TERRASS, J. M.

Study and Plan of Relief of the Street Traffic Congestion in the City of Los Angeles, Calif.

1922

STUDY AND PLAN OF RELIEF

OF THE

STREET TRAFFIC CONGESTION IN THE

CITY OF LOS ANGELES, CALIFORNIA.

A THESIS PREPARED IN THE

COLLEGE OF CIVIL ENGINEERING,

UNIVERSITY OF CALIFORNIA.

MAY, 1922.

By

John M. Terrass.

Candidate for the Degree of Bachelor of Science in Civil Engineering.

Presented to Dean of College of Civil Engineering for Approval May, 1922.

Presented to Advisor for Approval----------April, 1922.

Approved F. S. Foote

Advisor.

Presented to Dean of College of Civil Engineering for Approval May, 1922.

Approved C. Derleth Jr

Dean, College of Civil Engineering.

Copy for the adviser

LETTER OF TRANSMITTAL.

University of California,
Berkeley, California,
May 1,1922.

Professor Charles Derleth, Jr.
Dean, College of Civil Engineering,
University of California.

Dear Sir:

In accordance with the regulation of the College of Civil Engineering, University of California, I present my thesis entitled, Study and Plan of Relief of Street Traffic Congestion in the City of Los Angeles, California, for your consideration.

Respectfully submitted,

J M Terras

Candidate for the degree of
Bachelor of Science, College
of Civil Engineering.

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STUDY and PLAN of RELIEF of the STREET TRAFFIC CONGESTION In the CITY of LOS ANGELES, CALIFORNIA.

INTRODUCTION.

Traffic congestion, in the City of Los Angeles, has increased rapidly in the passed five years. Many complaints have been made by both the people and the public utilities which are directly affected by traffic congestion. Chief Engineer H. Z. Osborne, of the Los Angeles Board of Public Utilities, in a discussion of traffic conditions, estimated the present yearly losses due to congestion, as being $8,365,800. The estimate is based on the assumption that every street car patron loses, at least, five minutes a day from avoidable traffic congestion, and that time is worth $ .50 an hour to the individual. On this basis 16,731,600 hours or $8,365,800. were lost last year. This amount of money capitalized at 10% would justify a capital investment of $83,658,000. if, by its investment, five minutes a day could be saved to each person from the delays caused by traffic congestion. The delays caused to vehicles, most of which are automobiles, operating within the congested area, would probably be a great deal more than five minutes and the cost of operation and the time lost by their operators, worth much more than fifty cents an hour. Although the losses in due to traffic congestion are of a very intangivle nature when applied to a city at large, such an example as given be Mr. Osborne, shows that a large amount of capital could justifiably be expended to remove traffic congestion.

The purpose of this report is to suggest a plan of relieving traffic congestion and, in a general way show its practibility.

In reparing this report, the writer is indebted to Chief Engineer H. Z. Osborne and Assistant Engineers J. W. Walters and F. A. Lorentz of the Los Angeles Board of Public Utilities, for many valuable suggestions. Many helpful suggestions were also received from F. S. Foote, Professor of Railroad Engineering at the University of California, and M. B. Terrass, Office Engineer for the Santa Fe Railroad at Los Angeles, and the writer's father.

Chapter 1. Data

A. Development of the City of Los Angeles.

1. Population

During the last twenty years the population of the City of Los Angeles has increased very rapidly. The U. S. Census figures for the years 1870 to 1920 are given below with estimates for the years 1850 and 1860. On the following page the increase in population between the years 1850 and 1920 is shown graphically in Fig. 1.

Year	Population	Year	Population
1850	1610	1890	50395
1860	4385	1900	102479
1870	5728	1910	319198
1880	11183	1920	576673

2. Area.

The area of the City of Los Angeles has increased rapidly since November 5, 1913, when the Los Angeles Aqueduct from Owens Valley was completed. This was due to the desire of outlying districts to have a share of the water for both domestic and agricultural purposes. The date and area of each addition to the city since its foundation in 1781 are given below and also show in figure 3, page 7 and more fully on map number 1 at the end of the report.

The three largest additions since 1913 are the San Fernando, Westgate, and Westcoast annexations. These districts are agricultural districts principally and thus added comparatively few people to the city.

Date	Name	How Obtained	Area (Sq. Mi.)
1781--1850	Original City	Spanish Grant	28.01

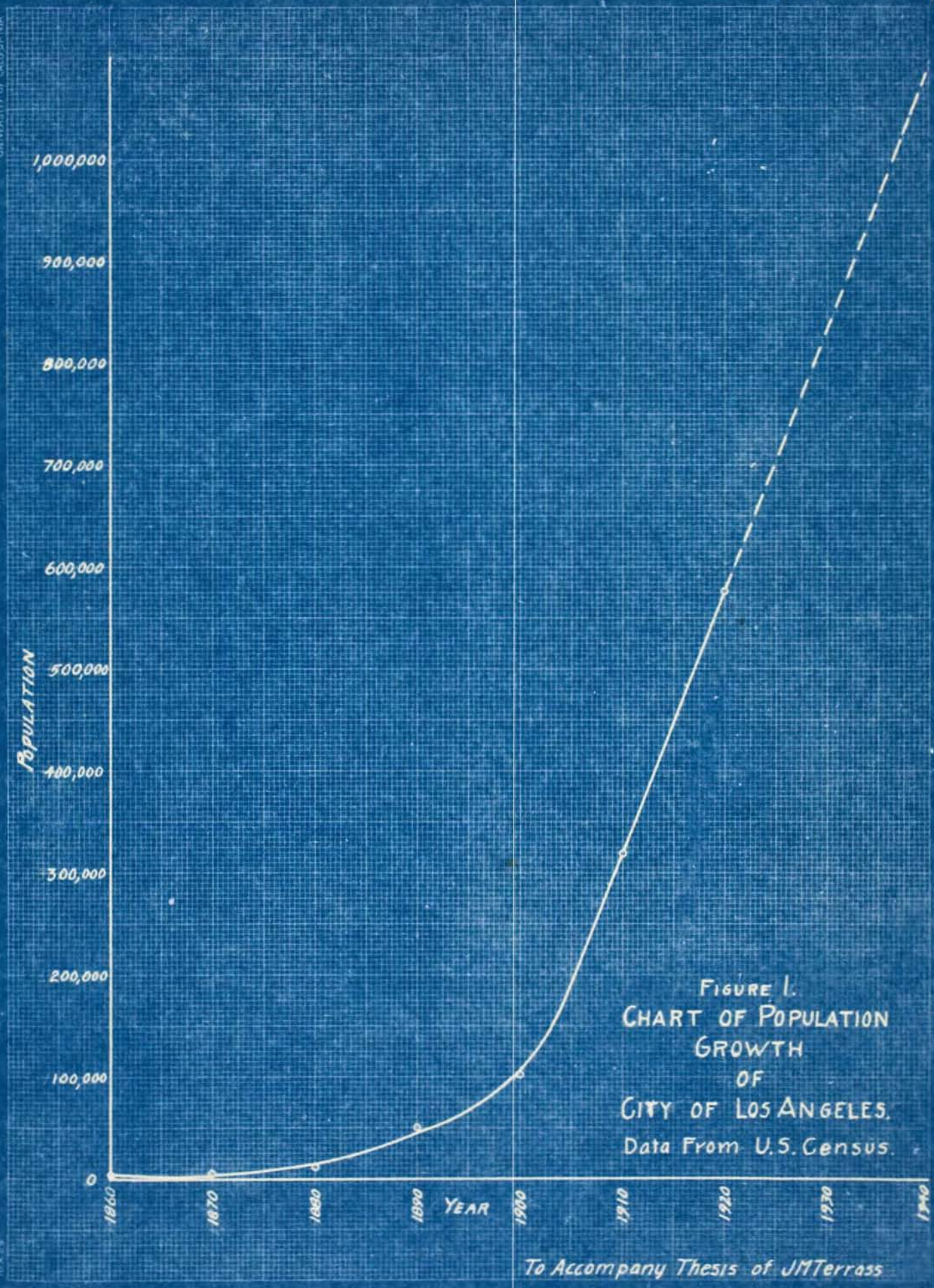


FIGURE I.
CHART OF POPULATION GROWTH OF CITY OF LOS ANGELES.
Data From U.S. Census.

To Accompany Thesis of J.M. Terrass

Date	Name	How Obtained	Area (Sq. Mi.)
Aug. 29, 1859	Southern Extension	Annexation	1.20
Oct. 18, 1895	Highland Park	Annexation	1.41
Apr. 2, 1896	Southern and Western	Annexation	10.18
Jun. 12, 1899	Garvanza	Annexation	0.69
Jun. 12, 1899	University	Annexation	1.77
Dec. 26, 1906	Shoestring	Annexation	18.64
Aug. 28, 1909	Wilmington	Consolidation	9.93
Aug. 28, 1909	San Pedro	Consolidation	4.61
Oct. 27, 1909	Colegrove	Annexation	8.72
Feb. 7, 1910	Hollywood	Consolidation	4.45
Feb. 27, 1910	East Hollywood	Annexation	11.11
Feb. 9, 1912	Arroyo Seco	Annexation	6.90
May 22, 1915	Palms	Annexation	7.30
May 22, 1915	San Fernando	Annexation	169.89
Jun. 10, 1915	Bairdstown	Annexation	3.40
Jun. 14, 1916	Westgate	Annexation	48.67
Jun. 16, 1916	Occidental	Annexation	1.04
Feb. 26, 1917	Owensmouth	Annexation	0.77
Jun. 15, 1917	Westcoast	Annexation	12.41
Jan. 23, 1918	Sawtelle	Annexation	1.82
Feb. 13, 1918	West Adams	Annexation	0.59
Feb. 16, 1918	Griffith Ranch	Annexation	0.23
Apr. 11, 1918	Hansen Heights	Annexation	8.30
1919	Not Listed		1.40
1920	Not Listed		2.23
1921	Not Listed		0.50
Jun. 30, 1921	Total Area of City of Los Angeles --------		366.17

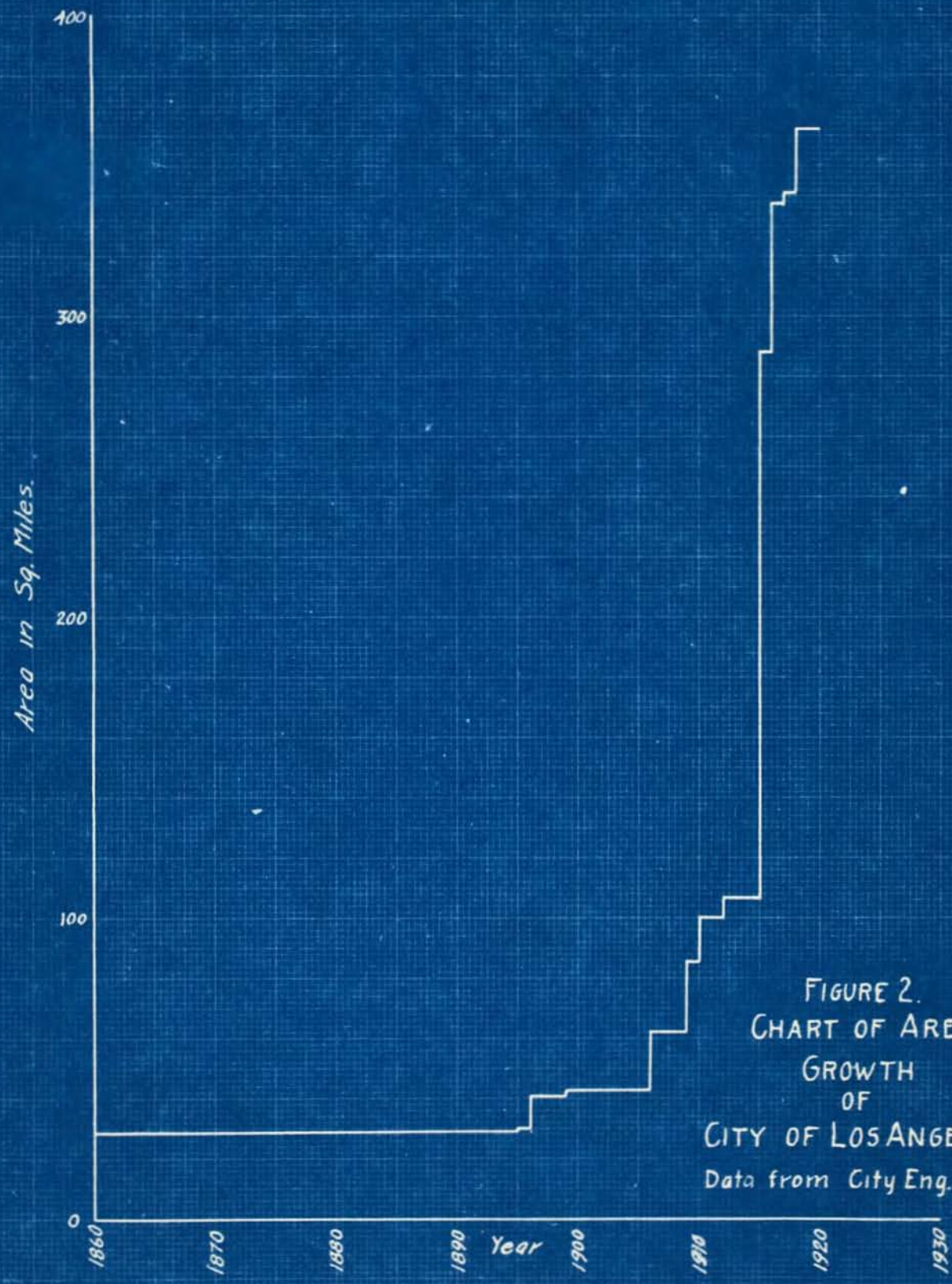
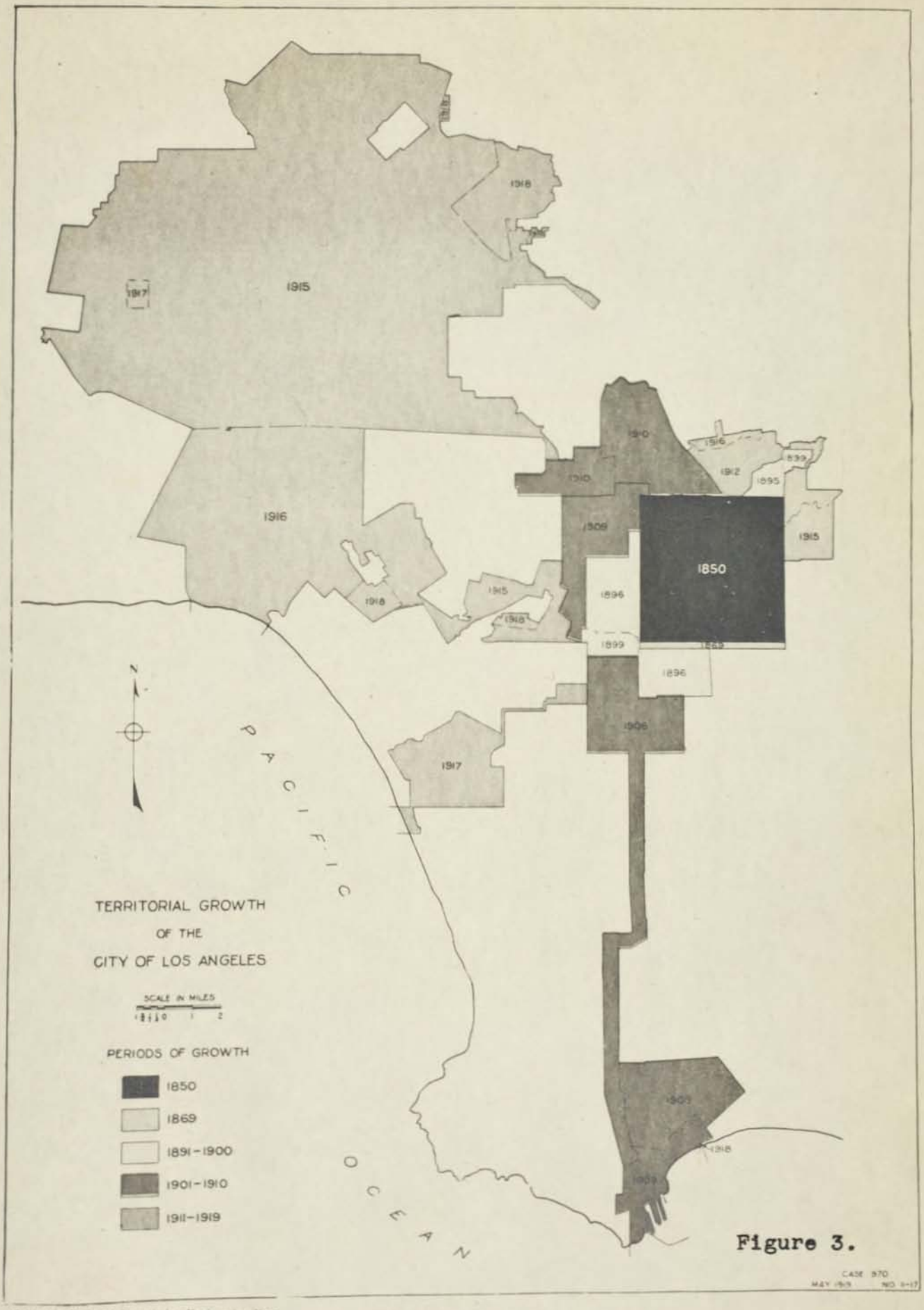


FIGURE 2.
CHART OF AREA
GROWTH
OF
CITY OF LOS ANGELES
Data from City Eng. Map.

To Accompany Thesis of J M Terrass.



California Railroad Commission Engineering Dept.

FIG. 5. TERRITORIAL GROWTH OF LOS ANGELES

Except for the first annexation, the periods of growth are by decades. In order that the density of population shall keep pace with the territorial growth, adequate rapid transit facilities are of prime importance.

From the Cal.R.R.Com.Report on the Union Terminal Investigation.
To Accompany Thesis of J.M.Terrass,May,1922.

The growth in area of the City is shown graphically on the preceding page figure 2.

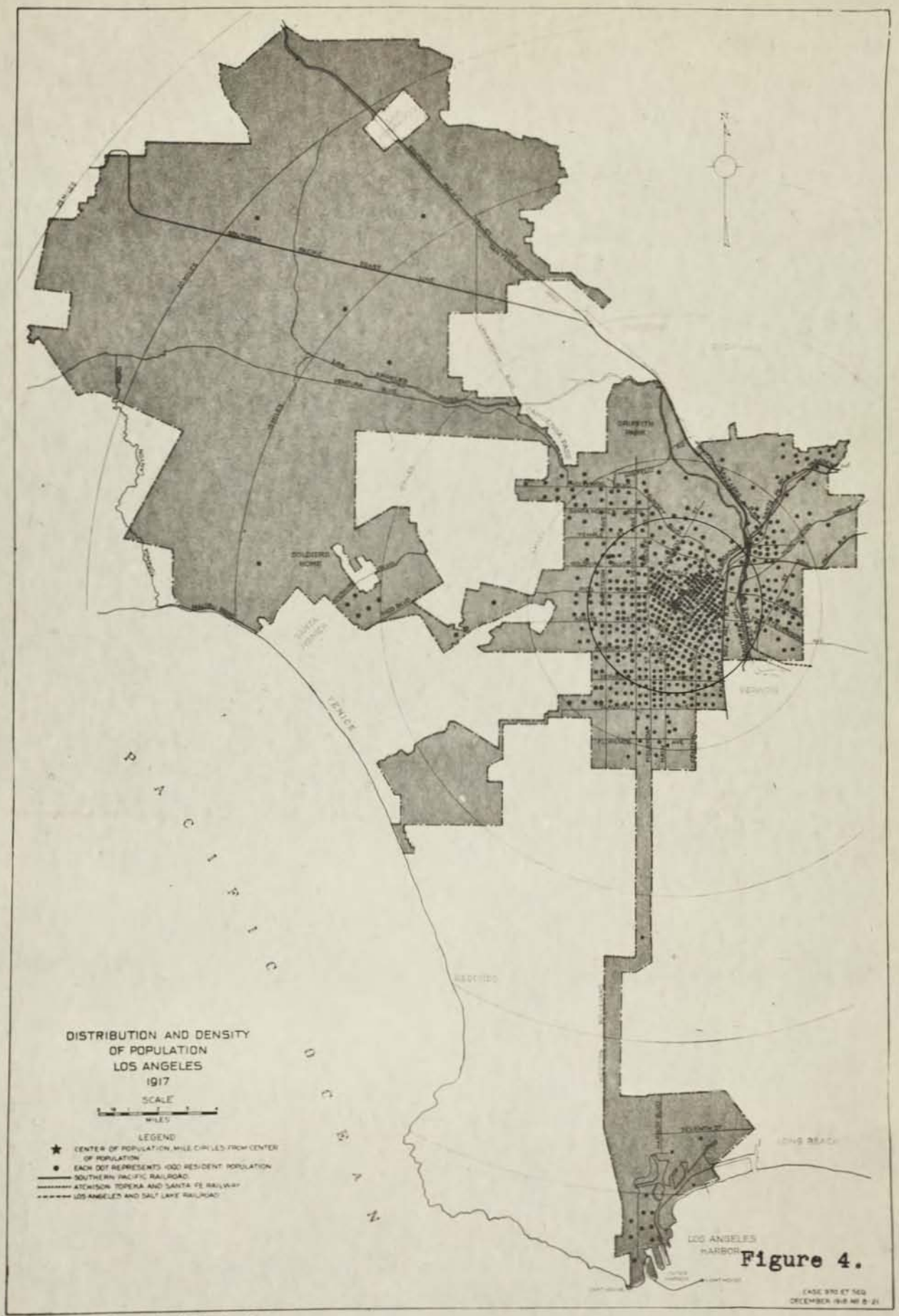
3. Distribution of Population.

The distribution of the population of the City of Los Angeles was studied in connection with the Railroad Grade Crossing and Terminal Investigation of Los Angeles made by the California Railroad Commission. Basing the distribution of population upon the registration of voters, a spot-map was prepared. Each spot represented a resident population of 1000, and was placed at a point which represented the center of the area occupied by this unit of population. Although the map was made in the year 1917, it probably show the present distribution of population very well. The map is show on the following page. The heavy black circle has a radius of three miles, the other circles have their radii shown.

4. Retail District.

Although the retail district may not exactly coincide with the congested district it may be used as a basis in comparing the areas subjected to the most dense traffic of the past and present.

During the last twenty years the retail district has been expanding very rapidly and thus adding street area in proportion. In the year 1900, the junction of Temple and Main Streets was looked upon as the business center of the city. At the present time Seventh and Broadway is the recognized business center. Seventh and Broadway is almost a mile south of Temple and Main Streets. The present tendency of expansion is toward the west and south. The principle retail streets up to the year 1915 were Main, Spring, and Broadway, and thus vehicular traffic had, at the most, only three blocks to travel to get out of the retail district, and, at that time, out of congestion. The result



California Railroad Commission Engineering Dept.

FIG. 6. DISTRIBUTION OF POPULATION IN 1917

Each dot represents 1000 resident population. The star marks the point where a north and south and an east and west line divides the population into two equal parts. This map is based upon the registration of voters.

From The Cal.R.R.Com.Report On The Union Terminal Investigation.

To Accompany Thesis Of J.M.Terrass,May,1922.

was little or not congestion of traffic. As shown on map No. 2, the retail district of 1920 was about 2.6 times as large as that of 1900. The population of the city in 1920 as given by the U. S. Census, was about 5.6 times that of 1900. Therefore the retail district has not grown in proportion to the population. As a result the street area has not increased in proportion to the population.

(B) Los Angeles Railway Corporation. (Local Transportation)

During the fiscal year 1919-1920 many transportation and traffic problems pertaining to rates of fare, service and operation were presented to the Los Angeles Board of Public Utilities and the California Railroad Commission for solution.

One of the results of the investigation made by these bodies was the rerouting of many of the Los Angeles Railway Corporation's lines. The through system of operation was continued wherever possible. With this method of operation the routing is from one terminal, through the business district, to the other terminal. For economic operation, the volume of traffic carried on each end of the line must be equal: also the conditions of operation must be substantially the same on the two divisions of the line. Differences of operation conditions may readily be appreciated by a study of the topographical features of the city. In selecting the routes for the several lines through the business district as many curves as possible were eliminated, it having been found that a car requires about three times as much time in rounding a 90 degree curve to the right, and about five times as much time in turning to the left as that required in moving straight across the intersection. The time being that during which the car is within the area bounded by lines connecting the property line corners.

The routing now in effect for the Los Angeles Railway Corporation cars is as recommended in a joint report made November 12, 1919 by the Los Angeles Board of Public Utilities and the California Railroad Commission in answer to an application for financial relief made by the Los Angeles Railway Corporation on January 21, 1919. Twenty of the twenty eight independent lines operated by the Corporation enter the congested district. Map No. 12 shows the routing of these twenty eight lines. Map No. 3 show the routing of the twenty lines passing through the congested district. Map No. 4 shows the volume of car traffic within the business district. The route of each line is also given, and the car flow data, on the next few pages.

LOCATION OF L. A. RY. CORP. LINES

Line A - West Adams and Lincoln Park

Route-- Mt. Clair and West Adams via Adams; Normandie. 24th; Hoover; Burlington; 16th; Hill; 1st; Spring; North Main; Sunset; North Broadway; Lincoln Park Ave.; looping back via North Main to Plaza; thence to west terminal over above route.

Line B - Brooklyn and Hooper Ave's.

Route -- 51st and Ascot via Ascot Ave.; private right of way; Hooper; 29th; Hooper; 12th; Main; Macy; Brooklyn; Evergreen; Wabash to City limits.

Line C - Angeleno andCrown Hill

Route -- Douglas St. and Kensington Road via Douglas to Edgeware; Bellevue; Beaudry; Alpine; Figueroa; Boston; Bunker Hill; California; Hill; Temple; North Broadway; First; Hill; 5th; Olive;

Sixth; Flower, Third; Boylston; Crown Hill; Columbia; Second; Loma Drive; Belmont to Temple.

Line D - West Sixth Street

Route -- Fifth and Central west, via Fifth; Olive, Sixth; private right of way; Larchmont and Melrose.

Line E - Eagle Rock and Hawthorne.

Route -- Eagle Rock City via private right-of-way; Avenue 28; Dayton; San Fernando Road; Pasadena Avenue; North Broadway; Sunset; North Main; North Spring; First; Broadway; Broadway Place; Main; Jefferson; Grand; Private right-of-way; Santa Barbara; Private right-of-way to Hawthorne.

Line F - East 4th and Hoover.

Route -- Dalton Branch. First and Fresno via Fresno to 4th; Merrick; Traction Way; 3rd; Main; Jefferson; Grand; Private right-of-way; Santa Barbara; Dalton; Vernon to Arlington.
Manchester Branch. Euclid and Stephenson via Euclid; 4th; Merrick; Traction Way; 3rd; Main; Jefferson; Grand; Private right-of-way; Santa Barbara; Hoover; Private right-of-way; Vermont to Manchester.

Line G - Griffith and Griffin.

Route -- Avenue 45 and Montecito Drive via Griffin; Avenue 26; Pasadena Avenue; North Broadway; Sunset; North Main; Spring; Main; 12th; Stanford; 14th; Griffith; Jefferson; McKinley to Vernon.

Line H - Maple and Heliotrope.

Route -- Melrose and Normandie via Melrose; Heliotrope; Temple; New Hampshire; 1st; Bimini Place; Private right-of-way; 2nd; Rampart; 6th; Alvarado; 7th; Maple; Woodlawn; Santa Barbara; Wall; 53rd; to San Pedro.

Line I - West First

Route -- 6th and Alvarado via Alvarado; Ocean View; Bonnie Brae 1st; Olive; 2nd; to Broadway. (Ending at 2nd and Olive during construction of 2nd street tunnel.)

Line J - West Jefferson and Huntington Park.

Route -- 9th Avenue and West Jefferson via West Jefferson; Grand; 7th; Mateo; 9th; Santa Fe; Vernon; Pacific Blvd.; Florence Avenue; Seville to Walnut Park.

Slausa Avenue Branch. Same route as above to Vernon and Santa Fe thence south via Santa Fe to Slauson Avenue.

Line L - West 11th and Lincoln Park.

Route -- L. A. High School via Country Club Drive; Victoria; 10th Hoover; 11th; Broadway; 1st; Spring; North Main; Mission Road; to Lincoln Park, Looping back via Lincoln Park avenue; North Broadway; Sunset; Main; thence to west terminal via above route.

Line M - Grand and Moneta

Route -- 54th and Mesa Branch.--54th and Mesa Drive via 54th; 2nd Avenue; 48th; Private right-of-way; Hoover; Santa Barbara; Grand; 11th; Broadway; 2nd; Spring; Main; Moneta; 54th to 1st avenue Manchester and 6th Avenue Branch.--6th Avenue via 48th st.; Private right-of-way; Hoover; Santa Barbara; Grand; 11th; Broadway; 2nd; Spring; Main; Moneta to Manchester.

Line N - West 9th and East 2nd.

Route -- 8th and Harvard via 8th; Vermont; 9th; Spring; 2nd; Traction Way; 3rd; Santa Fe to 2nd. (Santa Fe Station)

Line O - South Main.

Route -- Slauson and Main via Main; Spring to Temple. Return

via Main to Slauson.

Line P - West Pico and East 1st Street.

Route -- Rowan and Brooklyn via Rowan; 1st; Broadway; Pico to Delaware.

Line R - Stephenson and West 7th Street.

Route -- Stephenson Avenue at Cemetery via Stephenson; Boyle; 7th; Alvarado; 6th to Rampart.

Line S - San Pedro and Western.

Route -- Santa Monica and Western Avenue via Western; 3rd; Vermont; 6th; Commonwealth; Wilshire; Hoover; 7th; San Pedro; South Park; 61st to Moneta. Goodyear Branch: 61st and South Park via South Park; Merrill east to Goodyear Plant.

Line T - Temple Street.

Route -- Temple and North Spring via Temple; Hoover; Clinton; Fountain to Edgemont.

Line U - University and Central Avenue.

Route -- Slauson and Central via Central; 5th; Olive; 6th; Figueora; Washington; Estrella; 23rd; Union; Hoover; 32nd; McClintock; Vermont; 39th; Denker; 39th; to Western avenue. Manchester Branch.- From 39th and Vermont south via Vermont to Manchester.

Line W - Washington and Garvanza.

Route -- York Blvd. Branch: Washington and Rimpau via Washington; Flower; 10th; Main; Sunset; North Broadway; Pasadena Avenue; private right-of-way; Monte Vista; Avenue 61; Piedmont; Pasadena Avenue; York Blvd. to Avenue 50.

Buena Vista Terrace Branch,--Same as above to Pasadena and York Blvd. then via Eagle Rock Avenue to Buena Vista Terrace.

The following lines do not enter the business district.

Line K - East Jefferson and 38th Street.

Route -- 38th and Ascot via 38th; Central; Jefferson; University Avenue to Exposition Blvd.

Line V - Vernon and Vermont. (Cross town line.)

Route -- Route Vernon and Pacific Blvd. via Vernon; Vermont to 1st. St.

Gage Shuttle

Route -- Brooklyn and Rowan via Rowan; Hammel; Gage to terminus.

Indiana Shuttle.

Route -- Stephenson and Indiana via Indiana to 1st Street.

Mateo Street Shuttle.

Route -- 1st and Santa Fe via Santa Fe; Mateo to 7th street.

Homeward Avenue Shuttle.

Route-- Manchester and Moneta via Private right-of-way to Lary Junction and Moneta.

West Adams Shuttle.

Route -- Mt. Clair via West Adams to Glen Airy.

Vermont Avenue Shuttle.

Route -- Manchester and Vermont south via Vermont to Delta.

Data for L. A. Ry. Car Flow (obtained from schedule in effect Jan. 1, 1922.)

Line	Headway (Minutes)	Cars per Hour
C - Angeleno & Crown Hill	8	7.5
B - Brooklyn & Hooper Ave.	3½	17.1
E - Eagle Rock & Hawthorne	6	10.0
F - East 4th & Hoover St.		
Hoover St. Branch	5	12.0
Dalton Ave. Branch	5	12.0
M - Grand & Moneta		
54th & Mesa Branch	3	20.0
Manchester & Arlington Branch	3	20.0
G - Griffith & Griffin Ave.	6	10.0
H - Maple & Heliotrope Drive	3	20.0
S - San Pedro & Western Ave.	3	20.0
R - Stephenson Ave. & West 7th	3	20.0
T - Temple St.	4½	13.3
U - University & Central		
Manchester Ave. Branch	10	6.0
West 39th St. Branch	5	12.0
39th St. & Vermont turn back	10	6.0
W - Washington & Garvanza		
South	3	20.0
North	2½	24.0

Line	Headway (Minutes)	Cars per Hour
A - West Adams & Lincoln Park		
West	2½	24.0
East	5	12.0
L - West 11th & Lincoln Park		
West	3	20.0
East	5	12.0
I - West 1st St.	5	12.0
J - West Jefferson & Huntington Park	5	12.0
Through line	5	12.0
N - West 9th & East 2nd.	3½	17.1
P - West Pico & East 1st.		
East	2	30.0
West	2½	24.0
D - West 7th	5	12.0
O - South Main	5	12.0

L. A. Ry. Car Flow on Streets in Business District.

Street	From	To	West	East
Pico	Broadway	Figueroa	30.00	30.00
12th	San Pedro	Main	27.14	27.14
11th	Broadway	Grand	60.00	52.00
	Grand	Figueroa	20.00	12.00
10th	Main	Flower	20.00	24.00
9th	Spring	Figueroa	17.14	17.14

Street	From	To	West	East
7th	San Pedro	Maple	64.00	64.00
	Maple	Grand	84.00	84.00
	Grand	Figueroa	60.00	60.00
6th	Olive	Flower	43.50	43.50
	Flower	Figueroa	36.00	36.00
	Figueroa	Fremont	12.00	12.00
5th	San Pedro	Hill	36.00	36.00
	Hill	Olive	43.50	43.50
3rd	San Pedro	Main	24.00	24.00
	Flower	Boylston	7.50	7.50
2nd.	Broadway	Olive	12.00	12.00
	Spring	Broadway	40.00	40.00
	San Pedro	Spring	17.14	17.14
1st	Olive	Hope	12.00	12.00
	Broadway	Hill	31.50	19.50
	Spring	Broadway	78.00	64.00
	Spring	Los Angeles	24.00	30.00
Temple	Spring	Broadway	13.33	13.33
	Broadway	Hill	20.83	20.83
	Hill	Flower	13.33	13.33

L. A. Ry. Car Flow on Streets in Business District.

Street	From	To	North	South
Figueroa	Pico	6th	24.00	24.00
Flower	Pico	10th	24.00	20.00
	6th	3rd	7.50	7.50
Grand	Pico	11th	64.00	64.00
	11th	7th	24.00	24.00

Street	From	To	North½	South
Olive	6th	5th	43.50	43.50
	2nd	1st	12.00	12.00
Hill	Pico	5th	24.00	12.00
	5th	1st	31.50	19.50
Broadway	Pico	11th	30.00	24.00
	11th	10th	82.00	84.00
	10th	2nd	92.00	94.00
	2nd	1st	52.00	54.00
	1st	Temple	7.50	7.50
Broadway Place			10.00	10.00
Main	Pico	12th	86.00	86.00
	12th	Broadway Place	113.14	113.14
	Broadway Place	10th	103.14	103.14
	10th	Spring	127.14	123.14
	9th	3rd	71.14	67.14
	3rd	Temple	47.14	43.14
North Main			85.14	101.14
Spring	9th	2nd	73.14	73.14
	2nd	1st	16.00	16.00
	1st	Temple	50.00	70.00
Maple	Pico	7th	20.00	20.00

(C) PACIFIC ELECTRIC RAILROAD. (INTERURBAN TRANSPORTATION.)

The Pacific Electric Railroad Corporation operates, primarily, an interurban system, but does operate some local lines also. The location of the lines through the business district was made several years ago, at which time the present traffic conditions

could not be forseen. The Joint Report of the Los Angeles Board of Public Utilities and the California Railroad Commission previously mentioned caused the reduction of some of the traffic on Main street by the rerouting of some lines to the elevated tracks leading from the Main street station to San Pedro street and along San Pedro street, at surface, north and south to connect with the lines previously used. Other studies made with reference to a Union Station and to a betterment of service, have contemplated a complete rerouting of practically every P. E. line through the business district. These reports will be considered later.

The location of the P. E. lines and the volume of car traffic on them is given below, and also shown on maps No. 3 and No. 4 and on the general City map at the end of the report. In addition to the traffic given, there is, practically every day, from 40 to 50 special cars which may operate over any of the lines as occasion demands.

P. E. Lines Operating from Hill Street Station.

(Hill Street, Between 4th and 5th.)

Routes through Business District

N - from station north on Hill to Sunset; west on Sunset.

S - south on Hill to 16th; west on 16th.

Flow of Cars through Business District.

Line	Route	Cars per Hour
Hollywood		
Inbound	N	30
Outbound	N	30

Line	Route	Cars per Hour
Highland Ave.		
Inbound	N	3
Outbound	N	3
Echo Park Ave.		
Inbound	N	4
Outbound	N	4
South Hollywood-Santa Monica Boulevard		
Inbound	N	15
Outbound	N	15
Redondo Beach via Playa del Rey		
Inbound	S	3
Outbound	S	3
Hollywood-Santa Monica-Venice		
Inbound	N	4
Outbound	N	3
Venice Short Line		
Inbound	S	4
Outbound	S	11
Sawtelle		
Inbound	S	3
Outbound	S	3
Van Nuys-Owensmouth-San Fernando		
Inbound	N	3
Outbound	N	3

Line	Route	Cars per Hour
West 16th St. Local		
Route-- Hill St. from Sunset to 16th; west on Sunset and west on 16th.		
North		8
South		8

P. E. Lines Operating from Main St. Station

Routes through Business District

M. 1, Station, north on Main to 1st., east on 1st to Los Angeles, north on Los Angeles to Aliso.

M. 7, Station, south on Main to 7th, east on 7th to Alameda.

M. 9, Station, south on Main to 9th, east on 9th to Long Beach Ave.

L. 7, Los Angeles St. Station, over private right of way to 7th east on 7th to Alameda.

6 W. Los Angeles St. Station, west on 6th to Figueroa, north on Figueroa to 2nd, west on 2nd to Lake Shore.

N. Elev., Main St. Station, east on elevated tracks to San Pedro, south on San Pedro to 9th.

S. Elev., Main St. Station, east on elevated tracks to San Pedro, south on San Pedro to 9th.

6 E., 6th and Main Sts., east on sixth to Southern Pacific Station.

Car flow is for evening rush period (4:30 to 6:00 P. M.) and is given in terms of cars per hour.

Flow of cars through Business District

Line	Route	Cars per Hour
Pasadena Short Line		
Inbound	M. I.	4.7
Outbound	N. Elev.	4.7
Pasadena Oak Knoll Line		
Inbound	N. Elev.	4.0
Outbound	M. I.	4.0
Alhambra-San Gabriel Line		
Inbound	M. I.	3.3
Outbound	N. Elev.	3.3
Sierra Vista Line		
Inbound	M. I.	6.0
Outbound	M. I.	6.0
South Pasadena Line		
Inbound	M. I.	6.0
Outbound	M. I.	6.0
Watts Local Line		
Inbound	M. 9.	12.0
Outbound	M. 9.	20.0
Monrovia-Glendora Line		
Inbound	Elev. N.	2.0
Outbound	Elev. N.	2.7
Sierra Madre Line		
Inbound	N. Elev.	1.3
Outbound	M. I.	1.3

Line	Route	Cars per Hour
Long Beach Line		
Inbound	S. Elev.	3.3
Outbound	S. Elev.	2.7
San Pedro Line (via Dominguez)		
Inbound	S. Elev.	2.7
Outbound	S. Elev.	2.7
San Bernardino-Riverside-Redlands		
Pomona-San Dimas-Covina Line		
Inbound	N. Elev.	2.0
Outbound	N. Elev.	4.0
Whittier Line		
Inbound	S. Elev.	3.3
Outbound	S. Elev.	6.3
La Habra-Fullerton Line		
Inbound	S. Elev.	1.3
Outbound	S. Elev.	0.7
Edendale Line		
Inbound	6 W.	12.0
Outbound	6 W.	12.0
Santa Ana Line		
Inbound	S. Elev.	1.3
Outbound	S. Elev.	2.0
Redondo Beach via Gardena Line		
Inbound	S. Elev.	1.3
Outbound	S. Elev.	2.0

Line	Route	Cars per Hour
El Nido-Hawthorne-El Segundo Line		
Inbound	S. Elev.	2.0
Outbound	S. Elev.	2.0
Los Angeles-West Athens		
Torrance-San Pedro Line		
Inbound	S. Elev.	3.3
Outbound	S. Elev.	1.3
Newport Line		
Inbound	L. 7	0.7
Outbound	L. 7	0.7
Los Angeles-Culver Jct. (air line)		
Inbound	S. Elev.	1.3
Outbound	S. Elev.	2.7
Glendale-Burbank Line		
Inbound	6 W.	4.7
Outbound	6 W.	7.3

DATA FOR P. E. R. R. CAR FLOW DIAGRAM

Street	Cars per Hour
6th St. Main to Figueroa	
East	16.7
West	19.3
Figueroa St. 6th to 2nd	
South	16.7
North	19.3

Street	Cars per Hour
6th St. Main To Southern Pacific Station	
East	12.0
West	12.0
Main St. Station to 1st. 1st to Los Angeles; Los Angeles north	
North	17.3
South	20.0
Main St. Station to 9th	
North	12.0
South	20.0
Hill St., Station north on Hill to Sunset; west.	
North	66.0
South	67.0
Hill St. Station south on Hill to 9th	
North	22.0
South	29.0
Hill St. 9th to 16th; 16th St. west	
North	18.0
South	25.0
7th St., Main to Los Angeles	
West	0.0
East	0.0

Street	Cars per Hour
7th St., Los Angeles to Alameda	
West	0.7
East	0.7
9th St., Main to Alameda	
West	12.0
East	20.0

D. Vehicular Traffic.

1. Growth in Automobile Registration in Los Angeles County.

The growth in the number of automobiles registered in Los Angeles County, during the past eight years, has been very rapid. It has been much faster than the growth of the facilities required to handle vehicular traffic in the City of Los Angeles. The increasing number of automobiles is, to a very great extent, responsible for the congested condition of the City Streets. A chart is given on the following page, showing the growth of the automobile registration for the County. The data for the chart were obtained from the State Moter Vehicle Department and is given below.

Year	Registration.
1914	43,099
1915	55,217
1916	74,709
1917	93,654
1918	107,232
1922	172,313

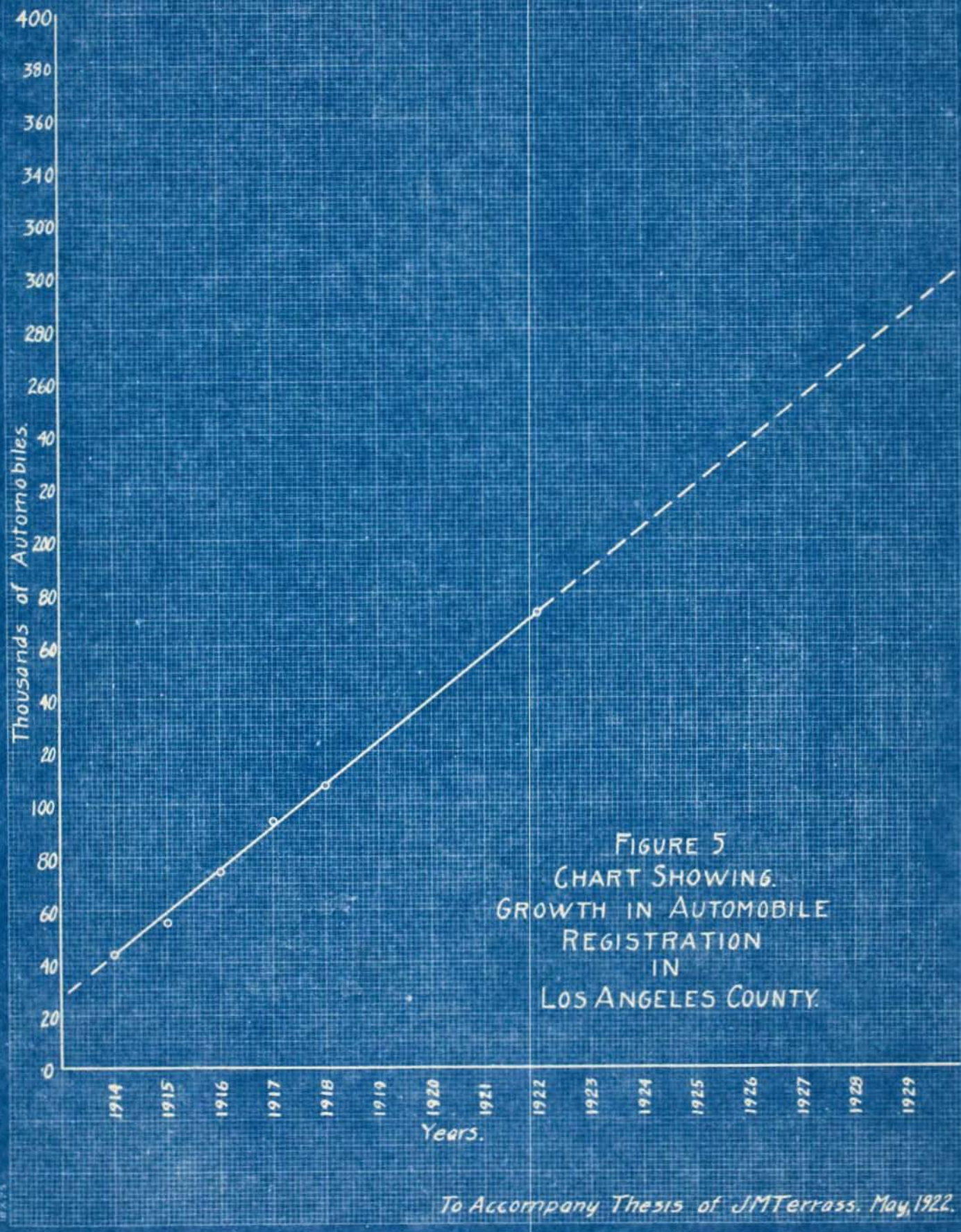


FIGURE 5
CHART SHOWING
GROWTH IN AUTOMOBILE
REGISTRATION
IN
LOS ANGELES COUNTY.

2. Number of Automobiles Using Streets of Business District per Day.

Mr. Richards of the Southern California California Automobile Club estimates that there are between 25,000 and 30,000 different automobiles on the streets of the business district of Los Angeles per day. These figures are based on the following statistics and estimates for January 1, 1922.

Automobiles registered in City of L. A. ----------	94,813
Automobiles registered in County of L. A. outside of the City ------ ----------	77,500
Estimated number of automobiles entering City from nearby counties ----------	80,000
Estimated number of automobiles arriving and departing from country at large ----------	650
Total ----------	252,313

Estimating from 10 to 12 percent of this total as using the streets each day, gives the generally accepted estimate of 25,000 to 30,000.

3. Check made by the Automobile Club of Southern California

Studies were carried on by the Autobobile Club of Southern California to determine the percentage of machines which entered the business district from one side, passed through and out another direction. Sixteen stations were established on the principle thoroughfares around the district and the time and number of every machine passing each station was recorded. A machine entering and not reappearing at one of these stations within an hour and a half was supposed to be on business within the district. The result of this study was the conclusion that an average of 3% of the machines

entering the business district passed through to another district. The maximum percentage per day found to pass through was 6%.

This conclusion is criticised by both the City Engineer, Mr. Griffin, and Mr. Whithall of the City Planning Department, as not representing the true facts, saying that many of the machine drivers probably had found the less direct routes of the side streets, which were not covered by the check, were time savers.

4. Check Made By The Los Angeles Board Of Public Utilities.

Accheck of vehicular traffic was made on October 18, 1921, by the Los Angeles Board of Public Utilities. Several representative street intersections were chosen with the assumption that representative data could be used to estimate the conditions at other intersections. During each hour of the afternoon the number of vehicles that approached from each direction and turned to the right, turned to the left, or passed straight through the intersection, was obtained. The data as taken are given on the following pages. These data show that the maximum density of traffic, during the hour 4:00 P. M. to 5:00 P. M., is in the central portion of the business district. Hill, Broadway, Spring, and Main Streets, between Third and Nineth Streets are considered the central portion of the business district. After 5:00 P. M. the maximum density is found at the edges of the district defined by the City Traffic Ordinance as the "Congested District". Between the hours 4:00 P. M. and 5:00 P. M. the average number of vehicles passing these intersections was 1136. At Fifth and Main Streets 935 and at Sixth and Broadway 1239 vehicles passed the intersections. During the hour 5:00 P. M. to 6:00 P. M. the average number was 1054. The lowest number passing an intersection was 729 at Sixth and Main Streets and the highest was 1434 at Sixth and Figueroa Streets.

The two low figures are both at Main Street intersections and are probably due to the presence of Pacific Electric trains operating on Main Street. Pacific Electric trains also operate on Sixth Street and undoubtedly that was the reason the smallest number of vehicles was found at the intersection of Sixth and Main Streets

The largest number of vehicles to any intersection was at Sixth and Figueroa Streets. In addition to the regular Police Traffic Officer, there are two L. A. Ry. men on duty from 4:00 P. M. to 6:00 P. M. at this intersection. The L. A. Ry. men help to get vehicular traffic into lines to facilitate rapid motion and at the same time make it possible for passengers to board the street cars without confusion and loss of time. The result of the use of the L. A. Ry. men is clearly shown in the large number of vehicles that pass this intersection.

With the available data, and a consideration of the causes for the extreme high and low numbers of vehicles passing intersections in the congested district, it seems reasonable to assume an average number of 1148 vehicles per hour at intersections where this is possible. 1148 is the average number of vehicles per hour that passed the intersection for which data was taken between the hours 1:00 P. M. and 6:00 P. M., and is a larger number than the average between the hours 4:00 P. M. and 6:00 P. M.

VEHICULAR CHECK MADE OCTOBER 18, 1921.

Time P. M.	Direction	Thru	Right	Left	Direction	Thru	Right	Left
			Sixth Street and Broadway.					
1-2	From North	275	85	0	From East	205	90	0
2-3	"	293	76	0	"	151	76	1
3-4	"	285	75	0	"	167	78	1
4-5	"	270	81	0	"	152	95	0
5-6	"	270	61	0	"	160	91	0
Average	"	279	76	0	"	167	86	0
1-2	From South	280	75	0	From West	195	70	0
2-3	"	334	109	0	"	170	78	1
3-4	"	340	74	0	"	295	110	1
4-5	"	300	100	0	"	141	99	1
5-6	"	294	83	0	"	101	78	1
Average	"	310	88	0	"	180	87	1

Number of automobiles passing intersection per hour;

Between the hours 4-5 PM----1239

5-6 PM----1139

4-6 PM----1189

1-6 PM----1274

Sixth and Main Streets

Time	Direction	Thru	Right	Left	Direction	Thru	Right	Left
P.M.								
1-2	From North	235	76	1	From East	152	45	4
2-3	"	280	80	0	"	120	60	0
3-4	"	275	110	0	"	125	71	0
4-5	"	286	96	0	"	176	90	0
5-6	"	120	61	0	"	90	80	0
Average	"	239	85	0	"	133	69	1
1-2	From South	180	83	0	From West	177	70	0
2-3	"	294	80	0	"	231	93	0
3-4	"	193	83	0	"	187	85	0
4-5	"	180	85	0	"	190	83	0
5-6	"	187	65	0	"	79	47	0
Average	"	207	79	0	"	173	76	0

Number of automobiles passing intersection per hour;

Between the hours 4-5 PM--- 1186

5-6 PM--- 729

4-6 PM--- 958

1-6 PM--- 1061

Fifth and Hill Streets.

Time	Direction	Thru	Right	Left	Direction	Thru	Right	Left
P.M.								
1-2	From North	174	105	37	From East	87	69	30
2-3	"	189	124	33	"	121	70	23
3-4	"	205	129	38	"	154	85	36
4-5	"	167	110	330	"	92	58	19
5-6	"	196	101	17	"	95	90	25
Average	"	186	114	91	"	110	74	27
1-2	From South	175	42	31	From West	129	26	145
2-3	"	190	47	33	"	141	29	188
3-4	"	133	45	17	"	100	19	120
4-5	"	135	42	25	"	102	30	96
5-6	"	140	38	17	"	120	33	144
Average	"	155	43	25	"	118	27	139

Number of automobiles passing intersection per hour;

Between the hours 4-5 PM--- 1206

5-6 PM--- 1016

4-6 PM--- 1111

1-6 PM--- 1209

Fifth and Main Streets

Time	Direction	Thru	Right	Left	Direction	Thru	Right	Left
P.M.								
1-2	From North	170	61	4	From East	92	27	0
2-3	"	236	69	0	"	142	20	0
3-4	"	261	111	0	"	112	32	0
4-5	"	239	66	0	"	98	26	0
5-6	"	256	71	0	"	103	27	0
Average	"	232	76	1	"	109	26	0
1-2	From North	192	44	0	From West	159	88	0
2-3	"	260	80	0	"	190	120	0
3-4	"	200	55	0	"	150	70	0
4-5	"	208	68	0	"	163	67	0
5-6	"	200	35	0	"	117	78	0
Average	"	212	56	0	"	156	85	0

Number of automobiles passing intersection per hour;

Between the hours 4-5 PM--- 935

5-6 PM--- 887

4-6 PM--- 911

1-6 PM--- 953

Sixth and Figueroa Streets

Time	Direction	Thru	Right	Left	Direction	Thru	Right	Left
P.M.								
1-2	From North	325	10	35	From East	88	20	28
2-3	"	300	13	33	"	100	20	30
3-4	"	250	12	37	"	100	18	26
4-5	"	300	18	23	"	125	22	38
5-6	"	300	21	20	"	180	30	51
Average	"	295	15	30	"	119	22	35
1-2	From South	355	75	8	From West	195	40	6
2-3	"	335	85	22	"	173	42	8
3-4	"	390	65	7	"	175	60	7
4-5	"	360	45	10	"	210	55	5
5-6	"	480	61	8	"	205	76	2
Average	"	384	66	11	"	172	57	5

Number of automobiles passing intersection per hour;

Between the hours 4-5 PM--- 1211

5-6 PM--- 1434

4-6 PM--- 1322

1-6 PM--- 1208

Sixth and Olive Streets

Time	Direction	Thru	Right	Left	Direction	Thru	Right	Left
P.M.								
1-2	From North	180	65	20	From East	136	24	49
2-3	"	195	85	17	"	151	37	43
3-4	"	200	84	11	"	156	23	56
4-5	"	234	78	8	"	115	35	43
5-6	"	360	98	5	"	136	34	47
Average	"	234	82	12	"	139	31	48
1-2	From South	165	77	28	From West	137	95	90
2-3	"	190	107	52	"	230	80	124
3-4	"	220	102	40	"	280	72	124
4-5	"	137	60	19	"	210	47	52
5-6	"	156	43	30	"	160	20	31
Average	"	174	78	34	"	203	63	82

Number of automobiles passing intersection per hour;

Between the hours 4-5 PM--- 1038

5-6 PM--- 1120

4-6 PM--- 1079

1-6 PM--- 1181

Average number of automobiles passing intersections at which checks were made; between the hours 4-5 PM-- 1136

5-6 PM-- 1054

4-6 PM-- 1095

1-6 PM-- 1148

5. Photograph Traffic Check.

At the present time the Automobile Club of Southern California is engaged in an attempt to photograph the traffic in the business district, from aeroplanes. The plan is to find the number of vehicles and street cars actually on the streets and their positions and directions of travel at several critical hours of the day, from enlargements of the aerial photographs. The idea is a good one, but thus far the results have not been very satisfactory, because of the shadows cast by the buildings . A reproduction of one of the photographs is given on the following page, but is of little value as a traffic check.

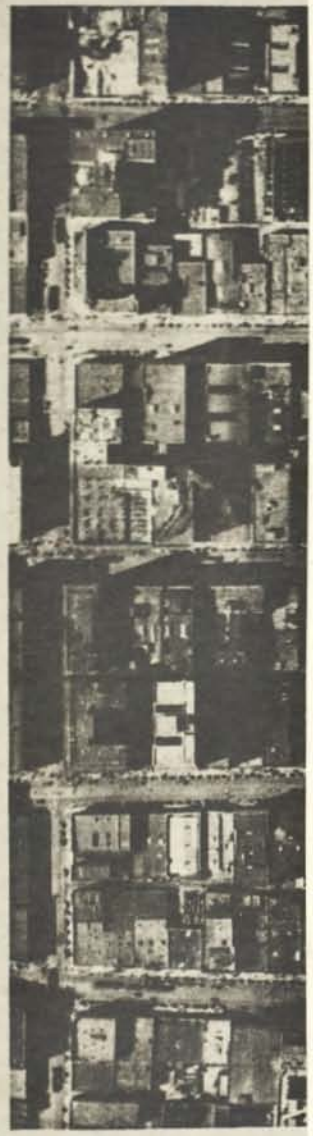
E. PEDESTRIAN TRAFFIC IN BUSINESS DISTRICT.

Pedestrian traffic checks have been made at two points by the Los Angeles Board of Public Utilities, Seventh street and Broadway, and Fifth street and Broadway. The method used was to count the number of people traveling in each direction on the eight sidewalks leading from the intersection. The detailed results of the Fifth and Broadway check for October 18, 1921, and the average and maximum number ofpedestrians per hour for the same intersection for several other dates are given on the following pages.

A check of the route used by pedestrians was made by City Engineer Griffin. This was done by stopping a large number of people in the business district and asking their starting point and their destination. The result of this check showed that 92% of the pedestrians were using the wrong streets to get to their destinations over the most direct and quickest route.

The average sidewalk in the business district is twelve feet wide.

Aerial Photograph of a Part of the Business District of Los Angeles.



To Accompany Thesis Of J.M.Terrass, May,1922.

Aerial Photograph Of That Portion Of The Business District Of Los Angeles Bounded At The Extreme Right By First Street, At The Extreme Left By Seventh Street, At The Top By Olive Street, And At The Bottom By Main Street.

Pedestrian Check - Fifth and Broadway - Oct. 18, 1921 2 P.M. to 6 P.M.

Direction of Flow		2-3 P.M.	3-4 P.M.	4-5 P.M.	5-6 P.M.	Total
N. side 5th	Eastbound	1514	1468	1688	1913	6583
	Westbound	1404	1398	1672	2207	6681
S. side 5th	Eastbound	1195	1040	880	1250	4365
	Westbound	2525	1835	2660	2690	9710
E. side Broadway	Northbound	1604	1460	1310	1970	6344
	Southbound	1125	1100	1075	1275	4575
W. side Broadway	Northbound	2760	3005	2835	2150	10750
	Southbound	3450	3120	2800	2390	11765
Totals ---------- -----		15582	14426	14920	15845	60773
Average per hour -------		15193				

COMPARISON OF PEDESTRIAN CHECKS

FIFTH AND BROADWAY

Date	Total Ped.	Max. per hr.	Average per hr.
Apr. 19, 1920	74751	20628	18688
May 5, 1920	60409	15986	15102
May 24, 1920	69651	18510	17413
June 28, 1920	66559	18168	16645
Nov. 29, 1920	81172	21218	20293
Oct. 18, 1921	60773	15845	15193

F. REGULATION OF TRAFFIC.

City Ordinances.

The following outstanding features were obtained from a copy of the Los Angeles City "Traffic Ordinance" No. 41090 (New Series), and are the regulations which affect traffic conditions.

1. Definition of Business District; Shown on Map No. 5

All those certain streets, alleys, courts and places included in that portion of the City of Los Angeles bounded and described as follows:

Beginning at a point on the easterly line of North Main Street, distant thereon sixty (60) feet northerly from the intersection of the easterly line of North Main Street with the southerly line of Plaza Street; thence easterly, parallel with the southerly line of Plaza Street to a point in the easterly line of Los Angeles Street; thence southerly along the easterly line of Los Angeles Street to the northerly line of Aliso Street; thence easterly along the northerly line of Aliso Street to a point in the northerly prolongation of the easterly line of San Pedro Street; thence southerly along said prolongation and along the easterly line of San Pedro Street to a point in the northerly line of Jackson Street; thence easterly along the northerly line of Jackson Street to a point in the northerly prolongation of the easterly line of Central Avenue; thence southerly along said last mentioned prolongation and along the easterly line of Central Avenue to a point in the southerly line of Seventh Street; thence westerly along the southerly line of Seventh Street to a point in the easterly line of San Pedro Street; thence southerly along the easterly line of San Pedro Street to a point in the southerly line of Pico Street;

thence westerly along the southerly line of Pico Street to a point in the westerly line of Figueroa Street; thence northerly along the westerly line of Figueroa Street to a point in the northerly line of Sunset Boulevard; thence easterly along the northerly line of Sunset Boulevard and the easterly prolongation thereof to a point in the easterly line of North Main Street; thence southerly along the easterly line of North Main Street to the point of beginning.

2. Definition of Congested District; Shown on Map No. 4.

The following streets or portions of streets:

Main Street, from First Street to Ninth Street;

Spring Street, from First Street to Ninth Street;

Broadway, from First Street to Ninth Street;

Hill Street, from First to Ninth Street;

Olive Street, from Fifth Street to Eighth Street;

Grand Avenue, from Sixth Street to Eighth Street;

The east side of Hope Street, from Sixth Street to Eighth Street;

First Street, from Los Angeles Street to Olive Street;

Second Street from Los Angeles Street to Olive Street;

Third Street from Los Angeles Street thru the tunnel to to Figueroa Street;

Fourth Street, from Los Angeles Street to Olive Street;

Fifth Street, from Los Angeles Street to Olive Street;

Sixth Street, from Los Angeles Street to Figueroa Street;

Seventh Street, from Maple Avenue to Figueroa Street;

Eighth Street, from Los Angeles Street to Figueroa Street;

The north side of Ninth Street, from Main Street to Olive Street;

Clay Street;

Winston Street, from Main Street to Los Angeles Street;

Turning to the left is not permitted in the following district between the hours of 9:00 A. M. and 6:15 P. M.

Main Street, from the northerly line of Fifth Street to the Southerly line of Seventh Street;

Spring Street, from the northerly line of Fifth Street to the southerly line of Seventh Street;

Broadway, from the northerly line of Fourth Street to the southerly line of Seventh Street;

Hill Street, from the northerly line of Sixth Street to the southerly line of Seventh Street;

Fourth Street, from the easterly line of Broadway to the westerly line of Broadway;

Sixth and Seventh Streets, from the easterly line of Main Street to the westerly line of Hill Street;

Fifth Street, from the easterly line of Main Street to the westerly line of Broadway;

Seventh Street from the easterly line of Main Street to the easterly line of Los Angeles Street;

Third Street, from the westerly line of Broadway to the westerly line of Hill Street, for vehicles traveling in a westerly direction.

3. Direction of traffic movements in alleys

The direction of traffic movements in all alleys within the congested district must be from south to north or from east to west.

4. Automobiles stopping behind and passing street cars.

Vehicles must stop ten feet behind street cars and interurban cars in the city at large. Within the congested district vehicles may pass street cars and interurban cars by keeping at least four feet from the steps of the same.

5. Parking of vehicles.

Vehicles stopping, except in emergency, must be parked with the right side toward the curb and within one foot of the curb.

Vehicles must not park within 35 feet of the near curb of an intersecting street.

Parking, between the hours of 10:00 A.M. and 4:00 P.M. in the congested district is limited to 45 minutes, and between the hours of 4:00 P.M. to 6:15 P.M. no parking is permitted in this district. Stops of 2 minutes may be made for the purpose of taking on, or discharging passengers.

6. Restrictions as to types of Vehicles.

Vehicles in tandem are allowed on Third Street and on Eighth Street only.

Dirt trucks, garbage trucks etc., not allowed in congested district between hours of 9:00 A.M. and 6:15 P.M.

7. Traffic Officers.

Traffic Officers are stationed at every street intersection within the congested district and also at many other points in the city at large, where regulation is necessary. At most of the intersections within the congested district, automatic "stop and go" signals are being used to assist the Officers and to give a clearer indication to the drivers of vehicles when and when not to proceed.

G. Value of Available Data.

Until recently the traffic problem has been one of regulation, and as such has been taken care of by the Police Department. The problem has developed into one which regulation alone cannot solve, and the solution of which is of very great importance to the future growth of the city. As an engineering problem, plans of relief, are just beginning to be studied and as yet very little data are available. The data that are available do not give all of the facts and some things that they seem to show are not at all true. These data may, however, be used to suggest new plans of relief and to show which of the plans already suggested, are worthy of further investigations. They will also be of value in directing these investigations.

Chapter 2. Present Conditions

(A) Points of Congestion.

The actual congested district is the "Congested District" as defined in the Los Angeles City Ordinance No. 41090 (New Series). Although this is not as apparent from the data given as it might be if more data ere available, it is very apparent to any one who is familiar with the city, especially those who have occasion to cross the district in automobiles. The greatest congestion is found in the central portion of this district up until about 4:00 P.M., after that time it is to be found on the streets leading from the central portion and on the outskirts of the above defined congested district.

(B) Causes of Congestion

The real cause of congestion of traffic is insufficient, or inefficient use of street area.

During the rush period from 4:00 P.M. to 6:00 P.M. there are many more street cars in operation than during the other hours of the day. Taking Sixth and Main Streets as an example, and assuming the degree of congestion to be the same during the afternoon, it seems that the increase in the number of street cars causes a proportional decrease in the number of vehicles. This conclusion is in accord with the data taken as to the number of vehicles passing this intersection per hour, but the data do not take into consideration the speed of flow of the traffic. Therefore the conclusion that there is a smaller number of vehicles on the streets during the rush period than during the other hours of the day does not hold. There is, probably, a much larger number of vehicles on the streets during this period than during any other period of the day. The increase in the number of street cars with a probable increase in the number of vehicles causes the velocity of flow of traffic to be much slower, and as a result, more congested.

With the present regulation allowing vehicles to for two minutes during the rush period, and the average width of streets, vehicles keep out of the space next to the curb to avoid delay and in order to pass street cars must move in single lines of flow. Vehicles, turning into and out of parking positions, delay traffic more where street cars block other vehicles from turning out to avoid such obstructions. Thus, where street cars are numerous enough to prevent the formation of a double line of vehicles and do not operate the tracks to full capacity, there is inefficiency.

At the present time the only outlet for traffic to the west between Sixth Street and Sunset Blvd. is Third Street. Thus it is necessary for westbound traffic to remain within the congested district between these limits. Broadway and North Main Street take practically

all of the traffic from the north, and northeast. The traffic of the east, south, and southwest is provided for by many streets.

(C) Conclusions Drawn From Present Conditions.

1. Street area is insufficient for present traffic.

2. Street area is inefficiently used.

3. Outlets for traffic are insufficient.

4. Increased efficiency in use of street area by regulation is practically impossible with present railway system in operation.

5. Pedestrian traffic, although somewhat congested at the present time, will probably adjust itself, and in doing so cause the retail district to expand. Expansion of the retail district is a desirable thing if warrented. Pedestrian traffic takes business with it and would thus warrent any expansion due to its presence.

CHAPTER 3.

Improvements and Plans for Improvements which will Affect Traffic Conditions.

(A) Second Street Tunnel

The Second Street Tunnel, now under construction, will extend from Hill Street to Figueroa Street on Second Street.

The West First Street L. A. Ry. line which now starts at Second and Olive streets, going north to First and then West on First to Bonnie Brae etc., will, on the completion of the tunnel, start at Second and Broadway, go west on Second through the tunnel to Fremont Avenue, then north on Fremont to First, then west on First Street as before. This will save a large amount of time and power for the West First Street line and will provide better and more efficient service to the people using this line.

The tunnel will also provide an ample roadway for a single line of vehicular traffic flowing in each direction. Sidewalks for pedestrian traffic will also be provided as in the case of other tunnels which have been constructed in the city.

The result expected from this tunnel is the reduction of vehicular traffic on Third Street, from Broadway to Figueroa to a little over half its present amount. During the "rush hours" 4:00 P.M. to 6:00 P.M. it is estimated that the saving in time to vehicles now using the Third Street Tunnel will be almost ten minutes in traveling from Figueroa to Broadway, and about half that amount in traveling from Broadway to Figueroa Street.

(B) Opening of Fifth Street.

The opening of Fifth Street from Broadway to Boylston Avenue and the development of a good boulevard for vehicular traffic has been practically assured by the City Council. The exact location and plans for this work have not been desided upon as yet. The Normal Hill Center, bounded on the east by Grand Avenue and on the north by Fifth Street, is the principle source of trouble. The Normal buildings are very near the present Fifth Street and would have to be removed if the street is to be widened to the south. Fifth Street, from Grand to Hope Street, is narrow and its centerline is a considerable distance north of the centerline of that portion east of Grand Avenue. Due to the lack of a general plan of action and development in regard to a civic center, considerable delay has been caused to the formation of plans for the development of Fifth Street. Undoubtedly some definite action will be taken in the very near future and a new outlet to traffic provided.

(C) Pacific Electric Tunnel Northwest From the Hill Street Station.

As a result of several complaints of poor service on the Hollywood line of the Pacific Electric Railway, the California Railroad Commission has recently granted an increase in the rates on this line for the construction of a direct route, from the Hill Street Station out of the congestion. The Railway Company plans to build a tunnel from the Hill Street Station, to First and Lucas Streets, as soon as the City will grant the necessary franchise. From First and Lucas Streets the route will be over the present Glendale line to Sunset Boulevard, where connecting tracks to the present Hollywood line on Sunset Boulevard will be constructed.

The result of the construction of such a tunnel will be the removal of all the Pacific Electric cars, except the Echo Park and Sixteenth Street lines, from Hill Street, and all the Pacific Electric cars, except those on the Edendale line, from Sixth Street and Figueroa Street. It will reduce the operating time on all the Pacific Electric lines now serving the northwestern portion of the City. It will also greatly relieve the traffic congestion on Hill and Sixth Streets.

The tunnel will be one mile in length and will cost as estimated by the Railway Company, $1,850,000.

In an article published in the Pacific Electric Magazine, Mr. D. W. Pontius, Vice President and General Manager of the Pacific Electric Railway System, says, "Application has been made by the Company for construction of a tunnel, from Hill street station, through to First street and Glendale avenue, and the franchise also includes provision for connecting up the car lines on Glendale avenue.

The building of the proposed tunnel means much to the City of Los Angeles, Hollywood, the Glendale district, and the San Fernando valley. The streets in the center of Los Angeles are now congested to a maximum and a plan must be worked out to take care of this condition since the city is growing so rapidly. The building of the tunnel will take from Hill street to First street, the major portion of the Hollywood cars, the San Fernando Valley trains, and will take from Sixth street, all the Glendale and Burbank trains. It is the greatest step for the relief of traffic since the question has been given consideration by the City of Los Angeles and it will be the first time that any real money has been spent excepting the building by the City of the Second street tunnel. When the tunnel is completed it will mean a reduction in the running time between Los Angeles and Hollywood, Glendale and the San Fernando Valley points of approximately 10 minutes.

While it is estimated that the tunnel will cost $1,850,000 and the new cars will cost approximately $900,000, it will mean an expenditure by the Pacific Electric of approximately $2,750,000 for the new improvements.

There are operated over 6th Street between Los Angeles and the Glendale-Burbank District 129 trains per day, and the removing of these trains from 6th Street will mean a tremendous improvement on this over-congested street.

There are operated between Hill Street station and the Hollywood district 1029 cars per day, and between Hill Street station and the San Fernando Valley 43 trains per day, and the taking of the major portion of these trains from Hill Street will likewise mean a decided improvement in the congested condition.

While the Hill Street station will be at grade as it is at present, the tunnel is to be set back from Hill Street 50 feet, so that the street frontage can be used for store car purposes, and the work will be carried out with a view of eventually constructing a subway to carry the Santa Monica Bay District trains over the same right of way as will be used by the Hollywood trains as far west as Maryland Street, and the terminal will be constructed to eventually build a large office building over the present Hill Street station site.

(D) Union Passenger Station.

Definite action was taken on the Union Terminal problem on July 3, 1916, at an informal conference of the Los Angeles City Council and the California Railroad Commission, at Los Angeles. The conference resulted in the California Railroad Commission undertaking to make a complete investigation of grade crossings and a union terminal. Under the direction of Chief Engineer Sachse the investigations were carried on and a report made to the Commission. Mr. Sachse report resulted in the following order by the California Railroad Commission;

IT IS HEREBY ORDERED:

1. That the Southern Pacific Company, The Atchison, Topeka and Santa Fe Railway Company, Los Angeles and Salt Lake Railroad Company and Pacific Electric Railway Company, do make and construct such additions, extensions, improvements to, and changes in, their railroad facilities in the City of Los Angeles, and do erect a union passenger station and buildings incidental thereto, in said City of Los Angeles, and perform such work and make and construct the necessary

fills, cuts, vieducts and other works and structures necessary for a separation of grades at the crossings enumerated in paragraph (a) of the findings of fact preceding this order, all in the manner and within the time hereinafter specified in this order, and such other orders as this Commission may hereafter make supplementary thereto.

2. The site of the union passenger station herein referred to shall be within that portion of the City of Los Angeles bounded by Commercial Street, North Main Street, Redondo Street, Alhambra Avenue, and the Los Angeles River. The specific location of said station within said area will be hereafter fixed and designated, pursuant to final plans to be prepared therefor as hereinafter provided.

3. That said defendants, Southern Pacific Company, The Atchison Topeka and Santa Fe Railway Company, Los Angeles and Salt Lake Railroad Company and Pacific Electric Railway Company and each of them, shall cause to be made and filed with this Commission complete plans, specifications and estimates for such additions, extensions, improvements and changes in facilities and such new structure of structures, separation of grades and other work, as hereinabove referred to, as follows:

(a) Relative to Grade Crossing Eliminations:

There shall be filed within sixty days from the date of this order a general plan or plans providing for grade separations at Macy, Aliso and Seventh Streets, in conformity with the specifications contained in the preceding opinion; profile or profiles and detailed drawings of each viaduct provided herein together with estimates of cost of construction for each viaduct, and for incidental expenditures and for damages; such plans, profiles, drawings and estimates to be prepared as hereinafter provided for.

(b) Relating to a Union Passenger Station:

There shall be filed within six months from the date of this order a general plan, or plans, with the necessary profile, or profiles, and general detail drawings of a passenger union station located on the Plaza site, as described in the preceding opinion and findings of fact, together with all necessary facilities and changes in existing facilities; also, estimates of cost of construction of the union passenger station, together with its necessary facilities and changes in existing facilities, and estimates of damages and salvage; also description and plans of the necessary temporary operating arrangements during the period of the transition pending the completion of new union passenger terminal facilities.

All plans, profiles, drawings and estimates shall be prepared as hereinafter provided for.

The filing by said defendants jointly of such complete plans, specifications and estimates shall be deemed a compliance with this order in particular.

4. Said defendants and each of them shall, within thirty days from the date of this order, appoint their respective representatives of whom there shall be not more than two for each defendant--upon a joint engineering committee, which committee shall be charged with the preparation of complete plans, specifications and estimates, hereinbefore referred to. Said defendants shall also, within thirty days from the date of this order, select and suggest for the approval of this commission and appoint a disinterested engineer as chairman of said engineering committee. If no such appointment be made within the time specified herein, the Commission will, itself, select and appoint the chairman of the engineering committee.

The City of Los Angeles shall be entitled to be represented upon the said engineering committee in the same manner and upon the same terms and conditions as each of said defendants.

5. The engineering committee shall prepare all plans, specifications profiles, designs and estimates in accordance with the provisions laid down in this decision, and with such further directions as may be issued from time to time by this Commission. In case of any disagreement by said committee on any matter properly before it, the decision of the chairman thereon shall be final; subject, however, to the ultimate approval of the Commission. Each party shall have the right to present to the Commission its individual views when the plans and estimates are submitted to the Commission for final approval.

6. The expense of all additions, extensions, improvements or changes in facilities and new structures and other work herein ordered--other than that relating to the separation of grades-- to be hereafter specifically provided for, but including the preparation of complete plans, specifications, and estimates by the engineering committee-- shall be at the joint cost of said defendants, upon such terms as to the apportionment and division, as they may, within a reasonable time agree upon, which time is hereby fixed at thirty days from and after the date of this order, for the apportionment of the cost of preparation of complete plans, specifications and estimates, and six months from and after the date of this order for the apportionment of cost of all other work; and in event of their failure to so agree, then upon such terms and in such proportions and in the manner in which the Commission may, after further hearing, fix by supplemental order; provided, however, that all compensation for any representatives of the City of Los Angeles on the engineering committee shall be paid by said City.

7. Within twenty days from the effective date of this order, the railroads shall file with the Commission a preliminary estimate of cost of preparing plans, specifications and estimates. After the appointment of the engineering committee, that committee shall file with the Commission weekly reports in the form prescribed by the Commission, showing the progress of the work and the character and distribution of the work done. The engineering committee shall also keep account of its expenditures and shall file monthly reports of all expenditures with the carriers and this Commission."

The Pacific Electric Railway was later withdrawn from this order because of its particular needs in station facilities and its much greater passenger traffic. In the year 1917 the Pacific Electric Railway carried 35,000,000 passengers and in the same year all the steam roads together carried 2,750,000 passengers or 7.8% of the number carried by the Pacific Electric Railway.

The Plaza Plan as outlined by the Railroad Commission includes some changes in the Los Angeles Railway tracks and routing. The principle changes would be made near the site of the station, and would undoubtedly result in better service and less loss of time in the northern portion of the business district by cars passing through it. The most important change in the routing of street cars as affecting the traffic situation, would be the routing of a large number of the cars serving the northern portion of the city, through the Broadway tunnel. The tracks would be placed in a subway through the tunnel and therefore would not interfere with the vehicular traffic which now uses the tunnel to get to North Broadway or Sunset Boulevard.

The Union Terminal Investigation was a direct result of many complaints of the grade crossings in the area between the business district and the Los Angeles River. The elimination of these

grade crossings will solve the traffic congestion problems of this portion of the City for many years to come.

The estimated cost of completing the Plaza Plan is $32,233,445. and is of course the main objection, given by the railroads, to the plan. Chief Engineer Sachse, in his letter of transmittal of the engineering report to the Railroad Commission, said, in part, "While a capital expenditure of over $32,000,000 seems large, it should be remembered that this money is to be expended over a term of years. In any event, whether the foregoing recommendations are adopted or not, very large capital expenditures aggregating probably in the neighborhood of the sum estimated by us will become necessary in the near future if the transportation of Los Angeles is to keep pace with the growth and the industrial and business development of the City. The choice is not between a large expenditure if these recommendations are adopted and a small one if they are not adopted; it is rather between an adequate and carefully planned development without wasteful expenditures and a haphazard growth dictated, in the main, by private interests from the standpoint of each individual road. In either case the burden of capital and operating costs must, in the end, be borne by the public.

"It is impossible to estimate in dollars the direct and indirect savings and benefits through the carrying out of these plans that will accrue to the railroads, to the passengers and to the shippers and also to the people and enterprises affected by transportation conditions. We have not hesitated in saying, however, that from the financial standpoint alone, the proposed expenditure is justified. In the larger aspect of city planning, there is no doubt that the City of Los Angeles should use every effort to assist in the carrying out of these recommendations."

Map No. 6 show the plan of the proposed terminal at the Plaza. The Pacific Electric lines are shown in black. The plan provides for a subway from the Main Street station, along Main Street to the union station, then for elevated tracks to the present line at the Macy Street crossing. The southbound Pacific Electric trains would be routed over a continuation of the present elevated tracks east of the Main Street station to the private right of way at Fourteenth and Alameda streets. Map No. 7 shows the general lay out of the Pacific Electric trains operating from the Main Street station.

The Southern Pacific, Salt Lake, and Pacific Electric Railroads proposed a joint passenger terminal at the present Southern Pacific Station and are ready to start work on their plan immediately. This plan proposes the construction of elevated Pacific electric tracks from the Main Street station eastward to the east side of the Los Angeles River, and then north along the river banks to connect with the present tracks just north of the Macy Street crossing. Map No. 8 show this plan, and Map No. 9 gives a general idea of the structures planned.

Plans were prepared for a union station at both the Santa Fe station and Southern Pacific Station sites by the Railroad Commission but finally rejected. Both of these plans provided for elevated structures practically similar to the structures proposed by the Southern Pacific, Salt Lake and Pacific Electric Railroads.

The railroads have taken the question of the authority of the Railroad Commission to order the construction of a union terminal, into the courts, and as yet no decision has been reached.

(E) Probable Future Development of the Pacific Electric Railway System.

The Pacific Electric Railway is essentially a rapid transit system, and as such must operate without serious congestion. At the present time practically all of its lines suffer from some congestion. In all probability all of the Pacific Electric Railway lines will be removed from the streets of the business district within a very few years. The California Railroad Commission, in its Los Angeles Terminal Investigation Report, recommends that a subway be constructed from the Main Street Station to the recommended union terminal at the Plaza Site to take care of all of the traffic to the north and east, and that an elevated structure be built to take all the traffic to the south. Other plans for a union terminal provide for an elevated structure from the Main Street Station to the east, which would take the north bound traffic across the Los Angeles River and north along the banks of the River to connect with the present lines to the north. South bound traffic would pass out over the same elevated structure to Alameda Street and then turn south and come to the ground surface on the private right of way of the Pacific Electric Railway which is now being used. Mr. B. J. Arnold's and also the Railroad Commission's reports look upon the construction of subways, both north and south, on Main Street from the Main Street station as very probable in the future and also the construction of an elevated line at least as far as Fourteenth and Alameda Streets.

With the completion of the new Hill Street Station Tunnel all of the traffic to the west will be handled from that point. In about the year 1905 the Pacific Electric Railway expended the sum of $1,590,000 toward the acquisition of a right of way for a tunnel to run from the Hill Street Station to a point on Vermont Avenue, a

distance of about two and a half miles to the west of the Station. The plan was to use such a tunnel for all the traffic to the west. This plan was not abandoned but was delayed by the financial depression of 1907, and will probably be undertaken in the near future.

Both Mr. B. J. Arnold and the Railroad Commission strongly recommended the connection of the two Pacific Electric Stations by means of a subwayoon Sixth Street from Main to Hill Street and from that point either diagonally across Pershing Sq uare to Fifth and Olive and into the tunnel, or making an easy turn and entering the Hill lStreet Station from Hill Street.

The plans for the construction of the tunnel from the Hill Street Station to First and Lucas Streets which are about to be realized call for the lowering of the tracks in the station several feet. Although no information has been given out by the Pacific Electric Officials this would seem to indicate that the subway plans as generally outlined will be carried out in the near future.

Chapter 4.

General Requirements and Methods which might be Used in Plans for the Relief of Traffic Congestion.

A. Requirements of a Plan of Relief of Traffic Congestion.

A plan of relief of traffic congestion must make provisions for three general classes of traffic; railway, vehicular and pedestrian. Vehicular and pedestrian traffic naturally go together within the business district of a city and from their nature, must occupy the city streets. Railway traffic, on the other hand, may or may not, be carried on in the public streets. Both vehicular and railway traffic are least congested when through routes of travel are provided.

1. Vehicular Traffic.

In Los Angeles, where the traffic congestion is general throughout the business district, it is due, to a large extent, to vehicles operating wholly within the congested district. At the close of the business day congestion occurs on streets leading from the business district. In a well organized city, traffic originating and ending at points outside the congested district, should not pass through this district. Traffic originating within the congested district and bound for an outside point should be able to get out of the congested district by a direct route. Traffic within the congested district between widely separated points should be able to operate outside the congestion. To provide for these three types of vehicular traffic a route circling the congested area should be provided. An inner circle would, if properly placed, take care of a large part of the traffic vetween points widely separated but within the business district. An outer circle would allow outside traffic to avoid congestion and outward bound traffic to get out of congestion by the most direct routes.

2. Railway Traffic.

Railway traffic is divided into three general classes of service; distant, commuter and local, depending upon the origin and destination of the passengers and upon the time required to make a trip. Distant traffic originates at points far enough away to make it impractical for passengers to come into the city each day for business or other purposes. Such passengers are not necessarily bound for the business district but are bound for the city in general. A union terminal is desirable, though not essential, for distant traffic.

Commuter traffic originates within an area of such size as will permit passengers to make trips into and out of the city each day. Time is the unit which controls the size of the commuter traffic, and is probably limited to one hour. In a really large business center the commuter area is the limiting area to the growth of the community as a whole. Railway lines handling commuter traffic are most successfully operated when the passengers are not brought to a central point in the business district, but are distributed at several points throughout this district. Railways depending on passengers of the commuter type for their revenue are lines commonly classed as rapid transit lines and as such must operate without congestion. Rapid transit lines are therefore the first lines to be considered when a separation of vehicular and railway traffic is necessary. They must have several stations or distribution points within the business district and in a large business district, must provide for transfering of passengers from one line to another.

Local traffic originates within the business district and points near enough to the business district to make it quicker to use other means of transportation than the rapid transit lines. In the largest cities of the United States, where many different types of railway lines are in use, the local traffic is almost entirely taken care of by surface cars which serve as distributers for the rapid transit lines operated as elevated or subsurface railways.

3. Pedestrian Traffic.

Pedestrian traffic does not require through routes of travel. Railway transfer points and stations are the points which are most congested, but with the present practice of making sidewalks twelve feet in width in the business district, pedestrian traffic

is not seriously congested. At several points on Broadway, if the present number of cars operating is to be continued, islands should be constructed to insure passengers safety while boarding the cars.

B. General Methods which might be used to Relieve Congestion.

1. Widening of Streets

(a) Widening of Streets by Moving Back the Lotline.

Probably the most satisfactory way of widening streets is to move back the lotline (as far as traffic operation is concerned). Within the congested district such a method would be practically impossible because of the great cost of removing large buildings. On streets outside the business district, where buildings are smaller and the value of land is much less, this method is often used.

(b) Arcading.

Arcading as here used means the widening of streets by removing the sidewalks from their present position and placing them under the second floors of the buildings in the space now occupied by show windows. This method, while expensive, would cost much less than the first method. So far as is known Arcading has never been used bo any great extent to widen streets and for that reason the effect it would have upon the value of the property involved is doubtful.

Arcading has been strongly urged as a means of widening existing alleys and also developing new alleys where needed.

2. Rerouting of Street cars on Congested Streets.

There are three general methods of routing street cars in the central portions of cities. They are the loop, through, and belt-line methods.

The loop method makes it possible for cars to approach the

business district, proceed around a loop and out again on the avenue of approach.

With through operation, streetcars approach the business district from one direction, pass through, and out in another direction.

Beltline operation is usually used in connection with the other methods of operation to connect the system and make it possible to get from one line to another without entering the congested area. As suggested by the name, beltline operation is continous around a closed system of tracks.

Of these three methods, the through method of operation is the best where the traffic on the two ends of the lines is balanced. It has been suggested that the loop method might be used in Los Angeles by making the loops outside the congested area and connecting the loops by means of a beltline. Such a system would mean a large amount of transfering unless the loops were very close to the destination of the passengers carried by each line. A large number of cars would be required to operate on the beltline and as the congested district increases in size, the saving in time to the passengers would be lost in waits at transfer points. Traffic on the carline streets would probably be as congested as ever. A careful consideration of these three methods of routing streetcars in Los Angeles leads to the conclusion that through operation is the best from both the operation and service standpoints.

During the period of most congestion, there are 557 street cars per hour in operation on the four principle business streets of Los Angeles. The maximum number of cars that can be operated on a private right of way without congestion is about 120 cars per hour, or a headway of 30 seconds. It would be possible to route all of the streetcar traffic over two of these streets if some of the lines, which

are not, in general, north and south lines, could be routed across the congested district. This would mean two streets could be used for vehicular traffic exclusively and two streets for railway traffic and some vehicular traffic. The present street intersections would have to be changed and the grades separated to permit vehicular traffic to cross the railway tracks without causing congestion. Grade separation at the required number of intersections would approach either a subway or an elevated condition of the railway or the street and would not give the satisfaction that a continous structure of either type would give. The relief would be temporary and probably by the time the required structures were completed, the traffic would have grown so that a subway or an elevated railway line would be necessary.

The conclusion drawn from rerouting studies is that rerouting of streetcars alone will not relieve traffic congestion.

3. Elevated and Subway Railway Structures.

When traffic becomes too congested to be taken care of on one surface the problem becomes one of choosing between the elevated structure and the subway. Both types are in use in the largest cities of the United States and the subway has been found to be the most satisfactory to the people of these cities. Quoting Mr. B. J. Arnold, who made a report on the transportation problem of Los Angeles in 1911, "Elevated lines are undesirable in commercial, hotel, retail and residence sections on account of noise, unsightliness, extra climb, detours and the shutting off of light. These factors are of less importance in an industrial or wholesale district".

4. One Way Traffic on Certain Streets.

One way traffic operation on some streets as a plan of relief of congestion has not been favored to any great extent in any of

the cities of America as a means of permanent relief and has only been considered after the streetcar lines have been removed by the construction of subways or elevated structures. As a system it has many advantages, but it is a very difficult problem to get such a system into operation due to the attitude of the property holders on the streets affected.

CHAPTER 5.

Conclusions.

A. Plan of Relief of Traffic Congestion.

1. General Outline of Plan.

The plan provides for Spring, Los Angeles, and Hill Streets as vehicular traffic streets only, and Main Street and Broadway as both vehicular and street car traffic streets. A large number of the street cars now in operation on these streets would be taken care of in a subway in Spring Street, running from Eleventh Street to the Plaza. All Pacific Electric Railway trains would be removed from the streets of the business district, by routing those from the Main Street station over a continuation of the present elevated structure, to points well out of the congestion, and those from the Hill Street station through tunnels in the hills to the west of the station. A short tunnel under First street would open Figueroa street to vehicular traffic from Sunset Boulevard and the northern part of the City in general. Second Street would be widened to eighty-four feet from Hill Street to San Pedro Street and thus provide for vehicular traffic between the north-western part of the city and the retail district or the wholesale district and the eastern part of the city in general. Ninth street would be widened and improved so that it could take care

of a large portion of the vehicular traffic from the south-eastern part of the city. Later, if necessary, Ninth street could be straightened and widened to the west of Figueroa Street and relieve Eighth street which will probably become congested within a few years. Alameda Street would act as an eastern distribution street as Figueroa street now acts as an western distribution street. What ever union terminal plan is adopted for the steam railroads, all but about 3% of the present railroad traffic will be removed from Alameda Street, and this 3% will be in operation during the late hours of the night only.

2. Rerouting of Street Cars.

(a) Los Angeles Railway.

In rerouting the street cars as few changes as possible were made, and the routes outside the business district were not changed at all. In the following statement of the routes of the Los Angeles Railway lines, the ones marked with an asterisk (*), are the only ones which would be changed, and the new lacation underlined. The new routing is shown on Map No. 10.

* Line A - West Adams and Lincoln Park.

Route -- Mt. Clair and West Adams via Adams; Normandie; 24th; Hoover; Burlington; 16th; Hill; 11th; subway; North Main; Sunset; North Broadway; Lincoln Park Ave; looping back via North Main to Plaza; thence to west terminal over above route.

* Line B - Brooklyn and Hooper Ave's.

Route -- 51st and Ascot via Ascot Ave; private right of way; Hooper; 20th; Hooper; 12th; subway; Macy; Brooklyn; Evergreen; Wabash to city limits.

Line C. - Angeleno and Crown Hill.

Route -- Douglas street and Kensington Road via Douglas to Edgeware; Bellevue; Beaudry; Alpine; Figueroa; Boston; Bunker Hill; California; Hill; Temple; North Broadway; First; Hill; 5th; Olive; 6th; Flower; 3rd; Boylston; Crown Hill; Columbia; 2nd; Loma Drive; Belmont to Temple.

Line D. - West Sixth Street.

Route -- 5th and Central west via 5th; Olive; 6th; private right of way ; Larchmont to Melrose.

* Line E. - Eagle Rock and Hawthorne.

Route --- Eagle Rock City via private right of way; Ave 28; Dayton; San Fernando Road; Pasadena Ave; North Broadway; Sunset; North Main; subway; Main; Jefferson; Grand; private right of way; Santa Barbara; private right of way to Hawthorne.

Line F. - East 4th and Hoover.

Route --- Dalton Branch. First and Fresno via Fresno; 4th; Merrick; Traction way; 3rd; Main; Jefferson; Grand; private right of way; Santa Barbara; Dalton; Vernon to Arlington.

Manchester Branch. Euclid and Stephenson via Euclid; 4th; Merrick; Traction way; 3rd; Main; Jefferson; Grand; private right of way; Santa Barbara; Hoover; private right of way; Vermont ot Manchester.

* Line G. - Griffith and Griffin.

Route --- Ave. 45 and Montecito Drive via Griffin; Ave. 26; Pasadena Ave; North Broadway; Sunset; North Main; subway; 12th; Stanford; 14th Griffith; Jefferson; McKinley to Vernon.

Line H. - Maple and Heliotrope.

Route --- Melrose and Normandie via Melrose; Heliotrope; Temple; New Hampshire; First; Bimini Place; private right of way; 2nd; Rampart; 6th; Alvarado; 7th; Maple; Woodlawn; Santa Barbara; Wall; 53rd. to San Pedro.

* Line I. - West First.

Route --- Alvarado and 6th via Alvarado; Ocean View; Bonnie Brae; 1st; Fremont; 2nd. to Broadway.

Line J. - West Jefferson and Huntington Park.

Route --- 9th. Ave. and West Jefferson via West Jefferson; Grand; 7th; Mateo; 9th; Santa Fe; Vernon; Pacific Blvd; Florence; Seville to Walnut Park.

* Line L. - West Eleventh and Lincoln Park.

Route --- L. A. High School via Country Club Drive; Victoria; 10th; Hoover; 11th; subway; North; Main; Mission Road; Lincoln Park; looping back via Lincoln Park Ave; North Broadway; Sunset; North Main; subway and thence to west terminal via above route.

Line M. - Grand Ave. and Moneta.

Route --- 54th and Mesa Branch. 54th and Mesa Drive via 54th; 2nd Ave; 48th; private right of way; Hoover; Santa Barbara; Grand; 10th; Broadway; 1st; Main; Moneta 54th to 1st Ave.

Manchester and 6th Ave. Branch. 6th Ave. and 48th street via 48th; private right of way; Hoover; Santa Barbara; Grand; 10th; Broadway; 1st; Main; Moneta to Manchester.

* Line N. - West 9th and East 2nd.

Route --- 8th and Harvard via 8th; Vermont; 9th; Figueroa; 10th; Broadway; 1st; Santa Fe to 2nd.

* Line O. - South Main.

Route --- Slauson and Main via Main; subway; North Spring to Alpine and return over the same route.

Line P. - West Pico and East First.

Route --- Rowan and Brooklyn via Rowan; 1st; Broadway; Pico to Delaware.

Line R. - Stephenson and West 7th.

Route --- Stephenson Ave. and Cemetery via Stephenson; Boyle; 7th; Alvardo; 6th to Rampart.

Line S. - San Pedro and Western Ave.

Route --- Santa Monica and Western Ave. via Western; 3rd; Vermont; 6th; Commonwealth; Wilshire; Hoover; 7th; San Pedro; South Park; 61st to Moneta.

Line T. - Temple Street.

Route --- Temple and North Spring Street via Temple; Hoover; Clinton; Fountain to Edgemont.

Line U. - University and Central Ave.

Route --- Slauson and Central via Central; 5th; Olive; 6th; Figueroa; Washington; Estrella; 23rd; Union; Hoover; 32nd; McClintock; Vermont; 39th; Denker; 39th; to Western Ave.

Manchester Branch. From 39th and Vermont south via Vermont to Manchester.

* Line W. - Washington and Garvanza.

Route --- York Blvd. Branch. Washington and Rimpau via Washington; Flower; 11th; subway; North Main; Sunset; North Broadway; Pasadena Ave; private right of way; Monte Vista; Ave. 61; Piedmont;

Pasadena Ave; York Blvd. to Ave. 20.

Buena Vista Terrace Branch. Same as above to Pasadena Ave and York Blvd then via Eagle Rock Ave. to Buena Vista Terrace.

(b) Pacific Electric Railway.

Practically all of the Pacific Electric Railway Cars would be routed over new tracks. Those from the Main Street station, eastward over elevated tracks and those from the Hill Street station, westward through tunnels. No provision was made for the Edendale line to go to the Southern Pacific Station because of the fact that by the time the plan has been put into operation, the station will probably have been moved to the Plaza site. The Echo Park and West 16th Street line would be rerouted through the business district as follows; from the Hill Street railway tunnel, east on 1st; south on Main to 16th; and West on 16th to connect with the present route. The rerouting is shown on map No. at the end of the report.

(c) Street Car Flow Through the Business District.

The car flow within the business district, for the routing as planned, was computed, using the headway for each line as it is at the present time. The car flow data are given on the following pages and are presented in graphical form on map No. 11.

Resulting Car Flow If Plan Is Adopted.

Street	From	To	West	East.
Pico	Broadway	Figueroa	24	30
11th	San Pedro	Main	27	27
	Main	Hill	64	48
	Hill	Flower	40	36
	Flower	Figueroa	20	12

Street	From	To	West	East
10th	Broadway	Grand	57	57
	Grand	Figueroa	17	17
7th	San Pedro	Maple	64	64
	Maple	Grand	84	84
	Grand	Figueroa	60	60
6th	Olive	Flower	43.5	43.5
	Flower	Figueroa	36	36
5th	San Pedro	Hill	36	36
	Hill	Olive	43.5	43.5
3rd	San Pedro	Main	24	24
	Flower	Figueroa	7.5	7.5
2nd	Broadway	Figueroa	12	12
1st	San Pedro	Main	41	47
	Main	Broadway	89	95
	Broadway	Hill	15.5	15.5
Temple	Spring	Figueroa	13.3	13.3
			South	North
Figueroa	Pico	6th	24	24
Flower	Pico	11th	20	24
	6th	3rd.	7.5	7.5
Grand	Pico	10th	64	64
	10th	7th	24	24
Olive	6th	5th	31.5	31.5
Hill	Pico	11th	24.	12
	5th	1st	7.5	7.5
	1st	Thru Tunnel	4	4
Broadway	Pico	10th	24	30
	10th	1st	81	87

Street	From	To	South	North
	1st	Temple	7.5	7.5
Spring	Thru Subway		101	97
Main	Pico	11th	92	92
	11th	3rd	72	72
	3rd	1st	48	48
Maple	Pico	7th	20	20

3. Required Construction and Estimated Cost of Construction.

The estimated cost of construction of the individual units of construction are approximate only, but will serve to show the practibility of the plan and give a general idea of the cost of putting it into operation. A close estimate of the cost of construction can only be made after a detailed design of the individual structures has been made, and such design does not fall within the scope of this report. Each item of construction will now be considered and an approximate estimate of the cost of each, given.

(a) Figueroa Street Tunnel.

At the present time very little traffic passes over that part of Figueroa Street between Second street and Sunset Boulevard. The principle reason for this, is the hill which intruduces very steep grades between Second and Diamond streets. The length of a tunnel which would eliminate these grades, would be about 740 feet, including the approaches. Basing the estimate of cost upon the contract price of the new Second street tunnel now being constructed and the estimated cost of the tunnel planned by the Pacific Electric Railway, out of its Hill street station, the cost of the Figueroa street tunnel should be about $230,000.

(b) Pacific Electric Railway Tunnels.

The Pacific Electric Railway Company has recently signified its intention to build a tunnel from the Hill street station, west and north to the intersection of Lucas and First streets. The estimated cost of this tunnel is $1,850,000. In the year 1905 $1,590,000 was expended in securing a right of way for a tunnel and subway from the Hill street station to a point on Vermont Avenue, from which point it was proposed to run a surface line to Vineyard station. This sum of money provided about 80% of the required right of way. The present plan is to run the tunnel to Maryland street over the same right of way as will be used by the tunnel to the north, and from that point to continue westward to Vermont Avenue. The probable length of this tunnel will be about two and one fourth miles. The probable cost, based on the northern tunnel estimate, will be $4,160-000 including the required construction from the western end of the tunnel to the Vineyard station connection.

(c) Pacific Electric Railway Elevated Structure.

In the two plans investigated by the Railroad Commission but not recommended, that is, the Southern Pacific Plan and the Santa Fe Plan, provision was made for the Pacific Electric Railway to construct an elevated structure east from the Main street station to the banks of the Los Angeles River and from there on Brooklyn Avenue to meet present line part elevated and part surface tracks. In the Southern Pacific Plan this structure was estimated to cost $902,423. and in the Santa Fe Plan, to cost $885,633. If neither of these plans are used, the cost would probably be increased to some extent and for either plan would probably be about $1,000,000. From Sixth and Alameda streets to Fourteenth and Alameda streets a double track elevated structure would be built. From other estimates

prepared by the Railroad Commission the probable cost would be $836,000. The total cost of the elevated structure would therefore be probably $1,836,000.

(d) Spring Street Subway.

The Spring Street Subway, as planned would run from Eleventh and Spring Streets, north along Spring Street, to Main Street, and then north along Main Street to a point near the north side of the plaza. Main Street, from the junction with Spring Street to the Plaza is ninty feet in width. The side walks, on this same portion of Main Street, are fifteen feet in width. Thus the available width, for subways and sewers, is sixty feet. Sixty feet would be ample room for two subways and the necessary sewers and conduits. Therefore, by building the subway along the west side of Main Street, from Spring Street to the Plaza, the plan would not interfere with a subway that might later be necessary along Main Street.

Chief Engineer Osborne, of the Los Angeles Board of Public Utilities, has estimated the cost of couble track subway construction, including the necessary movement and replacing of sewers and conduits, to be between $285 and $378 per linear foot. Using the larger of the two estimates, the cost of the proposed subway would be $1,682,000.

Six subway stations would be provided for at the following locations; the junction of Spring and Main Streets, First, Third, Fifth, Seventh, and Ninth and Spring Streets. Mr. B. J. Arnold, in his estimates for such stations in the Chicago subway reports, estimated them to cost $50,000. These reports were made several years ago and the same type of structures in Los Angeles, to day, would probably cost $75,000. Using $75,000 as the cost of

each station, the total would be $450,000.

The total cost of the subway would therefore be about $2,132,000.

(e) Widening of Second Street.

The present width of Second Street is sixty feet including twenty-four feet of sidewalks. The plan is to widen this street to a total width of eighty-four feet by arcading the sidewalks. This would provide a street of sixty feet width for vehicular traffic, and the same amount of sidewalk space as is now in use, between Hill and San Pedro streets. Secretary-Consultant Whitnall of the City Planning Commission roughly estimated the cost of construction of this work to be about $300,000.

(f) Widening of Ninth Street.

At the present time Ninth Street varies in width from sixty to eighty feet. The present width, with the street cars removed, would probably suffice for the near future, but with the expansion of the retail district toward the south the value of this property will increase rapidly. In a few years it will become imperative to widen Ninth Street and improve it for the entire length within the city limits. For this reason the widening should be done as soon as possible. Several estimates for the widening of Ninth Street between Figueroa and the Los Angeles River have been made in an approximate way and reported in the newspapers, the average of these estimates is about $400,000.

A new bridge was proposed by the Railroad Commission to replace the present wooden structure now crossing the Los Angeles River at Ninth Street. The present structure is only 18.4 feet in width and without sidewalks and is a poor condition of repair.

By the time the other features of the traffic plan have been completed replacement will become necessary and for that reason should be considered as a part of theplan. The Railroad Commission's estimate was for a reinforced concrete structure similar in design to the bridge now at Seventh Street. The cost was placed at $436,255.

The total estimated cost of the Ninth Street construction provided for in the plan for the present would be $836,255.

(g) Total Estimated Cost of Construction.

(a) Figueroa Street Tunnel ----------	$230,000
(b) Pacific Electric Railway Tunnels-	4,160,000
(c) Pacific Electric Railway Elevated Structural ----------	1,836,000
(d) Spring Street Subway ----------	2,132,000
(e) Widening of Second Street --------	300,000
(f) Widening of Ninth Street---------	836,255
TOTAL COST OF CONSTRUCTION ----------	$ 9,494,255.

B. Discussion of Plan

The plan reduces, slightly, the number of street cars on Broadway and Main Street and entirely removes the Pacific Electric trains from the streets of the business district. The street area available for vehicular traffic would be the same as at present on Broadway and Main Street, and greatly increased on Spring, Hill and Sixth streets, The opening of Fifth street to the west would probably decrease the volume of vehicular traffic on Seventh Street west of Spring Street by a very considerable amount. Sixth street, being opened to eastward traffic would do the same for the part of Seventh Street east of Spring Street. The widening and improvement

of Ninth Street would also relieve Seventh and Eighth streets. Considering the plan from an operation standpoint, it would probably relieve serious congestion of traffic for several years to come. Eventually more street car subways and rapid transit lines become necessary. This plan would fit well into any future system of railways and through boulevards that may become necessary.

The cost of the plan is large but as compared to the losses that would be eliminated, the plan is very economical. The largest part of the expense, as indicated by the estimates presented, would fall upon the Pacific Electric Railway Company. At the present time the income of this company would probably not warrent any such capital investment, but if the problem is attack in the right manner, a plan to subsidize it could probably be developed. It would probably more than pay the City of Los Angeles to pay the Pacific Electric Railway Company the interest on the excess capital put into such development over and above the amount that could justifiably be expended by the company at the present time.

C. Recommendations for Immediate Action by the City.

At the present time the City Charter of Los Angeles does not permit the building of subways or elevated railway structures on public property by private capital. The City should amend its Charter at once to permit the Pacific Electric Railway Company, at least, to proceed on the construction program it has already announced, and pave the way for future development along the same line.

Steps should be taken immediately toward the promotion of the Pacific Electric Railway tunnel on the line to Vineyard station.

Detailed designs and estimates should be made of the structures outlined in this report for purposes of comparison with other plans that may be suggested.

Publicity should be given to the general problem and plans offered, so that when the time comes for the people to decide upon the action to be taken, they will do so with intelligence and a full understanding of what they are doing.

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1. Annual Reports.

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Southern Pacific Company.

Pacific Electric Railway Company.

3. Railroad Grade Crossing and Terminal Investigation of Los Angeles.

California Railroad Commission, Engineering Department. Richard Sachse Chief Engineer.

4. Report on Hollywood Rate Case.

California Railroad Commission.

5. Report on Rerouting of Street Cars of Los Angeles

Board of Public Utilities, City of Los Angeles.

6. City Transportation, Chicago Railroad Terminals and Subways. B. J. Arnold.

7. Report on the Engineering and Operating Feature of the Chicago Transportation Problem. B. J. Arnold.

8. Report on the Re-arrangement and Development of the Steam Railroad Terminals of the City of Chicago.

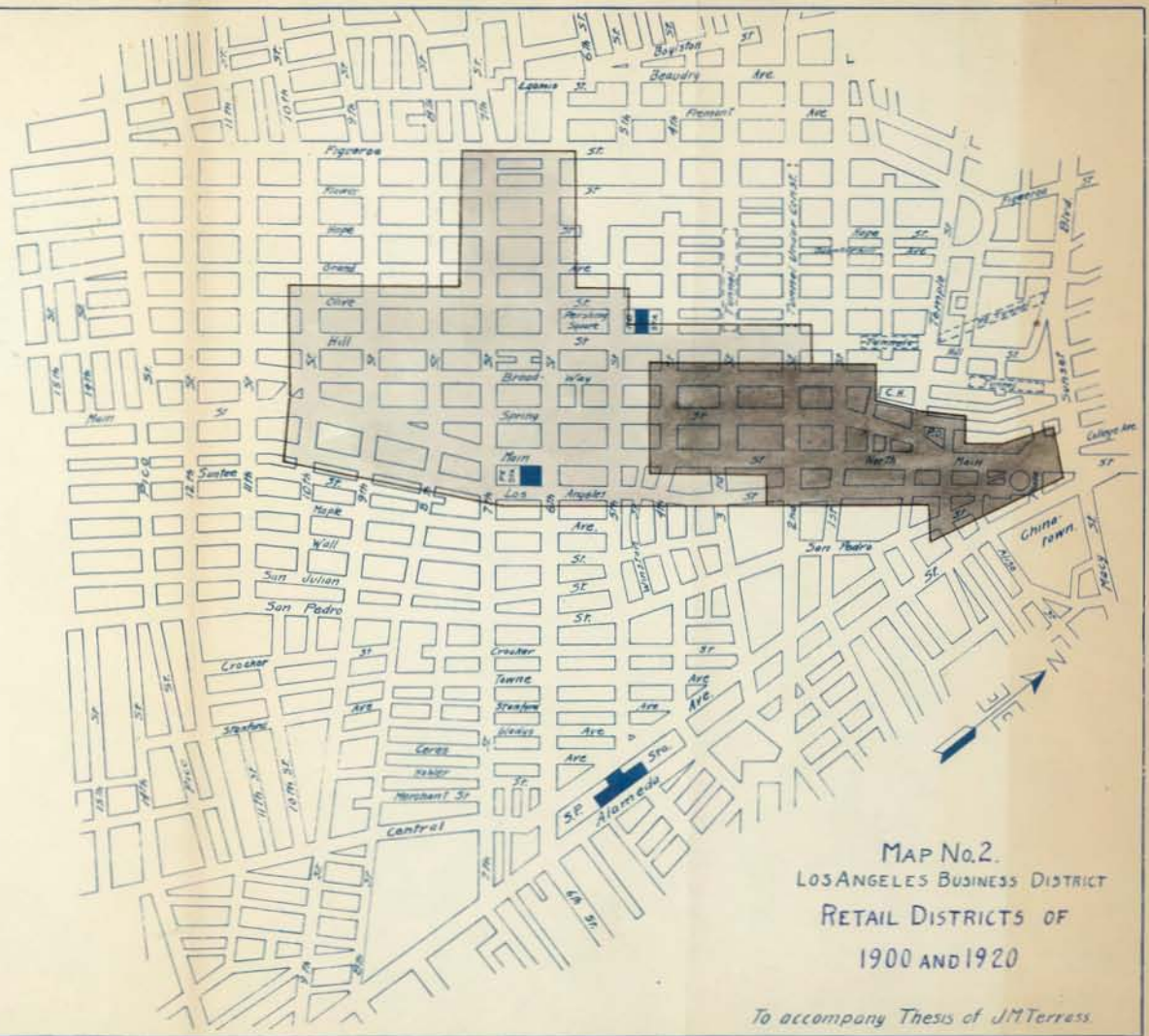
B. J. Arnold.

Map No. 1

To Accompany Thesis of J.M. Terrass May 1922

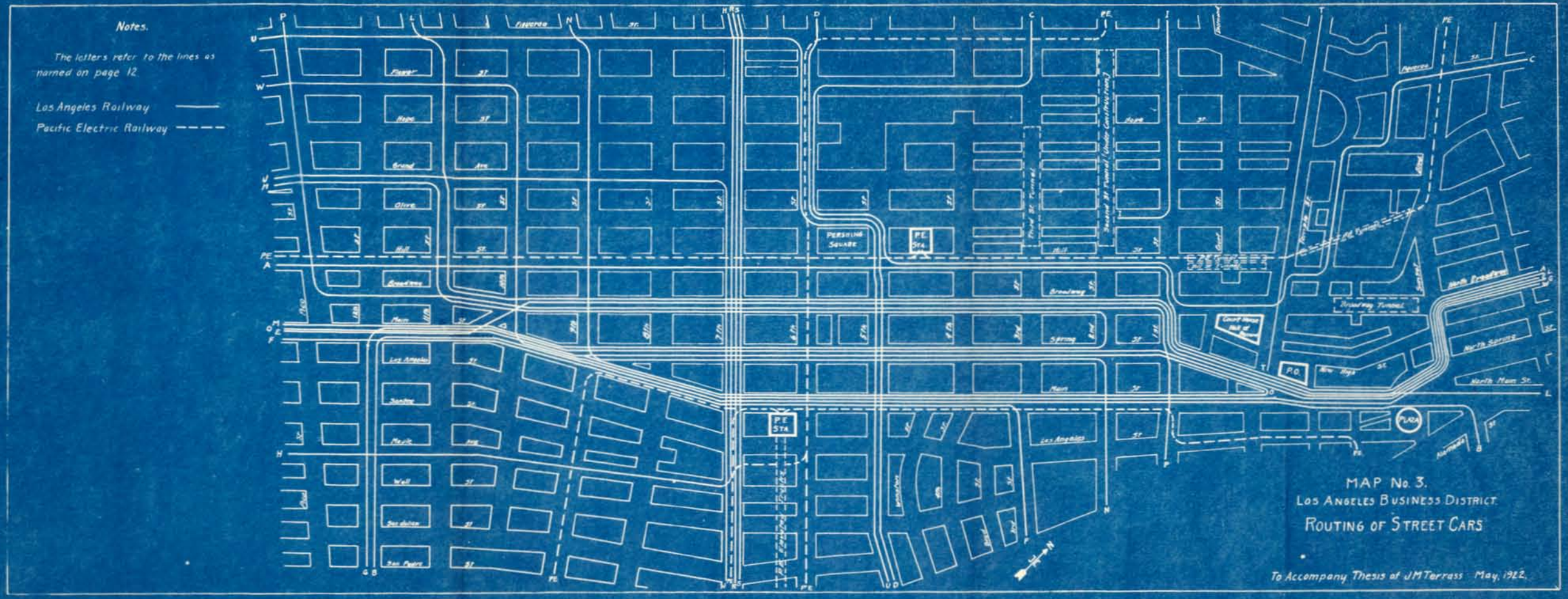
Notes.

The shaded portion of the map roughly represents the retail district of the year 1920. The darker portion represents the retail district of 1900. The area of the 1920 district is 2.6 times as large as the 1900 district.



MAP No. 2.
LOS ANGELES BUSINESS DISTRICT
RETAIL DISTRICTS OF
1900 AND 1920

To accompany Thesis of J.M. Terress.



Notes.

The letters refer to the lines as named on page 12.

Los Angeles Railway ———

Pacific Electric Railway - - - -

MAP No. 3.
Los Angeles Business District
Routing of Street Cars

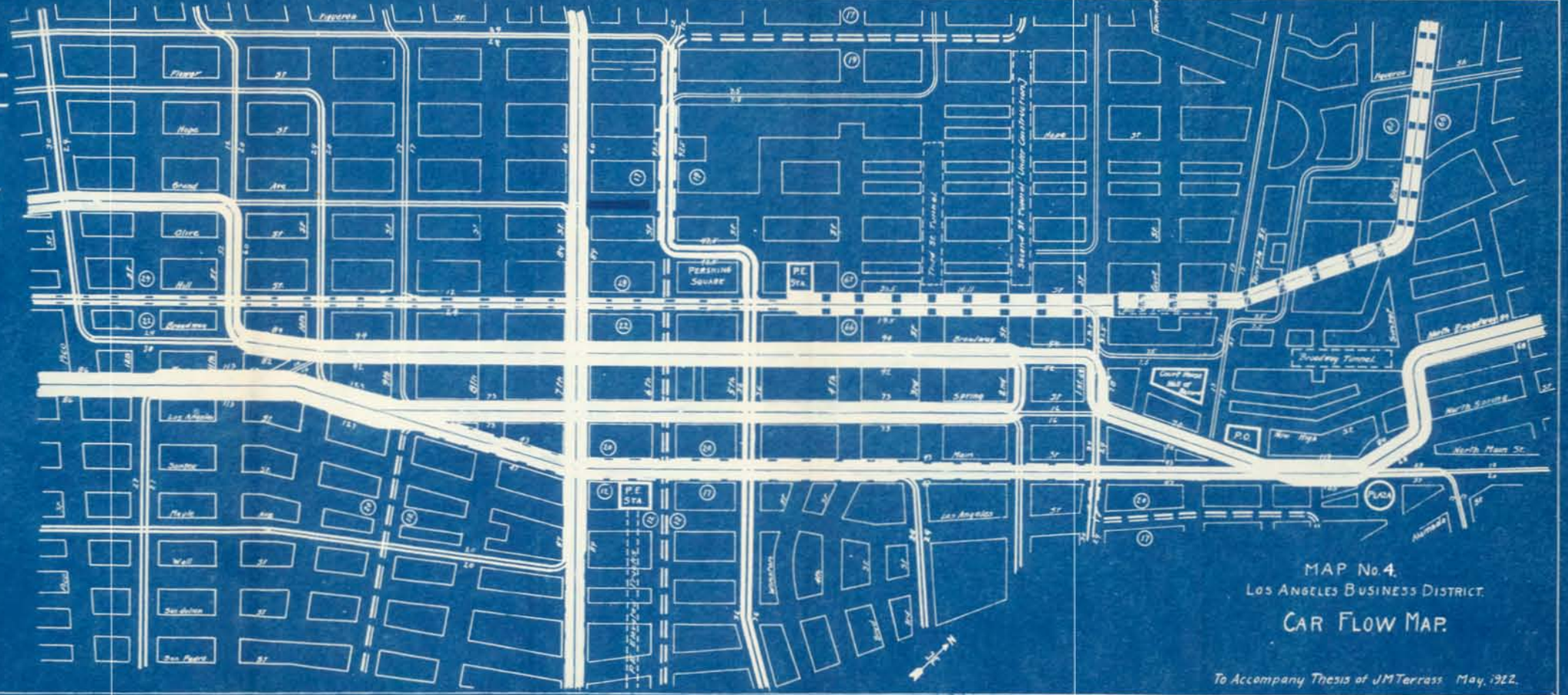
To Accompany Thesis of J M Terrass May, 1922.

Notes.

Pacific Electric Railway. — (22) —

Los Angeles Railway. — 22 —

The width of the lines shows approximately the number of cars passing a given point per hour. The numbers are also given.



MAP No. 4.

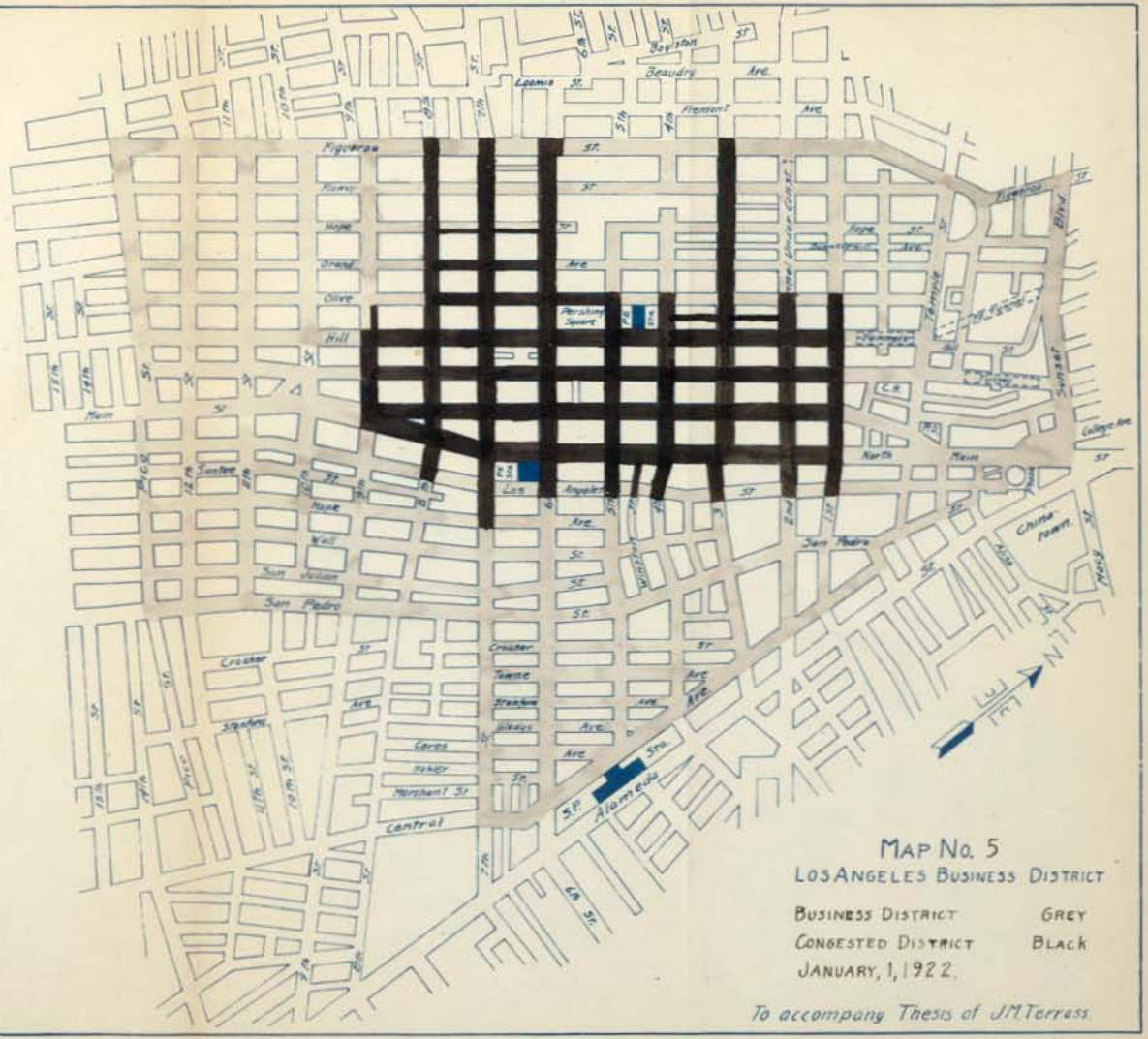
LOS ANGELES BUSINESS DISTRICT.

CAR FLOW MAP.

To Accompany Thesis of J.M. Terrass May, 1922.

Notes.

Districts shown, are defined in the Los Angeles City Ordinance No. 41090 (New Series).

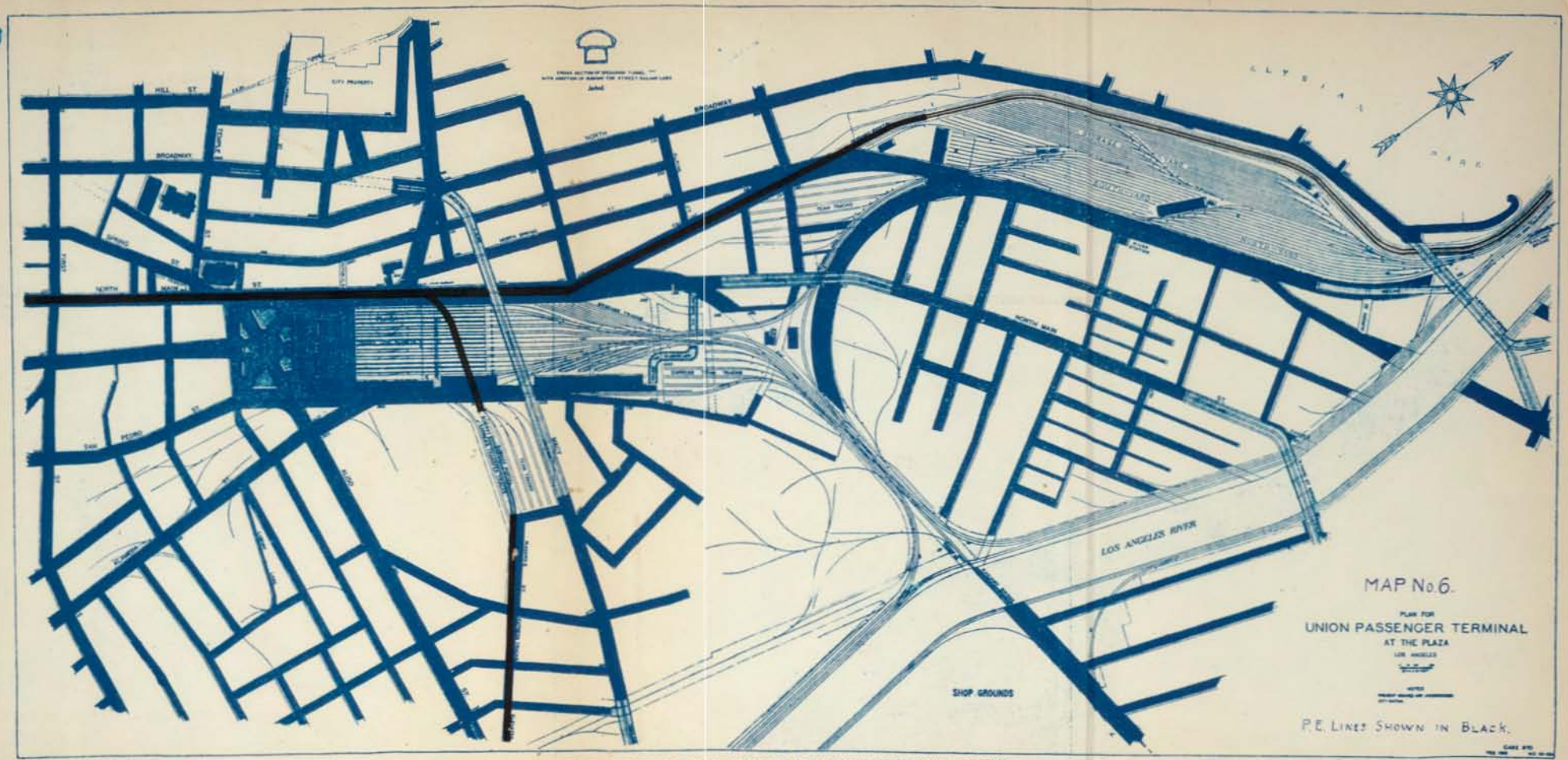


MAP No. 5
LOS ANGELES BUSINESS DISTRICT

BUSINESS DISTRICT	GREY
CONGESTED DISTRICT	BLACK

JANUARY, 1, 1922.

To accompany Thesis of J.M.Terress.



California Railway Commission Engineering Dept.

FIG. 129. ENGINEERING DEPARTMENT PLAN FOR A UNION PASSENGER TERMINAL AT THE PLAZA

This plan as it would be developed twenty or thirty years hence is shown. Note the convenient relation of the station to the roach yard and shop grounds, the strategic location of the station building near the end of the built up business district, and the accessibility and general convenience of the site.

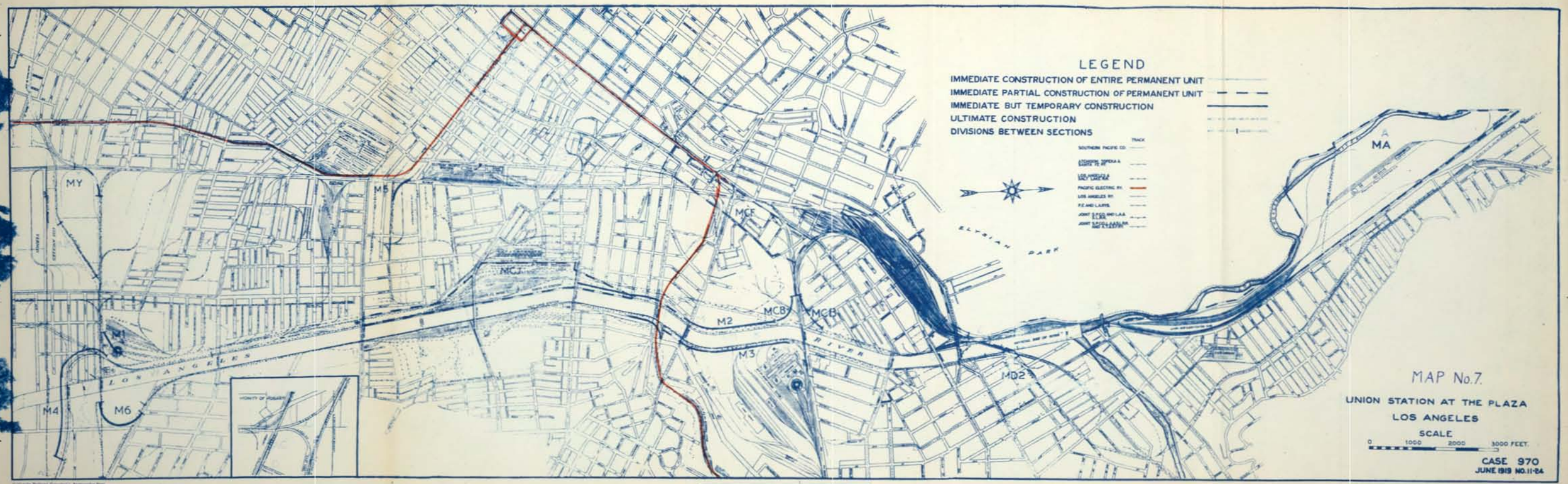


FIG. 206. KEY MAP FOR ESTIMATES FOR PLAZA PLAN

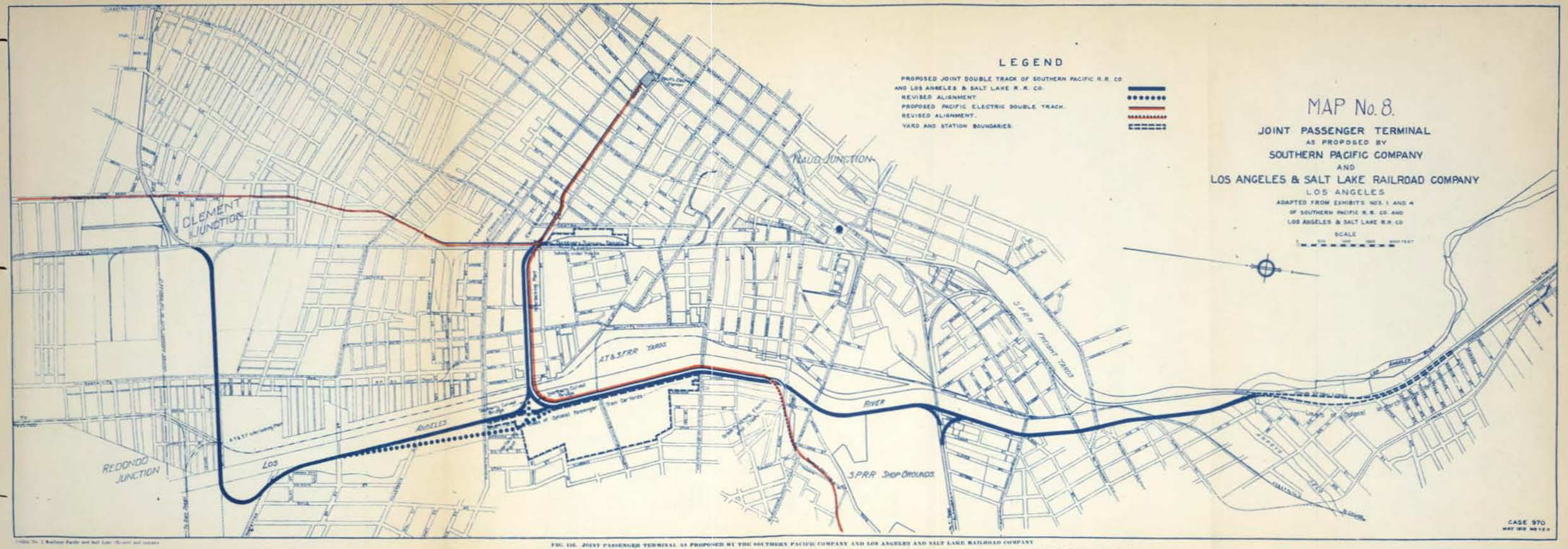
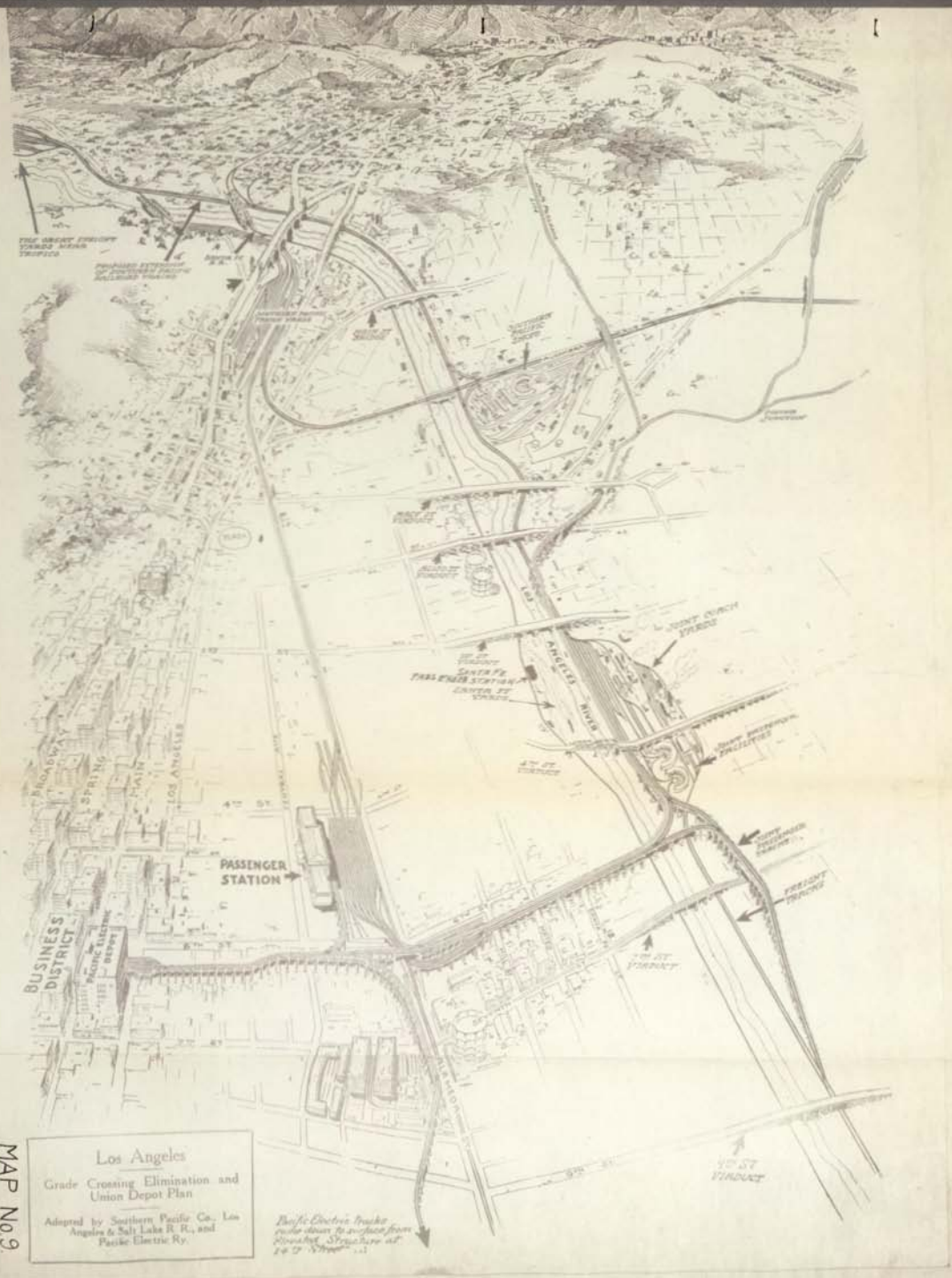


FIG. 116. JOINT PASSENGER TERMINAL AS PROPOSED BY THE SOUTHERN PACIFIC COMPANY AND LOS ANGELES AND SALT LAKE RAILROAD COMPANY

This is adapted from Exhibit Nos. 1 and 4 of the two roads, and shows the routes to be used jointly. The approach to the Southern Pacific Station is to be elevated from east of the river. The alignment for the Pacific Electric Railway is shown continued east from the present end at Wall Street, including a connection for the Long Beach Line. This is the plan contemplated in Application 1341. We recommend that this application be dismissed.



Los Angeles

Grade Crossing Elimination and Union Depot Plan

Adopted by Southern Pacific Co., Los Angeles & Salt Lake R. R., and Pacific Electric Ry.

MAP No. 9.

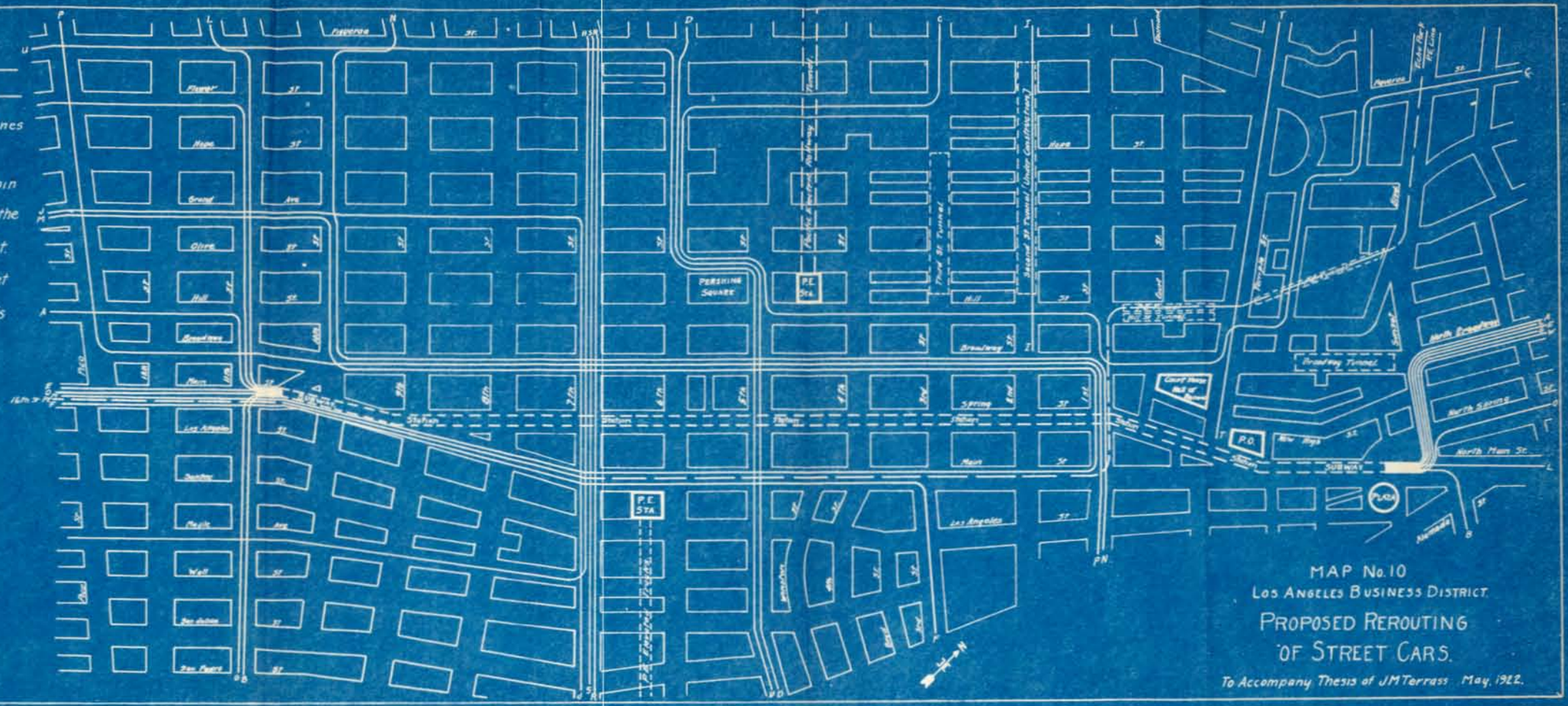
Notes.

Los Angeles Railway ————

Pacific Electric Railway — — —

The letters refer to the lines as named on page.

All P.E. trains from the Main Street Station operate over the elevated strusture to the east. P.E. trains from the Hill Street Station operate thru tunnels to the west.



MAP No. 10

Los Angeles Business District.

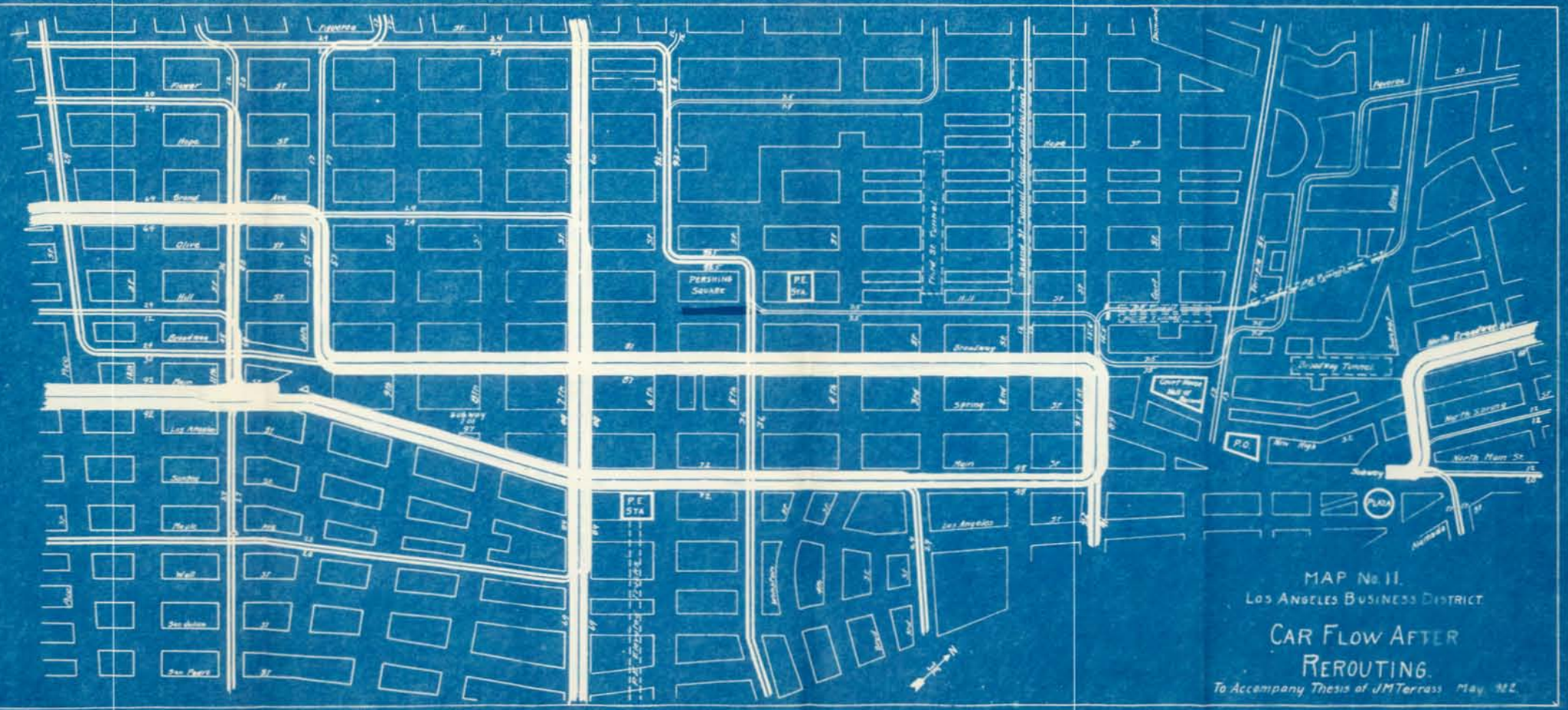
Proposed Rerouting of Street Cars.

To Accompany Thesis of J M Terrass May, 1922.

Notes.

The width of the lines shows approximately the number of cars passing a given point per hour. The numbers are also given.

The P.E. trains would not operate on the streets and therefore the P.E. car-flow is not given.



MAP No. II.

LOS ANGELES BUSINESS DISTRICT.

CAR FLOW AFTER REROUTING.

To Accompany Thesis of J.M. Terrass May 1912.

OFFICIAL TRANSPORTATION AND CITY MAP OF LOS ANGELES CALIFORNIA AND SUBURBS