construction deeper into the ground as would be required by a mezzanine level.

Adjacent to all except downtown stations, parking lot facilities are provided for the convenience of patrons using their own cars, rather than feeder buses or walking to reach the station.

Storage yards and shops for inspection and maintenance are provided at two locations, on the northern end just off Chandler Boulevard near Woodman Avenue and on the southern end just off Long Beach Boulevard between Compton Boulevard and San Antonio Drive. For the 45 mile installation each storage yard has ten tracks each capable of storing 10 cars. Three additional tracks of thirteen car capacity are provided for car cleaning and light inspection. All

of these tracks are at a lower height than on the main line so providing easy access to car interiors from ground level. Each yard is provided with an automatic car washer through which cars will pass between cleaning and light inspection tracks and the storage area. For the shorter installation, between North Hollywood and Compton the number of storage tracks and yard capacity are reduced in proportion to the number of cars required.

Both inspection and maintenance shops are provided with covered tracks long enough for three car trains. The southern shop, designated to handle periodic and heavy repairs has two tracks for such work and two more for heavy inspection and lubrication. These two tracks can also be used for heavy repairs if required. The northern shop is designed with two tracks for heavy inspection and one for light repairs. Both shops have office and repair shop areas for brake, drive, and control equipment repairs and for motor overhaul if this latter work is not handled on a contract basis by an outside service shop.

Entrance to and departure from the yards is provided to or from both inbound and outbound directions on the line. Track facilities required for this feature may also be used for turning trains short of the terminal stations when riding does not justify the full run.

CAR EQUIPMENTS

The cars are to be lightweight, double truck units, approximately 50 feet long and seating approximately 67 persons depending on the arrangement of seats finally adopted. The body, of semi-monocoque construction will have two large sliding doors on each side, near the quarterpoints of the car, to facilitate rapid loading and unloading. Inter-communicating doors for emergency use are provided in the ends of the car. All cars are identical except

that a proportion of the total number, to be used as lead cars, will have a streamlined nose and be equipped with a control position for train operation and the necessary automatic speed control apparatus. Trailing cars will be equipped with a modified control station for handling in yards and switching to make up trains.

Trains consisting of one lead car and one to seven trailing units can be operated. If consistent with estimates of riding, semi-permanent coupling of cars in pairs is advantageous.

Each of the two trucks per car will have two 30-inch double-flanged wheels mounted singly on each of the two axles. The axles will also carry a right angle gear box and a disc type brake and will run in roller bearings supporting the lightweight welded truck frame.

Each truck frame will carry two propulsion motor assemblies, driving through double universal joint propeller shafts, brake and control equipment and current collection devices. No propulsion power circuits or apparatus are located in the car body in the interest of maintaining simplicity and to avoid any increase in vertical dimensions which would in turn require proportionately higher supporting structures throughout the installation.

Each of the four propulsion motor assemblies per car consists of a 100 horsepower three phase, alternating current squirrel-cage induction type motor, to which is rigidly bolted a hydraulic torque-converter. This combination permits the induction motor to come up to speed very rapidly because the converter does not exert its maximum drag on the motor until the latter reaches a speed within its desirable operating range, approximately 87.5 per cent of synchronous speed and well above the point of breakdown torque. The net result of the combined characteristics is to provide an extremely smooth,

high rate of acceleration in vehicle speed practically up to vehicle balancing speed. It permits use of the very rugged squirrel-cage type of motor and complete elimination of alternating-to direct-current roadside conversion equipment and its corresponding investment.

The motor winding is arranged for full and half speed connections by means of a cam type group switch, which together with a main switch constitutes all the control equipment required. The half speed connection is used only for reduced speed running. Normal accelerations are made in the single high speed connection, thus eliminating "transitions" during acceleration. Because the lower, half-speed, shaft input speed to the converter also reduces the latter's torque multiplication factor, the resulting acceleration is also suitable for yard and switching movements.

Reverse movement, also at a reduced rate of acceleration, is obtained without gearing by reversal of the driving motor direction of rotation.

POWER SUPPLY SYSTEM

Three-phase, 60-cycle, alternating current at 2300 volts is delivered to the cars by using a dual wire contact system and the running rail as the three phase conductors. Energy is supplied this distribution system from simple, stationary transformer unit-substations located in parking lots adjacent to passenger stations. To insure continuity of supply, each substation is fed over two independent supply lines by the utility in whose area the substation is located. The substation itself is provided with two step-down transformers. In case of outage of a supply line or a transformer, the remaining unit, with

assistance from adjacent substations, can carry the load with auxiliary radiator cooling.

Within areas permitted by the configuration of utility supply sources, varying from two to five consecutive substations, the distribution system is in effect a secondary, line network with all the advantages of such a scheme. Although, within networks, sectionalizing of the distribution system is supplied where needed, a large part of the sectionalizing is provided by the breaks in continuity required by unmatched energy supply conditions existing in the utility systems. A total of 15 substations is supplied by the Los Angeles Department of Water and Power and 7 by Southern California Edison.

SIGNAL SYSTEM

A very complete and modern signal and automatic speed control system is provided to insure safety of operation on a minimum headway of 90 seconds. To avoid possible confusion between wayside signal aspects and background colored lighting, cab signal indications are provided in each train operating position. Any change of signal aspect to a more restrictive indication, that is, for example, one showing closer approach to a preceding train, requires acknowledgment by appropriate action on the part of the following operator or braking will be automatically initiated. Closing-up movements involving passing of a stop signal can be made, at slow speed only, following acknowledgment of the signal aspect by the operator first bringing the train to a full stop.

In areas where speed restrictions are established, the speed control feature will operate to reduce train speed to the allowable maximum if the operator does not do so. On longer radius curves, only a service brake

application is involved; on curves of moderate radius, power is cut off and braking initiated. In the case of sharp curves, such as exist on terminal loops, the motor control will be prevented from operating the motors in any but the lower speed connection, supplementary to braking action if required.

It is considered that the signal and speed control system provides maximum safety of operation, especially as it requires only features already proven in actual service.

SCHEDULE PERFORMANCE

The car equipments will have a scheduled speed, that is overall average speed including stop time at sixteen intermediate stations and reduced speed operation on severe curves, of 41 miles per hour. The running time from terminal to terminal over the 45 mile route is 66 minutes. The scheduled speed depends principally on the rates of acceleration and braking, which are the maximum consistent with available adhesion at the rail, and passenger comfort; and on the balancing, or free-running speed, in this case, 60 miles per hour. With station stops averaging 2.8 miles apart, a substantially higher balancing speed would be less economical as it would barely be attained before braking for the next station stop would commence. A lower balancing speed would probably be an adverse psychological factor in view of prevalent speeds on freeways.

TIME OF CONSTRUCTION

The construction schedule for the entire system is a function of several factors, the most important of which would be the time required for determination of concept, design, supply and fabrication of the steel shapes and plate and the construction of the subway section. It is felt that a period of six months will be required after award of contract to study the final routing, and crystallize

the design precepts. The actual design development would be accomplished in the ensuing year but mill orders for both Monorail and subway steel could be placed in the interim so that construction might be started at the end of this period. Because higher speeds are contemplated for Los Angeles than experienced in any previous similar installation it is recommended an initial section one or one and a half miles long be installed for advance testing purposes before all details for the entire project are released for construction.

It is estimated that the construction of the subway section will require thirty months and that all work involved in the construction of the remainder of the Monorail system can be completed within this time. Construction would be performed simultaneously in the several sections in order to reduce the overall time requirements. It is anticipated that the entire system could be completed within four years after award of contract.

MAINTENANCE AND OPERATING COSTS

The unit costs of maintenance, operating and power costs tabulated below, were estimated after careful comparison of the proposed service with an efficient, comparable operation. They are based upon an annual car mileage for the full length of the system of 23,750,000, indicated by others, as required for the expected riding. It should be noted that the intensity of use of the proposed service is high, that is the miles per car per year, the annual car-miles per track mile and the cars per hour per track mile all are high. Such figures are inherent in a fast and frequent service over a straight-away main line of considerable length.

Respectfully submitted,

GIBBS & HILL, Inc.

E. H. Anson
Vice President

E X H I B I T S

MAINTENANCE AND OPERATING UNIT COSTS

Maintenance Way & Structures - Annual Cost	$ 1,220,000.
Per Car Mile	5.14¢
Maintenance Equipment - Annual Cost	$ 1,750,000.
Per Car Mile	7.37¢
Operating Expense - Annual Cost	$ 2,426,000.
Per Car Mile	10.22¢
General Administrative Cost - Annual	$ 875,000.
Per Car Mile	3.68¢
Power	$ 1,750,000.
Per Car Mile	7.36¢
Total Maintenance, Operating, Power & Administrative Costs - Annual	$ 8,021,000.
Per Car Mile	33.8¢

FULL LENGTH OF LINE

Panorama to Long Beach

1. Estimated Cost of Construction

a.	Supporting Structures including girders and rail for Main Route, Turn Arounds and Terminal Loops (exclusive of Line Switches, Tunnel Section, Storage Yard Access Trackage and Storage Yards)	$40,988,710.
b.	Foundations and Anchor Bolts	14,078,653.
c.	Special Foundations for Freeway and River Channel Crossings	61,000.
d.	Retaining Walls, Drainage, Fencing, etc. for Turnaround at Washington Blvd.	262,500.
e.	Subway Section, Supporting Structures, Girders and Addition for Foundations - "Monorail Facilities ONLY"	1,423,569.
f.	Line Switches with Supporting Structures and Foundations	736,405.
g.	Painting	864,478.
h.	Traffic Islands in Streets for protection of columns	1,837,410.
i.	Elimination of Overhead Interferences	512,600.
j.	Elimination of Underground Interferences	124,850.
k.	Sub-soil Investigations	214,000.
l.	Subway Structure	21,800,000.
	Total	$82,904,175.

FULL LENGTH OF LINE

Panorama to Long Beach

2. Estimated Cost of Equipment and Appurtenances, Stations, Shops and Inspection Facilities, Yards, Power Supply, Power Transmission and Distribution Systems, Signals and Cars

a.	Passenger Stations (except subway)	$ 3,898,980.
b.	Subway Stations (tunnel structure not included)	450,000.
c.	Scheduled Repair Shop	802,000.
d.	Running Repair Shop	450,000.
e.	Parking Lots at Stations	427,250.
f.	Land Acquisition for Parking Lots, Storage Yards (no provision for R/W property)	2,833,780.
g.	Southern Storage Yard	2,499,666.
h.	Northern Storage Yard	2,329,345.
i.	Power Supply	2,534,520.
j.	Electric System	1,772,730.
k.	Signals and Intercommunication Systems	5,174,019.
l.	Cars 131 @ $80,000. each	10,480,000.
m.	Maintenance Equipment	110,000.
n.	Model Testing and Development	250,000.
o.	Engineering	3,500,000.
p.	Supervision during construction) Field Engineers and Inspectors) Field Survey Crews) Procurement of material and equipment)	5,000,000.
q.	Insurance during construction	1,000,000.
r.	Expenses for procuring property	400,000.
s.	Furnishings and equipment for Authority's general and administration offices	100,000.
t.	Placing equipment in operation and training personnel	250,000.
	Total	$44,262,290.

FULL LENGTH OF LINE

Panorama to Long Beach

3. Contingencies, (NOT including Escalation protection, Value of R/W property, Property Taxes during construction, Legal expenses, Expense of Authority's personnel during construction)	$10,000,000.
4. Basis of Estimate: Labor and material estimates are based upon prices as of December 1953 and the former on the basis of a 40 hour week at straight-time. As far as can be determined no royalties are payable on any part of the basic concept of the monorail	
Total Estimated First Cost	$137,166,465.

SHORTER LENGTH OF LINE

North Hollywood to Compton

1. Estimated Cost of Construction

a.	Supporting Structures including Girders and Rail for Main Route, Turn Arounds and Terminal Loops (exclusive of Line Switches, Tunnel Section, Storage Yard Access Trackage and Storage Yards)	$28,782,669.
b.	Foundations and Anchor Bolts	9,908,851.
c.	Special Foundations for Freeway and River Channel Crossings	49,000.
d.	Retaining Walls, Drainage, Fencing, etc. for Turn-around at Washington Blvd.	262,500.
e.	Subway Section, Supporting Structures, Girders and Addition for Foundations - "Monorail Facilities ONLY"	1,467,044.
f.	Line Switches with Supporting Structures and Foundations	371,694.
g.	Painting	595,627.
h.	Traffic Islands in Streets for Protection of Columns	1,269,470.
i.	Elimination of Overhead Interferences	415,050.
j.	Elimination of Underground Interferences	85,950.
k.	Sub-soil Investigations	139,000.
l.	Subway Structure	21,800,000.
	Total	$65,146,855.

SHORTER LENGTH OF LINE

North Hollywood to Compton

2. Estimated Cost of Equipment and Appurtenances, Stations, Shops and Inspection Facilities, Yards, Power Supply, Power Transmission and Distribution Systems, Signals and Cars

a.	Passenger Stations (except subway)	$ 2,243,200.
b.	Subway Stations (tunnel structure not included)	450,000.
c.	Scheduled Repair Shop	802,000.
d.	Running Repair Shop	450,000.
e.	Parking Lots at Stations	262,000.
f.	Land Acquisition for Parking Lots, Storage Yards and Sub Stations (no provision for R/W property)	2,046,900.
g.	Southern Storage Yard	2,457,666.
h.	Northern Storage Yard	2,009,345.
i.	Power Supply	1,818,900.
j.	Electric System	1,327,566.
k.	Signals and Intercommunication Systems	4,183,100.
l.	Cars 117 @ $80,000. each	9,360,000.
m.	Maintenance Equipment	110,000.
n.	Model Testing and Development	250,000.
o.	Engineering	3,000,000.
p.	Supervision during construction) Field Engineers and Inspectors) Field Survey Crews) Procurement of material and equipment)	4,000,000.
q.	Insurance during construction	750,000.
r.	Expenses for procuring property	300,000.
s.	Furnishings and equipment for Authority's general and administration offices	100,000.
t.	Placing equipment in operation and training personnel	250,000.
	Total	$36,170,677.

SHORTER LENGTH OF LINE

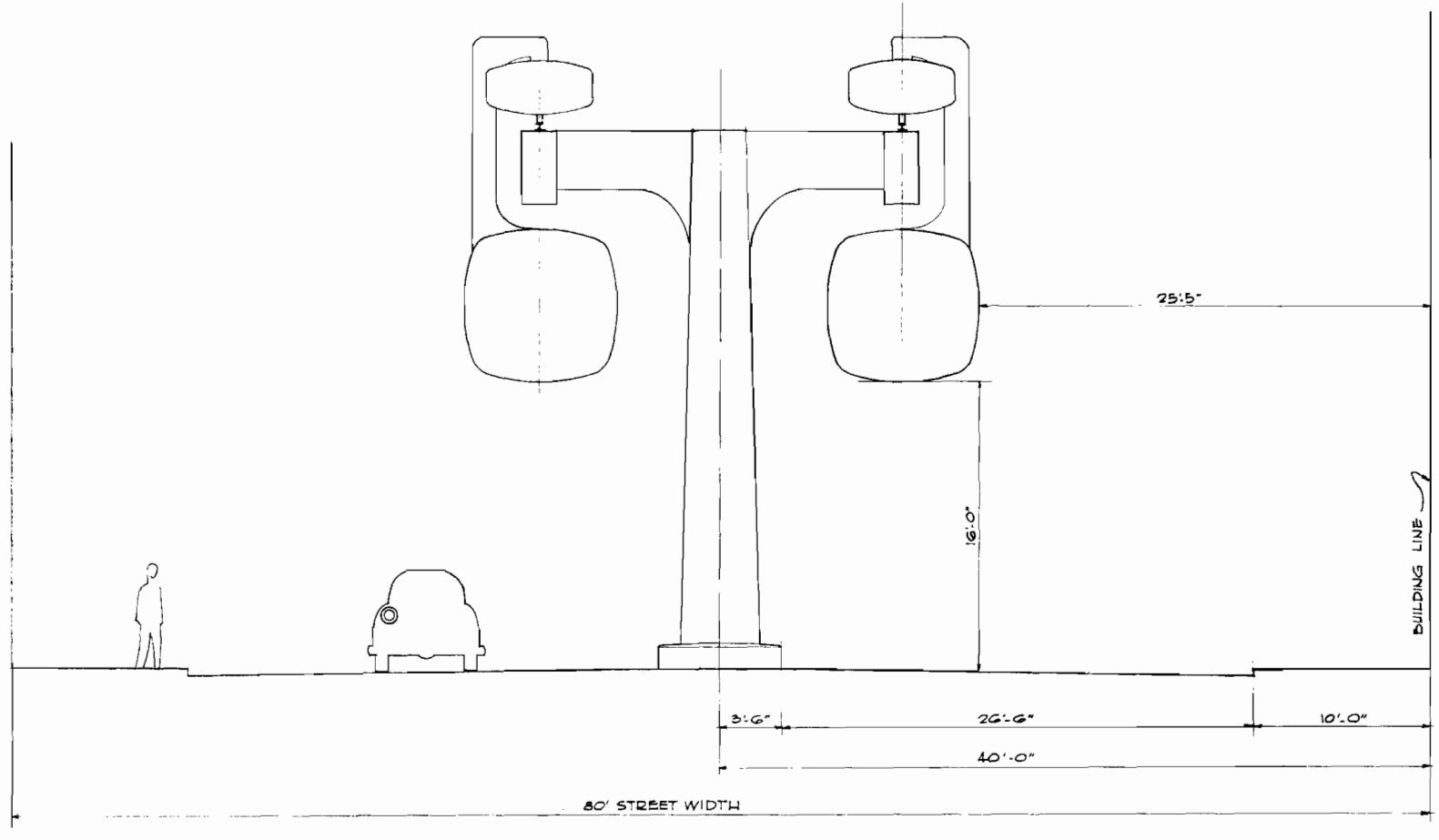
North Hollywood to Compton

3.	Contingencies (Not including Escalation protection, Value of R/W property, Property taxes during construction, Legal expenses, Expense of Authority's personnel during construction.)	$ 10,000,000.
4.	Basis of Estimate: Labor and material estimates are based upon prices as of December 1953 and the former on the basis of a 40-hour week at straight time. As far as can be determined no royalties are payable on the basic concept of the Monorail.	
	Total Estimated First Cost	$111,317,532.

CONDENSED PROFILE

SCHEMATIC ARRANGEMENT OF LINE

CROSS-SECTION OF MINIMUM WIDTH STREET



LOS ANGELES METROPOLITAN TRANSIT AUTHORITY
MONORAIL STUDY - LOS ANGELES, CALIFORNIA

CROSS SECTION
80' STREET

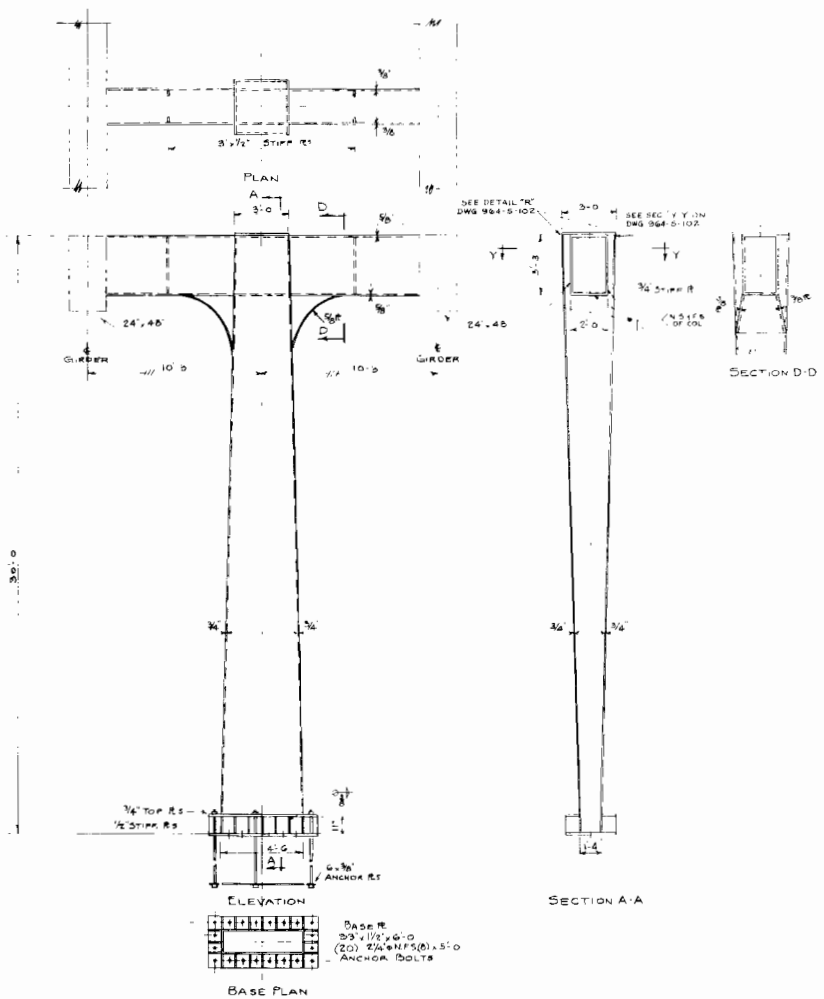
GIBBS & HILL INC.
ENGINEERS - CONSTRUCTORS
NEW YORK - LOS ANGELES

SCALE 1/8"=1'-0"

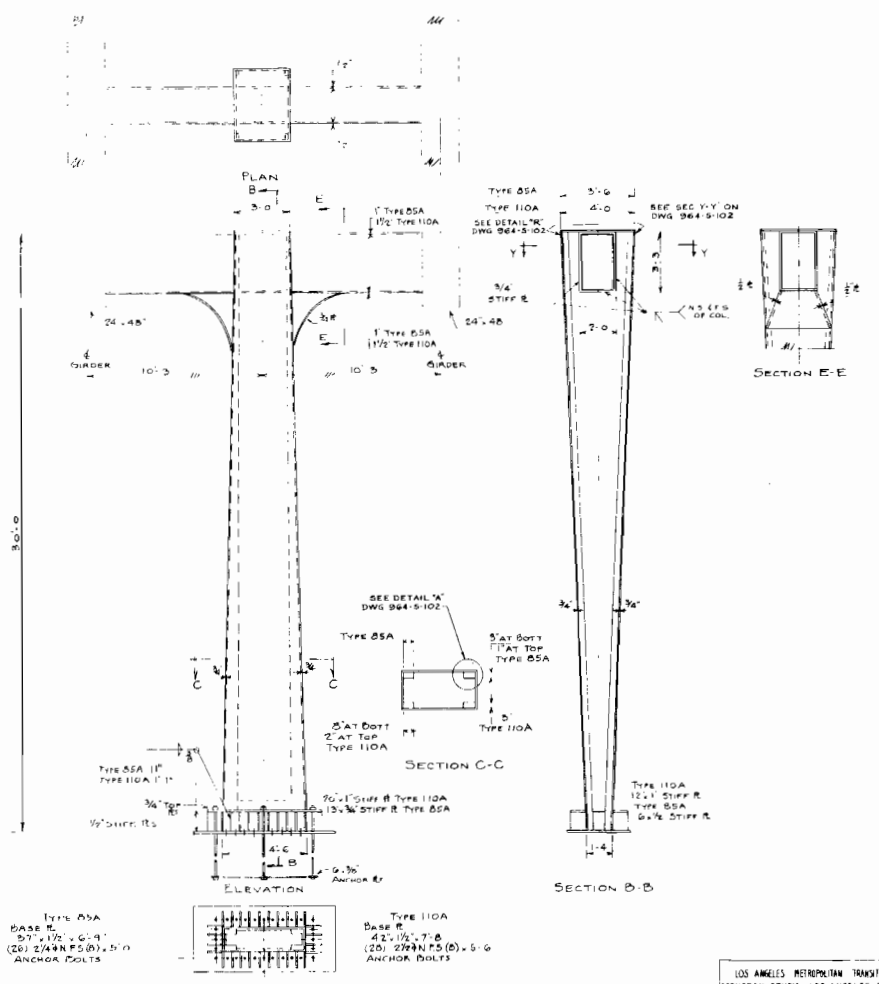
964-A-5

12-15-53

TYPICAL STRUCTURAL SUPPORT



STRUCTURE TYPE 60A



STRUCTURE TYPE 85A, TYPE 110A

LOS ANGELES METROPOLITAN TRANSIT AUTHORITY
MONORAIL STUDY - LOS ANGELES, CALIFORNIA

TYPICAL
SUPPORT STRUCTURES
16' CLEARANCE

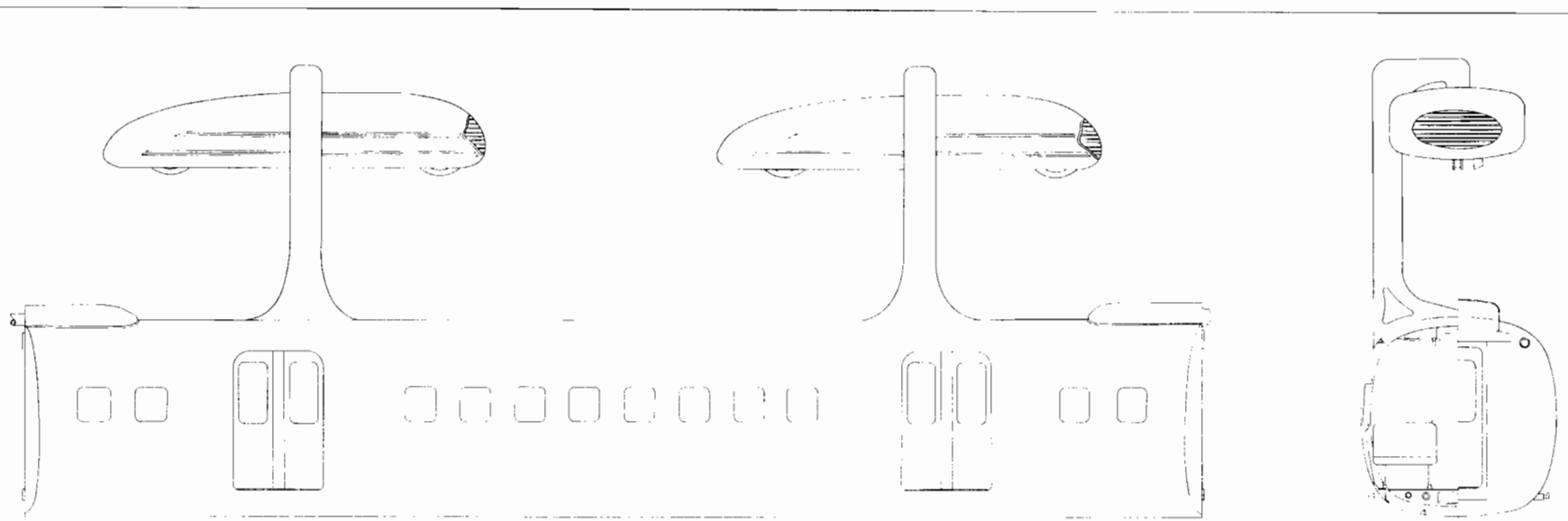
GIBBS & HILL, INC.
ENGINEERS CONSTRUCTORS
NEW YORK LOS ANGELES

SCALES

964-5101

Dec. 1, 1955

GENERAL ARRANGEMENT OF MONORAIL CAR



LOS ANGELES METROPOLITAN TRANSIT AUTHORITY
MONORAIL STUDY LOS ANGELES, CALIFORNIA

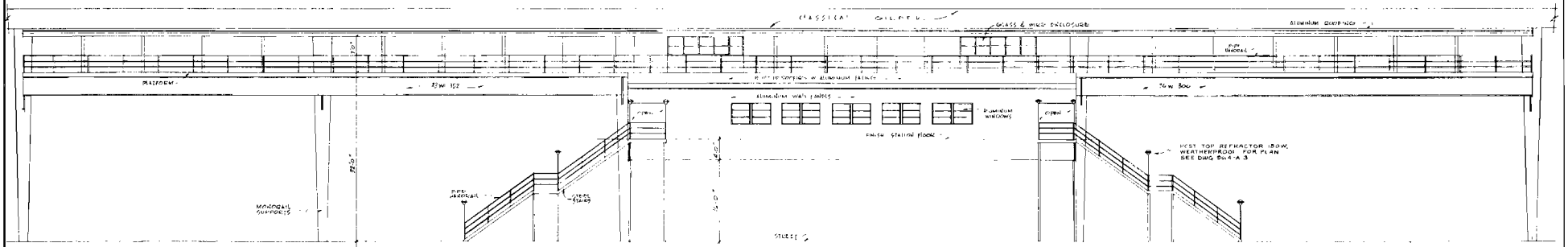
GENERAL ARRANGEMENT
MONORAIL CAR

GIBBS & HILL, Inc
ENGINEERS CONSTRUCTORS
NEW YORK LOS ANGELES

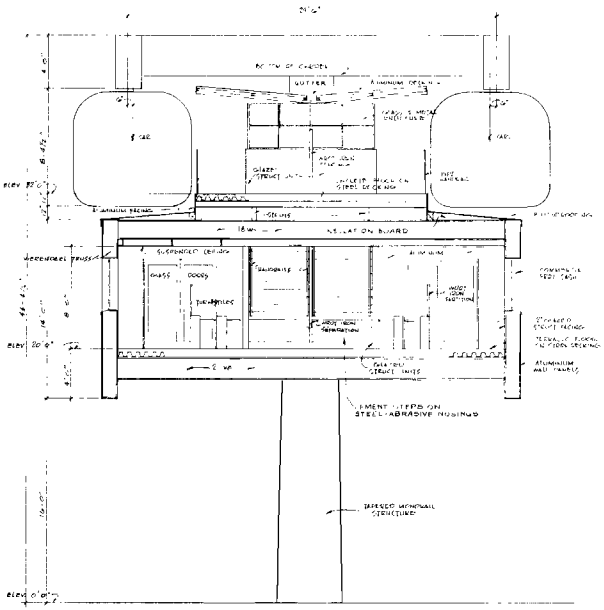
964-M1

Dec 1, 1963

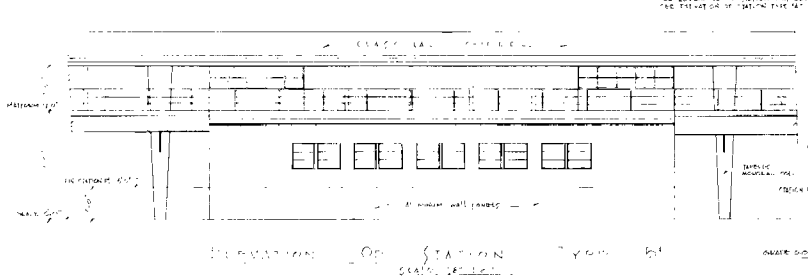
STATION ELEVATION AND SECTIONS



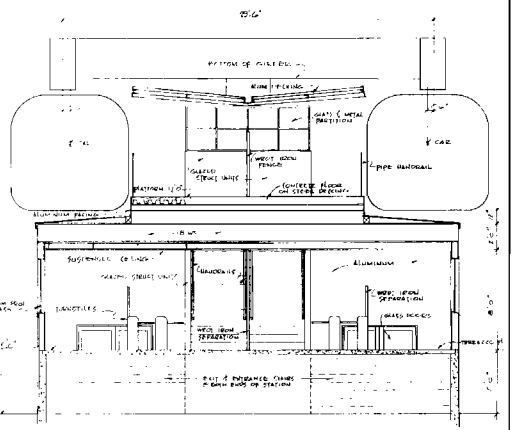
ELEVATION OF STATION TYPE "A"
SCALE 1/4"=1'-0"



SECTION THRU STATION
TYPE "A"
SCALE 1/4"=1'-0"



ELEVATION OF STATION TYPE "B"
SCALE 1/4"=1'-0"



SECTION THRU STATION
TYPE "B"
SCALE 1/4"=1'-0"

LOS ANGELES METROPOLITAN TRANSIT AUTHORITY
MONORAIL STUDY - LOS ANGELES, CALIFORNIA

ELEVATIONS - SECTIONS
TYPES "A" & "B" STATIONS

GIBBS & HILL, INC.
ENGINEERS - CONSTRUCTORS
NEW YORK - LOS ANGELES

SCALE AS SHOWN

964-A-2

DEC 1, 1963

STATION PLANS AND ARRANGEMENT

NOTES:

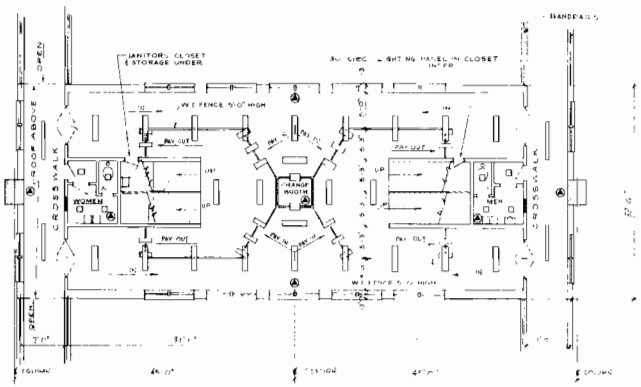
TYPE 'A-1' ON STREET STATIONS W/DIVIDING BARRIER FOR STATION & PLATFORMS

TYPE 'A-2' ON STREET STATIONS W/O BARRIERS

TYPE 'B-1' OFF STREET STATIONS W/DIVIDING BARRIERS

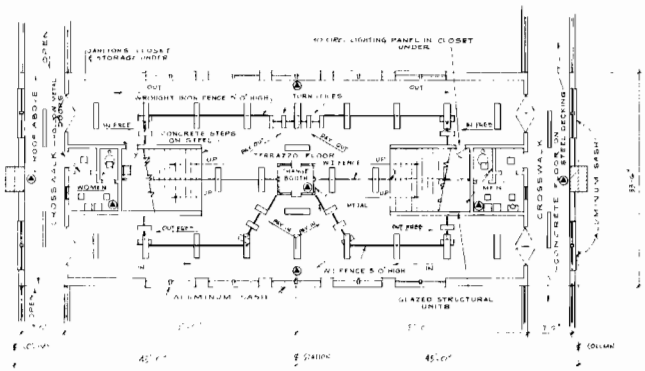
TYPE 'B-2' OFF STREET STATIONS W/O BARRIERS

TYPE 'C' SUBWAY STATIONS



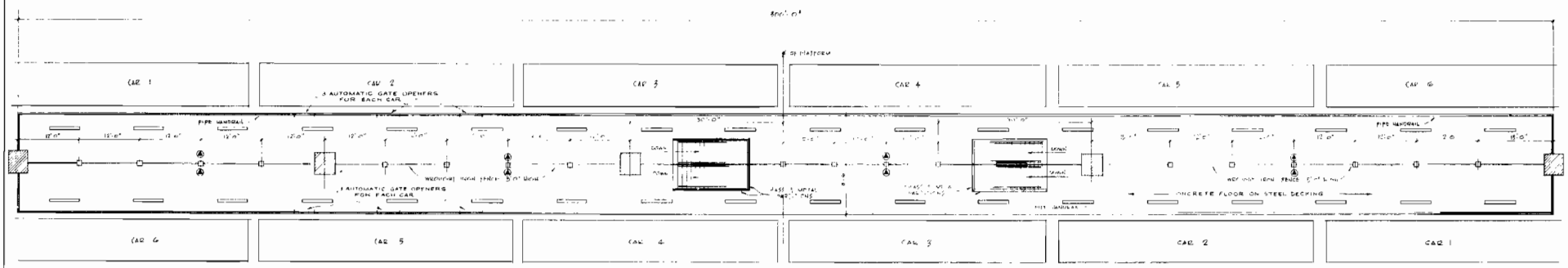
STATION LAYOUT - ZONE 'B'
SCALE 1/4"=1'-0"

NOTE:
NOTES SHOWN ON PLAN OF ZONE 'C' APPLY TO ZONES 'A' & 'B' EXCEPT AS NOTED AND SHOWN ON GROUND LEVEL STATION



STATION LAYOUT - ZONE 'C'
REVERSE LAYOUT FOR ZONE 'A'
SCALE: 1/4"=1'-0"

NOTE
SEE SHEET No. 964-A-3 FOR PLAN OF GROUND LEVEL STATION "B"



STATION PLATFORM
SCALE 1/8"=1'-0"

LIGHTING SYMBOLS

- SLIMLINE FIXTURE - 1 - 72" 430 MA LAMP, WEATHERPROOF, SURFACE MOUNTING
- FLUORESCENT FIXTURE - 2-40 WATT LAMPS, WITH A BALITE DIFFUSING PANEL, FLUSH MOUNTING
- INCANDESCENT FIXTURE - 100 WATT, WITH ALBALITE DIFFUSING PANEL, FLUSH MOUNTING
- TWISTLOCK RECEPTACLE - 15AMP, 125 VOLT, 3 WIRE (ONE POLE GROUNDED), WITH CAST IRON PLATE WITH LIFT COVER

Dec. 1, 1953

LOS ANGELES METROPOLITAN TRANSIT AUTHORITY
MONORAIL STUDY - LOS ANGELES, CALIFORNIA

PLANS B LIGHTING LAYOUT
STATION "A"

GIBBS & HILL, INC.
ENGINEERS - CONSTRUCTORS
NEW YORK - LOS ANGELES

SCALE AS SHOWN

964-A-1

P L A T E S

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