Trends in Traffic Diversion on Edens Expressway

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●NEARLY 200,000 motorists were interviewed by the Cook County Highway Department on August 31st, September 1st and September 2nd, 1954.

This survey was a follow-up of a similar road interview type survey held on the same days (Tuesday, Wednesday and Thursday) in August and September of 1950.

During the three day survey, 300 men from the Cook County Highway Department were used to secure the facts on origins and destinations.

This year's follow-up survey was refined as a result of the experience gained in 1950. The field structure of the survey was established in 1950. This structure was maintained in the 1954 follow-up with several field improvements and the addition of interview stations along Edens Expressway which was not open to traffic in 1950.

The survey consisted of road interview stations across three screen lines on routes paralleling Edens Expressway. Figure 1 shows the station locations. All these stations were operated for 16 hours beginning at 6 A.M. and concluding at 10 P.M. The five screen line stations A were operated on Tuesday, August 31; the seven B line stations on Wednesday, September 1; and the seven C line stations on Thursday, September 2. In this total of 19 interview stations, traffic volumes varied from 3,000 to 35,000 vehicles in 24 hours.

Consideration was given to the number of lanes, existence of median strips, proximity to large industrial plant areas, variation in illumination, quantity of truck traffic, proximity to signalized or stop-signed intersections, and sight distance. Of all of the variables affecting the station set-up, most important was the item of traffic volumes at peak hours. This obviously, had a direct bearing on the number of personnel required to secure interviews.

Despite the difficulties encountered in such a large operation, 74.9 percent of all motorists passing through the stations were interviewed. A higher percentage was, of course, obtained at stations of lesser volume.

Figure 1 shows the location of the stations and their comparative 1950-1954 volumes.

Volume counts were maintained at all stations by mechanical counters, registering fifteen minute and hourly totals.

Table 1 shows the 16-hour-total volume comparisons for 1950 and 1954. These 16-hour totals represent 87.8 percent of the 3-day, 24-hour volumes in 1950, and 88.5 percent of the 3-day, 24-hour volumes in 1954.

Figures 2 and 3 show the origins and destinations by six general areas of south bound traffic through Line B.

TRAFFIC DIVERSION

Edens Expressway was opened to full traffic use in December 1950. This expressway was located and designed on the basis of the findings of our 1941 origin-and-destination survey.

In this survey, the last four digets of the state license plates were noted by observers at 380 recording stations, two hundred of which were located outside of Chicago. The observations of this survey were analyzed by business-machine methods.

From this information traffic was assigned to Edens Expressway on the basis of optimum time-distance. As the work of traffic assignment progressed, it became apparent that improvements in techniques were necessary to achieve stability in traffic assignment results. As a result it was decided to conduct a before and after study to add knowledge to the field of traffic assignment and its subdivisions.

The commonly accepted principal subject divisions in traffic assignment are: (1) traffic diversion, (2) traffic "generation", and (3) normal growth.

Traffic diversion as commonly used denotes the traffic which is drawn to a new or improved facility from alternate existing routes. It must be pointed out that the notion of diversion need not be limited to new or improved facilities but can occur from a relative change in the usefulness of such alternate routes.

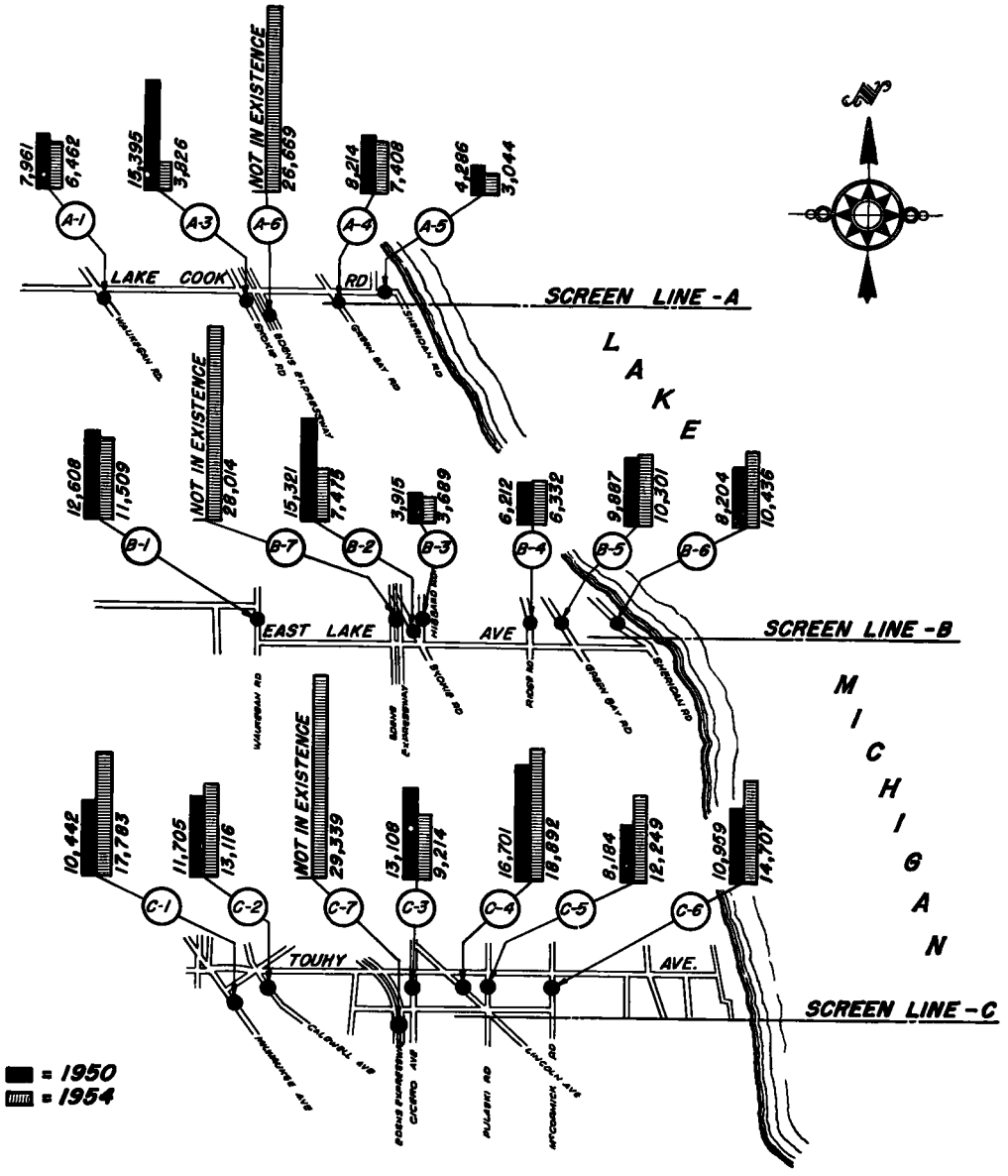

Figure 1. North and south 16 hour 2 way traffic volumes.

Traffic generation includes by common acceptance two categories: (1) primary generation which is that traffic "created by" a new facility and (2) secondary generation which is that traffic resulting from intensified land use as a result of expressway construction.

The commonly accepted implication in the term "generation" is that the new facility creates vehicular traffic and that the created traffic did not exist before the construction of the new and generating facility.

Normal growth is generally defined as that traffic increase due to growth in vehicle registration and population.

Table 1 gives a clear indication of the diversion which has occurred on the facilities under study in our 1950-1954 study. At this time it should be pointed out that for this discussion diversion is considered to include two aspects: (1) diversion onto the Expressway from within the subject corridor and (2) diversion from outside the subject corridor.

TABLE 1

16 HOUR TOTAL VOLUME COMPARISONS FOR EDENS ORIGIN-DESTINATION SURVEY

Station	Location	1950 Volume	% of Total	1954 Volume	% of Total
Total for all A Stations		35,856		47,409	
A-1	Waukegan Rd.	7,961	22.2	6,462	13.6
A-3	Old Skokie	15,395	42.9	3,826	8.1
A-4	Green Bay Rd.	8,214	22.9	7,408	15.6
A-5	Sheridan Rd.	4,286	12.0	3,044	6.4
A-6	Edens Expressway	.....	.....	26,669	56.3
Total for all B Stations		56,147		77,756	
B-1	Waukegan Rd.	12,608	22.5	11,509	14.9
B-2	Skokie Rd.	15,321	27.2	7,475	9.6
B-3	Hibbard Rd.	3,915	7.0	3,689	4.7
B-4	Ridge Rd.	6,212	11.1	6,332	8.1
B-5	Green Bay Rd.	9,887	17.6	10,301	13.2
B-6	Sheridan Rd.	8,204	14.6	10,436	13.4
B-7	Edens Expressway	.....	.....	28,014	36.1
Total for all C Stations		71,099		115,300	
C-1	Milwaukee Ave.	10,442	14.7	17,783	15.4
C-2	Caldwell Ave.	11,705	16.5	13,116	11.4
C-3	Cicero Ave.	13,108	18.4	9,214	8.0
C-4	Lincoln Ave.	16,701	23.5	18,892	16.4
C-5	Crawford Ave.	8,184	11.5	12,249	10.6
C-6	McCormick Blvd.	10,959	15.4	14,707	12.8
C-7	Edens Expressway	.....	.....	29,339	25.4

Table 1 illustrates the diversion experienced onto the expressway from within the subject corridor. This subject corridor was arbitrarily determined by the geographical extent of this survey. Screen Line A, which is the farthest north, extends on the east from Sheridan Road adjacent to Lake Michigan, to Waukegan Road, on the west, a width of nearly four miles. The width of the corridor at the B line is nearly 5½ miles. This screen line is also located between Sheridan Road and Waukegan Road. At the south screen line the width of the corridor is 4½ miles. The south end of the subject corridor is between McCormick Boulevard on the east and Milwaukee Avenue on the west.

To establish a measure of comparison between 1950 and 1954 traffic volumes, a normal growth factor had to be determined. Several approaches were possible for this purpose: (1) county-wide vehicle registration increase; (2) vehicle registration increase limited to the subject corridor; (3) motor-fuel-tax increase for the survey area in Cook County outside the City of Chicago; and (4) various indices of population growth.

After examining these possibilities it was decided that an unbiased estimate of normal growth could best be achieved by selecting as a base the vehicle registration 1950-1954 index within the limits of the subject corridor. This was found to be 28.8 percent, which was a substantially higher index than any of the others available for use. Although 28.8 percent was the average for all the communities in the corridor, there was a wide variation about this average.

Included in this corridor are 23 communities with a total 1954 population of 353,000 ranging in size from 2,500 to 80,000. The total vehicle registration in 1954 for these communities is 90,000, ranging from 250 vehicles to 25,000 vehicles.

Five charts showing hourly traffic volume comparisons for Line A were constructed to give the relation between the actual 1954 volumes and the expected 1954 volumes

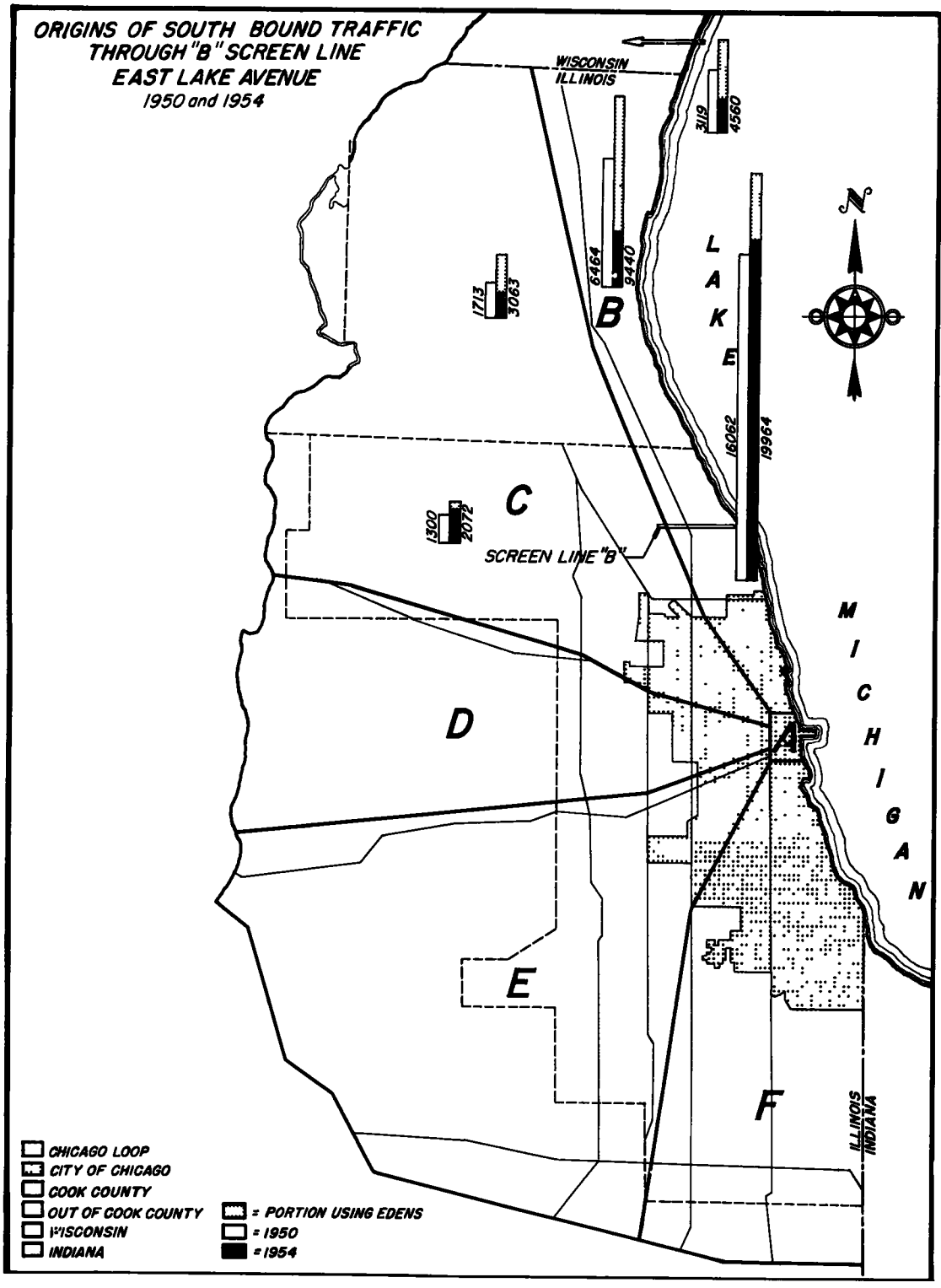
ORIGINS OF SOUTH BOUND TRAFFIC
THROUGH "B" SCREEN LINE
EAST LAKE AVENUE
1950 and 1954
WISCONSIN
ILLINOIS
3119
4560
6464
9440
1713
3063
B
LAKE
16062
19964
N
1300
2072
C
SCREEN LINE "B"
MICHIGAN
D
A
E
F
ILLINOIS
INDIANA
CHICAGO LOOP
CITY OF CHICAGO
COOK COUNTY
OUT OF COOK COUNTY
WISCONSIN
INDIANA
= PORTION USING EDENS
= 1950
= 1954

Figure 2.

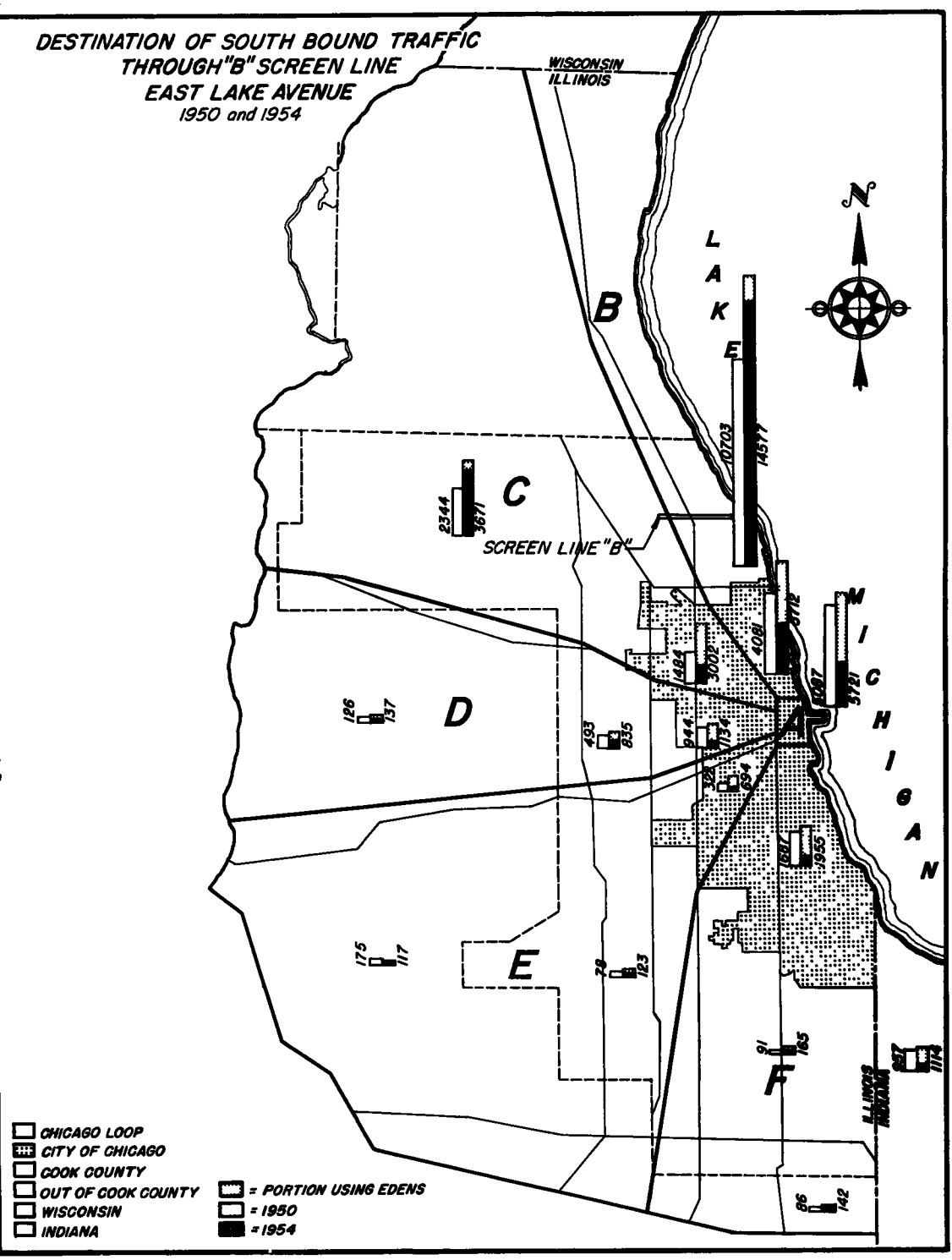
DESTINATION OF SOUTH BOUND TRAFFIC
THROUGH "B" SCREEN LINE
EAST LAKE AVENUE
1950 and 1954
WISCONSIN
ILLINOIS
B
C
D
E
F
A
LAKE
MICHIGAN
N
SCREEN LINE "B"
2344
3671
10703
14577
3112
408
1484
3002
1087
3121
126
137
493
835
944
1734
192
654
1887
3955
175
117
78
123
91
165
87
114
86
142
CHICAGO LOOP
CITY OF CHICAGO
COOK COUNTY
OUT OF COOK COUNTY
WISCONSIN
INDIANA
= PORTION USING EDENS
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Figure 3.

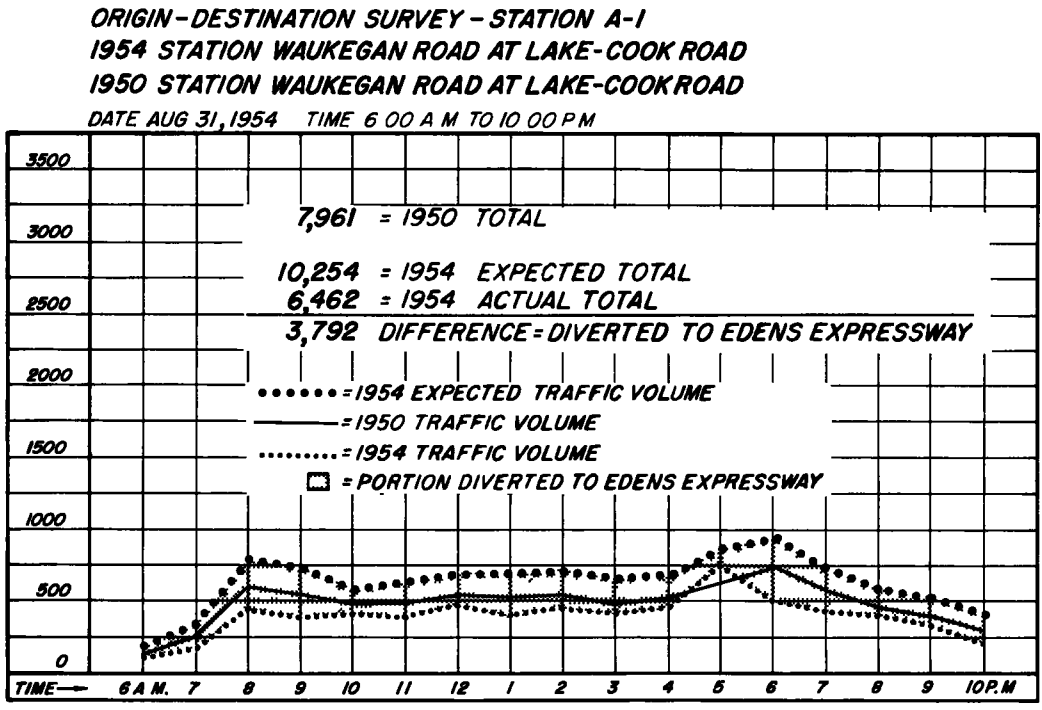


Figure 4. Hourly traffic volume comparisons, 1950 and 1954.

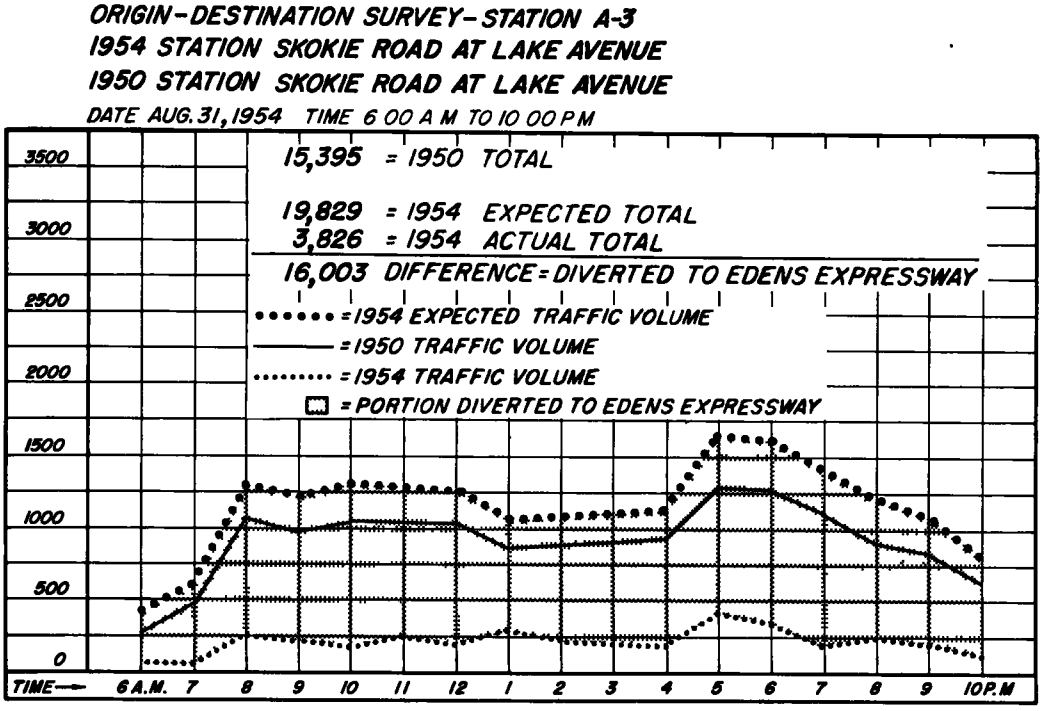


Figure 5. Hourly traffic volume comparisons, 1950 and 1954.

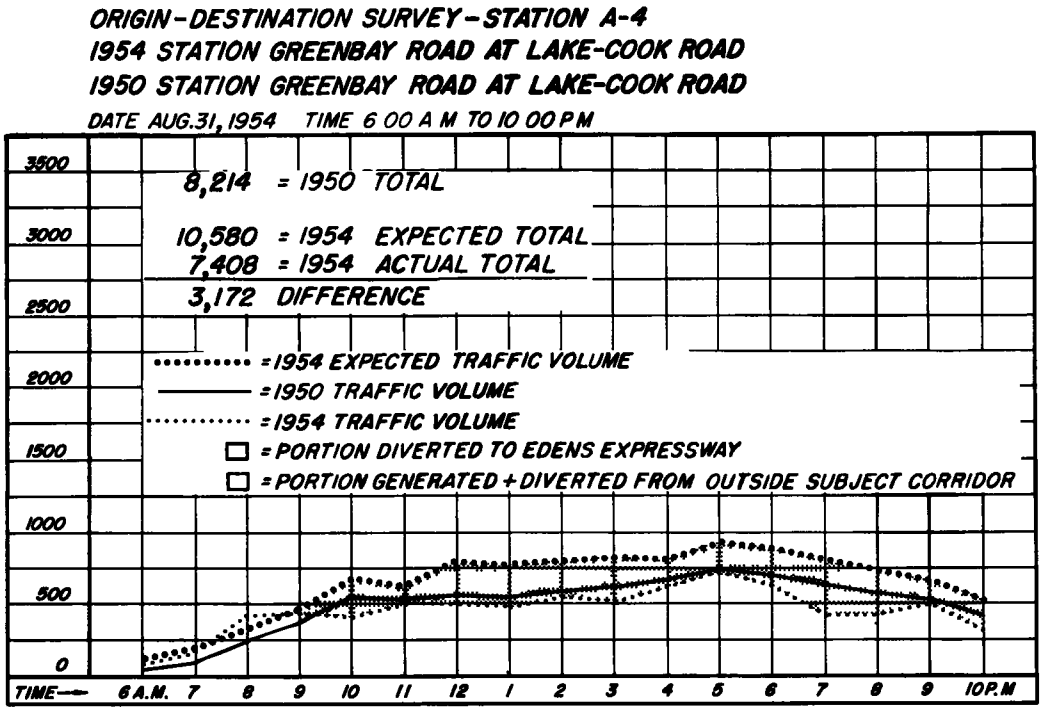


Figure 6. Hourly traffic volume comparisons, 1950 and 1954.

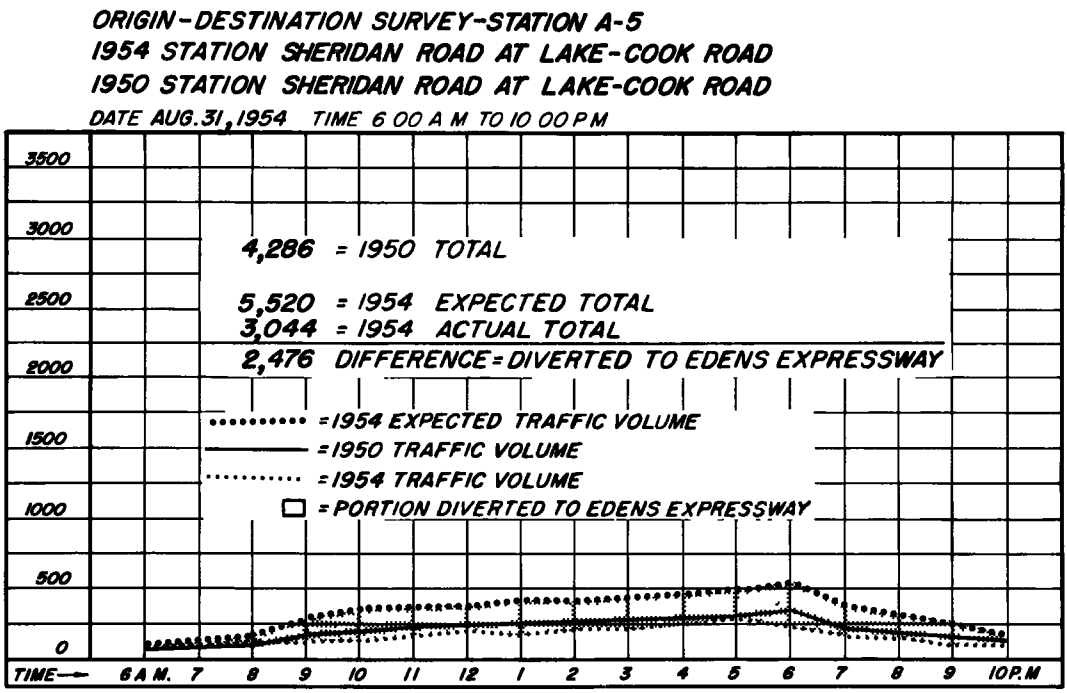


Figure 7. Hourly traffic volume comparisons, 1950 and 1954.

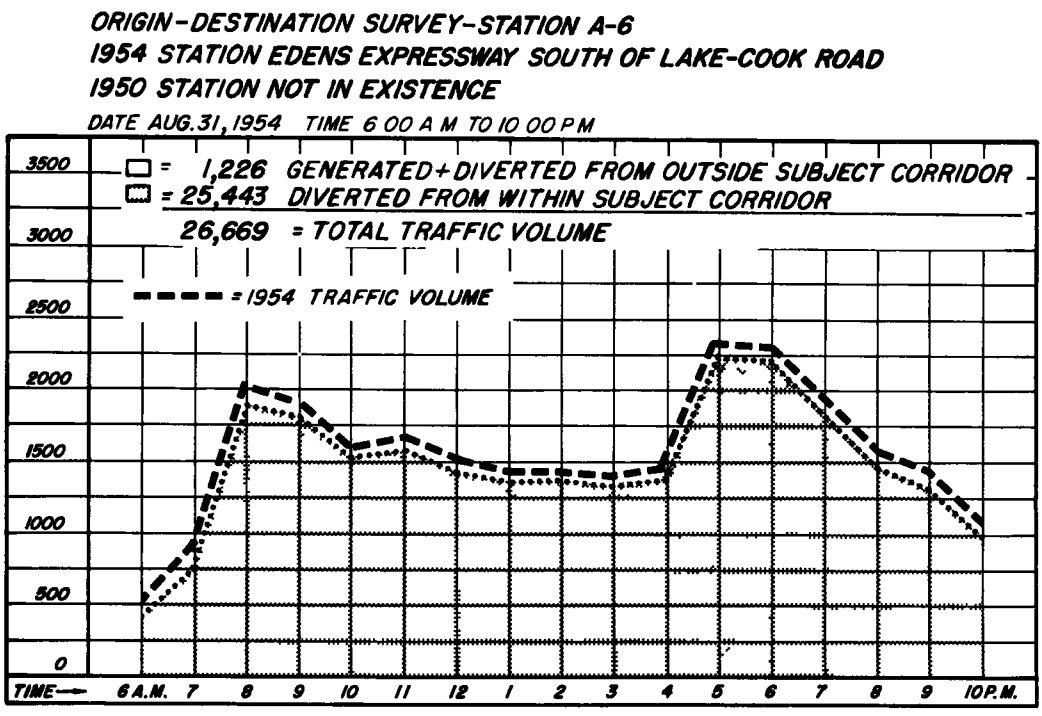


Figure 8. Hourly traffic volume comparisons.

based on the expansion of the 1950 actual volumes by the use of the normal growth factor of +28.8 percent. Each of these charts shows the hourly performance for its respective survey station.

An examination of these charts shows the existence of a substantial section of the diversion gradient. Skokie Highway, which is most nearly adjacent to Edens, shows 80.7 percent diversion to Edens. The percentage of diversion from Green Bay Road and Sheridan Road to the east are 30.0 percent and 44.9 percent, respectively. Waukegan Road, which is west of Skokie and Edens, shows a diversion of 37.0 percent. The total volume diverted to Edens from the A screen line from within the subject corridor was 25,443 vehicles in 16 hours. All of the A stations show a substantial degree of diversion to Edens Expressway.

Even more startling is the diversion gradient at the B screen line. The table below illustrates the gradient characteristic on both sides of the expressway. The gradient nearly vanishes to the east at Sheridan Road. On the west, Waukegan Road conforms to the same gradient it had at the A screen line to the north.

PERCENTAGE OF DIVERSION TO EDENS EXPRESSWAY, B SCREEN LINE STATIONS

Station	Waukegan Rd. B-1	Edens Expwy. B-7	Skokie Rd. B-2	Hibbard Rd. B-3	Ridge Rd. B-4	Green Bay Rd. B-5	Sheridan Rd. B-6
*% Diverted To Edens	29.1	----	62.1	26.8	20.9	19.1	1.2

*The percentage shown is the ratio of diverted traffic to total expected traffic for each station.

Graphically, traffic assignment to the expressway can be represented as a function of different variables. Four such variables considered are (1) the time ratio, (2) the distance ratio, (3) the time saved, and (4) the maximum miles of available expressway.

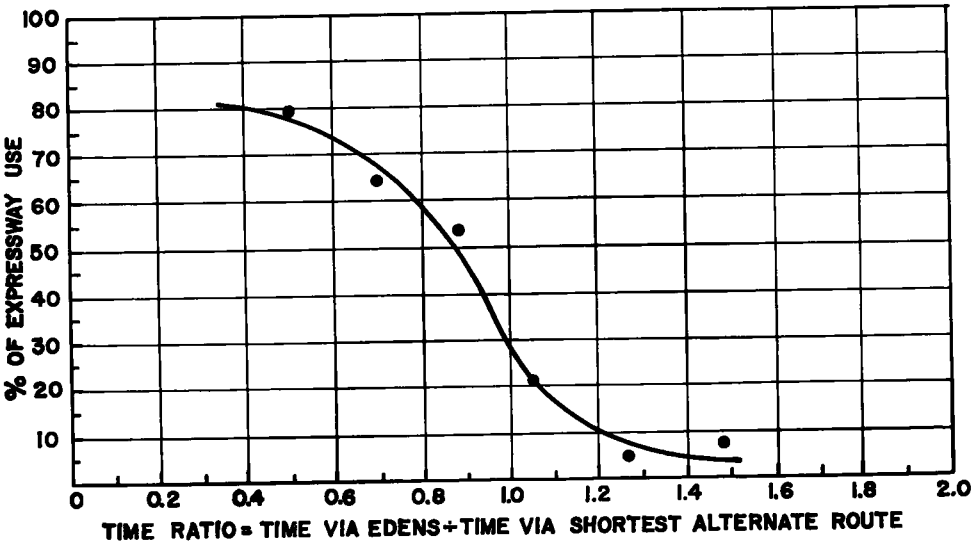


Figure 9. 1954 origin destination traffic survey traffic assignment to Edens expressway.

Figures 9 through 12 show these relationships. The time ratio is defined to be the time via Edens Expressway divided by the time via the shortest alternate route. When the time ratio is 0.5, about 80 percent expressway usage can be expected and when the time ratio exceeds 1.5, little or no expressway usage is found. The time ratio gives a fairly stable measure of traffic assignment.

The distance ratio is a less stable measurement of traffic assignment, but does give a fair picture. When the distance ratio is 0.7, about 75 percent expressway usage is found. One might expect this percentage to be much higher, but it should be pointed out that due to the nature of Edens Expressway, there is a lack of trips on which distance can be saved by using the expressway and, in such cases where distance can be saved, the trip is likely to be relatively short, so that expressway travel is less desirable. On the other end of the curve, when the distance ratio exceeds 1.5. less than 10% express-

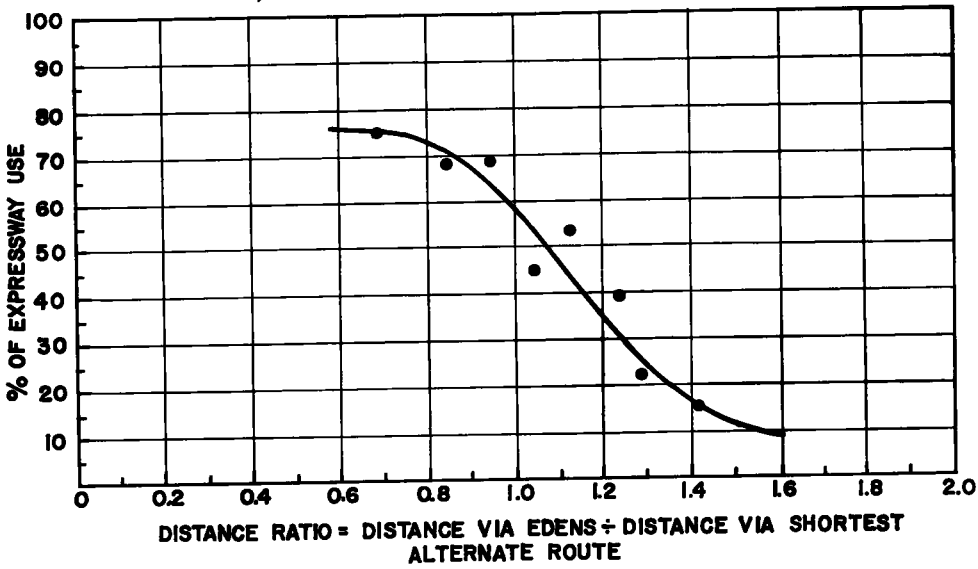


Figure 10. 1954 origin destination traffic survey traffic assignment to Edens expressway.

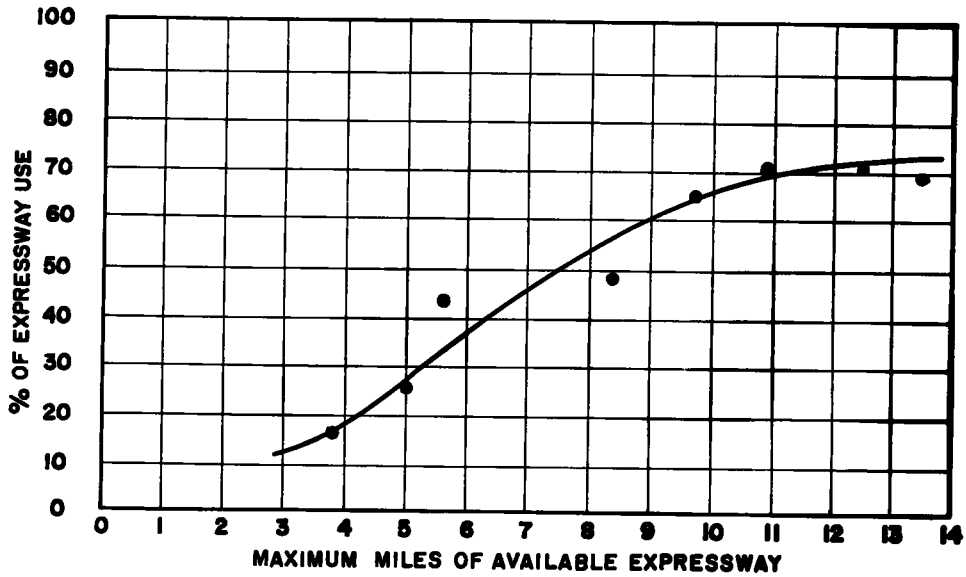


Figure 11. 1954 origin destination traffic survey traffic assignment to Edens expressway.

way usage is expected.

Figure 11 shows percentage of expressway use as a function of time saved by traveling via the expressway. This seems to be a very stable indicator of traffic assignment. When using the expressway results in a loss of 10 minutes, about 10 percent usage is found. When there is no time saved by using Edens, the usage is about 25 percent and when as much as 30 minutes can be saved, over 90 percent usage is found. This is only possible on relatively long trips, indicating a relationship to total trip length.

Figure 12 shows expressway usage as a function of the maximum miles of expressway available for a particular trip. There is a very definite tendency toward a higher percentage of expressway use as more expressway is available for a trip.

When less than four miles of expressway can be used for a trip, less than 20 percent expressway usage is found. When the entire 13.5 miles of the expressway can be used

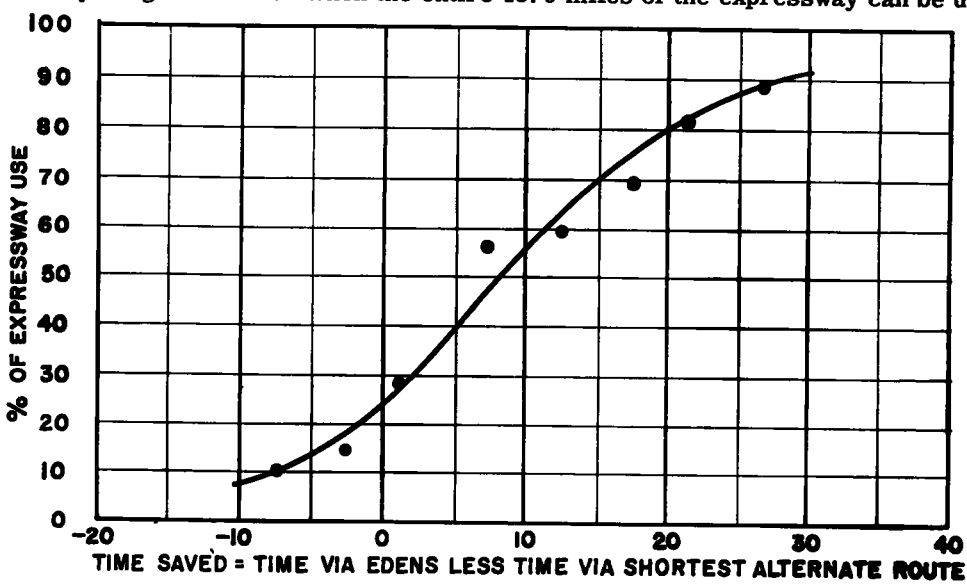


Figure 12. 1954 origin destination traffic survey traffic assignment to Edens expressway.

TABLE 2

GENERATION OF TRAFFIC PASSING THROUGH SCREEN LINE A

Origin	Total 1954 Traffic	Total Generation 1950-1954	Generation by Edens Exp.	% Generation by Edens
Evanston	2,165	345	345	15.9
Glencoe	2,518	1,458	0	0
Glenview	642	78	34	5.3
Golf	10	0	0	0
Kenilworth	142	18	17	12.0
Morton Grove	187	26	26	13.9
Northbrook	1,936	547	4	0.2
Northfield	254	74	40	15.7
Skokie	654	79	79	12.1
Wilmette	787	152	152	19.3
Winnetka	1,212	112	79	6.5
Deerfield	2,136	442	442	20.7
Highland Park	8,073	729	729	9.0
Lake Bluff	226	11	2	0.9
Libertyville	397	142	142	35.8
Mundelein	134	70	70	52.2
North Chicago	934	—236	0	0
Waukegan	1,835	—418	0	0
Winthrop Harbor	33	— 32	0	0
Zion	210	53	53	25.2

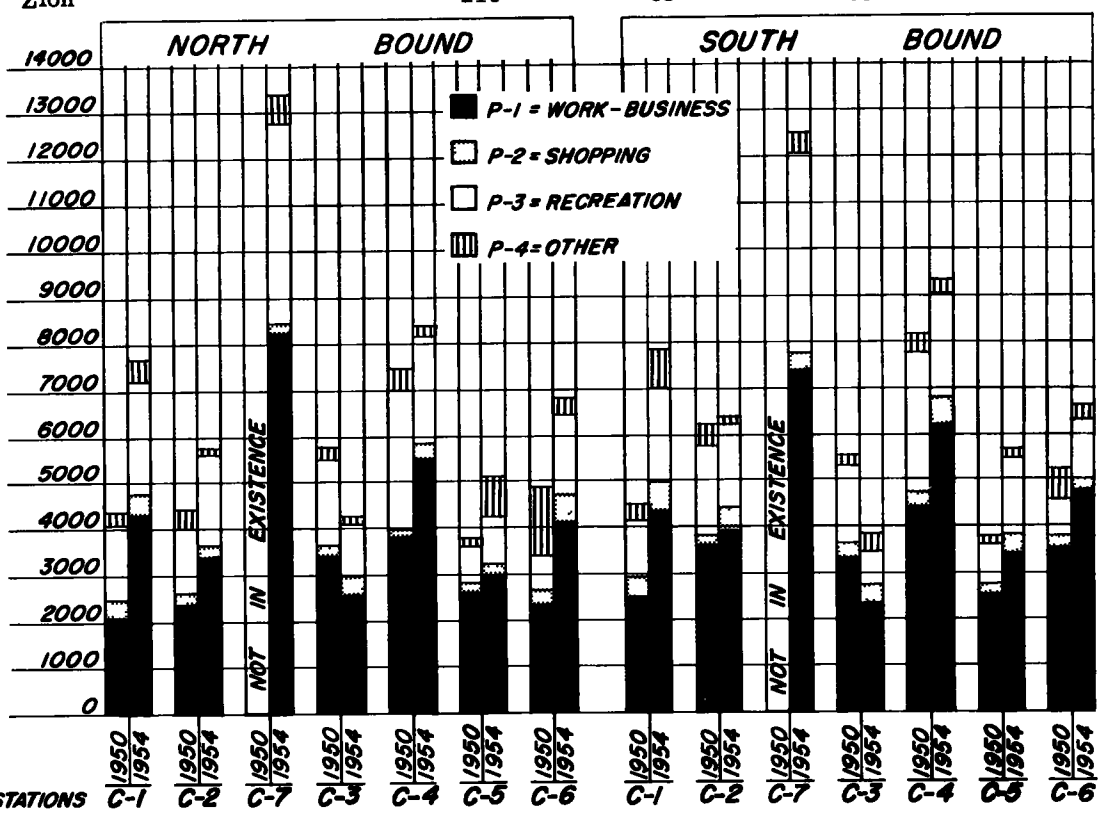


Figure 13. 1950 and 1954 comparison of trip purpose for passenger cars.

for a trip, about 70 percent usage is found. The curve flattens out rapidly after the point where about 10 miles of expressway is available. The number of miles of expressway available, although a fairly good indicator of expressway usage, is not as good as either the time ratio, or the time saved, but seems to be slightly better than the distance ratio.

A multiple regression study was done on the basis of zone to zone transfers to develop an equation predicting the proportion of expressway use as a function of three variables. The resulting equation follows:

$$Y = .368 - .262\,X_1 + .103\,\frac{X_2 + 6}{10} + .255\,\frac{X_3}{10}$$

where Y = estimated proportion of expressway use.
X_1 = the time ratio (as previously defined).
X_2 = the time saved in minutes by using Edens Expressway.
X_3 = the length in miles of expressway use for the trip involved.

There are 86 degrees of freedom for testing the significance of the regression coefficients. All three show significance above the 0.01 level.

TABLE 3

GENERATION OF TRAFFIC PASSING THROUGH SCREEN LINE B

Origin	Total 1954 Traffic	Total Generation 1950-1954	Generation by Edens Exp.	% Generation by Edens
Evanston	7,668	1,598	300	3.9
Glencoe	2,892	0	0	0
Glenview	3,723	— 235	0	0
Golf	39	0	0	0
Kenilworth	2,074	70	0	0
Morton Grove	456	21	9	2.0
Northbrook	3,693	0	0	0
Northfield	1,132	114	42	3.7
Skokie	1,663	258	258	15.5
Wilmette	6,723	1,236	55	0.8
Winnetka	6,628	— 380	0	0
Deerfield	1,279	99	48	3.8
Highland Park	4,473	712	712	15.9
Lake Bluff	204	— 58	0	0
Libertyville	369	86	86	23.3
Mundelein	131	49	49	37.4
North Chicago	905	247	247	27.3
Waukegan	1,637	— 117	0	0
Winthrop Harbor	20	— 30	0	0
Z on	169	0	0	0

The multiple correlation coefficient is 0.794, indicating that the regression equation gives a fairly good estimate of the proportion of expressway use.

TRAFFIC GENERATION

In any new concept considerable latitude in results is experienced up to a point where terminology and technique achieve maximum refinement, understanding and acceptance. Any problem statement is at the mercy of the definition of the terms currently used. In view of this, it is most important that a concise definition of traffic generation be re-

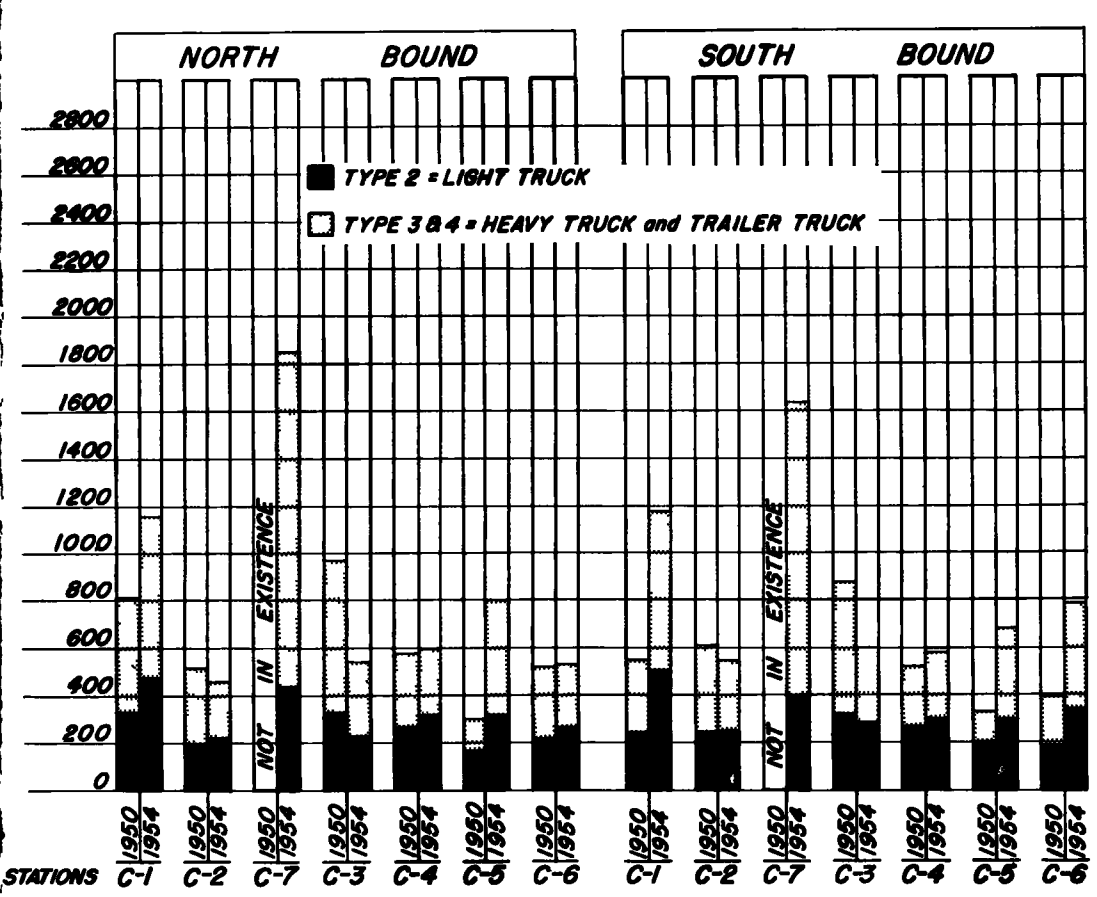


Figure 14. 1950 and 1954 comparison of truck traffic.

stated for this discussion.

In our staff discussions regarding traffic generation attributable directly to a new expressway, there appeared considerable misunderstanding as to the relative significance of the term "generation" to "diversion." Included in existing terminology there appear definitions for primary and secondary generation which merely add fuel to the misunderstanding of the problem.

The currently accepted definition of primary generation was previously stated to be "that traffic created by a new facility." To many in this field of endeavor, this definition is reported to be vague in the sense that a highway cannot create. Attempts have been made, some with moderate degrees of success, to show that there has been no increase in the number of trips beyond that expected by normal growth and that any increase in traffic volume would merely reflect a change in mode of travel. If such is the case, then generation would have to be explained in terms of this change and might even be less mystifying if a specially symbolic name were set aside for it.

The currently accepted definition of secondary generation was stated to be "traffic resulting from intensified land use." If it could be shown that there were such an intensified land use after the creation of an expressway, then by this definition, this intensified use would be called secondary generation. However, it must be pointed out that intensified land use can result from many factors, only one of which is expressway construction. Other factors influencing intensified land use may be: industrial development, shopping-center development, trends toward metropolitan decentralization, economic growth. If specific weight factors could be attached to each of these components of intensified land use, then we might arrive at some tangible measure of any one factor any one factor including the influence of expressways. To arrive at such weights would certainly require a tremendous improvement and expansion in origin

TABLE 4

GENERATION OF TRAFFIC PASSING THROUGH SCREEN LINE C

Origin	Total 1954 Traffic	Total Generation 1950-1954	Generation by Edens Exp.	% Generation by Edens
Evanston	5,263	835	106	2.0
Glencoe	1,093	152	105	9.6
Glenview	3,189	— 196	0	0
Golf	54	— 54	0	0
Kenilworth	217	5	0	0
Morton Grove	2,366	536	232	9.8
Northbrook	1,543	50	50	3.2
Northfield	463	22	12	2.6
Skokie	11,867	1,643	0	0
Wilmette	1,532	252	125	8.2
Winnetka	998	— 15	0	0
Deerfield	546	89	78	14.3
Highland Park	1,911	421	407	21.3
Lake Bluff	108	0	0	0
Libertyville	412	58	23	5.6
Mundelein	232	— 84	0	0
North Chicago	534	— 106	0	0
Waukegan	1,137	81	81	7.1
Winthrop Harbor	19	0	0	0
Zion	149	47	40	26.8

destination survey techniques.

One of the approaches to this problem would be to recognize that diversion is the principal effect of an expressway on parallel routes. Intensified land use, for example, could certainly be considered as a qualitative aspect of diversion. To assume that a new homeowner would buy a car only because an expressway exists if obviously weak. In all probability a new homeowner possessed his vehicle prior to moving into the vicinity of an expressway and, therefore, can be considered within the category of diverted traffic.

During staff discussions, and after trying several techniques to isolate the component of generation, it was offered that one way to measure this component would be the home interview technique. This technique, in contrast to other techniques involved, gives a more-direct measure by eliminating vague assumptions. It is unreasonable to assume that all growth beyond a certain point can be accounted for by any one factor, expressway construction or otherwise. It seems fairly clear that all factors involved are interrelated and that the isolation of any one would be extremely difficult. However, this approach does not aid in solving the problem. To attempt a solution one must make assumptions for explanatory purposes and, by the methods of trial and error, may find it necessary to change these assumptions.

Twenty communities were selected as being those "most" affected by Edens Expressway. For each community, a factor for vehicle registration growth 1950-1954, was determined.

The first problem was to compute the total volume of generated traffic originating in each of these 20 communities. One must be careful in doing this not to erroneously assign all such generated traffic to the expressway. This can be avoided by a breakdown by individual stations. In many cases, substantial generation was found on stations other than the expressway. Tables 2, 3, and 4 show the generation data for each of the 20 communities at each of the three screen lines.

Highland Park is probably the most-favorably located town for using Edens Expressway, consequently, one might expect to find a large amount of traffic generation from Highland Park. This expectation seems justified, for at the A screen line, 729 of the 8,073 vehicles from Highland Park were generated by the expressway. This is about 9.0

percent. Of these, 51.5 percent were passenger car business trips and 36.8 percent trucks. The remainder were shopping and recreation trips.

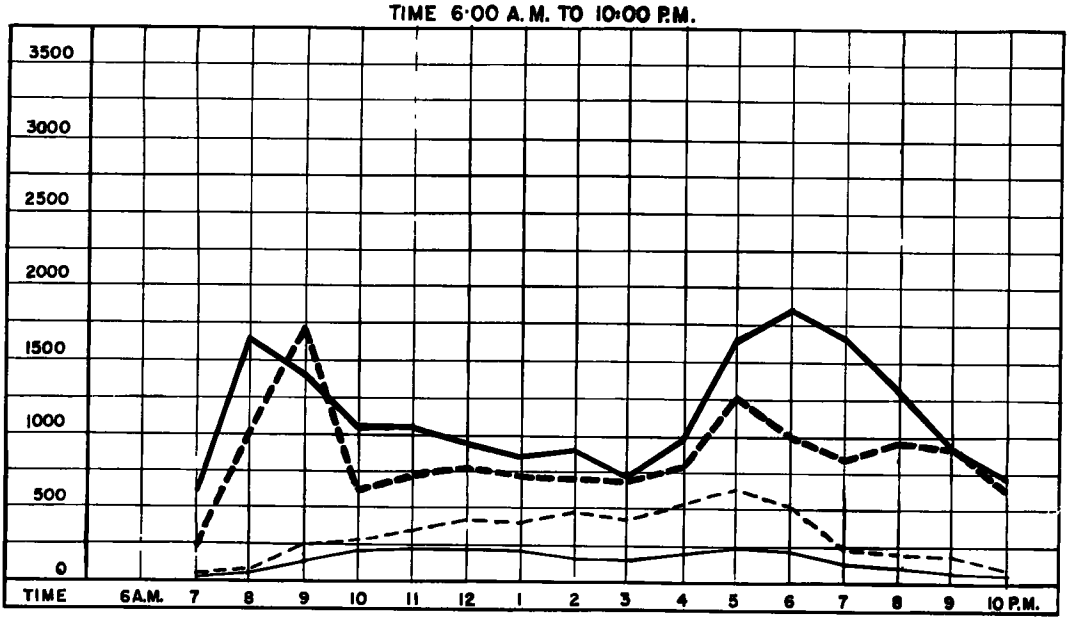
At the B line, Highland Park again shows substantial generation. The number of generated trips is 712, 36.8 percent being business trips, 55.6 percent recreation, and the remainder, trucks.

Highland Park at the C screen line, showed 21.3 percent generation, accounted for by Edens. Of 407 trips generated by Edens, 41.5 percent were passenger car business trips, 31.9 percent recreation, 18.2 percent trucks, and the remainder shopping and miscellaneous.

In general, the appearance of generation of traffic by the expressway was sketchy. In those cases where marked generation did appear, an important factor was the location of the community with respect to the expressway.

One might wonder about the length of the generated trips as well as the purpose of these trips. Following the generated trips from Highland Park through the three screen lines, a sharp dropoff in volume appears between the B and C screen lines. At the C screen line there are still well over half of the generated trips which appeared at the A screen line. Many of these vehicles were destined for the Loop and the north and northwest sides of Chicago, so it can be safely concluded that at least half of the trips generated from Highland Park were of 20 or more miles in length and used the full length of Edens Expressway. More than 90 percent of the generated trips were of 10 miles or more in length and used over half of the full length of Edens.

This seems to conform to the ideas on traffic assignment presented in the discussion of diversion. The amount of generation will be closely correlated with length of trip, length of expressway available for the trip, time ratio, and distance ratio, where time



CLASSIFICATION	%	
"A" STATIONS North & South	MALE	FEMALE
ALL "A" STATIONS	80.0	20.0
NON-EXPRESSWAY	71.3	28.7
EXPRESSWAY	87.6	12.4
5 STATE EXPERIENCE*	67.0	33.0

MALE - EDENS

FEMALE - EDENS

MALE - NON EXPRESSWAY

FEMALE - NON EXPRESSWAY

*PUBLIC ROADS, Dec, 1954, Motor-Vehicle-Use Studies in Six States.

Figure 15. Highway usage variations, origin-destination survey, A screen line stations, male and female drivers, north and south.

and distance comparisons are made with the best alternate mode of transportation, as well as with expressway versus alternate routes. If these functional relationships can be found, traffic generation will lose much of its mystic characteristics and probably can be readily explained in terms of a shifting in mode of transportation.

It should be noted that traffic generation is highly correlated with diversion and that generation will never appear in the absence of diversion, except in the purely artificial case where a new facility is built where no facility of any kind previously existed.

The approach to traffic generation used here only considers the growth of traffic originating in a particular zone or community. The identical approach could be used for traffic destined to a particular community.

Another way is to consider the generation of traffic between pairs of zones. This will present complexities as far as the computational work is concerned, in that a growth factor should be determined which is a function of the two growth factors (i.e., the growth factors of the particular pair of zones).[1]

However, the advantage to this approach is that it allows immediate comparisons between varying degrees of generation and length of trip, length of expressway available for the trip, etc. One big disadvantage is that where a large number of zones are used, the interchange between any pair of zones will be relatively small. One would clearly be treading on dangerous ground if he spoke of a generation of 10 or 15 vehicles between a pair of zones, since such a volume might easily be accounted for by pure chance. The suggested technique is to start from the general and work to the particular. In other words, before talking about the generation between Zone A and Zone B, first determine if there is a significant volume of generation for either Zone A or Zone B, taken separately.

This approach tends to minimize the probability of erroneously naming a chance increase generation.

If this approach, with local indices of growth, is to be used the computational labor could be lessened considerably by the use of electronic computing equipment.

TRIP-PURPOSE VARIATION

The information gathered in the field for this comparative 1950-1954 road interview survey included not only origin-and-destination information, vehicle types, and volumes, but also trip purpose data.

Figures 13 and 14 show the trip-purpose variation by type and purpose and truck traffic for all stations in Screen Line C.

Two small tables are also included to show the distribution of passenger-car traffic on Edens Expressway by purpose, and the percentage comparisons of make to female drivers on the expressway and on nonexpressways.

PERCENTAGE DISTRIBUTION OF PASSENGER CAR TRAFFIC ON EDENS EXPRESSWAY STATIONS IN 1954

Station	Work Business	Shopping	Recreation	Other
A-6	56.9	2.5	34.4	6.2
B-7	57.9	2.2	35.6	4.3
C-7	60.7	1.9	33.3	4.1

[1] Originally it was thought that this method could be used with one average growth factor for all communities, instead of local growth factors. This was tried, but with no reasonable degree of success, and any generation which was present, tended to be obliterated by inconsistent results.