

TRAFFIC CHARACTERISTICS  
OF THE  
FREEWAY INTERCHANGE TRAFFIC  
OF THE  
INBOUND GULF FREEWAY

by

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## I. INTRODUCTION

A comprehensive study of freeway operation, design and control was initiated in 1963 on a six-mile section of the Gulf Freeway in Houston. The project was organized into three major study phases: Operations, Design, and Systems Analysis. The study of interchange traffic was assigned to the Design Phase of the Project. This phase has as one of its objectives the development of the travel characteristics, on the city streets as well as on the freeway, of the traffic that interchanges with the freeway.

### Scope of the Study

The scope of this study is to provide information that will reliably describe the travel patterns of the interchange traffic\* of the Gulf Freeway during periods of peak traffic. A complete survey of this traffic will be accomplished by the use of origin-destination surveys of ramp traffic, volume counts on the freeway, frontage roads and city streets and turning movement studies at major intersections. The work of the first year was concentrated on the morning peak traffic and the results of the studies presented in this report are for the eleven entrance ramps on the inbound side of the Gulf Freeway.

Analyses of the data are limited to detailed presentations of the information that illustrates as many travel characteristics as are necessary to describe the patterns of the interchange traffic. Some interpretations of the travel patterns are made in the report, but the major contribution of this work is the presentation of the data.

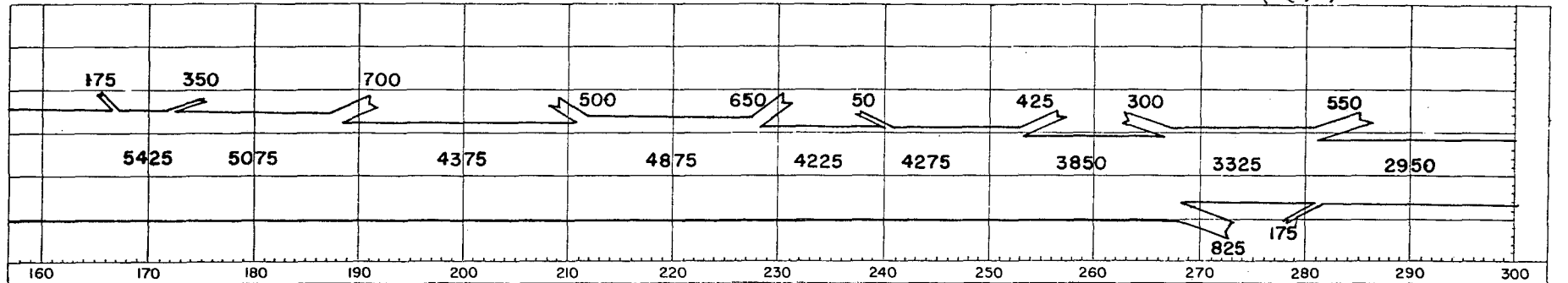
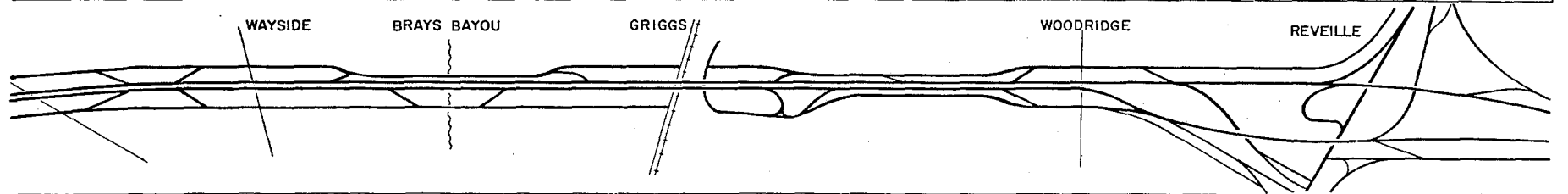
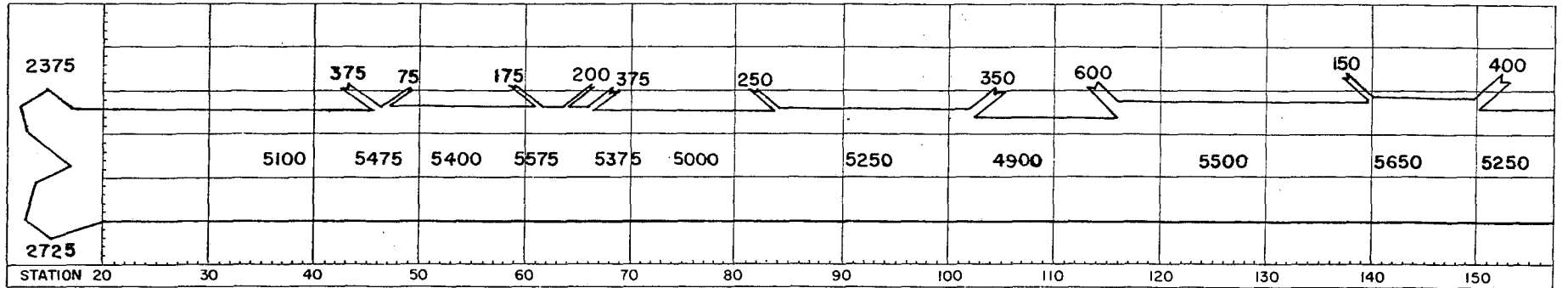
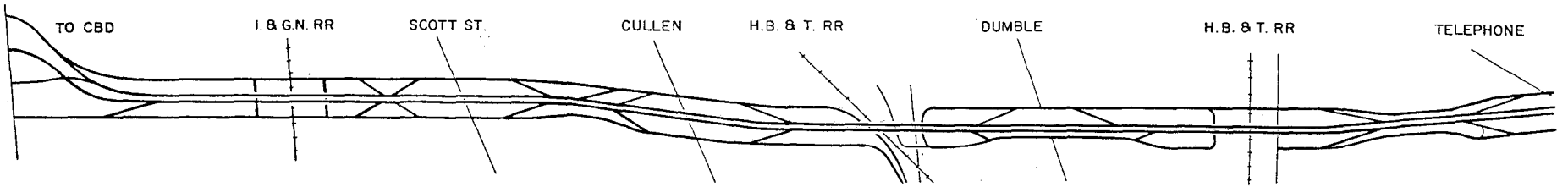
### Objectives of the Study

The primary objective is to develop the travel patterns of the traffic that enters the Gulf Freeway from the Reveille Interchange to the Distribution System at Dowling Street. In particular, the study was designed to accomplish the following:

- (1) To establish the "travel corridor" limits, or zone of influence of the Gulf Freeway.
- (2) To determine the trip lengths of the traffic entering the freeway in the study area.
- (3) To determine the routes used on the city street system to approach the Gulf Freeway.

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\* Interchange Traffic refers to that traffic that enters the freeway by way of one of the eleven entrance ramps in the study area.



VOLUME FLOW MAP  
INBOUND GULF FREEWAY 7-8 A.M.

FIGURE 1

- (4) To determine the origins and destinations of the motorists who enter the freeway by one of the entrance ramps in the study area.

## II. STUDY PROCEDURES

### Study Locations

The Gulf Freeway experiences severe congestion every weekday morning from the Reveille Interchange to Wayside Interchange. Figure 1 illustrates the typical traffic volumes from 7:00 to 8:00 A.M. Also on this sketch are eleven entrance ramps that were studied. These ramps were studied in four groups:

Group 1: State Highway 35 - The first ramp selected for a study was the left hand entrance ramp at State Highway 35. The traffic using this ramp did not have a convenient alternate route to bypass the survey station so that almost 100 percent usage was experienced during the study. Although the ramp volume was high, there was adequate storage room for vehicles delayed at the survey station. This ramp presented the best conditions for developing the study technique with minimum disruption to traffic.

Group 2: State Highway 225, Woodridge Ramp, Mossrose Ramp - The second survey was conducted two months later on the next three ramps in the freeway system. These three were grouped together so that traffic bypassing one of the ramps would eventually enter the freeway at one of the study ramps, because of the discontinuous frontage road at Griggs Road.

Group 3: Griggs Ramp, Wayside Ramp, Telephone Road, Dumble Ramp - The third survey was conducted two months later on the next four ramps downstream. Again, the discontinuous frontage road at the Dumble Area prevented traffic from bypassing the study ramps to enter the freeway.

Group 4: Cullen South Ramp, Cullen North Ramp, Scott Ramp - One month later the fourth survey was conducted on the remaining three ramps. A large number of vehicles bypassed the study area and continued to the business district on the frontage road. No attempt was made to encourage this traffic to enter the freeway at one of the study ramps.

### Data Collection Procedure

All study techniques designed to give information on the origin and destination of motor vehicle trips were considered for use in this survey. Two limitations placed on the study were that disruption of the traffic had to be at a minimum when working with freeway traffic and the survey was concerned with that specific group of motorists that entered the freeway in the study area from one of the eleven ramps during the morning peak.

The "lights on" technique<sup>1\*</sup> was considered because it can be applied to a specific segment of traffic, such as entrance ramp traffic. This procedure instructs all motorists in the traffic stream to be studied to turn on their headlights. Observers stationed at various locations record the vehicles' positions. This technique was rejected because the data were limited only to the travel patterns of the interchange traffic on the freeway lanes.

The roadside interview technique was rejected because of the delay and inconvenience to the motorists and the possible distraction to the freeway traffic. Home or business interviews would require a very large sample to obtain sufficient data from the particular segment of the freeway traffic that is being studied.

A technique which combines the use of field observations and mailed questionnaires was developed for use in a Los Angeles Freeway study<sup>2</sup> and later adapted for use in a study in Chicago.<sup>3</sup> This procedure requires that the license plate numbers of all vehicles using the ramp during the study period be recorded. The names and addresses of the vehicle owners are then obtained from Motor Vehicle Registration records and questionnaires with return postage guaranteed envelopes enclosed are mailed to these persons. Since favorable returns were received in the studies in Los Angeles and Chicago, the same type of questionnaire form and data return by mail procedure were selected for this study.

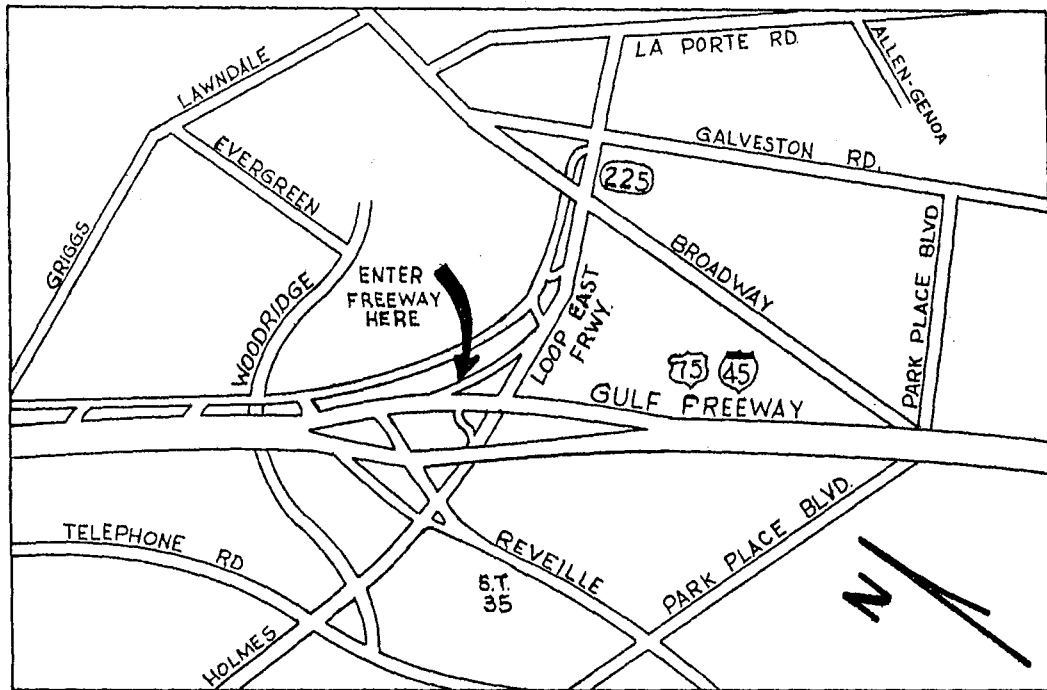
However, the method of distribution of the questionnaires was changed. Each motorist entering the ramp during the study period was stopped and issued a questionnaire, return postage guaranteed envelope, and a letter of explanation (Figures 2, 3, & 4). The forms were issued at a rate faster than the vehicles could merge into the freeway so that the motorists did not experience any additional delay (Figure 5) This procedure has several advantages:

1. 100 percent distribution is assured.
2. Motorists may fill out the form immediately after the trip in question.
3. Office work in preparing the forms for distribution is reduced.
4. Forms are received by the driver of the vehicle making the trip and not by the owner of the vehicle.
5. Recording and addressing errors are eliminated.
6. Time of arrival for each vehicle can be determined accurately.

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\* Numbers refer to references listed at the end of the paper.

QUESTIONNAIRE



The following questions concern the trip being made at the time you receive this questionnaire.

1. Please draw a line directly on the above street map showing the route you followed in reaching the indicated entrance ramp. If the origin of the trip is not included in the area shown, extend the route to the border of the map.

2. Where did this trip begin?

Street Address	City	Time of Day
----------------	------	-------------

3. Where did this trip end?

Street Address	City	Time of Day
----------------	------	-------------

4. What exit ramp did you use to leave the freeway? (Check One)

<input type="checkbox"/> Exit No. 7-Wayside	<input type="checkbox"/> Exit No. 4-Calhoun-Elgin	<input type="checkbox"/> Exit No. 1-Sampson
<input type="checkbox"/> Exit No. 6-Telephone	<input type="checkbox"/> Exit No. 3-Cullen	<input type="checkbox"/> Pease Street
<input type="checkbox"/> Exit No. 5-Lombardy	<input type="checkbox"/> Exit No. 2-Scott	<input type="checkbox"/> US 75 North-Calhoun St.

5. How often is this trip made between 6:30 and 8:30 a.m. (Check One)

<input type="checkbox"/> Seldom	<input type="checkbox"/> Twice per week	<input type="checkbox"/> Four times per week
<input type="checkbox"/> Once per week	<input type="checkbox"/> Three times per week	<input type="checkbox"/> Five or more times per week

6. Do you ever use other routes to make this trip?  yes  no.

If yes, what major streets are used? \_\_\_\_\_

After you have completed this questionnaire, please mail it back to us in the addressed envelope at your earliest convenience to the Texas Highway Department, Research Project, P. O. Box 26656, Houston, Texas 77032.

THANK YOU FOR YOUR COOPERATION

FIGURE 2



TEXAS HIGHWAY DEPARTMENT

FIRST CLASS  
PERMIT No. 8946  
HOUSTON, TEXAS

**BUSINESS REPLY MAIL**

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

• POSTAGE WILL BE PAID BY —

TEXAS HIGHWAY DEPARTMENT  
RESEARCH PROJECT  
BOX 26656  
HOUSTON, TEXAS 77032



FIGURE 3





COMMISSION  
HERBERT C. PERRY, JR., CHAIRMAN  
HAL WOODWARD  
J. H. KULTGEN

## TEXAS HIGHWAY DEPARTMENT

STATE HIGHWAY ENGINEER  
D. C. GREER

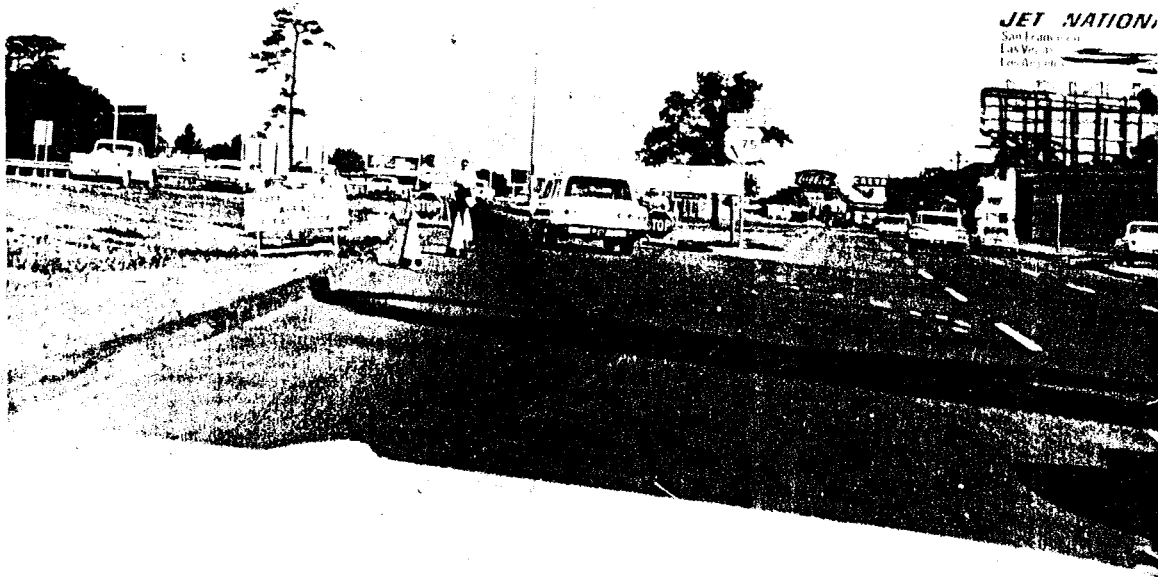
IN REPLY REFER TO  
FILE NO.

Dear Motorist:

We need your help in a Special Traffic Study of the Gulf Freeway which is being conducted in cooperation with the Texas Transportation Institute. This study has the objective of providing safer and more efficient operation on the Gulf Freeway. In order to develop better traffic operation on freeways, it is necessary to learn how the individual motorist uses them.

You are not required to sign any form and the information provided by you will be kept confidential. We would appreciate your completing the attached questionnaire as accurately as possible and returning it to our office.

Your participation and cooperation in this survey will be greatly appreciated.



DISTRIBUTION OF ORIGIN AND  
DESTINATION FORMS TO FREEWAY  
RAMP TRAFFIC

FIGURE 5

### Data Reduction Procedure

As the returns were received through the mails, the forms were coded according to the items listed in Appendix A. The origins and destinations were assigned zones according to the official coding index of the City of Houston<sup>4</sup>, and the Origin-Destination Survey of Houston<sup>5</sup> Metropolitan Area conducted by the Planning Survey Division of the Texas Highway Department. Other information was zoned in a convenient order for tabulation.

The data were put on IBM punch cards and the various tabulations required to categorize the information were made.

### III. RESULTS OF STUDIES

The response to the surveys was very favorable (Table 1). The overall return was approximately 57 percent and the response from some of the critical ramps such as SH 35, Mossrose, and Griggs Road was higher. The validity of the results is further substantiated by the fact that more than 90 percent of the returns indicated that this trip was made 5 or more times during the week.

TABLE 1

#### Schedule of

#### ORIGIN-DESTINATION STUDIES

<u>Date</u>	<u>Ramp</u>	<u>Number of Questionnaires Distributed</u>	<u>Number of Questionnaires Returned</u>	<u>Percent of Total Distributed</u>
Nov. 21, 1963	S.H. 35	1200	783	65.3
Jan. 23, 1964	S.H. 225	718	419	58.4
	Woodridge	609	395	65.0
	Mossrose	750	493	65.8
Mar. 12, 1964	Griggs Road	1000	596	59.6
	Wayside	539	248	46.0
	Telephone Rd.	598	288	48.1
	Dumble	559	226	40.4
Apr. 10, 1964	Cullen South	470	247	52.6
	Cullen North	299	148	49.5
	Scott	<u>149</u>	<u>59</u>	<u>39.6</u>
	Total	6891	3902	56.7

In the following sections the information has been analyzed and tabulated for each individual ramp and then combined to present the combined effect of interchange traffic on the freeway and city street system.

### Traffic Assignment

Questionnaires were distributed at each of the eleven ramps from approximately 6:45 to 8:30 A.M. The number of vehicles entering the freeway during this period at each ramp is shown in Figure 6. Other numbers shown on the frontage roads and city street system are indications of how the ramp traffic is distributed over the approach routes. These are combined volumes with all eleven ramps represented on the one drawing. Figures 7 through 17 show the same information for individual ramps.

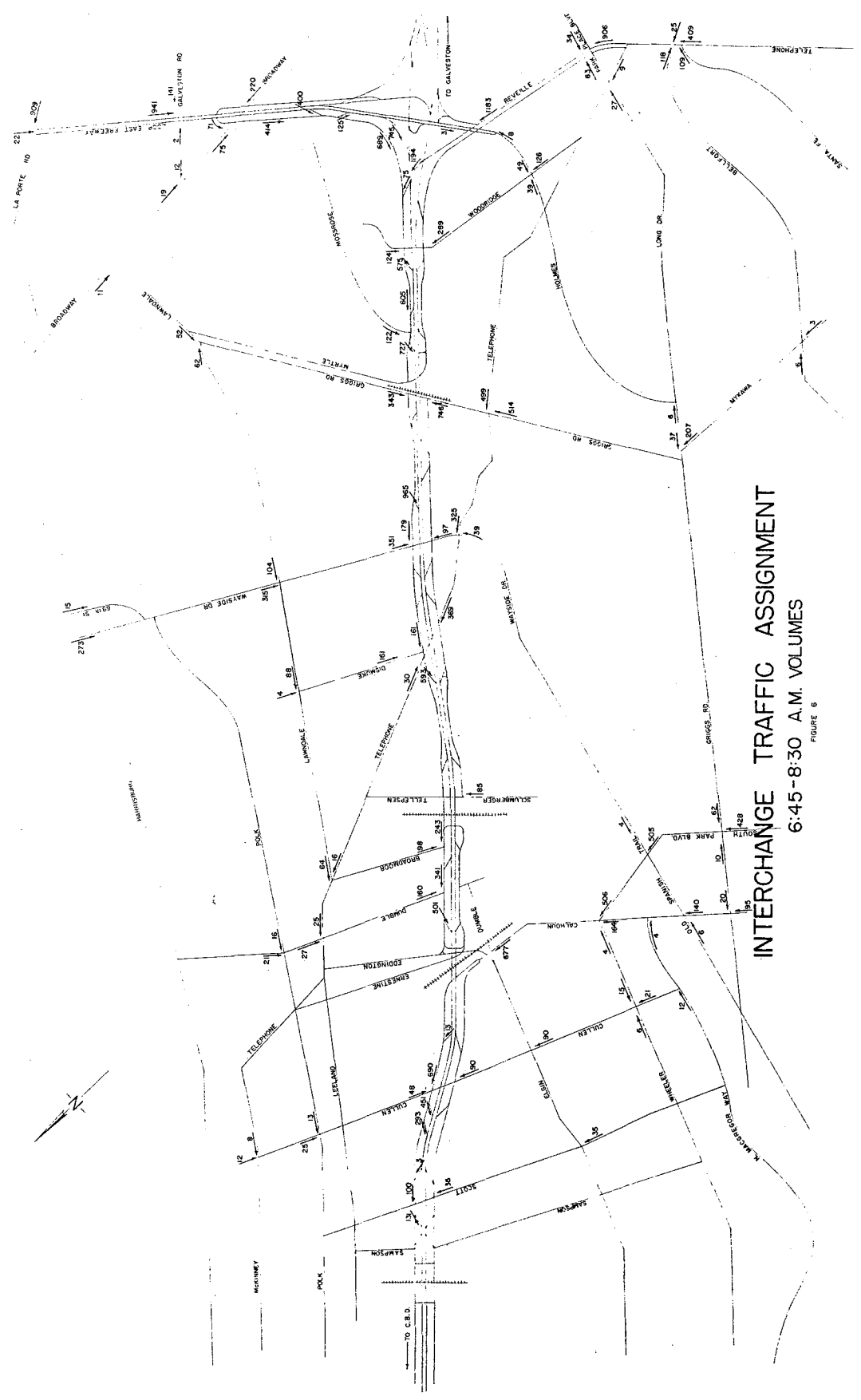
The volumes at the intersections near the freeway are very accurate because the freeway system is limited to a few access streets and because sketches included on the questionnaires provide some information on approach routing. The volumes shown at some distance (over one mile) from the freeway are assigned to the street system according to the location of the trip origins. These are somewhat in error due to the omission of minor streets that are used as feeders to the major street system.

This information is important in the study of traffic reassignment, which is necessary when ramps are to be controlled, or signal timing systems are to be altered. These figures can be broken down into any time intervals so that the control period volumes can be studied separately.

### Summary Tables

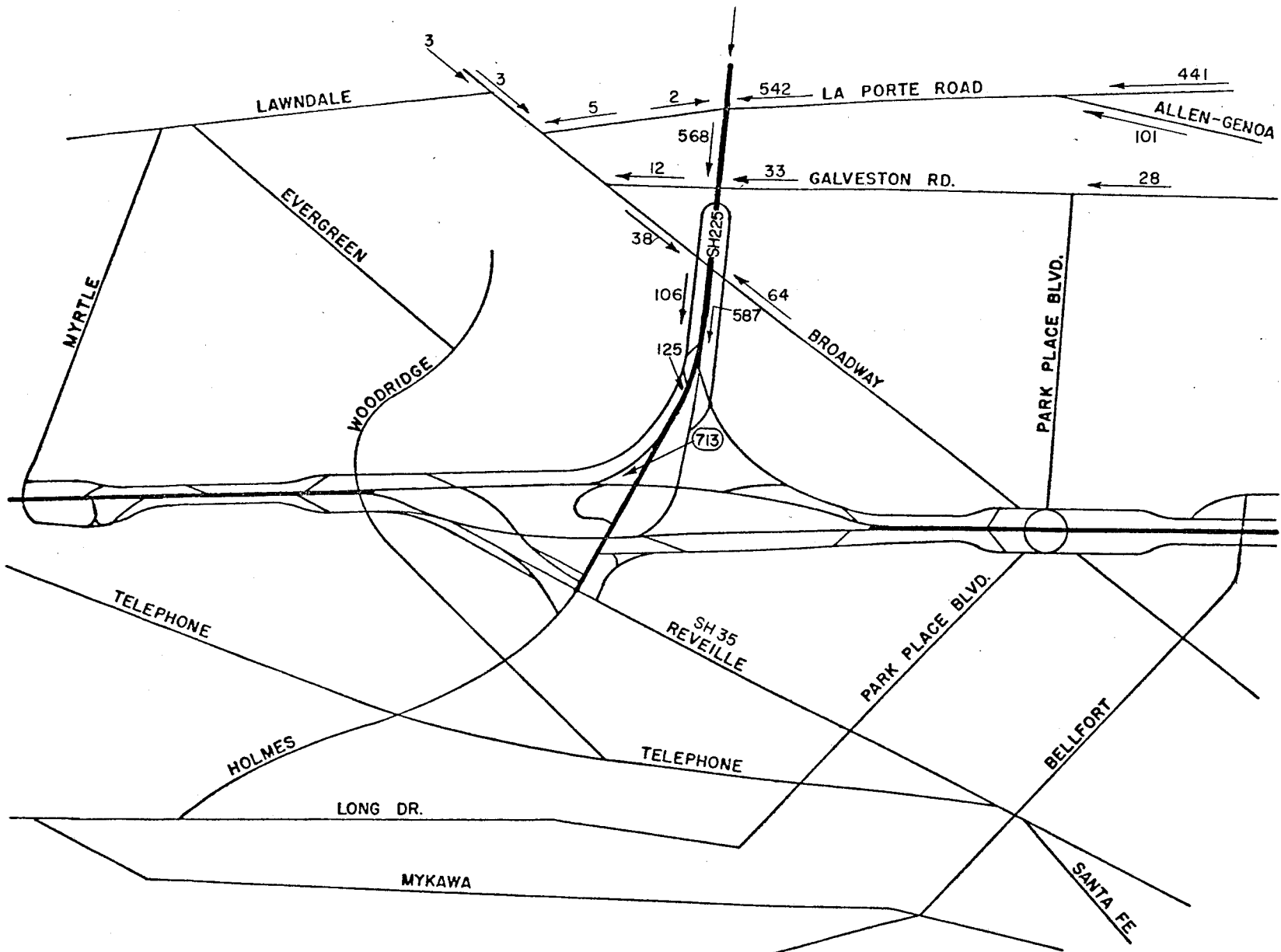
Tables 2 through 12 present some of the data from the returns for the individual ramps. The data on the present return, the exit ramp used, frequency of use, and the use of alternate routes are presented in 15-minute time periods. Totals, shown for the forms returned, are expanded for the total number distributed. In every case this expansion is based on the percent return only. The totals for each time interval can be expanded based on the rate of return of the forms distributed during that period. This rate seems to vary according to the degree of difficulty experienced by the motorists. The more serious the problem, the higher the response rate.

The distance in miles between the entrance ramp and every downstream exit ramp is included on the form. With these freeway trip lengths and the number of vehicles using each exit ramp, the distribution and average of the freeway trips for each ramp can be obtained.



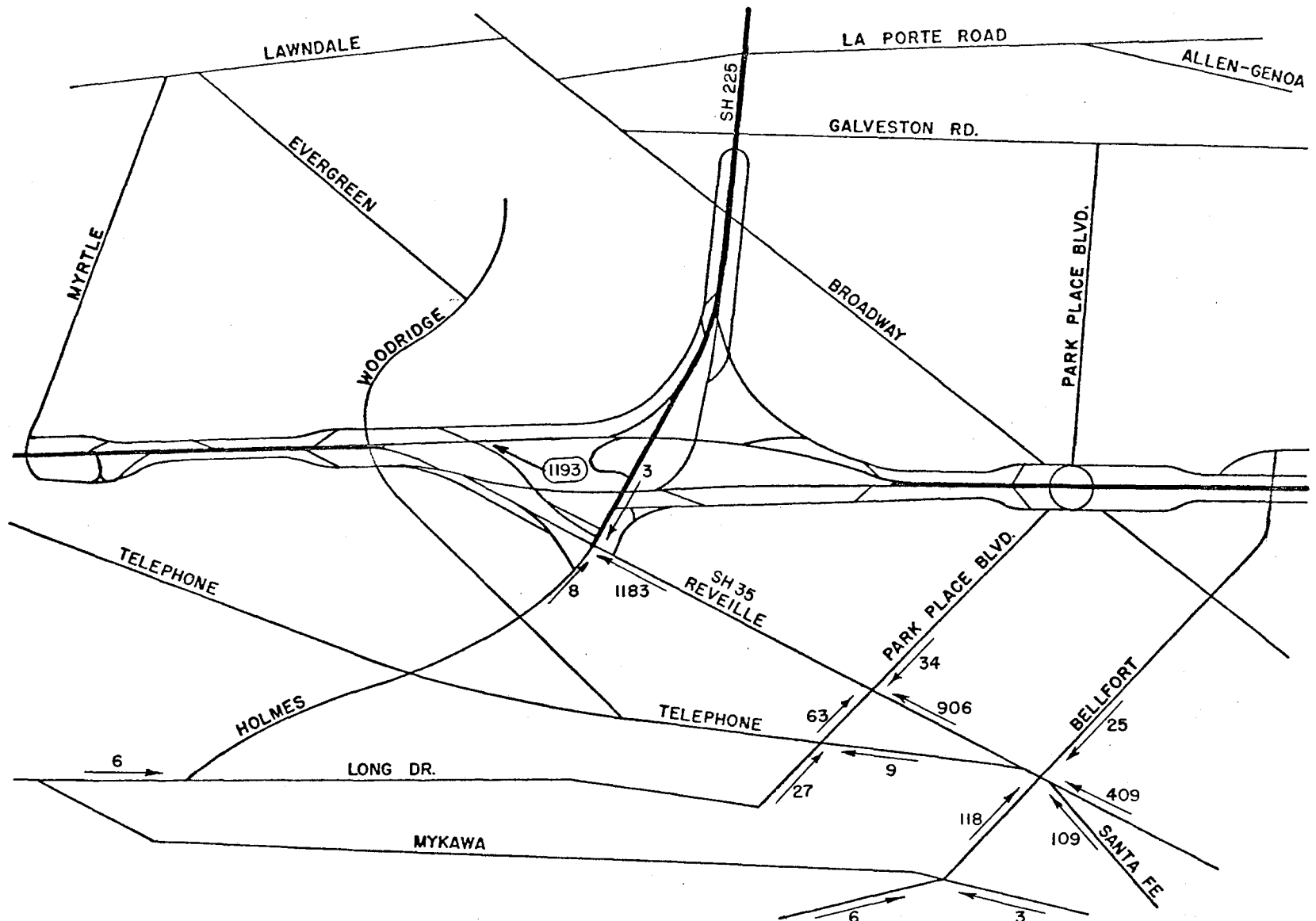
**INTERCHANGE TRAFFIC ASSIGNMENT**  
**6:45-8:30 A.M. VOLUMES**

FIGURE 6



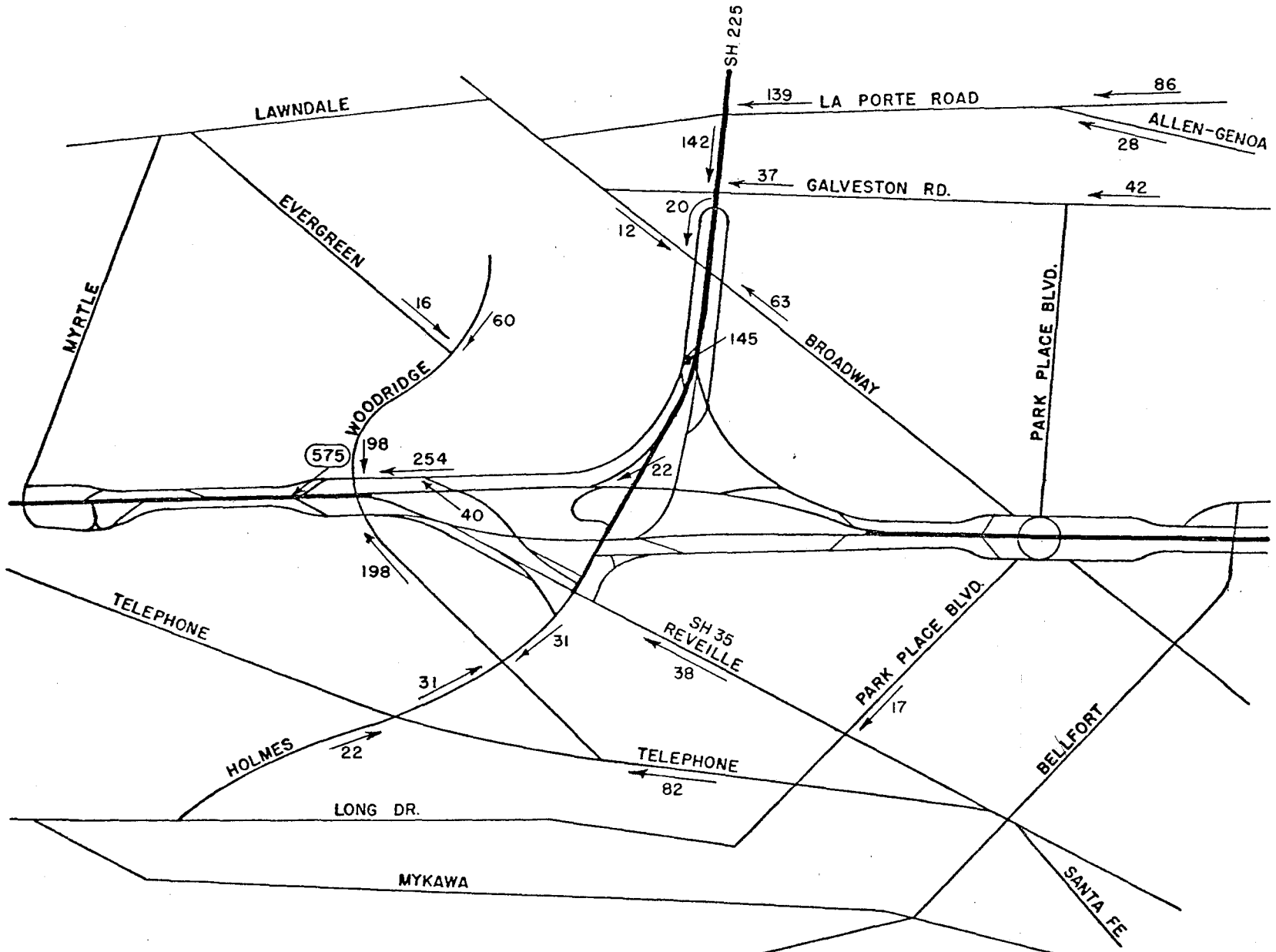
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
 THE GULF FREEWAY AT STATE 225 ENTRANCE RAMP

FIGURE 7



ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT STATE 35 ENTRANCE RAMP

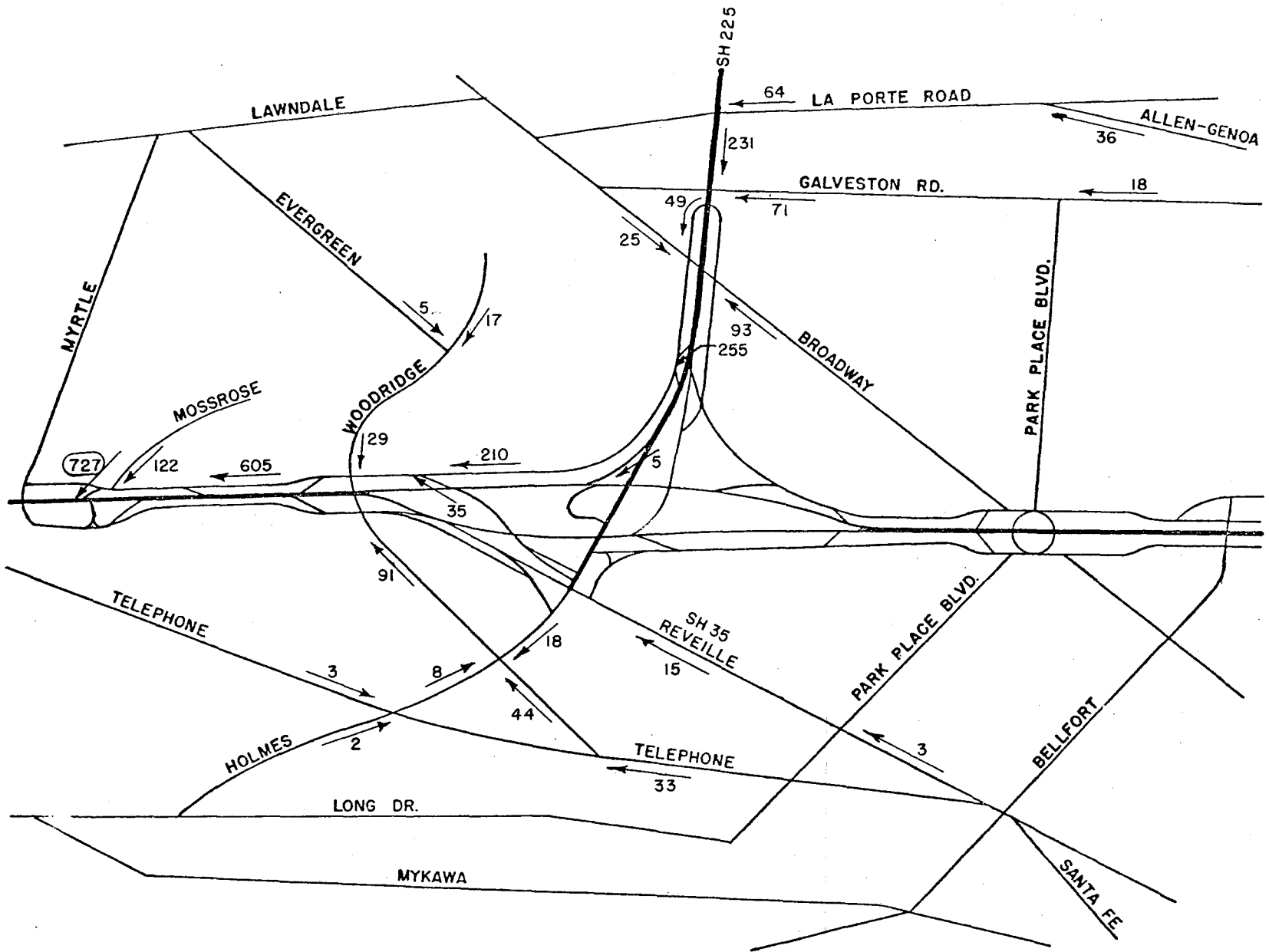
FIGURE 8



ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
 THE GULF FREEWAY AT WOODRIDGE ENTRANCE RAMP

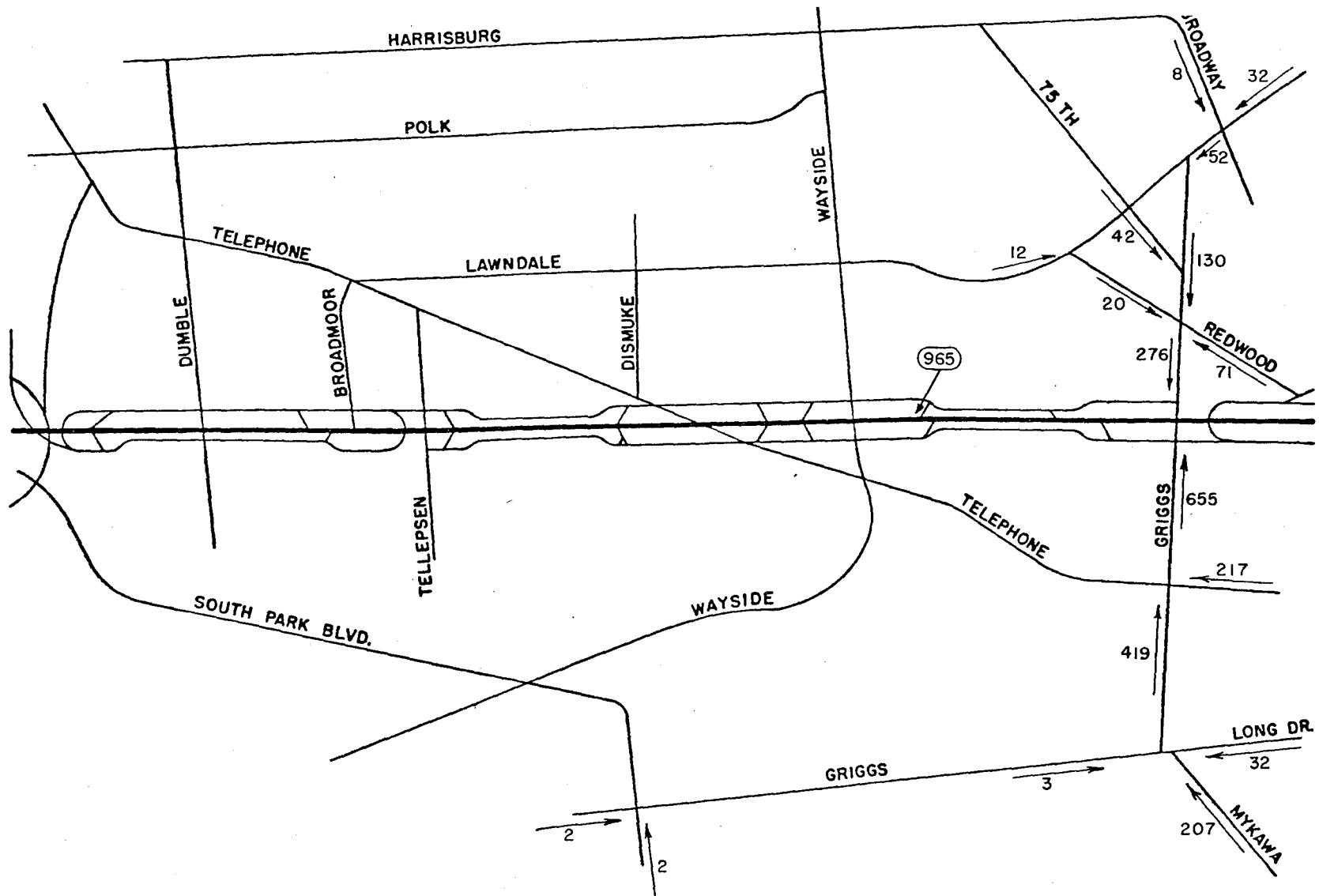
FIGURE 9





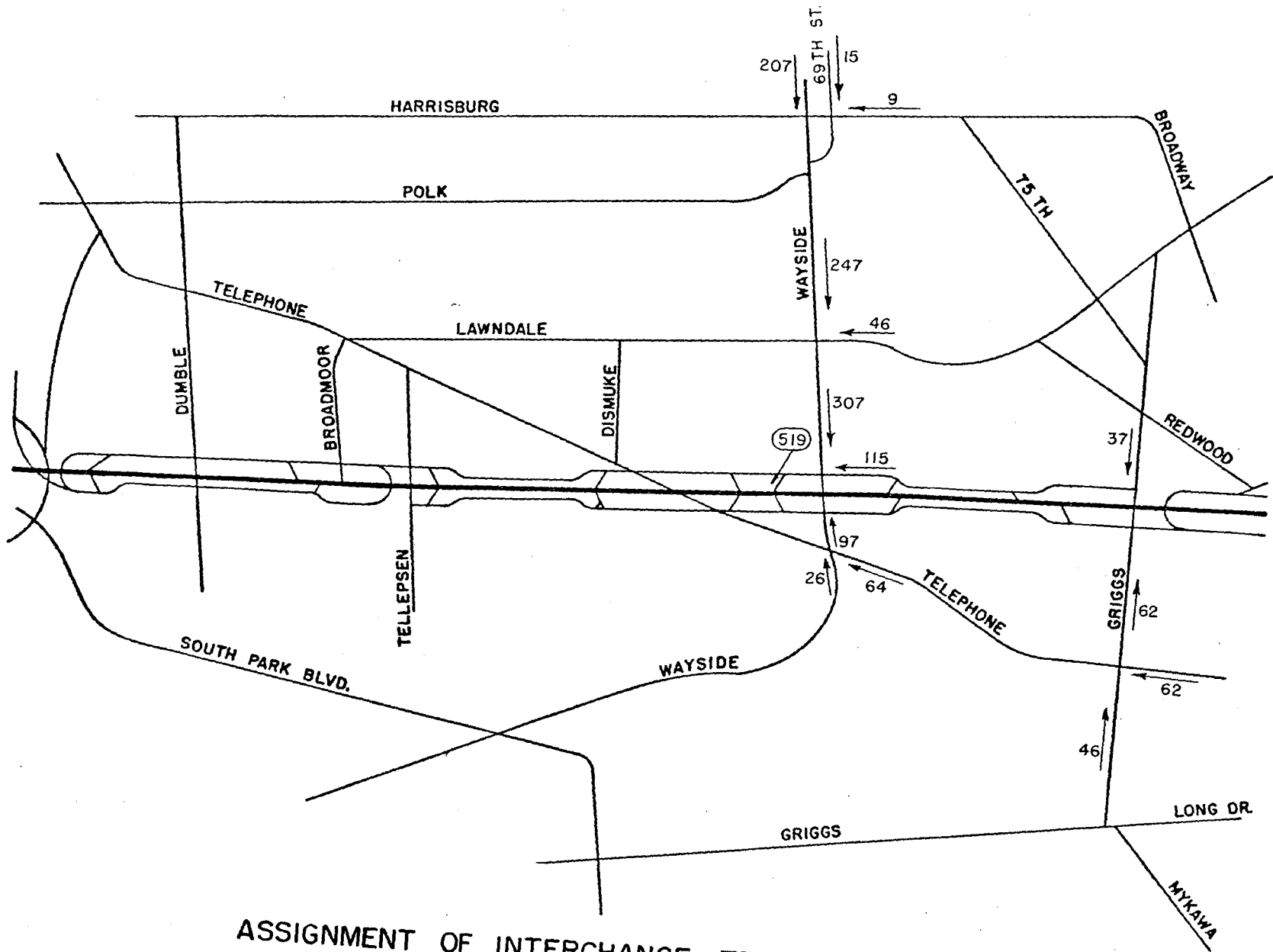
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT MOSSROSE ENTRANCE RAMP

FIGURE 10



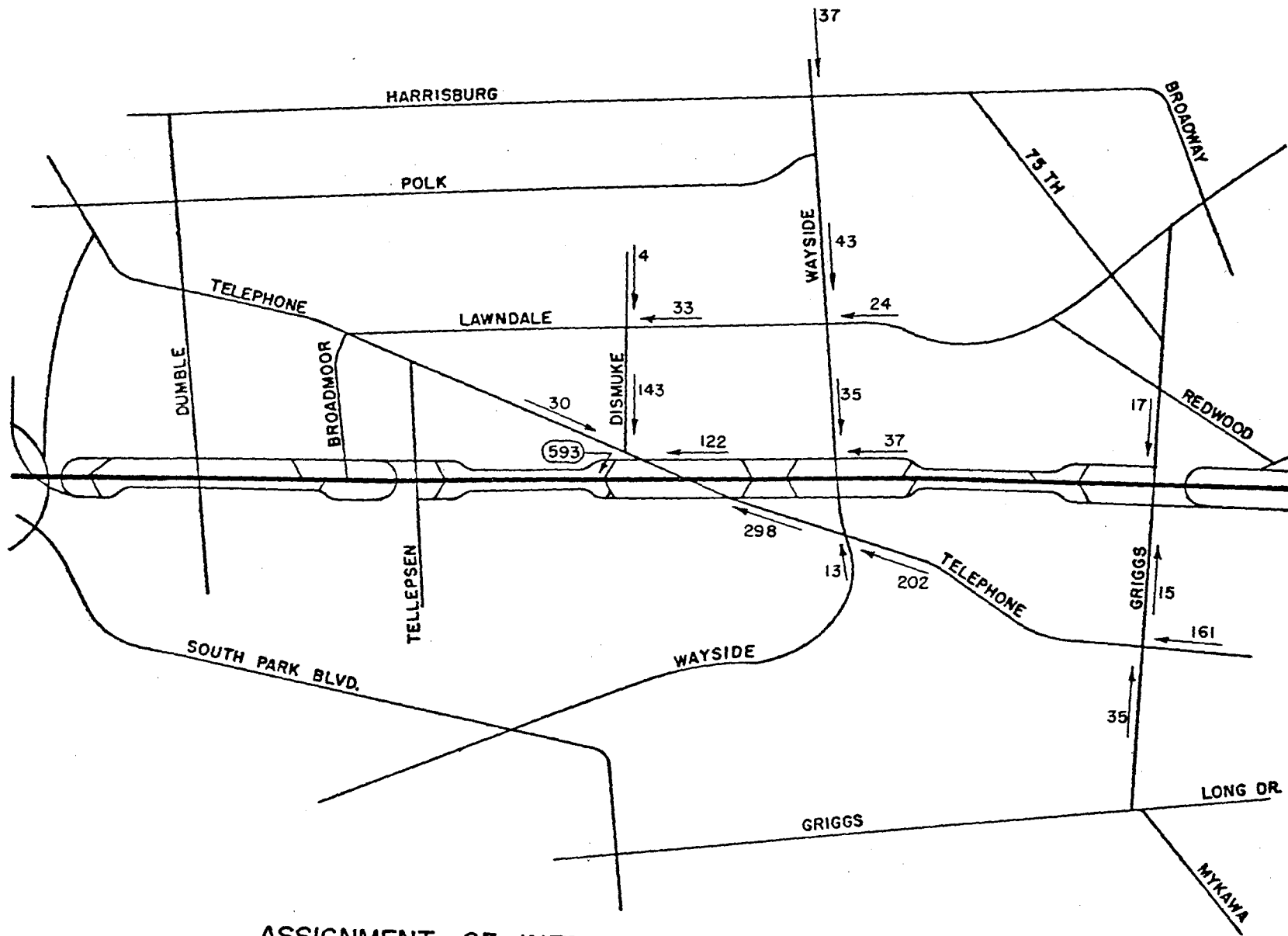
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT GRIGGS ENTRANCE RAMP

FIGURE 11



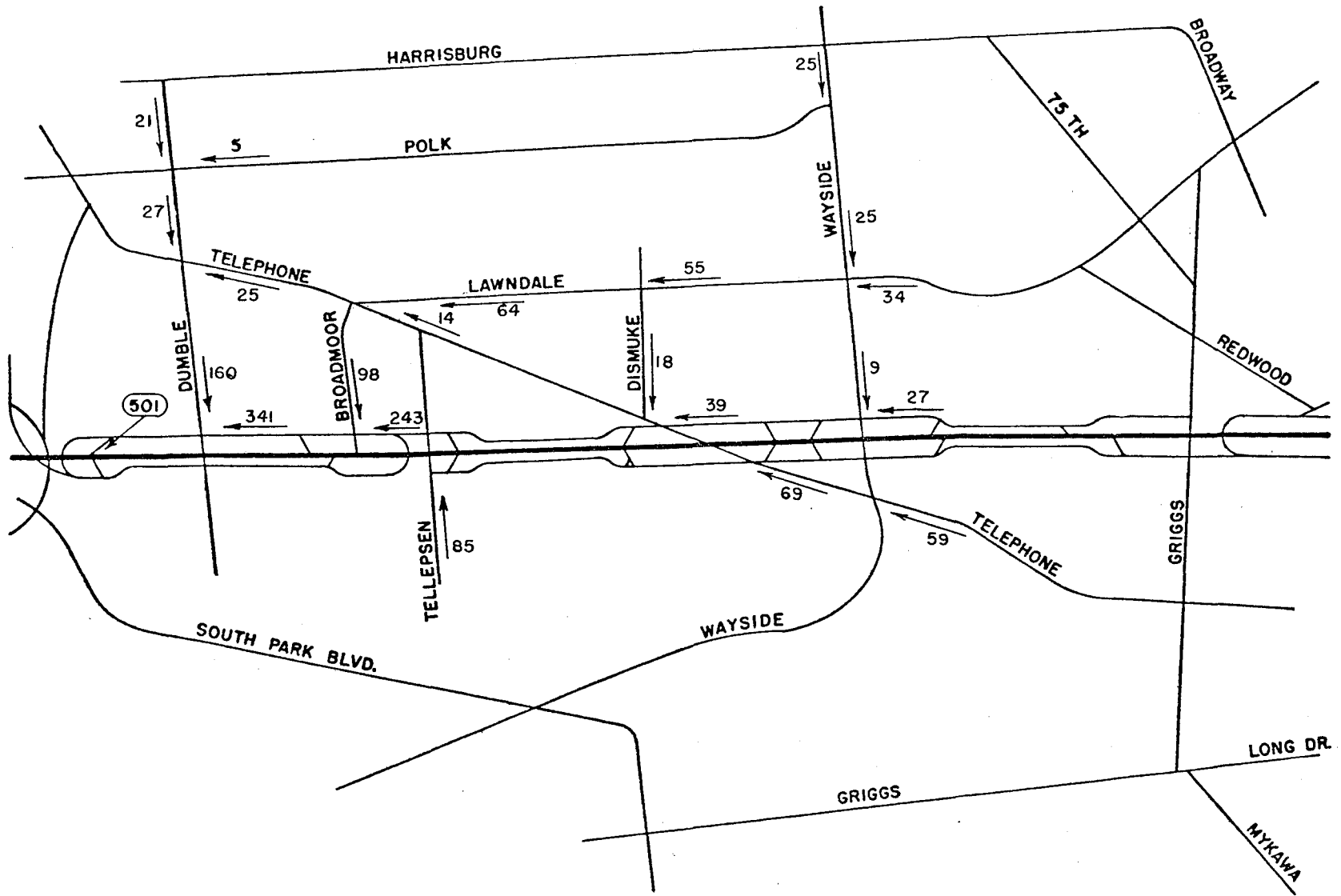
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
 THE GULF FREEWAY AT WAYSIDE ENTRANCE RAMP

FIGURE 12



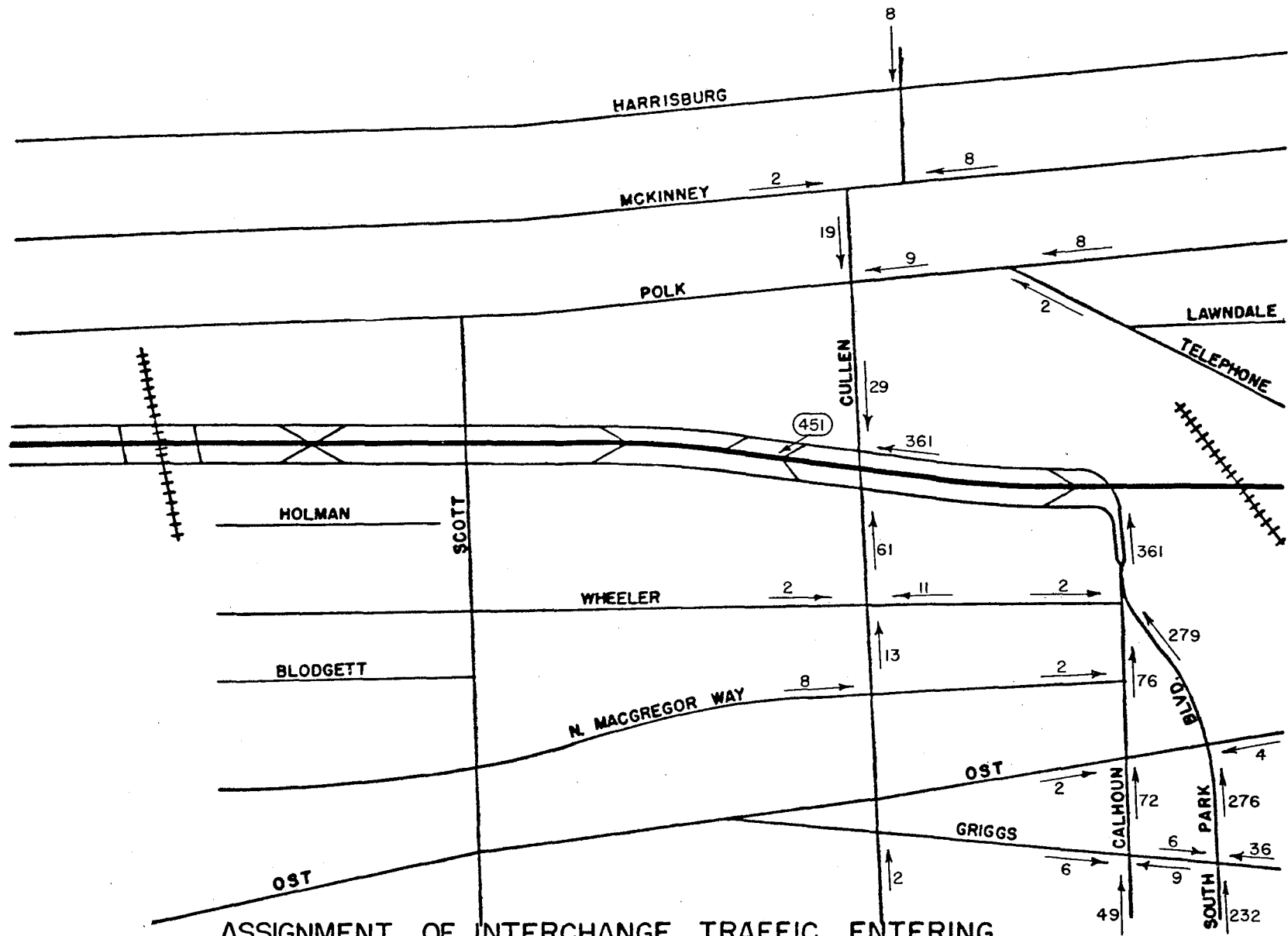
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT TELEPHONE ENTRANCE RAMP

FIGURE 13



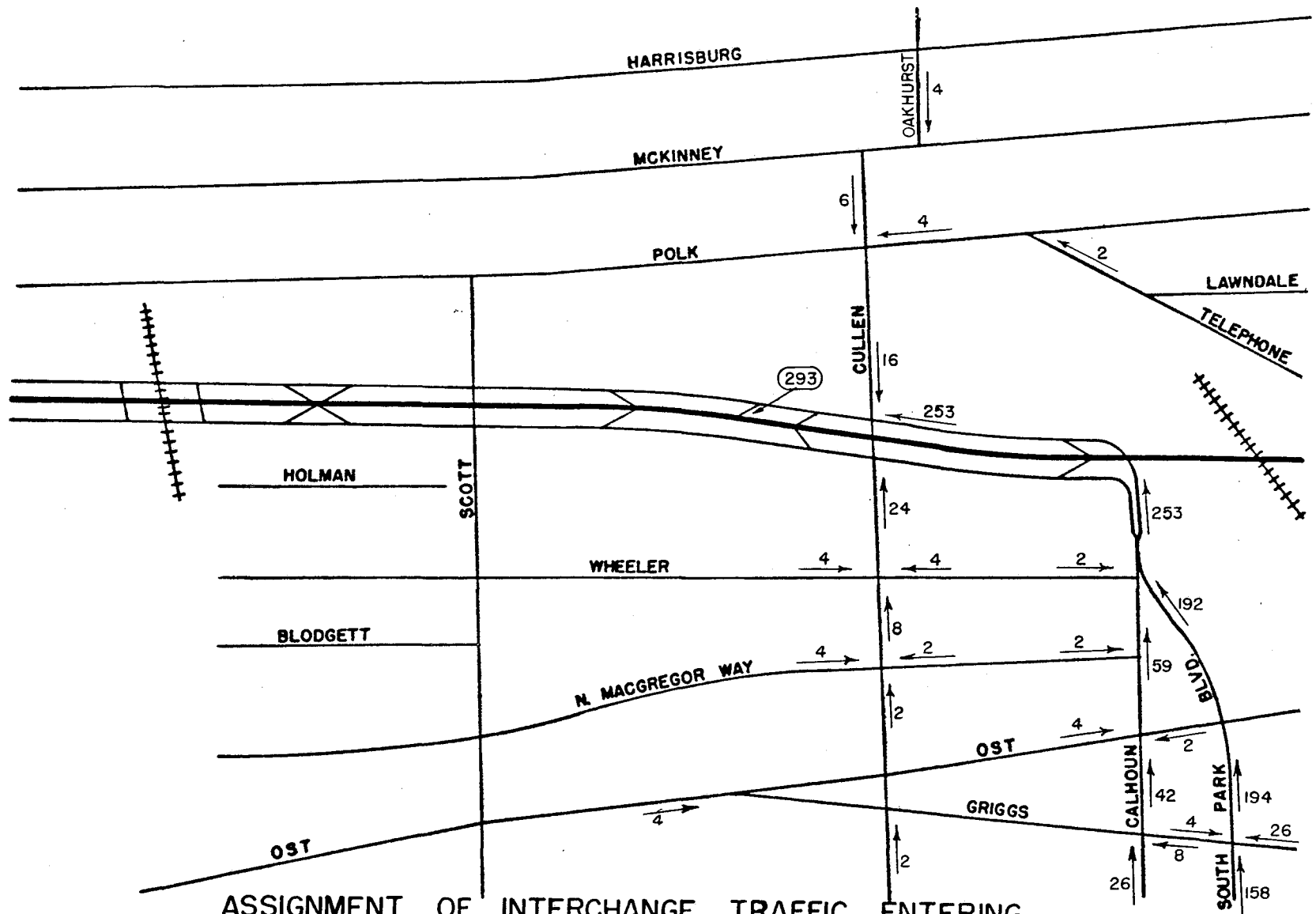
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT DUMBLE ENTRANCE RAMP

FIGURE 14



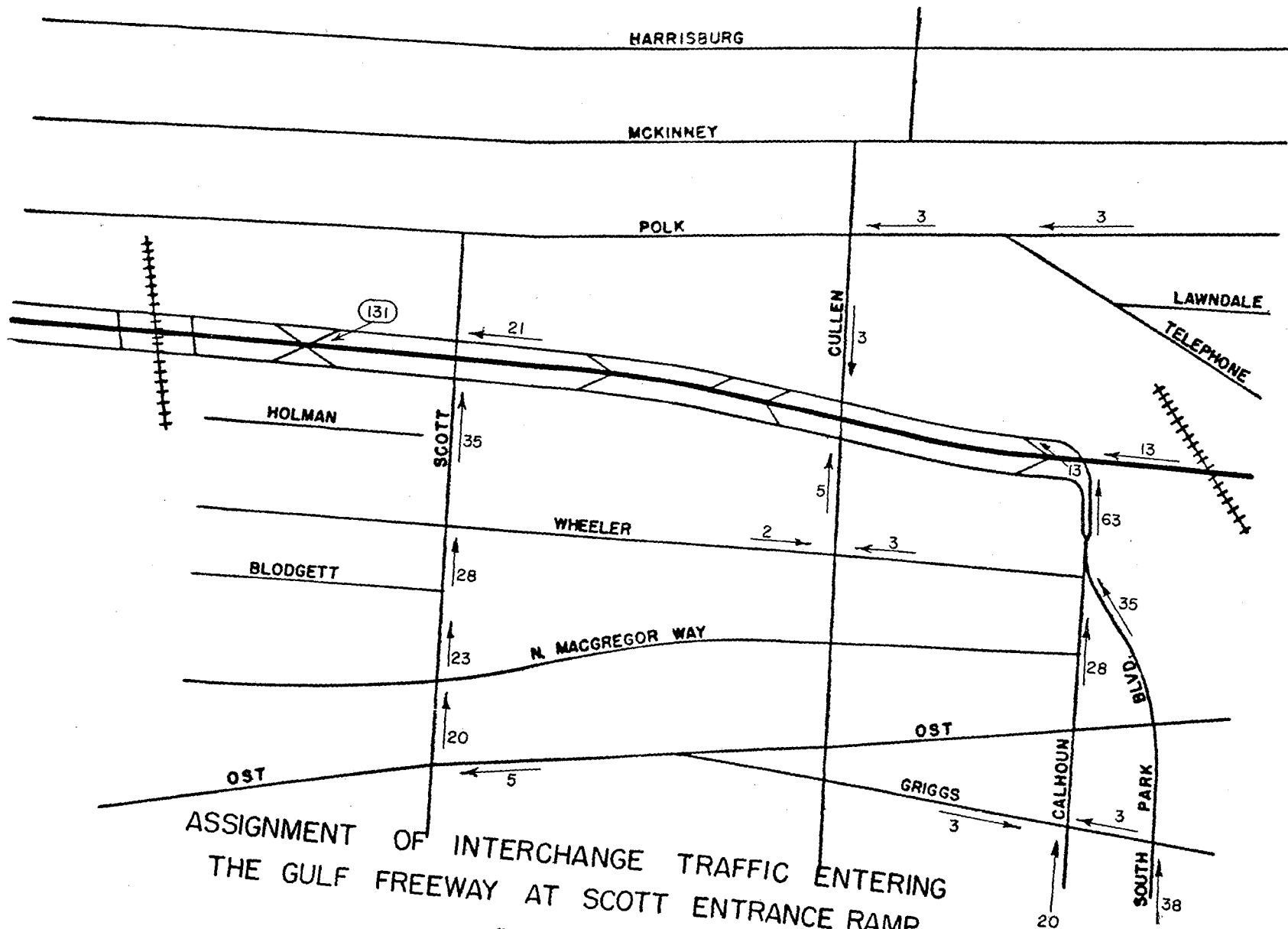
ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT CULLEN SOUTH ENTRANCE RAMP

FIGURE 15



ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
THE GULF FREEWAY AT CULLEN NORTH ENTRANCE RAMP

FIGURE 16



ASSIGNMENT OF INTERCHANGE TRAFFIC ENTERING  
 THE GULF FREEWAY AT SCOTT ENTRANCE RAMP

FIGURE 17



TABLE 2

RESULTS OF QUESTIONNAIRES  
RECEIVED FROM 225 RAMP

	Time of Day Entered Freeway							Total	Expanded Totals
	6:58 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:23		
Total No. Distributed	37	137	135	117	89	135	68	718	718
Total No. Returned	20	81	86	67	49	72	37	419	718
Percent Return	54.1	59.1	63.7	57.3	55.1	53.4	54.4	58.4	100.0
<u>Exit Ramp Used</u>	<u>Distance in miles</u>								
No. 9 - Woodridge	0.15	--	1	--	--	--	--	1	2
No. 8 - Griggs	0.70	--	--	--	--	--	1	1	2
No. 7 - Wayside	1.23	--	--	--	1	4	3	10	17
No. 6 - Telephone	2.06	--	--	--	--	1	1	2	3
No. 5 - Lombardy	2.56	--	1	--	3	--	--	5	9
No. 4 - Calhoun	3.05	2	6	6	6	2	8	32	56
No. 3 - Cullen	3.64	3	4	--	5	4	4	22	38
No. 2 - Scott	4.07	--	3	1	1	1	4	10	17
No. 1 - Sampson	4.38	--	4	6	1	3	6	22	38
Pease	4.89	5	37	33	25	20	21	157	274
US 75 - Calhoun	4.89	9	22	39	24	13	22	142	247
Did not indicate	1	3	1	1	1	1	2	10	17
<u>Frequency of Use</u>									
Seldom	--	4	3	1	2	8	5	23	40
Once/week	--	1	1	1	1	--	1	5	9
Twice/week	--	1	--	2	1	--	2	6	10
Three/week	--	1	--	4	2	1	1	9	16
Four/week	--	1	1	--	1	--	2	5	9
Five or more/week	20	73	81	59	41	63	28	365	636
Did not indicate	--	--	--	--	1	--	--	1	2
<u>Other Routes</u>									
Yes	4	21	18	15	13	21	17	109	190
No	16	59	67	50	34	50	21	297	517
Did not indicate	--	1	1	2	2	1	1	8	14

TABLE 3  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM STATE 35 TRAFFIC

	Time of Day Traffic Entered Freeway								Total	Expanded Totals
	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30	8:15 to 8:30		
Total No. Distributed	121	201	195	181	174	175	153	1200	1200	
Total No. Returned	75	125	131	130	114	120	88	783	1200	
Percent Return	62.0	62.1	67.0	71.7	65.4	68.5	57.5	65.3	100.0	

<u>Exit Ramp Used</u>	<u>Distance in miles</u>										Total	Expanded Totals
No. 9 - Woodridge	--	--	--	--	--	--	--	--	--	---	---	
No. 8 - Griggs	0.49	2	1	1	--	3	1	3	11	17		
No. 7 - Wayside	1.02	1	11	2	7	5	10	10	46	71		
No. 6 - Telephone	1.85	1	1	2	3	4	6	3	20	31		
No. 5 - Lombardy	2.35	2	2	4	6	9	2	2	27	41		
No. 4 - Calhoun	2.84	3	7	6	5	14	8	5	48	74		
No. 3 - Cullen	3.43	3	2	1	2	6	8	4	26	40		
No. 2 - Scott	3.85	3	4	3	4	3	2	2	21	32		
No. 1 - Sampson	4.16	6	10	6	9	4	5	7	47	72		
Pease	4.67	25	49	51	50	34	37	33	279	427		
Us 75 - Calhoun	4.67	15	34	46	40	32	40	16	223	341		
Did not indicate		14	4	9	4	--	1	3	35	54		

Frequency of Use

Seldom	--	1	2	1	4	3	4	15	23
Once/week	--	1	1	1	2	2	--	7	11
Twice/week	--	--	2	--	3	2	5	12	18
Three/week	--	1	1	1	3	3	6	15	23
Four/week	6	--	2	2	--	3	1	14	21
Five or more/week	66	121	122	124	102	107	70	712	1092
Did not indicate	3	1	1	1	--	--	2	8	12

Other Routes

Yes	17	15	29	43	43	40	29	216	331
No	56	109	101	86	70	80	58	560	848
Did not indicate	2	1	1	1	1	--	1	7	11

TABLE 4  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM WOODRIDGE

	Time of Day Traffic Entered Freeway								Total	Expanded Totals
	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30	8:30 to 8:45		
Total No. Distributed	50	76	119	133	96	66	69	609	609	
Total No. Returned	29	40	78	108	66	36	38	395	609	
Percent Return	58.0	52.6	65.5	81.2	68.8	54.5	55.1	65.0	100.0	

<u>Exit Ramp Used</u>	<u>Distance in miles</u>									
No. 9 - Woodridge	--	--	--	--	--	--	--	--	---	---
No. 8 - Griggs	0.21	--	--	--	--	--	--	--	---	---
No. 7 - Wayside	0.74	1	2	1	9	7	9	4	33	51
No. 6 - Telephone	1.57	--	--	2	1	1	--	1	5	8
No. 5 - Lombardy	2.07	1	--	1	5	6	--	1	14	22
No. 4 - Calhoun	2.56	2	1	7	11	6	1	4	32	49
No. 3 - Cullen	3.15	3	--	--	4	5	3	3	18	28
No. 2 - Scott	3.57	--	--	3	5	2	--	--	10	15
No. 1 - Sampson	3.88	1	2	6	5	5	--	4	23	35
Pease	4.39	11	17	33	35	18	10	12	136	212
US 75 - Calhoun	4.39	9	16	24	31	15	11	8	114	174
Did not indicate		1	2	1	2	1	2	1	10	15

Frequency of Use

Seldom	--	1	--	1	1	--	3	6	9
Once/week	--	--	--	1	--	--	--	1	2
Twice/week	--	--	1	--	--	2	1	4	6
Three/week	--	--	1	--	--	1	1	3	5
Four/week	--	--	1	--	--	2	1	4	6
Five or more/week	29	39	73	106	65	31	32	375	578
Did not indicate	--	--	2	--	--	--	--	2	3

Other Routes

Yes	11	19	23	40	32	15	21	161	248
No	18	21	55	66	33	21	17	231	356
Did not indicate	--	--	--	2	1	--	--	3	5

TABLE 5  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM GRIGGS-MOSSROSE RAMP

	Time of Day Traffic Entered Freeway							Total	Expanded Totals
	6:50 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:22		
Total No. Distributed	24	145	143	164	179	71	24	750	750
Total No. Returned	14	101	93	113	114	45	13	493	750
Percent Return	58.4	69.6	65.0	69.0	63.6	63.5	54.1	65.8	100.0

<u>Exit Ramp Used</u>	<u>Distance in miles</u>									Total	Expanded Totals
No. 9 - Woodridge	--	--	--	--	--	--	--	--	---	---	
No. 8 - Griggs	--	--	--	--	--	--	--	--	---	---	
No. 7 - Wayside	.32	1	15	15	22	40	14	4	111	169	
No. 6 - Telephone	1.15	--	1	7	5	7	3	2	25	38	
No. 5 - Lombardy	1.65	--	4	3	8	8	2	--	25	38	
No. 4 - Calhoun	2.14	--	7	4	8	10	4	1	34	52	
No. 3 - Cullen	2.73	--	2	3	5	5	1	1	17	26	
No. 2 - Scott	3.15	--	2	3	1	1	1	--	8	12	
No. 1 - Sampson	3.46	2	7	7	8	3	2	1	30	46	
Pease	3.97	8	39	36	32	18	10	3	146	221	
US 75 - Calhoun	3.97	2	19	12	22	22	6	1	84	128	
Did not indicate	1		5	3	2	--	2	--	13	20	

Frequency of Use

Seldom	--	--	--	--	--	3	--	3	5
Once/week	--	1	--	--	--	1	--	2	3
Twice/week	--	--	2	--	--	--	1	3	5
Three/week	--	2	--	--	--	--	--	2	3
Four/week	--	--	1	1	2	1	--	5	8
Five or more/week	14	96	90	112	112	40	12	476	723
Did not indicate	--	2	--	--	--	--	--	2	3

Other Routes

Yes	5	37	37	35	58	19	7	198	301
No	9	61	56	76	55	24	6	287	437
Did not indicate	--	3	--	2	1	2	--	8	12

TABLE 6  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM GRIGGS TRAFFIC

	Time of Day Traffic Entered Freeway							Total	Expanded Totals
	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30		
Total No. Distributed	152	149	116	183	162	138	100	1000	1000
Total No. Returned	73	92	76	120	99	78	56	596	1000
Percent Return	48.1	61.7	65.5	65.6	61.1	56.5	56.0	59.6	100.0

---

<u>Exit Ramp Used</u>	<u>Distance in miles</u>								
No. 9 - Woodridge		--	--	--	--	--	--	---	---
No. 8 - Griggs		--	--	--	--	--	--	---	---
No. 7 - Wayside		--	1	1	1	2	2	--	7
No. 6 - Telephone	0.30	2	1	--	1	4	1	1	10
No. 5 - Lombardy	0.80	--	--	--	5	6	--	1	12
No. 4 - Calhoun	1.29	3	7	5	7	9	10	4	45
No. 3 - Cullen	1.88	--	--	3	--	5	6	4	18
No. 2 - Scott	2.30	3	--	--	3	7	1	2	16
No. 1 - Sampson	2.61	7	8	8	16	6	5	5	55
Pease	3.12	29	41	36	50	34	25	17	232
U.S. 75 - Calhoun	3.12	19	30	20	30	21	21	18	159
Did not indicate		10	4	3	7	5	7	4	40

---

<u>Frequency of Use</u>									
Seldom	1	3	2	--	3	3	4	16	27
Once/week	--	--	1	--	4	1	2	8	13
Twice/week	1	--	--	4	--	2	4	11	19
Three/week	1	1	1	--	2	3	2	10	17
Four/week	1	--	--	2	2	1	1	7	12
Five or more/week	68	87	72	114	88	67	43	539	907
Did not indicate	1	1	--	--	--	1	--	3	5

---

<u>Other Routes</u>									
Yes	25	39	32	43	41	38	11	229	386
No	46	53	44	77	57	40	45	362	609
Did not Indicate	2	--	--	--	1	--	--	3	5

RESULTS OF QUESTIONNAIRES  
RECEIVED FROM WAYSIDE TRAFFIC

Time of Day Traffic Entered Freeway

	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30	Total	Expanded Totals
Total No. Distributed	25	71	85	86	87	78	107	539	539
Total No. Returned	10	30	41	43	42	35	44	248	539
Percent Return	40.0	42.3	48.3	50.0	47.3	44.8	41.2	46.0	100.0

Exit Ramp Used	Distance in miles								
No. 9 - Woodridge		--	--	--	--	--	--	---	---
No. 8 - Griggs		--	--	--	--	--	--	---	---
No. 7 - Wayside		--	--	--	--	--	--	---	---
No. 6 - Telephone	0.08	--	--	1	--	--	--	1	2
No. 5 - Lombardy	0.58	--	--	1	--	1	2	3	7
No. 4 - Calhoun	1.07	1	5	2	7	5	6	32	70
No. 3 - Cullen	1.66	1	3	1	--	4	1	12	26
No. 2 - Scott	2.08	--	--	2	--	--	--	3	7
No. 1 - Sampson	2.39	--	1	2	4	1	2	10	22
Pease	2.90	1	6	15	15	14	5	74	163
U.S. 75 - Calhoun	2.90	4	14	14	14	15	12	85	187
Did not indicate		3	1	3	3	3	8	25	55

Frequency of Use

Seldom	--	5	1	3	3	3	7	22	48
Once/week	--	--	2	1	2	2	1	8	18
Twice/week	--	1	--	1	1	1	--	4	9
Three/week	--	--	--	1	1	--	3	5	11
Four/week	--	--	1	3	1	2	1	8	18
Five or more/week	10	24	36	34	32	26	32	194	426
Did not indicate	--	--	1	--	2	1	1	4	9

Other Routes

Yes	7	12	20	23	16	15	19	112	246
No	3	17	21	19	23	19	24	126	277
Did not indicate	--	1	--	1	3	1	1	7	15

TABLE 8  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM TELEPHONE TRAFFIC

	Time of Day Traffic Entered Freeway							Total	Expanded Totals
	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30		
Total No. Distributed	79	51	144	112	93	79	41	599	599
Total No. Returned	36	20	76	60	37	40	17	288	599
Percent Return	45.6	39.2	52.7	53.6	39.8	50.6	41.5	48.1	100.0

Exit Ramp Used	Distance in miles	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30	Total	Expanded Totals
No. 9 - Woodridge		--	--	--	--	--	--	--	---	---
No. 8 - Griggs		--	--	--	--	--	--	--	---	---
No. 7 - Wayside		--	--	--	--	--	--	--	---	---
No. 6 - Telephone		--	--	--	--	--	--	--	---	---
No. 5 - Lombardy	0.19	3	--	--	--	1	1	1	6	13
No. 4 - Calhoun	0.68	7	2	5	8	3	5	2	32	67
No. 3 - Cullen	1.27	2	1	--	2	2	3	--	10	21
No. 2 - Scott	1.69	1	1	1	3	--	1	--	7	15
No. 1 - Sampson	2.00	3	--	5	--	4	--	--	12	25
Pease	2.51	5	7	35	19	10	14	6	96	201
U.S. 75 - Calhoun	2.51	8	6	19	20	11	9	4	77	161
Did not indicate		7	3	11	8	6	7	4	46	96

Frequency of Use	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30	Total	Expanded Totals
Seldom	2	1	2	1	--	1	4	11	23
Once/week	--	--	2	--	--	1	--	3	6
Twice/week	1	--	--	1	2	--	2	6	13
Three/week	2	--	2	1	4	1	2	12	25
Four/week	--	1	1	3	1	--	3	9	19
Five or more/week	29	18	67	53	28	36	6	237	496
Did not indicate	2	--	2	1	2	1	--	8	17

Other Routes	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30	Total	Expanded Totals
Yes	15	10	38	25	15	19	10	132	276
No	20	9	35	32	20	20	6	142	298
Did not indicate	1	1	3	3	2	1	1	12	25

TABLE 9  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM DUMBLE TRAFFIC

	Time of Day Traffic Entered Freeway							Total	Expanded Totals
	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30		
Total No. Distributed	37	69	95	116	72	94	76	559	559
Total No. Returned	14	26	33	62	29	38	23	226	559
Percent Return	37.8	37.7	34.8	58.5	40.3	40.4	30.2	40.4	100.0

---

<u>Exit Ramp Used</u>	<u>Distance in miles</u>								
No. 9 - Woodridge		--	--	--	--	--	--	---	---
No. 8 - Griggs		--	--	--	--	--	--	---	---
No. 7 - Wayside		--	--	--	--	--	--	---	---
No. 6 - Telephone		--	--	--	--	--	--	---	---
No. 5 - Lombardy		2	2	3	1	--	2	11	27
No. 4 - Calhoun		1	1	2	4	1	3	12	30
No. 3 - Cullen	0.39	2	--	1	--	1	4	10	25
No. 2 - Scott	0.81	--	--	--	--	--	1	2	5
No. 1 - Sampson Pease	1.12 1.63	1	1	4	2	1	--	9	22
U.S. 75 - Calhoun	1.63	1	8	9	28	11	11	77	190
Did not indicate		--	2	3	5	8	4	23	60

---

<u>Frequency of Use</u>									
Seldom	2	--	--	1	4	--	5	12	30
Once/week	--	--	1	--	--	1	--	2	5
Twice/week	--	--	--	--	--	2	--	2	5
Three/week	--	--	--	--	1	1	--	2	5
Four/week	--	1	--	1	1	--	--	3	7
Five or more/week	12	25	32	60	21	34	18	202	502
Did not indicate	--	--	--	--	2	--	--	2	5

---

<u>Other Routes</u>									
Yes	3	14	15	25	9	17	10	93	232
No	11	12	18	36	17	20	13	127	315
Did not indicate	--	--	--	1	3	1	--	5	12



TABLE 10  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM CULLEN SOUTH TRAFFIC

	Time of Day Traffic Entered Freeway							Total	Expanded Totals
	6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30		
Total No. Distributed	62	59	76	60	71	59	83	470	470
Total No. Returned	28	33	45	37	38	25	41	247	470
Percent Return	45.2	55.9	59.2	61.7	55.5	42.4	49.4	52.6	100.0

<u>Exit Ramp Used</u>	<u>Distance in miles</u>								
No. 9 - Woodridge		--	--	--	--	--	--	--	--
No. 8 - Griggs		--	--	--	--	--	--	--	--
No. 7 - Wayside		--	--	--	--	--	--	--	--
No. 6 - Telephone		--	--	--	--	--	--	--	--
No. 5 - Lombardy		--	--	--	--	--	--	--	--
No. 4 - Calhoun		--	--	--	--	--	--	--	--
No. 3 - Cullen		--	--	--	--	--	--	--	--
No. 2 - Scott	0.13	--	--	--	--	--	--	--	--
No. 1 - Sampson	0.44	--	--	1	--	--	1	1	3
Pease	0.95	14	13	20	--	21	8	16	92
U.S. 75 - Calhoun	0.95	11	19	22	20	16	15	22	125
Did not indicate		3	1	2	17	1	1	2	27

Frequency of Use

Seldom	3	--	--	--	--	--	4	7	13
Once/week	--	--	1	1	1	--	--	3	6
Twice/week	--	--	--	2	2	1	1	6	11
Three/week	1	--	--	--	1	2	2	6	11
Four/week	--	1	--	--	--	--	--	1	2
Five or more/week	24	32	44	34	34	22	34	224	427
Did not indicate	--	--	--	--	--	--	--	--	--

Other Routes

Yes	6	5	16	10	11	10	13	71	135
No	22	27	29	27	27	15	26	173	329
Did not indicate	--	1	--	--	--	--	2	3	6

TABLE 11  
RESULTS OF QUESTIONNAIRES  
RECEIVED FROM CULLEN NORTH TRAFFIC

		Time of Day Traffic Entered Freeway							Total	Expanded Totals
		6:45 to 7:00	7:00 to 7:15	7:15 to 7:30	7:30 to 7:45	7:45 to 8:00	8:00 to 8:15	8:15 to 8:30		
Total No. Distributed		23	40	57	46	49	36	48	299	299
Total No. Returned		9	25	35	18	23	18	20	148	299
Percent Return		39.1	62.5	61.4	39.2	46.9	50.0	41.7	49.5	100.0

<u>Exit Ramp Used</u>	<u>Distance in miles</u>									
No. 9 - Woodridge		--	--	--	--	--	--	--	---	---
No. 8 - Griggs		--	--	--	--	--	--	--	---	---
No. 7 - Wayside		--	--	--	--	--	--	--	---	---
No. 6 - Telephone		--	--	--	--	--	--	--	---	---
No. 5 - Lombardy		--	--	--	--	--	--	--	---	---
No. 4 - Calhoun		--	--	--	--	--	--	--	---	---
No. 3 - Cullen		--	--	--	--	--	--	--	---	---
No. 2 - Scott	0.07	--	--	--	--	--	--	1	1	2
No. 1 - Sampson	0.38	--	1	2	--	--	--	1	4	8
Pease	0.89	5	14	17	10	1	7	11	65	132
US 75 - Calhoun	0.89	3	7	15	7	12	11	6	61	123
Did not indicate		1	3	1	1	10	--	1	17	34

<u>Frequency of Use</u>										
Seldom		--	--	2	--	--	1	--	3	6
Once/week		--	--	--	--	--	--	2	2	4
Twice/week		1	1	--	1	1	--	1	5	10
Three/week		1	1	--	--	1	--	--	3	6
Four/week		--	1	2	--	--	--	--	3	6
Five or more/week		--	22	31	17	21	17	16	124	251
Did not indicate		7	--	--	--	--	--	1	8	16

<u>Other Routes</u>										
Yes		1	7	13	3	5	8	4	41	83
No		8	18	22	15	18	10	15	106	214
Did not indicate		--	--	--	--	--	--	1	1	2



### Freeway Trip Lengths

The trip lengths of traffic entering the study section from the entrance ramps were determined from the ramp spacing. The fact that the study area was in the last five miles of the freeway which ends at the distribution system to the downtown street system accounted for the large percentages of traffic destined for the end of the freeway. The number of vehicles destined for each of the ramps is listed in Tables 2 through 12. A summary of the average trip lengths compared to the maximum trip lengths is shown in Table 13. The only unusual feature of this table is the apparent reversal of the trend in average trip length at the Griggs Road. This reversal is due to the large decrease in Average Trip Length at the Mossrose Ramp. Table 5 indicates a high volume of traffic entering at Mossrose and exiting at Wayside, a total freeway trip of 0.32 miles. The reason for this short freeway trip is the discontinuous frontage road at Griggs Road. Although in absolute numbers the short trips on the freeway are small, their effect on the freeway operations is magnified during periods of heavy traffic congestion. It is apparent that some attempt should be made to eliminate these trips from the freeway lanes.

### Freeway Area of Influence

To define the area of influence the Gulf Freeway has on the travel patterns in the Houston Area, the desire lines for all trips using the freeway during the morning peak were plotted (Figures 18 and 19). More than 90 percent of all origins fell within one mile on either side of the freeway. A tabulation of the trips from zone of origin to zone of destination is presented in Appendix B. These zonal interchanges represent the 65.7 percent return received for the entire study.

### Trip Desire Lines

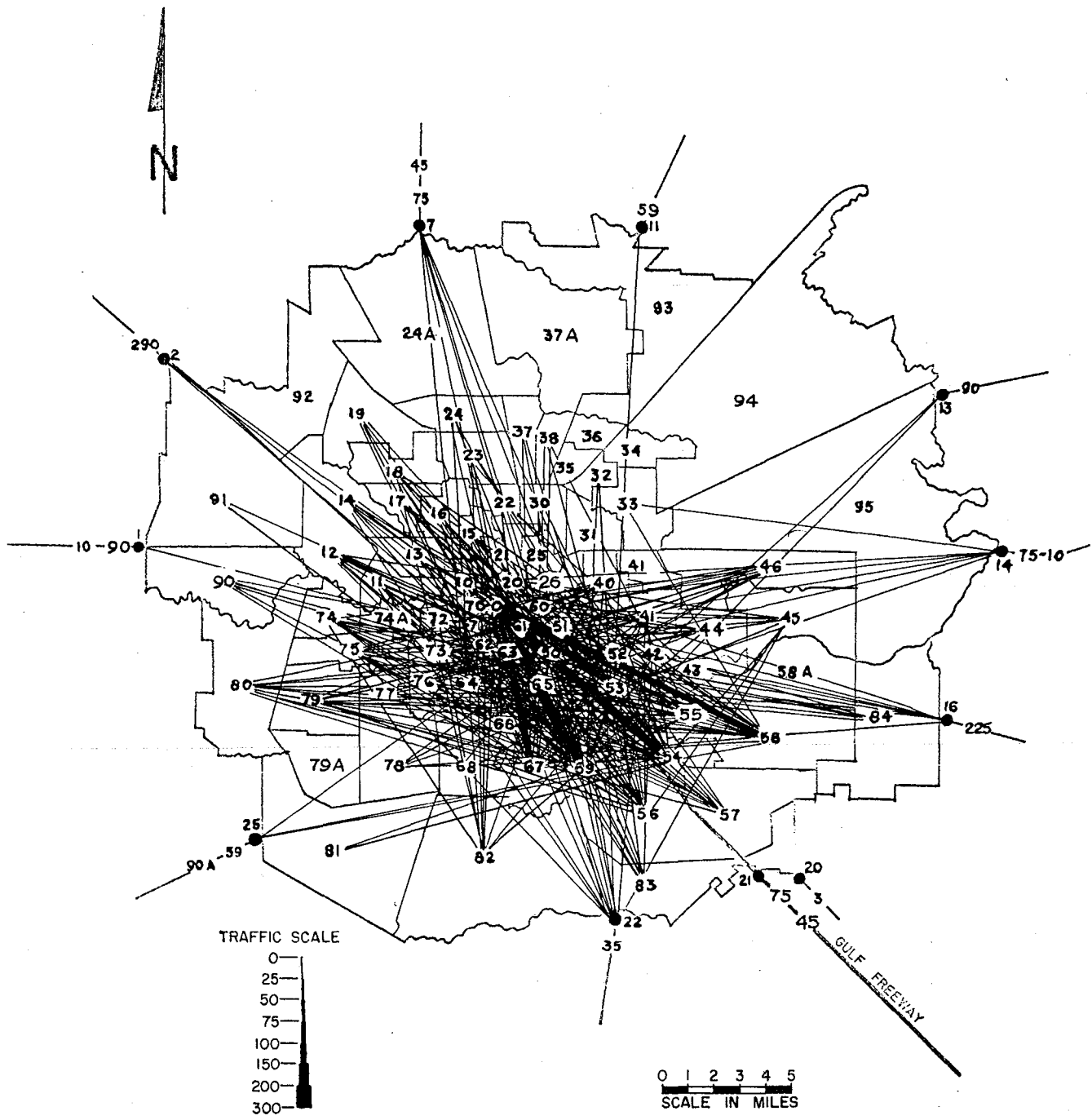
The areas of influence for the individual entrance ramps are indicated on the drawings of the origin-destination desire lines with the freeway link included (Figures 20-30). These drawings indicate how far from the freeway diversion may be effective if entrance ramps are to be controlled. These presentations also illustrate the distribution of freeway trip lengths from each of the entrance ramps. The desire lines point out the possible diversion of some traffic to more suitable travel routes on the surface street system.

The areas of influence for individual exit ramps are shown in the drawings of the exit ramp-destination desire lines. (Figures 31-40). Since the origins of these trips were represented in the preceding section, they were not replotted on these drawings.

TABLE 13  
 FREEWAY TRIP LENGTH  
 FOR VEHICLES  
 ENTERING GULF FREEWAY

ENTRANCE RAMP	AVERAGE TRIP LENGTH (Mi)	MAXIMUM TRIP LENGTH* (Mi)
State Hwy. 225	4.37	4.89
State Hwy. 35	3.99	4.68
Woodridge	3.69	4.39
Mossrose	2.65	3.98
Griggs	2.75	3.12
Wayside	2.48	2.90
Telephone	2.12	2.52
Dumble	1.53	1.63
Cullen South	0.94	0.95
Cullen North	0.87	0.89
Scott	0.53	0.53

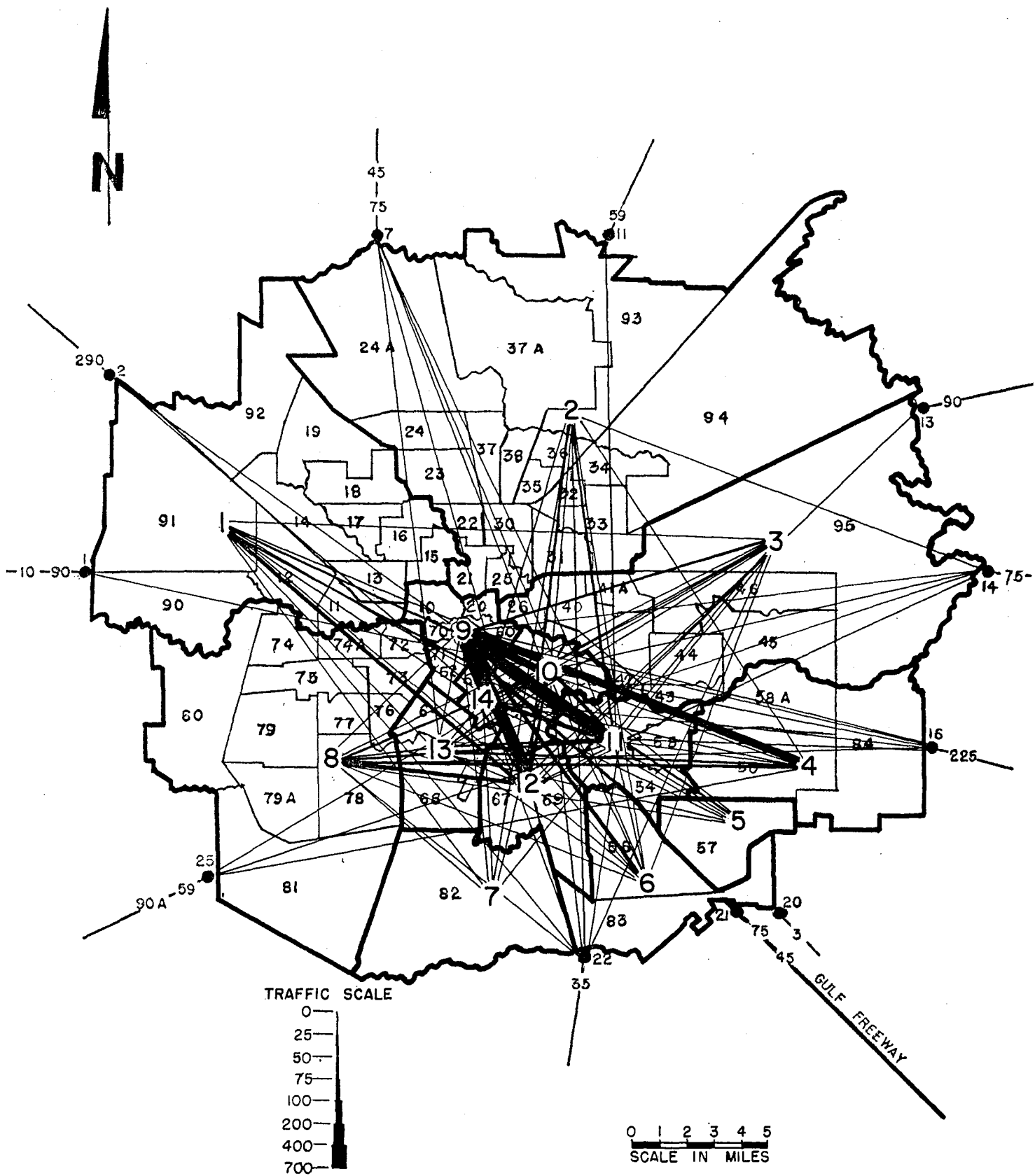
\* - Maximum Trip Length is the distance from the Entrance Ramp to the Distribution System at Dowling Street.



# HOUSTON DISTRICT MAP

TRIP DESIRE LINES  
 GULF FREEWAY  
 6:45-8:30 AM

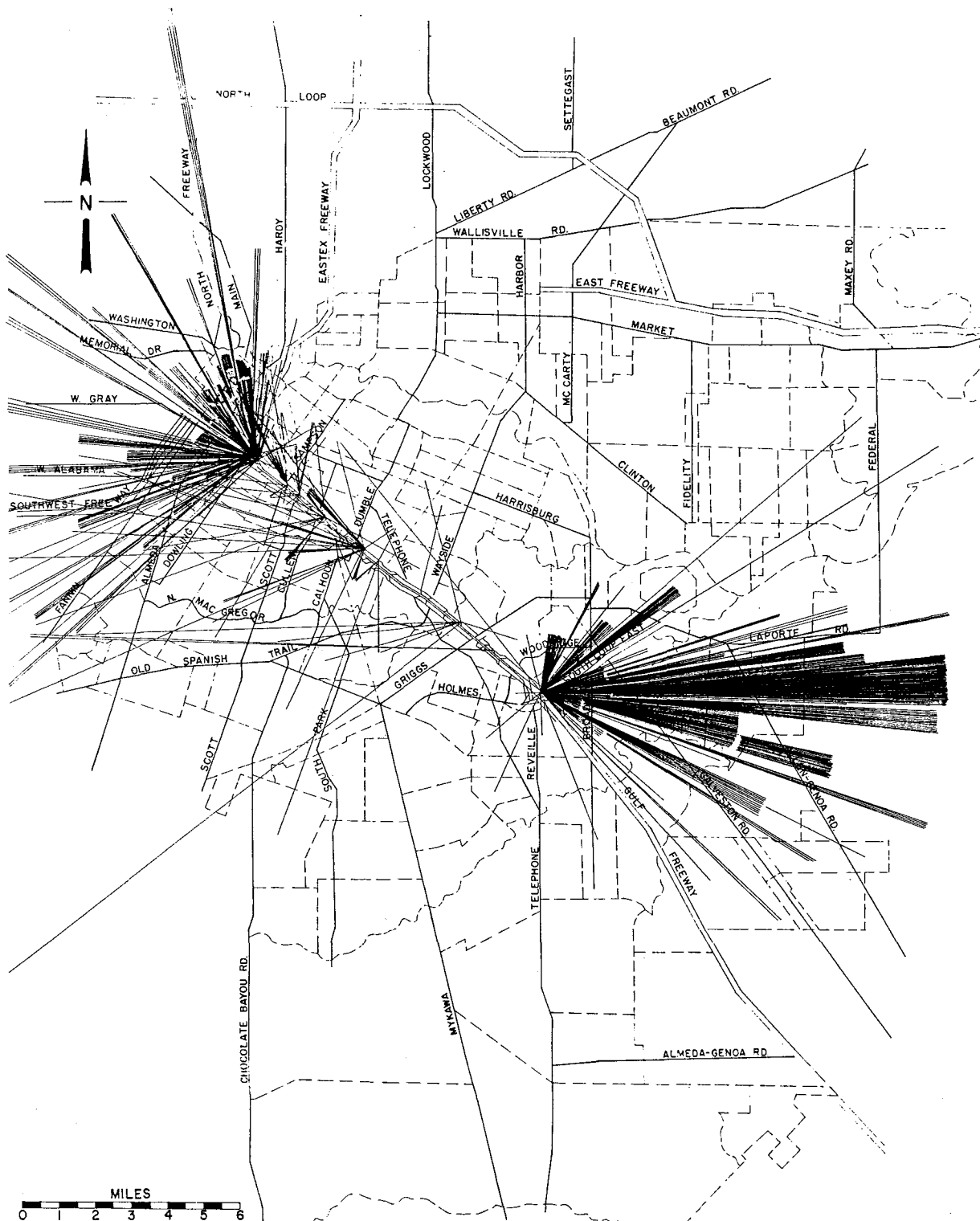
FIGURE 18



# HOUSTON DISTRICT MAP

TRIP DESIRE LINES  
 GULF FREEWAY  
 6:45-8:30 AM

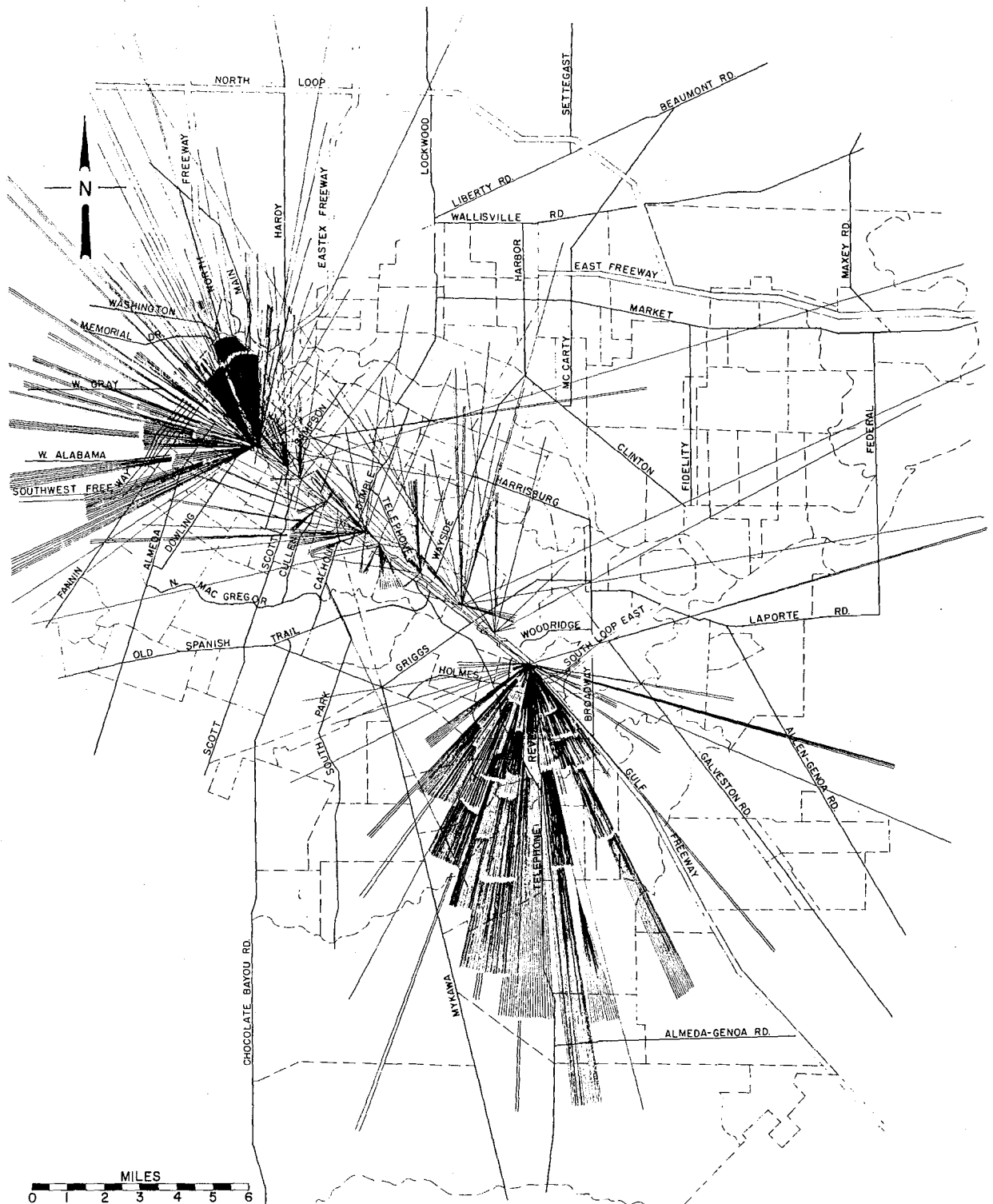
FIGURE 19



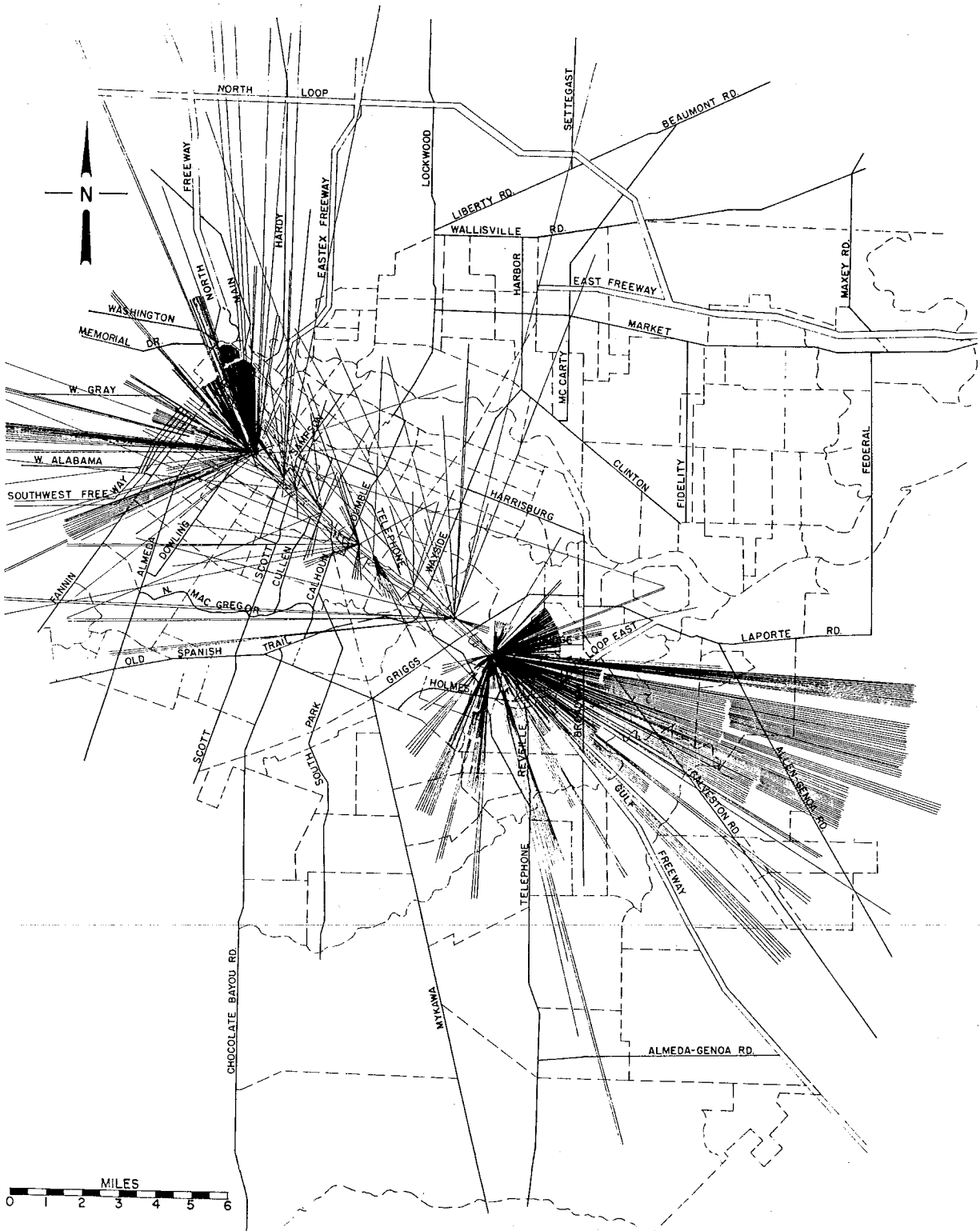
STATE 225 ENTRANCE RAMP  
 AREA OF INFLUENCE  
 ORIGIN - DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

FIGURE 20

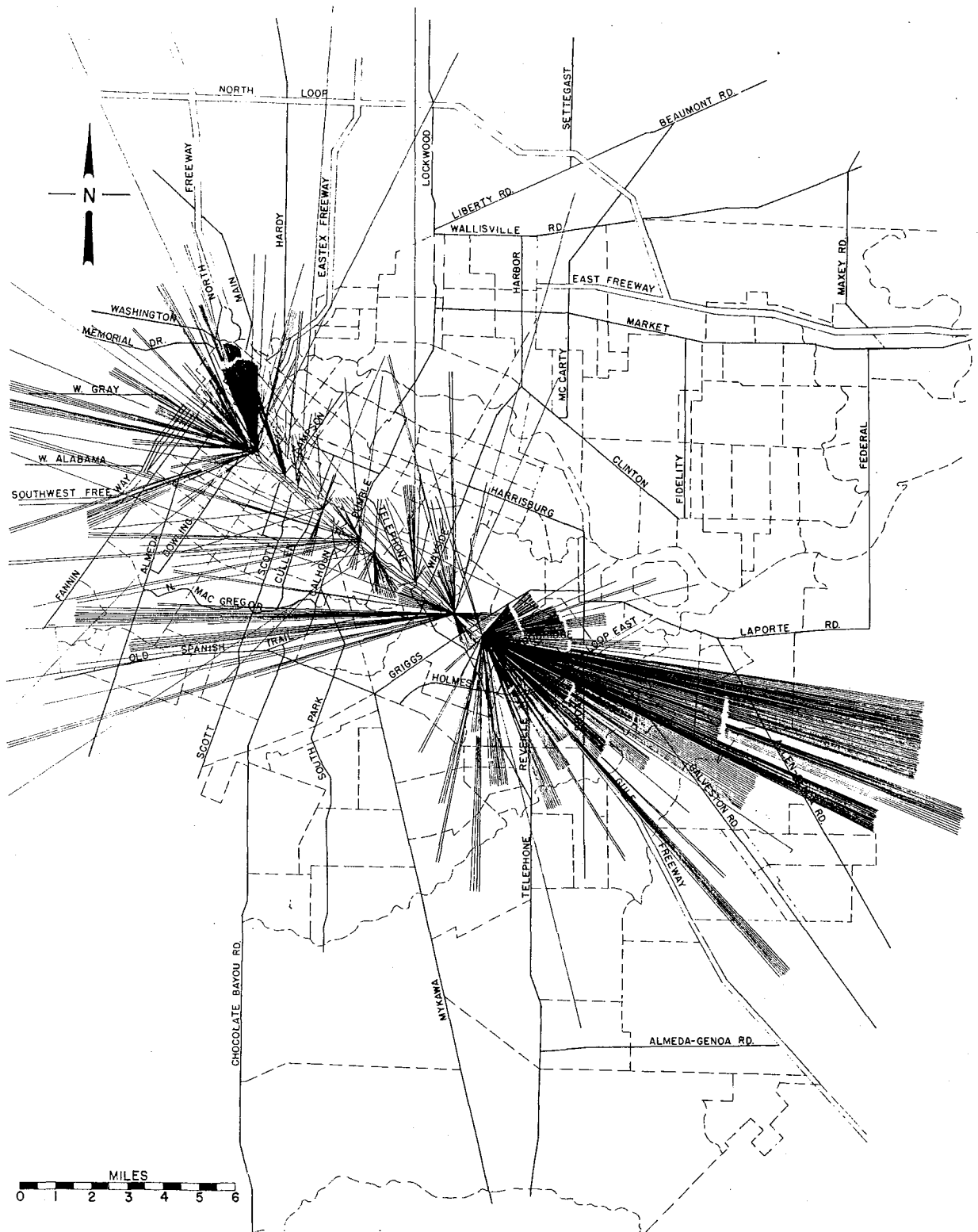




STATE 35 ENTRANCE RAMP  
 AREA OF INFLUENCE  
 ORIGIN-DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.



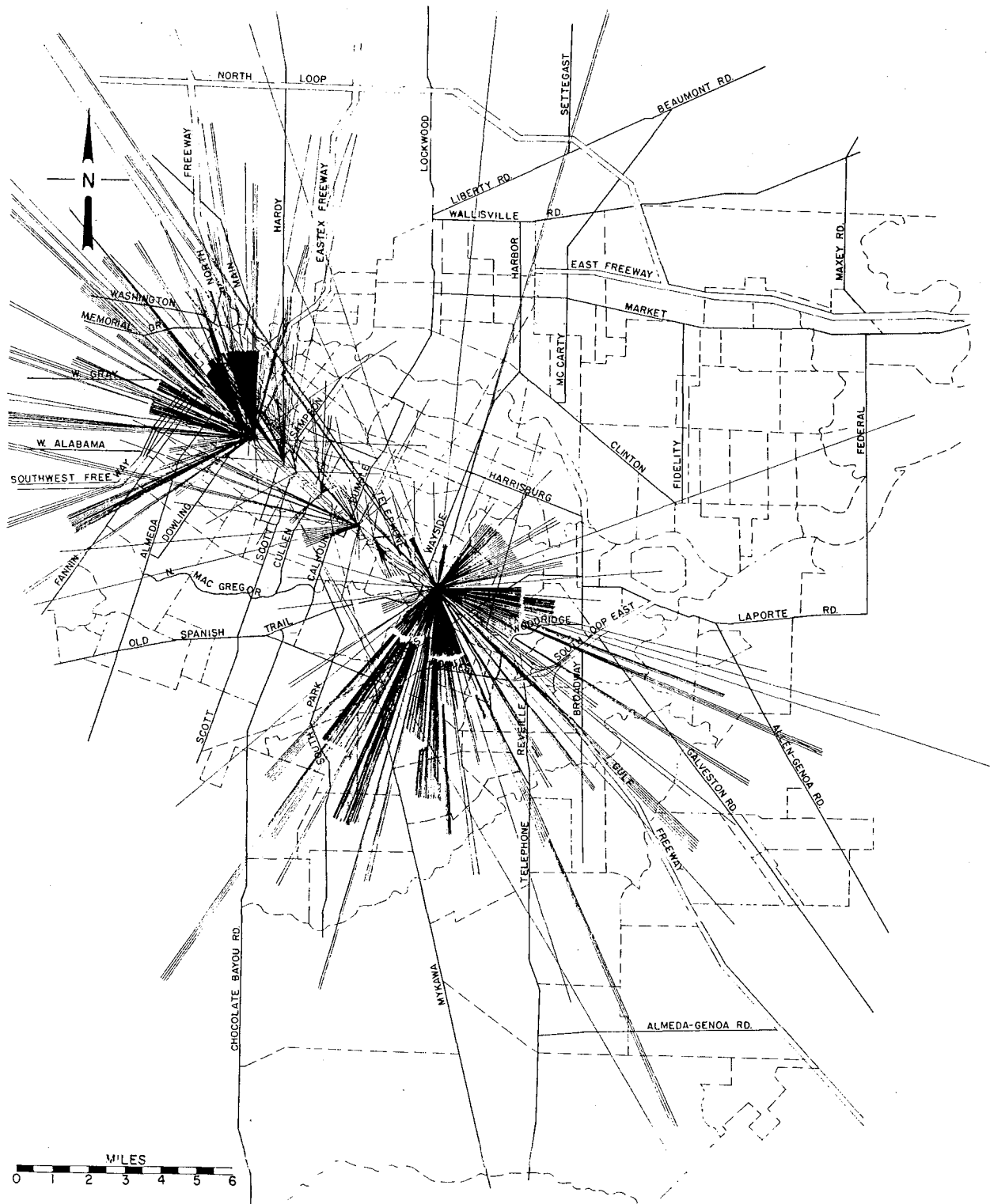
WOODRIDGE ENTRANCE RAMP  
 AREA OF INFLUENCE  
 ORIGIN - DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.



# MOSSROSE ENTRANCE RAMP

AREA OF INFLUENCE  
 ORIGIN - DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

FIGURE 23



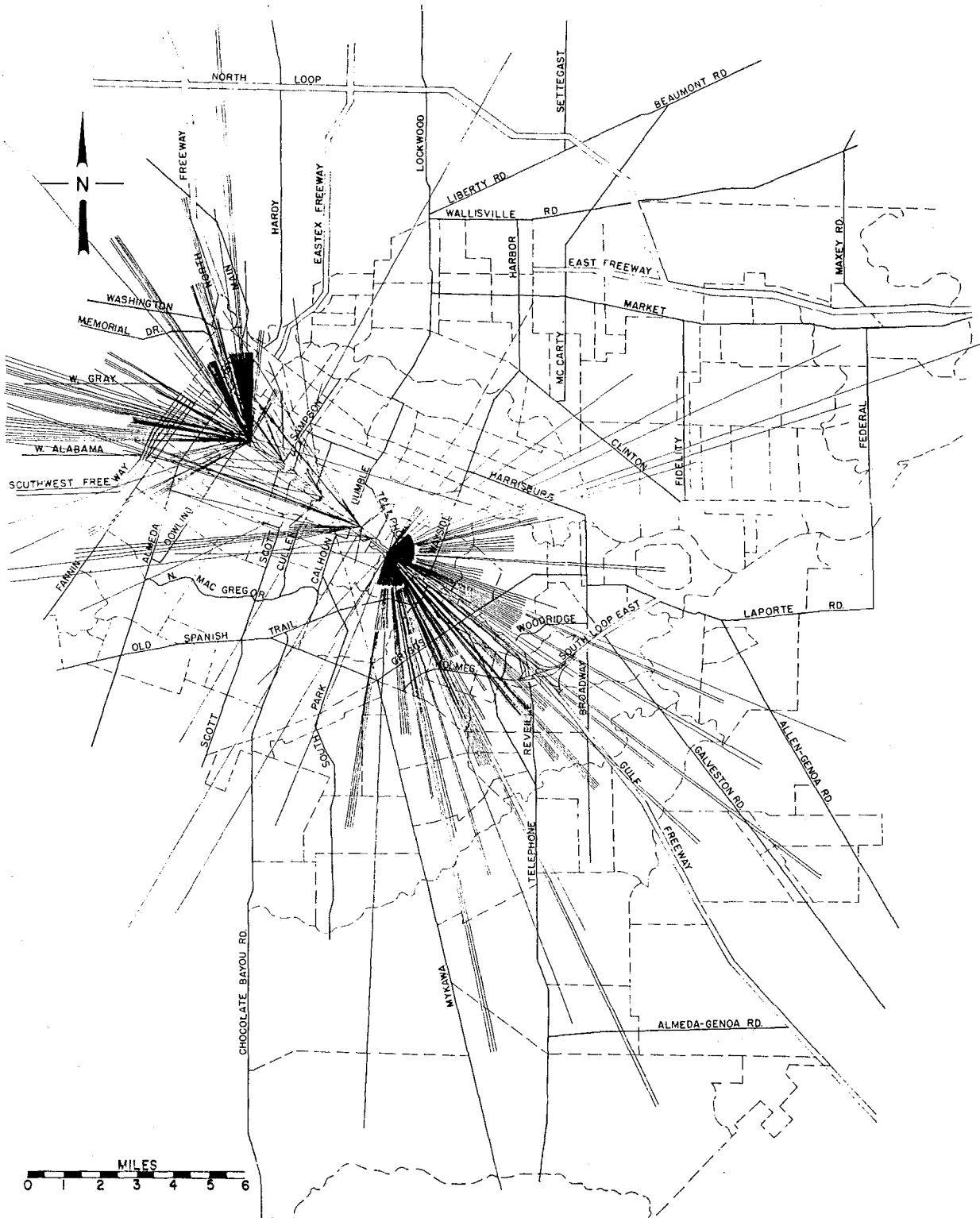
GRIGGS ENTRANCE RAMP  
 AREA OF INFLUENCE  
 ORIGIN-DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45-8:30 A.M.

FIGURE 24



WAYSIDE ENTRANCE RAMP  
 AREA OF INFLUENCE  
 ORIGIN-DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

FIGURE 25



TELEPHONE ENTRANCE RAMP  
 AREA OF INFLUENCE  
 ORIGIN-DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

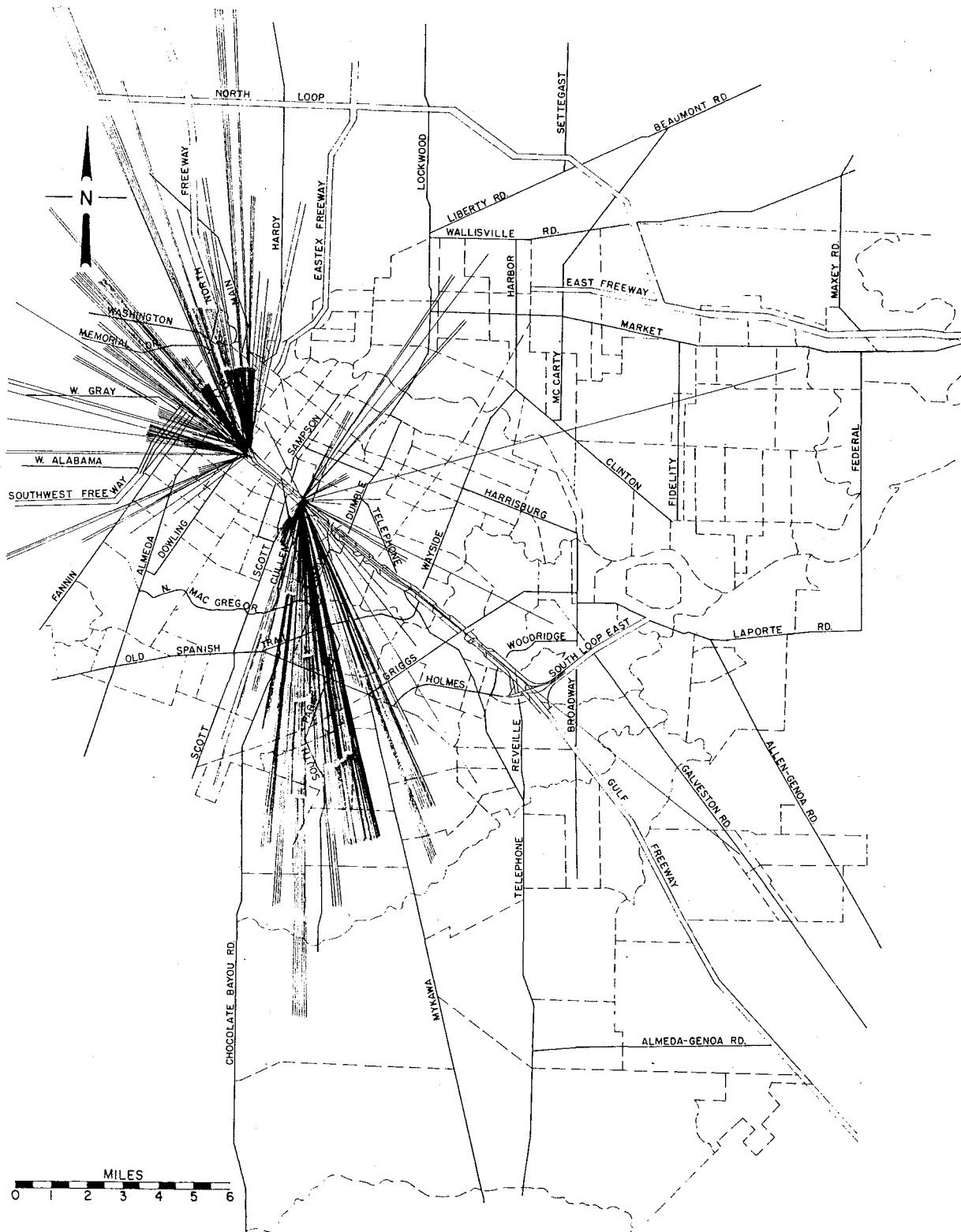
FIGURE 26



# DUMBLE ENTRANCE RAMP

AREA OF INFLUENCE  
 ORIGIN-DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

FIGURE 27

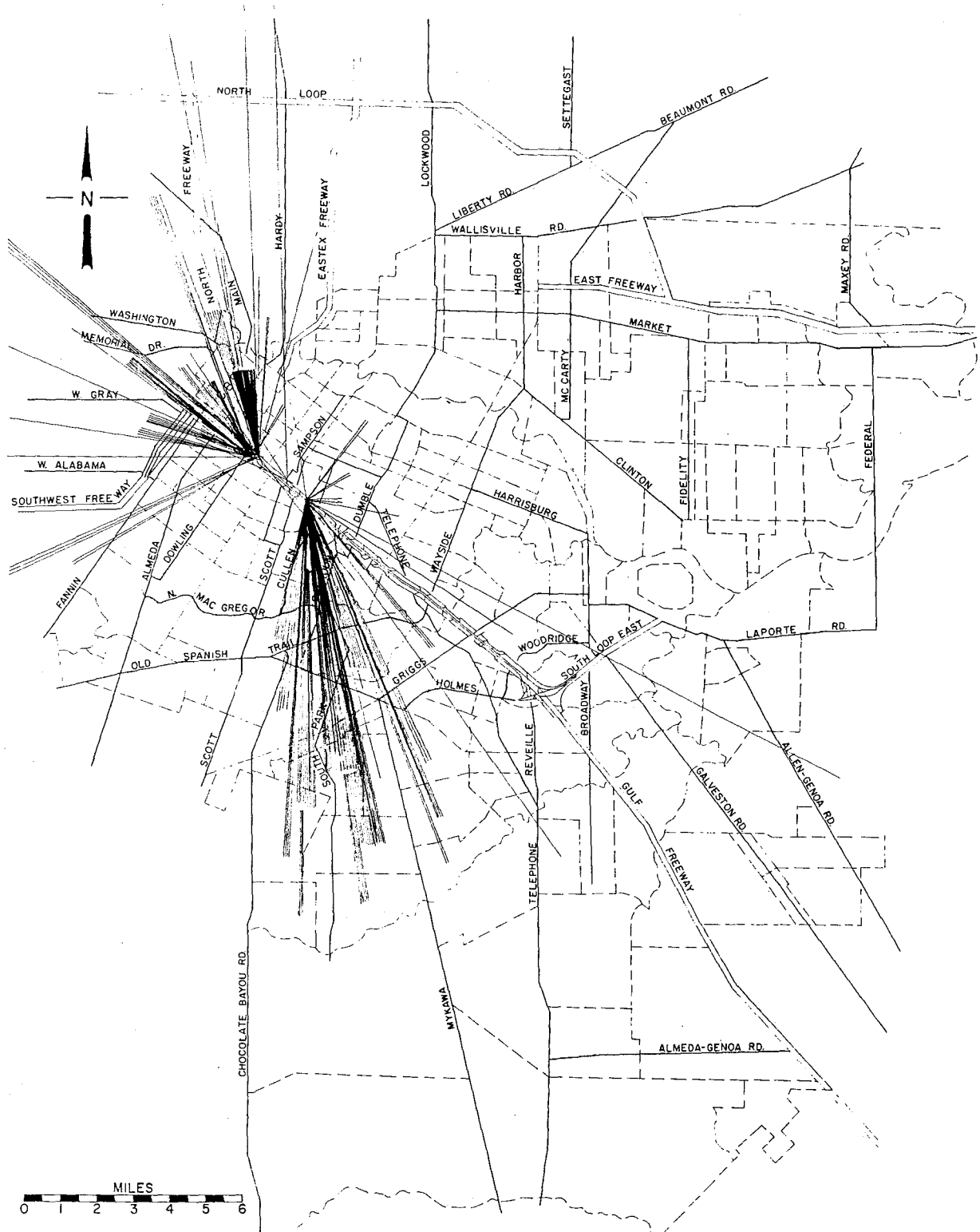


# CULLEN SOUTH ENTRANCE RAMP

AREA OF INFLUENCE  
 ORIGIN-DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

FIGURE 28

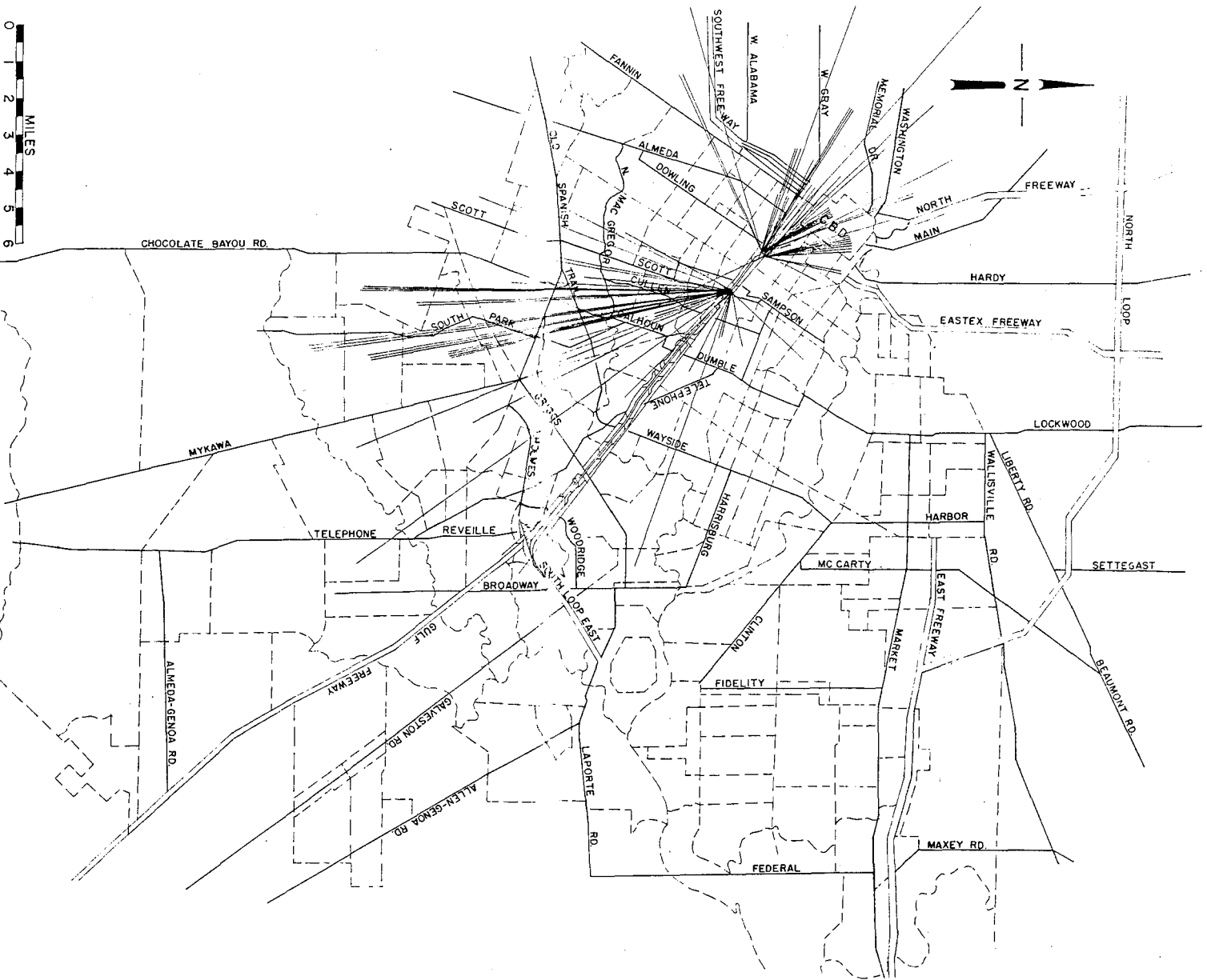




# CULLEN NORTH ENTRANCE RAMP

AREA OF INFLUENCE  
 ORIGIN - DESTINATION DESIRE LINES  
 VIA FREEWAY LINK  
 6:45 - 8:30 A.M.

FIGURE 29



**SCOTT ENTRANCE RAMP**

AREA OF INFLUENCE

ORIGIN - DESTINATION DESIRE LINES

VIA FREEWAY LINK

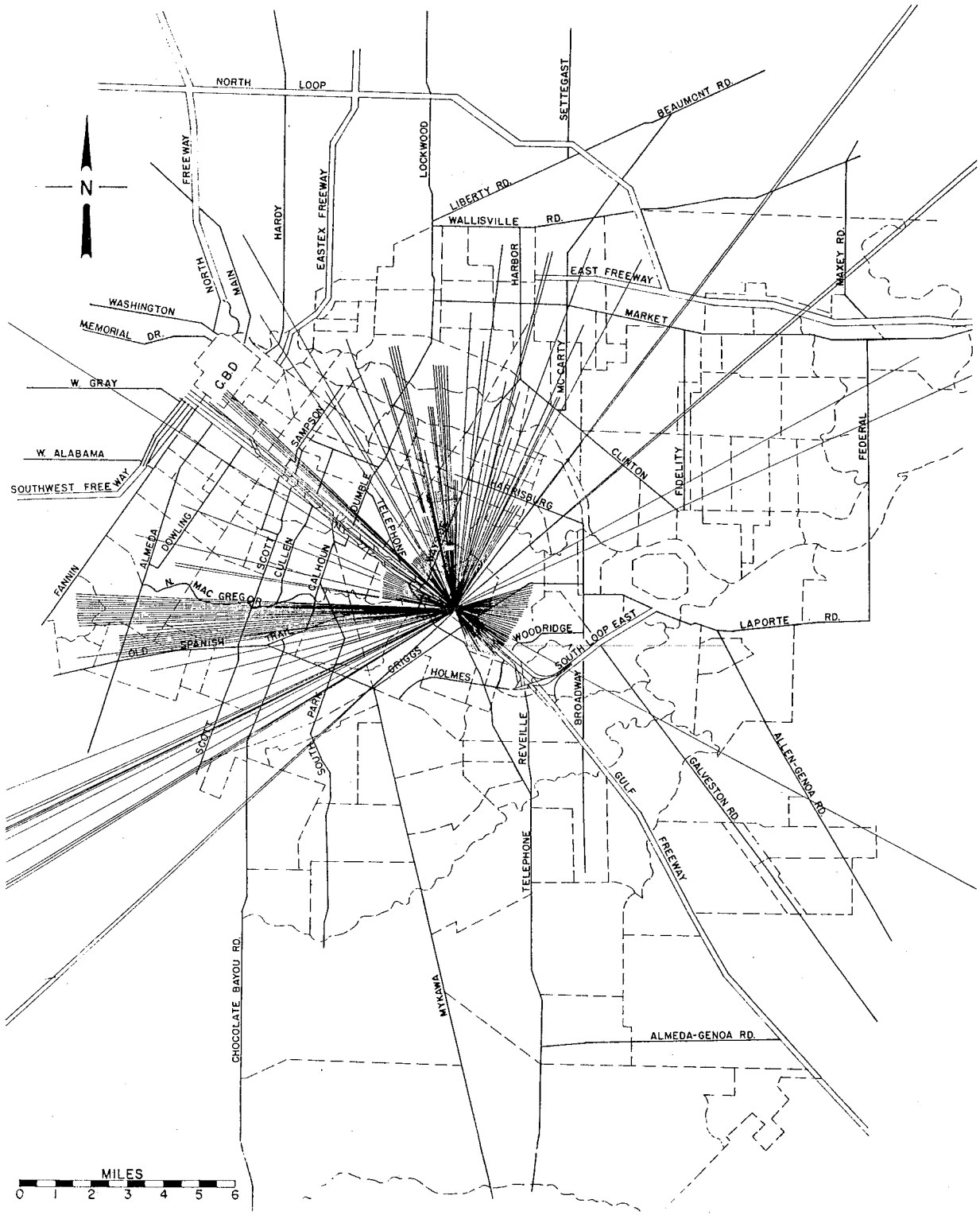
6:45 - 8:30 A.M.

FIGURE 30



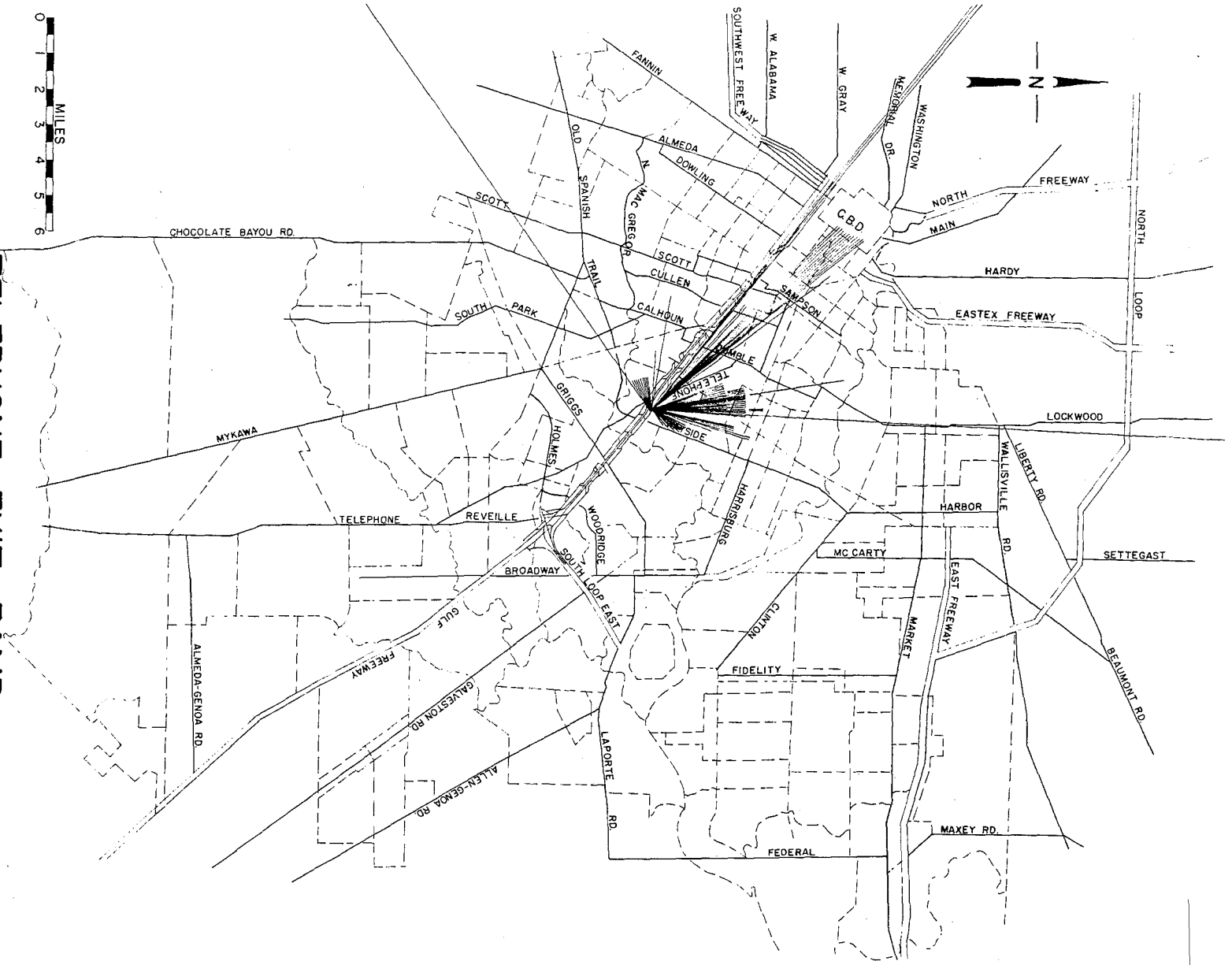
**GRIGGS EXIT RAMP**  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.

FIGURE 31



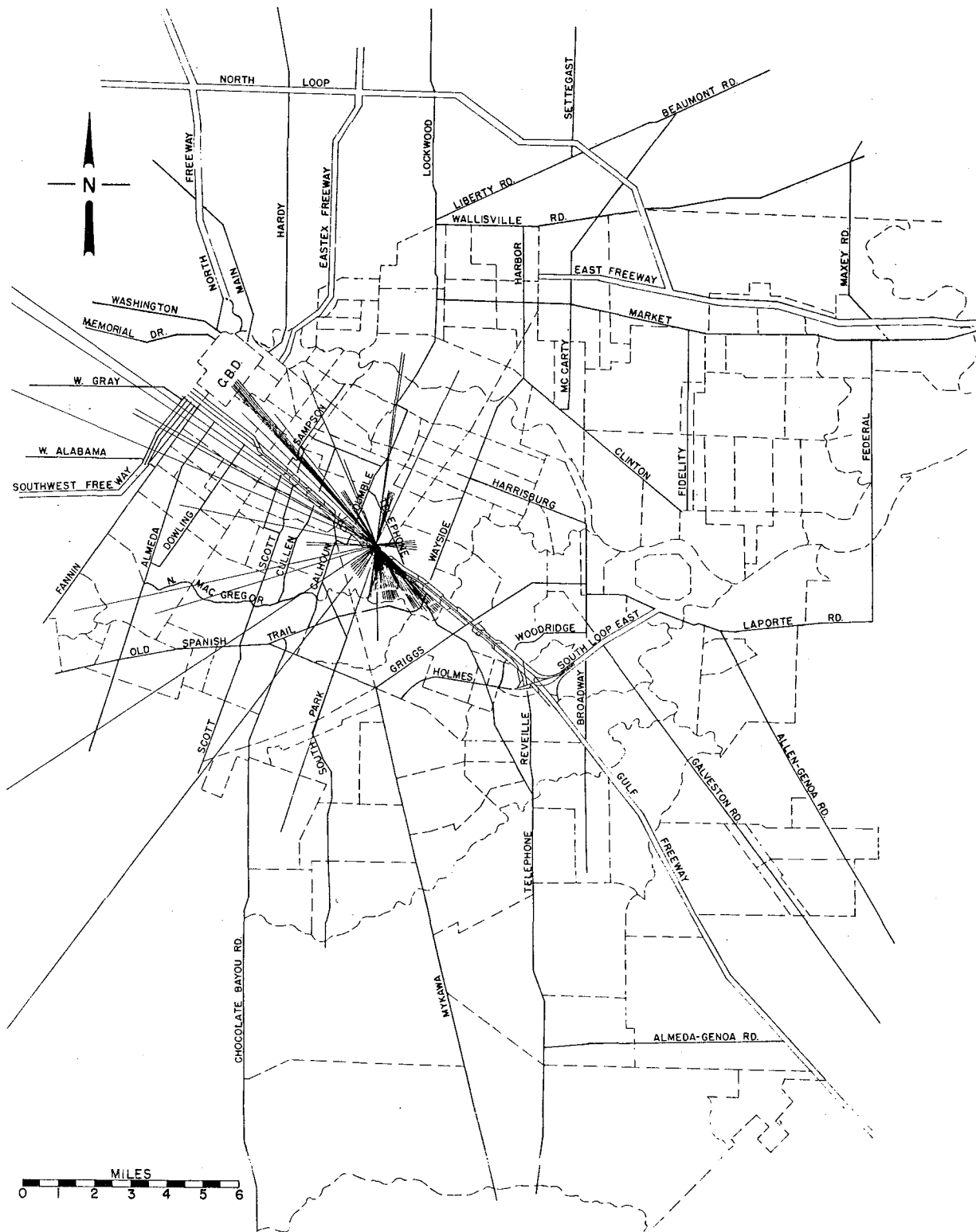
WAYSIDE EXIT RAMP  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.

FIGURE 32

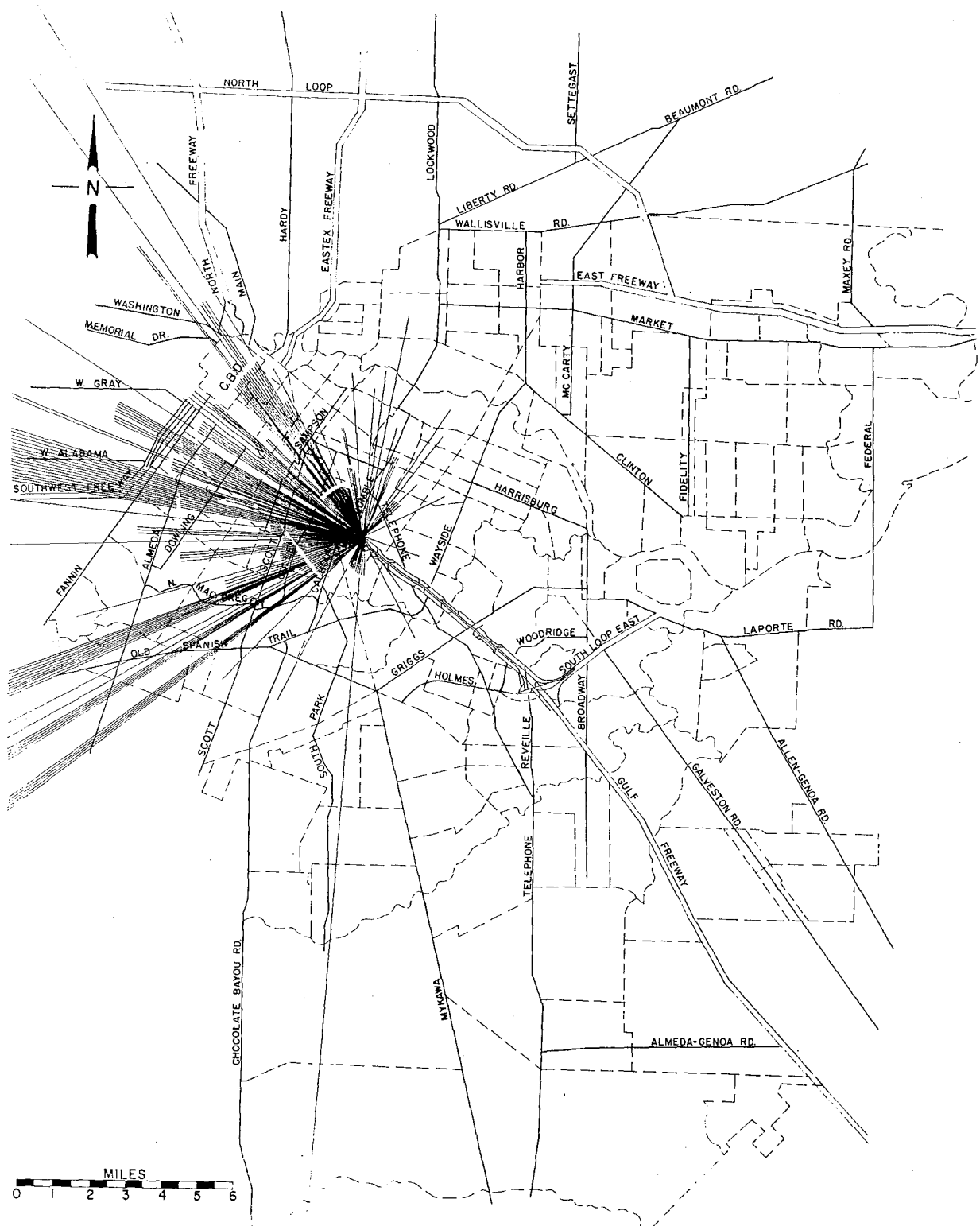


**TELEPHONE EXIT RAMP**  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.

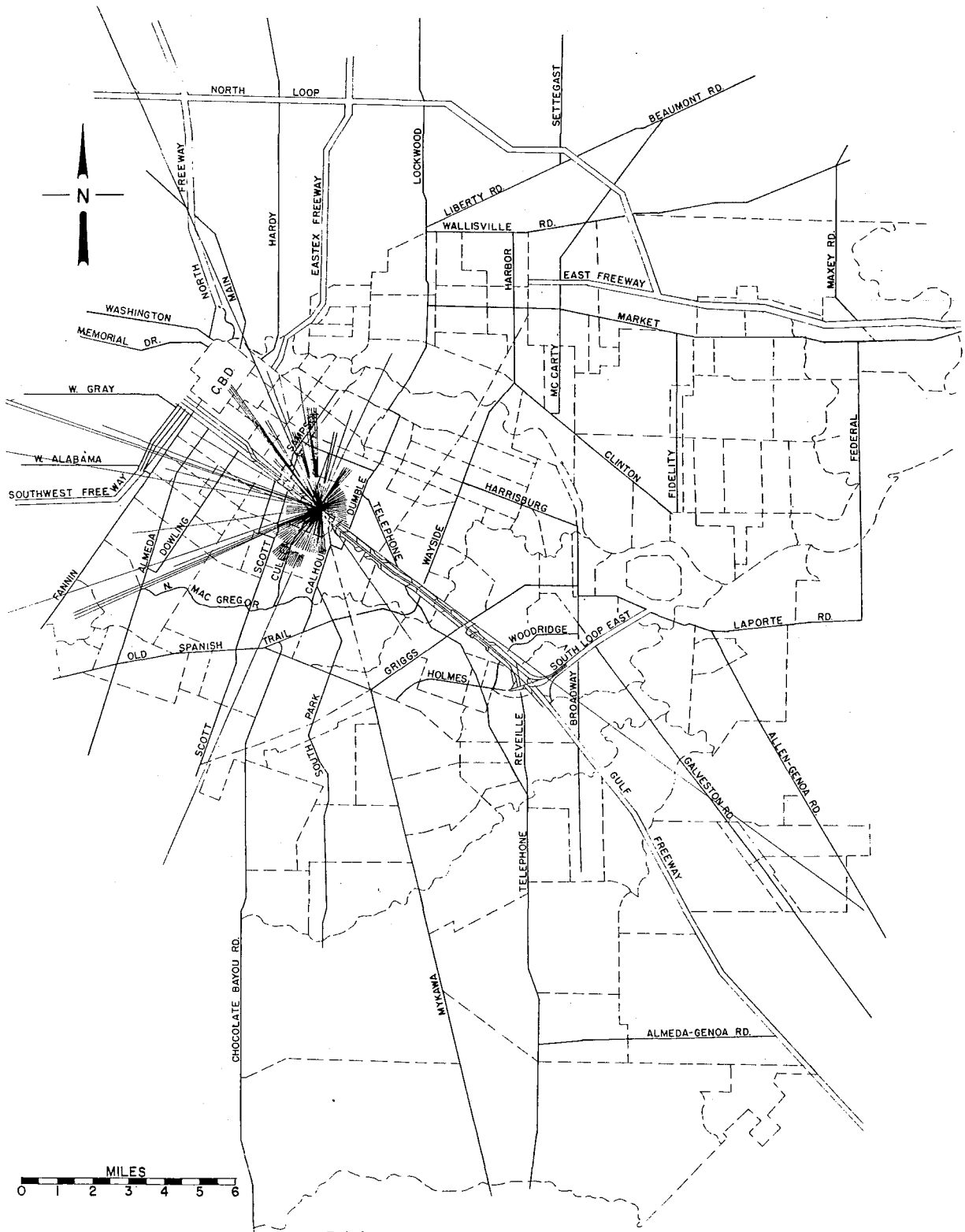
FIGURE 33



**LOMBARDY EXIT RAMP**  
**AREA OF INFLUENCE**  
**DESIRE LINES TO TRIP DESTINATION**  
**6:45 - 8:30 A.M.**

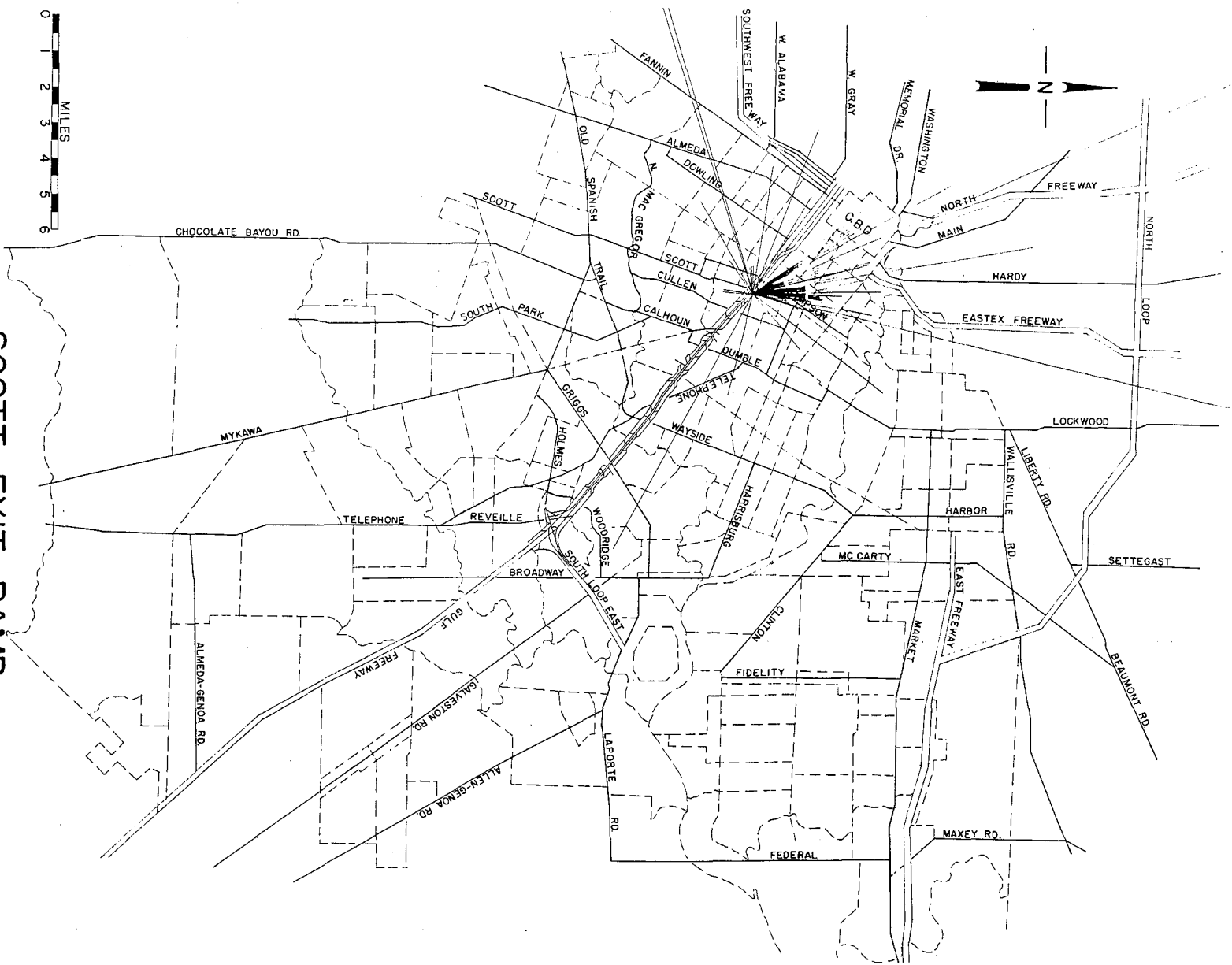


**CALHOUN-ELGIN EXIT RAMP**  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.



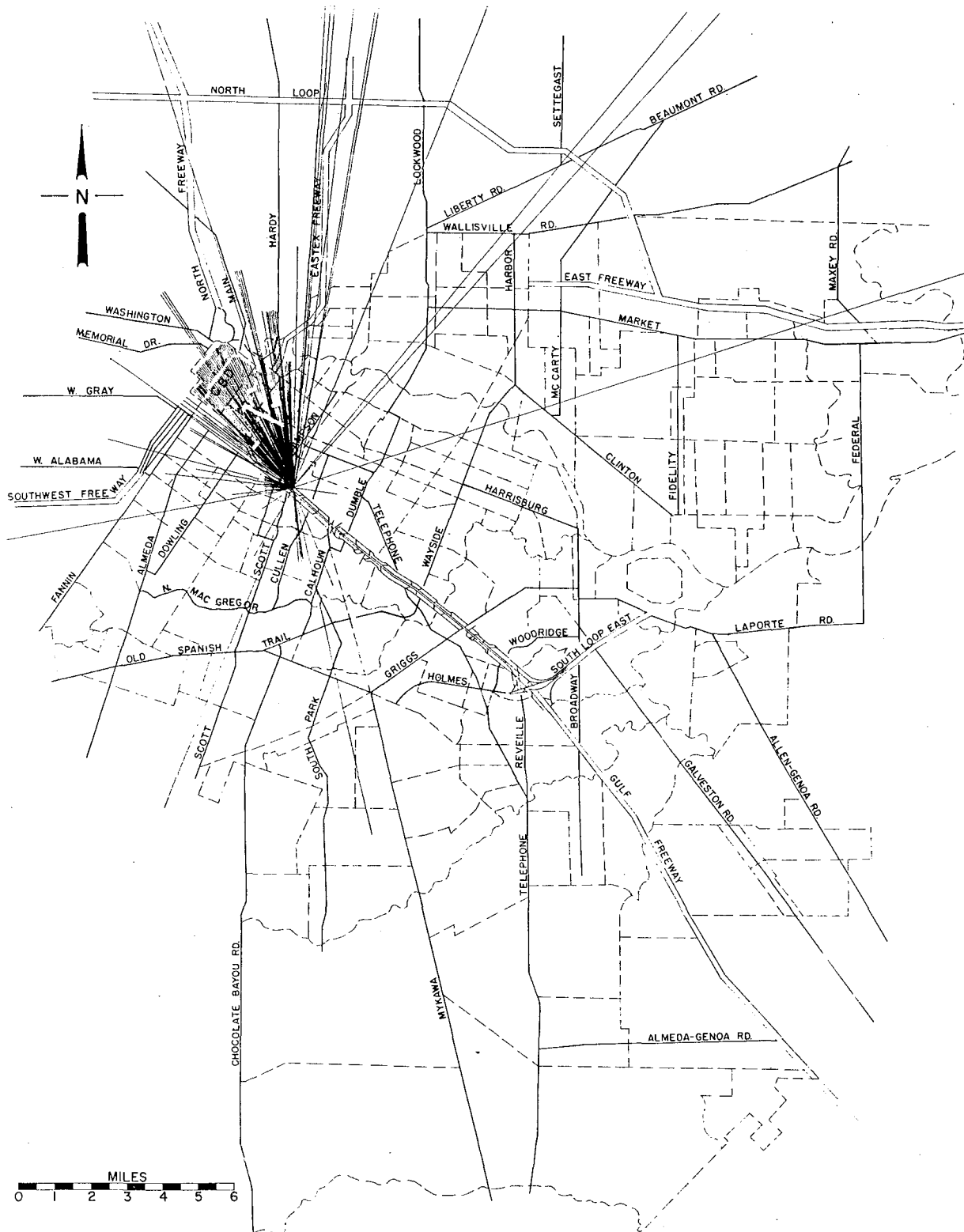
**CULLEN EXIT RAMP**  
**AREA OF INFLUENCE**  
**DESIRE LINES TO TRIP DESTINATION**  
**6:45 - 8:30 A.M.**





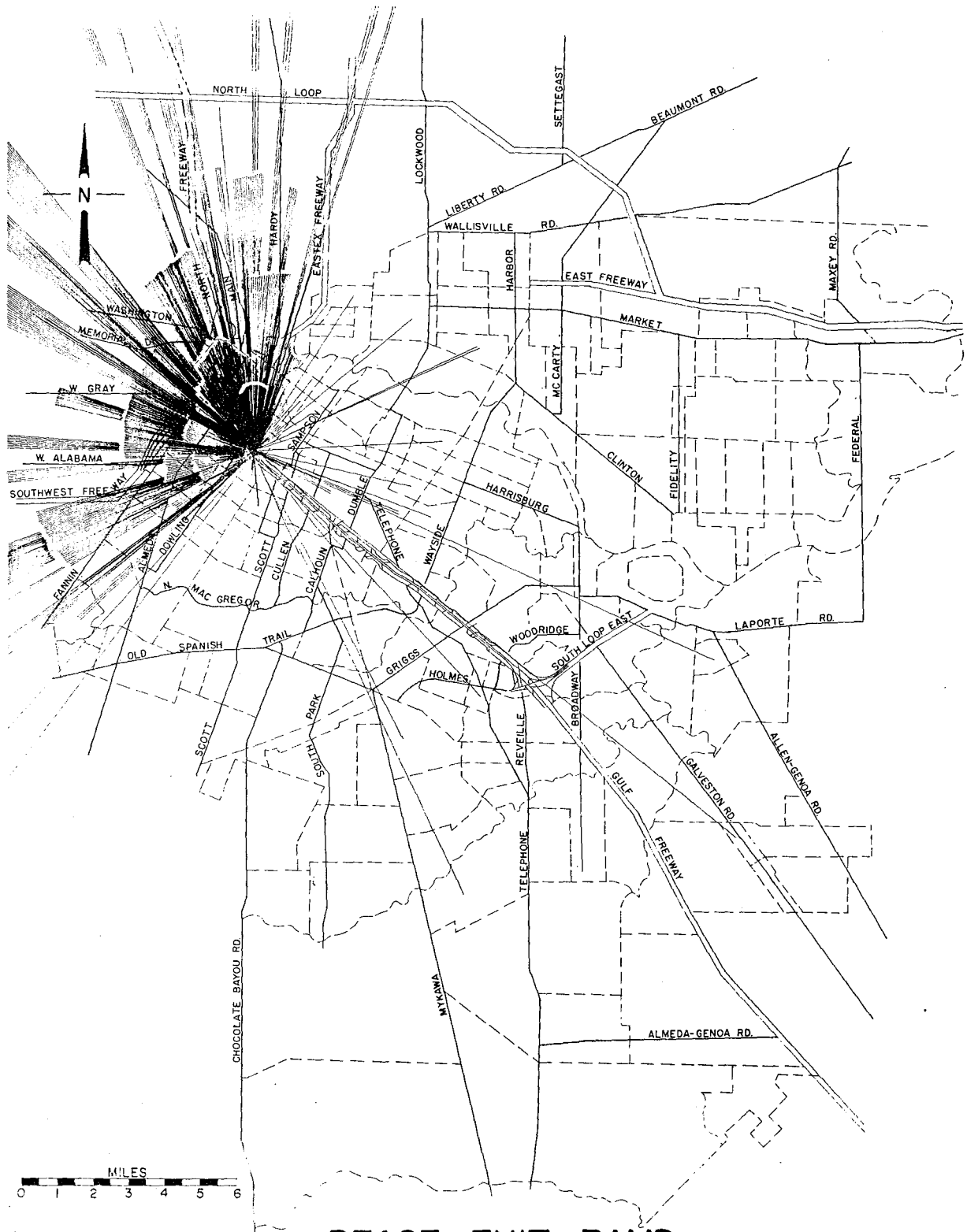
**SCOTT EXIT RAMP**  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.

FIGURE 37

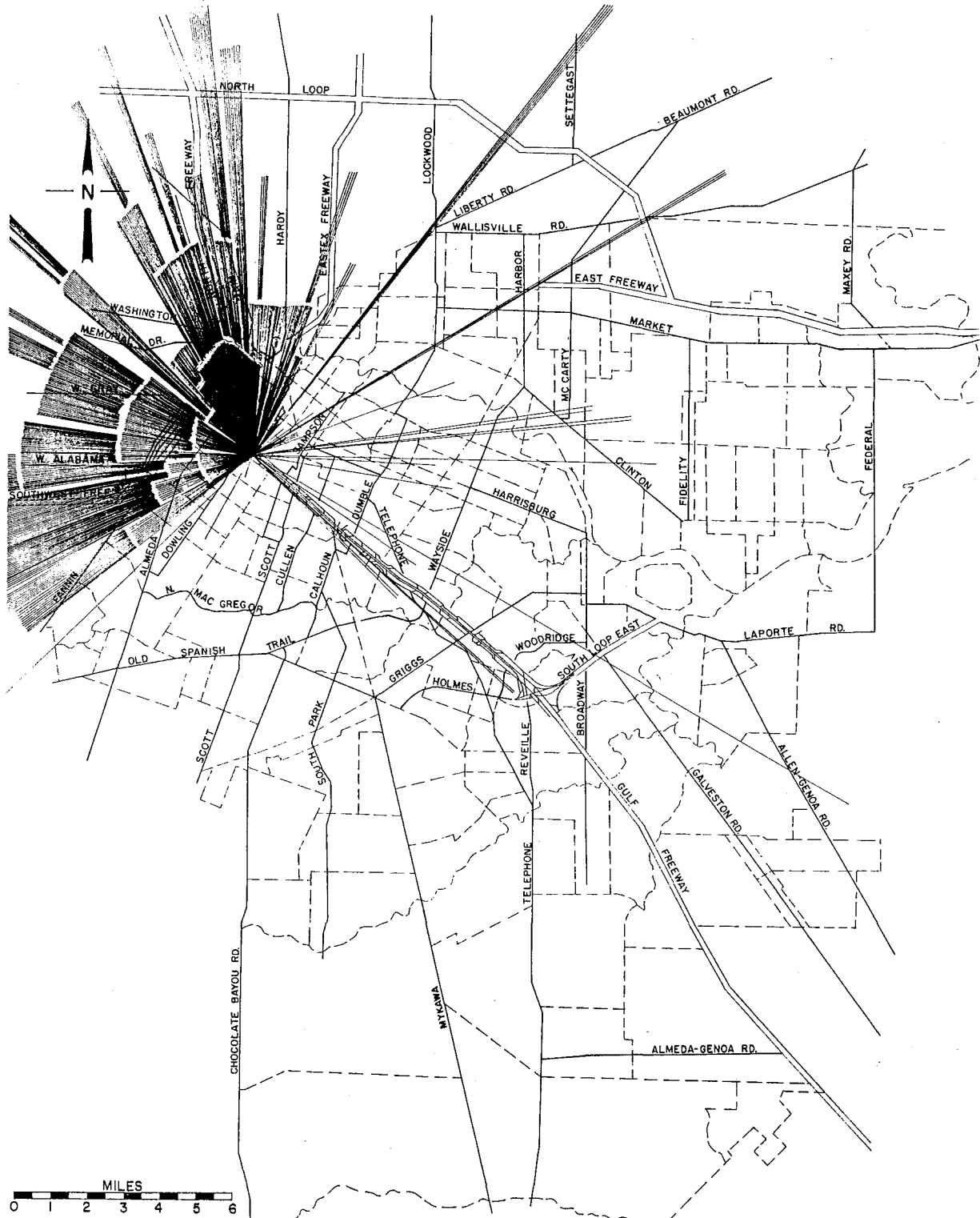


**SAMPSON EXIT RAMP**  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.

FIGURE 38



PEASE EXIT RAMP  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.



U.S. 75 NORTH EXIT RAMP  
 AREA OF INFLUENCE  
 DESIRE LINES TO TRIP DESTINATION  
 6:45 - 8:30 A.M.

### Diversion of Ramp Traffic

In each of the four origin-destination surveys, some traffic diversion was noted. Although some of the diversion was caused by the study itself, most of the drivers were seeking a better way to complete their trip. The following statements concerning the diversion are based on comments received by the motorists and on daily observations of the traffic patterns at these ramps: Figure 6 is used to reference the routes used to bypass the ramps.

State 35 Entrance Ramp - The lack of a convenient bypass route for this ramp reduces the amount of diversion. It was noted, however, that if the queue at the ramp were sufficiently long to extend past the Holmes Road Overpass, the approaching traffic would divert through an adjacent Shopping Center Parking Lot to Woodridge. During the day of the survey, approximately ten percent of the total ramp volume of 1350 vehicles per two hours used this alternate route.

State 225, Woodridge and Mossrose Entrance Ramps - It has been observed that as the congestion develops on the freeway in the Reveille Interchange, traffic approaching from the east on State 225 diverts to the frontage road and continues to the entrance ramps downstream at Woodridge and Mossrose. From the questionnaires returned, the following estimates of the volume of traffic bypassing these ramps from 6:45 to 8:30 A.M. can be made:

Ramp	Total Number Entering	Total Number Bypassing
State 225	718	670
Woodridge	609	412
Mossrose	750	---

Griggs, Wayside, Telephone and Dumble Entrance Ramps - The volume of traffic bypassing these ramps via the frontage road is very small. The intersections at Wayside and Telephone restrict the movement along the frontage road enough to discourage its use as a bypass route. Also, the operating characteristics of the freeway and ramps at these locations are good during the entire peak period. There is some diversion evident in the selection of routes to approach the freeway. It is felt that the conditions on the street system have more effect on the selection of routes than the entrance ramp to be used. A breakdown of the traffic volumes that bypass upstream ramps are listed below:

Ramp	Total Number Entering	Total Number Bypassing
Griggs	1000	87
Wayside	539	103
Telephone	599	67
Dumble	559	---

Cullen and Scott Entrance Ramps - A large volume of traffic bypasses these ramps because the continuous frontage roads provide an acceptable route to the end of the freeway. Very few vehicles passing these ramps use the downstream ramp to enter the freeway.

#### Alternate Routes

Question number 6 on the questionnaire is concerned with the use of alternate routes on the city street system to avoid the use of the freeway. The tabulations of the answers are given in Tables 2-12. Thirty-six percent of the interchange traffic have used other routes. This indicates that many motorists are willing to try, and perhaps continue to use, other routes if they result in improvements over the freeway trip.

The streets named as alternate routes are included on the map in Figure 6. This information was helpful in designating alternate routes to be used in ramp control studies.

#### Comments on Returns

The questionnaire form did not include a remarks section. However, many of the motorists offered comments that were pertinent to the freeway problem. These comments were in most cases constructive criticism of the design and control of the freeway. The statements indicated an awareness by the motoring public of the problems that are associated with a traffic facility of this type.

Although most of the comments were of a critical nature, many persons offered their time and services to answer any other questions. In general, the public was pleased to see that someone was interested in "their" problem.

A few of the more important remarks received are listed below:

- \* Need continuous frontage roads
- \* Improve entrance ramp design
- \* Close some entrance ramps
- \* Keep trucks off freeway during peak traffic
- \* Place screen in median to reduce distraction
- \* Need for better and faster accident investigation

#### IV. CONCLUSIONS

The techniques used in this study for obtaining travel patterns of the interchange traffic provided good results with minimum interference to traffic. Only in locations where stopping the traffic is hazardous should the method of distribution be changed.

The design of the questionnaire should be improved. The definition of the trip for which the questions are asked should be included in the explanation. Several returns gave information on the trip made during the afternoon peak.

The high percent return indicated an acceptance by the public of this type of survey. This same study will be made next year of the entrance ramps on the outbound side of the freeway.

The information received from this type of survey has been most valuable in several phases of the research on the improvement of freeway operations.

## REFERENCES

1. Port of New York Authority, Planning Division, "Route 3 - 'Lights-On' Traffic Survey," September, 1960.
2. Brenner, R. and Fischer, D., "A Quantitative Evaluation of Traffic in a Complex Freeway Network," HRB Bulletin 291, pp. 163-205.
3. Chicago Expressway Surveillance Project, "Characteristics of Traffic Entering the Westbound Congress Expressway within the Pilot Detection System Study Section," Report 5, March 17,  $\frac{1}{2}$ 1962.
4. Houston Traffic Survey Coding Index, 1953.
5. Texas Highway Department Planning Survey Division "Houston Origin-Destination Survey 1960."



APPENDIX

APPENDIX A

Origin and Destination Survey Code

A. GENERAL CARD LAYOUT

<u>Col. No.</u>	<u>Item</u>
1-2	Entrance Ramp No. - Inbound
4-7	Questionnaire No.
9-12	Distribution time
14-18	Origin Zone No.
19	Area - other than Houston
21-24	Origin time
26-29	Destination Zone No.
30	Area - other than Houston
33-36	Destination time
38-39	Exit Ramp No. - Inbound
41	Frequency of Trip
43	Use of Other Routes

B. ITEM CODES

1. Col. 1-2: Entrance Ramp No.

01 - State 225	05 - Griggs Road
02 - State 35	06 - Wayside
03 - Woodridge	07 - Telephone Road
04 - Mossrose	08 - Dumble
	09 - Cullen Upstream
	10 - Cullen Downstream
	11 - Scott

2. Col. 4-7: Questionnaire Numbers

0000 - End of study number

3. Col. 9-12: Time of Questionnaire Distribution

Clock Time determined at the survey station that the questionnaire was issued.

0630 - 0830 Usual study period

4. Col. 14-18: Origin Zone Number

1st 4 digits - Highway Planning Survey Zone No.  
5th digit - T.T.I. subzone number

5. Col. 19: Area - other than Houston

0 - Unknown (99999 in Col. 14-18)
1 - Pearland (96000 in Col. 14-18)
2 - Alvin (9700 in Col. 14-18)
3 - Friendswood (9800 in Col. 14-18)

- 4 - Pasadena
- 5 - Out of Town
- 6 - Baytown
- 7 - La Porte - Deer Park
- 8 - Channel View

6. Col. 21-24: Origin Time

Clock Time taken from Questionnaire:  
0630 - 0830 Usual study period

7. Col. 26-29: Destination Zone No.

4 digit Highway Planning Survey Zone No.

8. Col. 30-31: Area - other than Houston

External Station Number

9. Col. 33-36: Destination Time

Clock time taken from Questionnaire  
0630 - 1000 Usual Study Time

10. Col. 38-39: Exit Ramp No.

- |                                 |                              |
|---------------------------------|------------------------------|
| 00 - No Answer                  | 06 - Exit No. 3 - Cullen     |
| 01 - Exit No. 8 - Griggs        | 07 - Exit No. 2 - Scott      |
| 02 - Exit No. 7 - Wayside       | 08 - Exit No. 1 - Sampson    |
| 03 - Exit No. 6 - Telephone     | 09 - Pease Street            |
| 04 - Exit No. 5 - Lombardy      | 10 - US 75 North-Calhoun St. |
| 05 - Exit No. 4 - Calhoun-Elgin |                              |

11. Col. 41 - Frequency of Trip

- |                    |                                 |
|--------------------|---------------------------------|
| 0 - No Answer      | 4 - Three times per week        |
| 1 - Seldom         | 5 - Four times per week         |
| 2 - Once per week  | 6 - Five or more times per week |
| 3 - Twice per week |                                 |

12. Col. 43 - Use of other routes

- 0 - No Answer
- 1 - Yes
- 2 - No

APPENDIX B

ZONE OF DESTINATION

ZONE OF ORIGIN	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
401																			
402								1	1										
403																			
407																			
413																			
417																			
418																			
419																			
440							1												
441																			
446											1								
450					1														
451													1						
461	1				1														
462																			
463																			
465																			
466																			
467																			
500	1		1			1			1		1	1							
501	1	1			1	1		1	1		1					1	1		
502			1	1	3	3	1		3	1		1	2	3	1				
503			1			2	1		2		1	1						1	
505												1							
507	2	1	4		4	5	5	2	3		5		1	1	2	2	3		1
508					2				1		1						1		
512																			
515																			
521																			
522																			
523											1								
526								1											
527							1				1								
530	1			1	1	2	1		5		1		2		1		1		
531								1			2					1			

ZONE OF DESTINATION

ZONE OF ORIGIN	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
532	2	4	2	2	9	8	7	5	2	3	6	3		2		1	1	1	1
533	2	4	1		4	7	2	7	2	3	2			3		1		2	
534								2											
535	1							1											
536		1				1	1	1	1	1		1							
537			1																
538	2				1		1		1		1								
539	1																		
540								1	1										
541	1	3	1	1	5	2	6	3	3		1								
542	1		2		1	8	3	1			1								
543	2	5	2		7	7	5	5	2	2	4	2		2		1		1	
544	1	5	6	4	2	10	3	5	5	2	4	2		2			1		
545					1	4	2	4	2	2	3	1		1					
546	1		1	1	1	3	3	2	1	1									1
547																			
549		1		1	3	3		5	2			1			1	1			1
550		1																	
551						1													
553	3		2		4	10	10	5	3	1	4		1						
554																			
560	3			2		9	1	2	3		1		1	1					
561	2		2	1	1	5	3	3	1		1		1			1			
562					1	2			1										
564					1														
565		1			1		2	2	2		1	1	1						
570			1			1	1												
571																			
573								1						1		1			
575						3			1			1							
576						1													
577												1							
578			2		1	2			1										1
581	1														1				
582																			

ZONE OF DESTINATION

ZONE OF ORIGIN	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
584	1	2	3	2	11	19	11	7	1	5	3	3	2	5		1	2		
585	2	1	1			2		1	2										
586	1	4	2	2	3	7	4	2	6	3	3			2					
616																			
628																			
634		1														1			
640						1													
641																			
648						3	2	1			1								
650		1	1		3	1					1			1				1	1
652																			
653	2	1		2	5	3	1	1	2		3			3					
654					1	1	1	3			3		1						
655		2	3	2	5	5	9	3	3	2	2	1		3					
656					1	2	1				2				1		3		
657						2						1							
658		1					3	1			1			1					
664							1												
665						4			1				1						
666												1				1			
667																			
670		1			1	1					1	2							3
671	1	1			2	2		3	3		2		1	1		1	1		
672											1		1						
673		1	2	2	4	2	5	4		2	6	2	2	3	2	1	1		1
674											1								
675			1	1	1	2	4	4	1	1	3		1				1	1	1
676		1			3	1					3		2		1				2
677	1	2	4	2	10	8	2	5	6		8	4	1		1				
678		3	1			4	2		1		2		1						
679							1	2			1		1	1			1		
690	1	3	4	1	2	13	10	6	8	3	5	2		1			1		
691		1		1	2	2					1								
692			2	1	2	2	1	3	1	1	1								
693	2	3	1	3	6	2	6	4	2	4	1	4				1	1		

ZONE OF DESTINATION

ZONE OF ORIGIN	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
694	2	1			1	2	5	3	1		2								
695		1			1	1	1	2		2				1					
696	2	1	8	2	3	6	11	5	5		5	3	1	3			1		
697		2	2		5	5	4	4	3	5	4	1	1	1		1			
698	2	1	1		1	5	4	1		2	1	2	1						
699	4	3	1	1	11	16	4	2	8	3	6		1			1			1
823					1									1					1
824		1					1												
830			1				1				2								
831			1				1			1	1					1			
833																			
840			1	1															
841								1		1									
960	3	1		1	1	2	1	1	4		2	1			1				
970	1		3		2	1	2	1			2								
980	1							2											
999	1	1			1	1	1		2		1							1	
99-4	1	1	1		1		2												
99-5	2					1	1		1										
99-6			2	1		1	1	1	5	2									
99-7	1		4	1		9	2			1	2								
99-8							1												

ZONE OF DESTINATION

✕	19	20	21	22	23	24	25	26	30	32	33	37	38	40	41	42	45	50	51
401																			
402																			
403																			
407																			
413																			
417																			
418																			
419																			
440																			
441																			
446																			
450																			
451																		1	
461																			
462																			
463																			
465																			1
466																			
467																			
500																			
501							1												
502							1											3	
503																			
505																			1
507	1	2	3																1
508																			1
512																			
515																			
521		1																	
522																			
523																			
526																			
527																			
530			1																1
531									1										

ZONE OF ORIGIN



ZONE OF DESTINATION

ZONE OF ORIGIN	19	20	21	22	23	24	25	26	30	32	33	37	38	40	41	42	45	50	51
532		1	2	1	1	1			2	1								3	2
533		2	2		1								1					2	
534																			
535						1													
536																		1	
537																			
538																		1	1
539																			
540		1																1	
541		1	2					1										5	
542			1															3	
543		7	2					4	1					1	1	2	1	10	2
544	1	1	1					2						1				5	2
545		1				1												3	1
546							1											1	
547																		1	
549					1		1									1		3	
550																			
551																			1
553		3		1	1								1					6	1
554																			
560		1						1				1			2			5	1
561		2	1										1					2	1
562			1																
564																		1	
565			2				1	1									1	1	
570																		1	
571																			
573																			
575																		1	
576																		1	
577																			
578																		3	1
581																			
582																			

ZONE OF DESTINATION

ZONE OF ORIGIN	19	20	21	22	23	24	25	26	30	32	33	37	38	40	41	42	45	50	51
584		2									1							12	1
585																			
586			2	1														5	
616																			
628		1																	
634																			
640																			
641																			
648																			
650					2	2			1										
652						1													
653		1				1									1			6	
654					1	2													
655					1								1					3	
656		2												1				1	
657					1														
658									1										
664																			
665																			
666																			
667	1																		
670			1															2	
671																		1	
672		1																	
673		2	2	1	1										1			3	
674						1							1						
675			2																
676											1								
677		2	1	1		1												1	1
678								1										1	
679	1																	1	
690		1	2				1				2	1	1	1	1			7	1
691											1	1						1	
692																		2	
693		3	1				1												1

ZONE OF DESTINATION

✕	19	20	21	22	23	24	25	26	30	32	33	37	38	40	41	42	45	50	51
694	1												2					3	
695					1				1									1	
696			1			1		1				1						4	2
697	1	1	2					1										2	
698		3	2				1		1						1	1		2	1
699		1								1				1	2	3		9	3
823					2	1										1		1	
824			1																
830																1			
831																		3	1
833																		1	
840																		1	
841																			
960								1					1	1	1		1	3	1
970						1	1	1							2			1	
980																			
999			2															1	
99-4		1																	
99-5																			
99-6																			
99-7																		5	1
99-8											1								

ZONE OF ORIGIN

ZONE OF DESTINATION

✕	52	53	55	57	60	61	62	63	64	65	66	67	68	70	71	72	73	74	75
401							1							1					
402																			2
403							2		1						1				
407																1	1		
413												1							
417														1					
418																	2		
419								1	1										
440							2			1						1			
441							1												1
446												1							
450							2										1		
451																1			
461							2			1								1	
462							2		1	1						1			
463									1								1		
465															1				
466							1												
467							1								1				2
500							1								1		1		1
501						1	4								1				2
502						3	9		2	1				4	5	2	3		2
503						1	4			1				1	2		1	1	1
505																			
507					1	4	5	2		8			1	2	7	1	3	2	7
508					1	2	3								1			1	
512																	1		
515																1			
521							1			2									1
522									1						1				
523									1					1					
526																		1	
527							1												2
530					1	2	9		2	4				3	5	4	5	1	4
531						1	1			2					2		1		

ZONE OF ORIGIN

ZONE OF DESTINATION

52	53	55	57	60	61	62	63	64	65	66	67	68	70	71	72	73	74	75
532	1			1	17	16	1	1	15	2			1	10	3	10	3	6
533				1	18	10	1	7	7	2			3	8	3	4	1	5
534						3	1		1					2				
535																		1
536	3					2		3	2	1		1	1	1	1	2		1
537																		
538				1	1	3	1		1				1	1				
539																		
540									1							1		
541	1				5	7	1	3	2	1				1	1	2	1	
542				1	5	1		1	6				1			2	1	
543	1			3	8	7	4		16				3	4	4	7	1	4
544	1				10	11	2	2	7				4	6	3	2	1	4
545	1	3			2	4	1	1	4				2		1	1	1	2
546					2	1			6					1	1			1
547						1												
549				2	3	4			5		1			3	1	3		7
550					1			1										
551						1			2					2				
553	1	2		3	6	10	2	3	2	3	1		1	3	1	5		6
554								1										
560	1	1		1	2	10	1		3				1		1		1	1
561		1		2	1	4		1	1				1		1	2	1	
562						2												
564						1												
565				2	3	4			3					2	1	1		
570		1			1	1								3		1		2
571																		
573					1			1	1									
575	1																	
576		1																
577		2																
578		2		2	1	3			6					2		1	1	
581								1	1						1			2
582				1	1	1												

ZONE OF ORIGIN

ZONE OF DESTINATION

52	53	55	57	60	61	62	63	64	65	66	67	68	70	71	72	73	74	75
584	6			2	18	30	4	13	19	2			3	15	8	10		10
585	4				2	3		3	2					1				
586	1			2	5	10	1	3	13	1			1	6	4	2	1	7
616																1		
628															2			
634																	1	
640																		
641																		
648	1					2										1		
650					1									4			1	1
652																		
653				1	6	12			1					4	3	5	1	4
654					2	1								1	1	1		
655					9	5	1	1	3					4	7	3		1
656						2							2	5				
657						1												
658						1			1						1			
664																		1
665														1				
666																		
667															1			
670					1	1							2	3	2			
671					1	3							1	2	1			
672						1											1	
673				1	3	14							4	6	3			
674																		
675					2	2								1	3			
676					1	1							2	1	2		1	
677				2	4	12		1					1	9	4	1		3
678					1	7							1	3	1			
679						1								1				
690				1	10	8	1	1	4				1	8	3	4	2	7
691				1	1	2			1							1		2
692					2	1							1					2
693					5	3								2		1		1

ZONE OF ORIGIN

ZONE OF DESTINATION

ZONE OF ORIGIN

X	52	53	55	57	60	61	62	63	64	65	66	67	68	70	71	72	73	74	75
694					1	4	4			2					3		1	1	4
695						2	2								2	1			1
696	1	1			1	3	5	1		3				1	9	4	2	1	2
697	1	3	1			9	5	1	2	2					5	3	3	1	3
698		1				4	8	3		3					5	2		1	1
699	4	1			2	14	10	1		13				5	4	4	4	1	2
823						1	3			2				1	4	1	1	1	
824						1	2												
830						1									1		1		
831	1	3				2				2					2				
833		1								2					1				
840									1	1				1					
841							1												
960		1			1	6	5	1		6				1	3	1	1		
970					2	2	4	1		5				1	2	1			
980		4					1			3					1				1
999		1					5	2	1	3				1	3		2		
99-4						1	1										1		
99-5		1					2		2	2					2	1	3		
99-6		1				4	9		3	4					1	1	5	1	1
99-7		5				4	8		1	6	1			1	1	1	2		2
99-8						1	8			4					2	1	5		

ZONE OF DESTINATION

✕	76	77	78	79	80	81	82	83	90	91	94	95	99					
401																		
402																		
403		1		1														
407																		
413				1														
417																		
418																		
419																		
440																		
441	1																	
446																		
450																		
451																		
461			1										1					
462																		
463		1																
465																		
466	1																	
467			1															
500				2									1					
501				1	1													
502		1		1	1								2					
503				1	1													
505																		
507	1	1											11					
508																		
512																		
515													1					
521																		
522																		
523																		
526					1								1					
527																		
530		2		1									2					
531	1								1				2					

ZONE OF ORIGIN



ZONE OF DESTINATION

✕	76	77	78	79	80	81	82	83	90	91	94	95	99						
532	1		1										8						
533	2	1		3					1				10						
534																			
535	1																		
536					1														
537																			
538																			
539													1						
540						1							1						
541		1		2					2	1			1						
542				2									3						
543	3		1	1									7						
544		1											4						
545		2											1						
546	1				1														
547																			
549				2	2								2						
550																			
551									1				2						
553				1	2								4						
554																			
560					1								4						
561	1				1					1			2						
562																			
564																			
565				1									1						
570													1						
571																			
573				1															
575																			
576																			
577																			
578													1						
581																			
582																			

ZONE OF ORIGIN

ZONE OF DESTINATION

✕	76	77	78	79	80	81	82	83	90	91	94	95	99						
584	2	1	1	4	2								6						
585	1	1	1										1						
586	1			1						2									
616					1														
628																			
634																			
640																			
641																			
648																			
650																			
652													3						
653	1		1		4								3						
654													1						
655													5						
656																			
657					1								1						
658																			
664																			
665													2						
666																			
667																			
670													1						
671													2						
672																			
673					1				1				6						
674													1						
675					1				1				2						
676													1						
677													6						
678					1								1						
679					1														
690							1												7
691																			3
692																			1
693		1																	3

ZONE OF ORIGIN

ZONE OF DESTINATION

✕	76	77	78	79	80	81	82	83	90	91	94	95	99						
694													1						
695																			
696									1	1			3						
697						1							3						
698		1			1					1			2						
699				1	2				1				4						
823																			
824													1						
830																			
831																			
833																			
840													1						
841																			
960													2						
970													1						
980																			
999	1												33						
99-4													3						
99-5			1										2						
99-6									1				1						
99-7													3						
99-8	1												2						

ZONE OF ORIGIN

## PUBLICATIONS

### Project 2-8-61-24 Freeway Surveillance and Control

1. Research Report 24-1, "Theoretical Approaches to the Study and Control of Freeway Congestion" by Donald R. Drew.
2. Research Report 24-2, "Optimum Distribution of Traffic Over a Capacitated Street Network" by Charles Pinnell.
3. Research Report 24-3, "Freeway Level of Service as Influenced by Volume Capacity Characteristics" by Donald R. Drew and Charles J. Keese.
4. Research Report 24-4, "Deterministic Aspects of Freeway Operations and Control" by Donald R. Drew.
5. Research Report 24-5, "Stochastic Considerations in Freeway Operations and Control" by Donald R. Drew.
6. Research Report 24-6, "Some Considerations of Vehicular Density on Urban Freeways" by John J. Haynes.
7. Research Report 24-7, "Traffic Characteristics of the Freeway Interchange Traffic of the Inbound Gulf Freeway" by William R. McCasland.