# REPORT OF COMMITTEE ON ORIGIN AND DESTINATION SURVEY TECHNIQUES

D. GRANT MICKLE, *Chairman*
*Traffic Engineer, Automotive Safety Foundation,*

JOHN T. LYNCH, *Secretary*
*Chief, Planning Surveys Section, Public Roads Administration*

In the 1944 report of the Committee,[1] various methods for making origin and destination surveys in urban areas were outlined and a method recently developed, based on interviews in the home and at the roadside, was described in detail. Since the publication of that report, there has been a considerable expansion of the use of this new method, and, as a result of the experience gained, some improvements have been made in the procedures

Comprehensive surveys have been in progress in the areas of the following 37 cities:

Atlanta, Georgia
Baltimore, Maryland
Baton Rouge, Louisiana
Boston, Massachusetts
Charlotte, North Carolina
Chattanooga, Tennessee
Cincinnati, Ohio
Columbus, Georgia
Denver, Colorado
Fort Wayne, Indiana
Greenville, South Carolina
Indianapolis, Indiana
Jacksonville, Florida
Kansas City, Missouri
Lincoln, Nebraska
Little Rock, Arkansas
Mason City, Iowa
Memphis, Tennessee
Milwaukee, Wisconsin
Nashville, Tennessee
Newark, New Jersey
New Orleans, Louisiana
Oklahoma City, Oklahoma
Omaha, Nebraska
Ottumwa, Iowa
Port Huron, Michigan
Providence, Rhode Island
Richmond, Virginia
St. Joseph, Missouri
St. Louis, Missouri
Savannah, Georgia
Shreveport, Louisiana
South Bend, Indiana
Spartanburg, South Carolina
Springfield, Missouri
Tulsa, Oklahoma
Waycross, Georgia

Smaller cities within the metropolitan areas of those mentioned, some of them in adjoining States have generally been included in the survey. For example Covington, Kentucky, is included in the Cincinnati survey and the Newark survey includes 42 separate municipalities. In all cases the work is being done under the direct supervision of the State highway department in cooperation with the Public Roads Administration and with municipal and other local agencies

To check the accuracy of the results, ground counts have been made at bridges and other points of traffic concentration. Comparisons have been made between these counts and traffic computed from the interview data to have passed by the points during each hour of the day and night. In addition travel by workers to and from certain plants and areas, as determined from the interviews, has been compared with data obtained from the employers and other sources concerning the daily number of workers. From these checks it has been found that work travel was generally fully reported in the interviews whereas travel for other purposes was less fully reported, particularly in the earlier surveys.

[1] *Proceedings*, Highway Research Board, Vol. 24, p. 238.

Figure 1 shows a comparison of the number of passenger cars counted at five control points in Denver, Colorado, with the number calculated from the interviews to have passed these points. The comparison is by hours and the traffic computed from the interviews is sub-divided into that which passed a cordon of external stations located around boundaries of the area and work travel and non-work travel performed entirely within the area The external travel was computed from roadside interview data and the internal work and non-work travel was computed from home-interview data. This comparison is somewhat typical of the earlier surveys. The work travel was rather fully reported in the home interviews and the comparison for the morning peak, which consisted mainly of travel to work, is therefore very close; the comparison for the afternoon peak, in which travel for the purpose of shopping and for other purposes is mixed with the predominant travel from work, is not quite so close, while that for other periods of the day is considerably less satisfactory. In this case it was found that multiplying the non-work travel by 2 5 gave a curve which followed the ground count very closely throughout the day, for each of the control points and for all five of them combined. It seems reasonable to assume therefore that the unreported work travel followed very closely that which was reported and that the survey results as adjusted represent a reasonably accurate picture of the daily traffic movements. In any event the adjusted data should be sufficiently accurate for design purposes since the adjustments are relatively small for the peak-hour periods which are used for the basis of design

In the surveys which have been more recently undertaken, improvements have been made in the procedures so that better control point checks are being obtained Figure 2 shows a comparison of ground counts with expanded interview data, including both trucks and passenger cars, at three control points in Milwaukee. In this case the comparison is sufficiently close so that no adjustment was deemed necessary. The night trips which apparently were missed in the interviews in fairly large proportion are not considered to be of any great importance so far as route selection and design are concerned These better results have been obtained by more careful training of the interviewers and by placing emphasis on the completeness of the

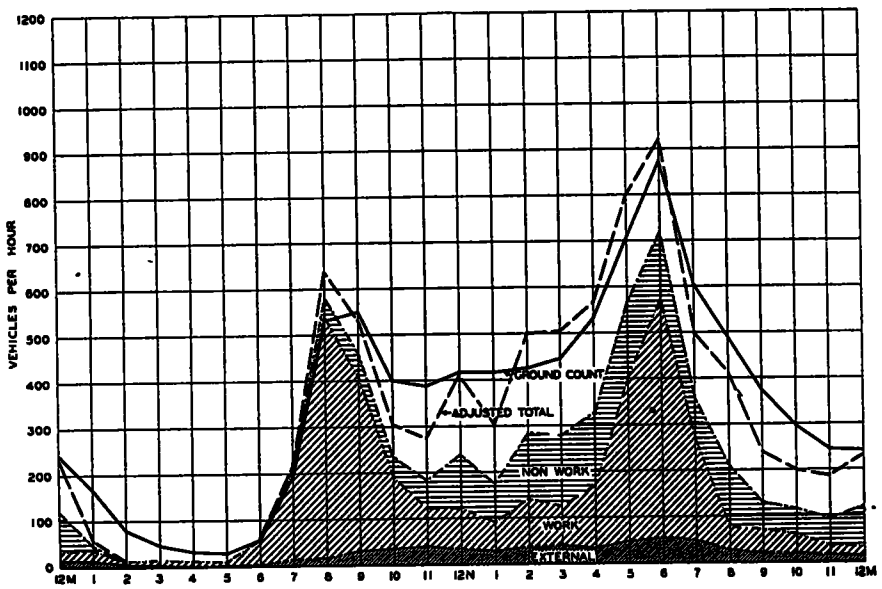



**Figure 1. Comparison of the Actual Number of Passenger Cars Counted at Five Control Points in Denver, Colo., with the Number Reported in Interviews to Have Passed These Points**

data rather than on speed. In addition, simplification of the form has made the recording of the trips less laborious, thus encouraging more complete trip reporting Since the failure to report trips completely during the war is believed to have been due in part to unwillingness to admit violation of gasoline rationing and other wartime restrictions, it is anticipated that the termination of these restrictions will result in still better comparisons between ground counts and interview data

lines of travel by methods similar to those used in Kansas City, and will give analyses of the traffic which will use expressways and other improvements on various proposed alternate locations Among the cities for which such reports are in the process of preparation are Charlotte, Cincinnati, Fort Wayne, Memphis, Milwaukee, New Orleans, Providence, Richmond, and others.

The technique described in the report of the Committee was designed primarily for wartime

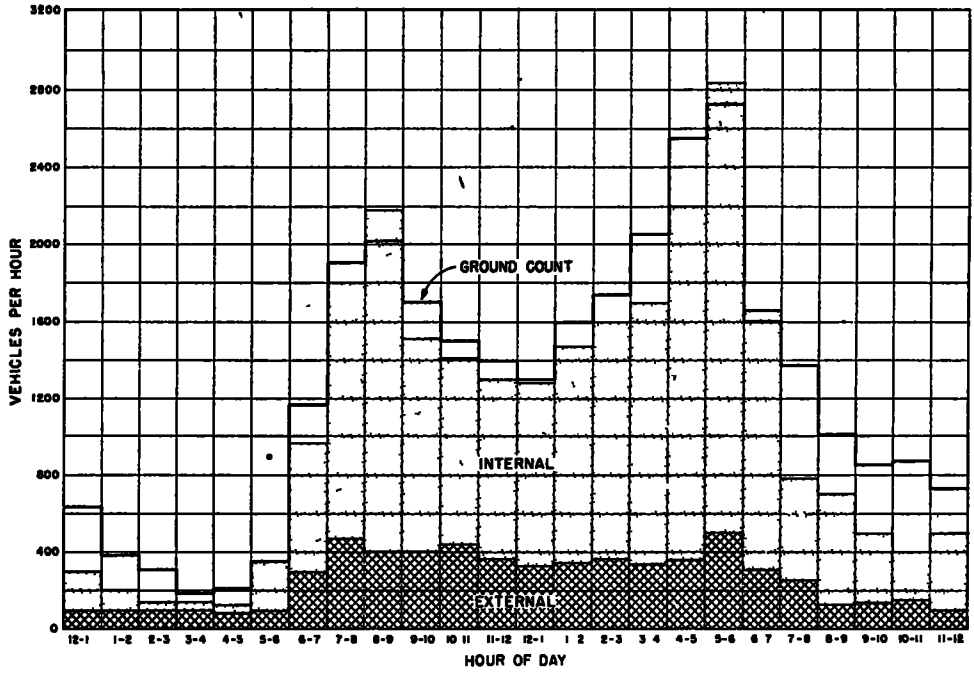



**Figure 2. Comparison of the Number of Passenger Cars and Trucks Counted at Three Control Points in Milwaukee, Wis., with the Number Estimated from Interviews to Have Passed These Points**

For a number of the cities where these studies have been undertaken the analysis of the results has reached an advanced stage The method of analysis and the use being made of the data in the Kansas City area is described in some detail by Mr John M Picton in a paper presented at this meeting. The data obtained in Denver, Atlanta, Savannah, Richmond, and numerous other cities are being used in route selection and in the determination of design features for portions of the interstate system. Reports are being prepared for a number of cities which will show the desired

conditions and had as a primary purpose the obtaining of information which would be helpful in making plans for immediate postwar construction. Now that the war is over, it is believed that modifications can be made in the procedures which will result in greater accuracy and the obtaining of data of greater value from a long-range point of view For example, in the surveys so far made the field work has been done in a relatively short period and seasonal coverage has been lacking. It would be much better if the work could be spread over the year and the number of interviewers

correspondingly reduced. In addition to the supplying of the seasonal coverage, this would permit more careful selection and training of the interviewers. As another example, no information has been obtained on the week-end travel because the restriction in effect during the war greatly reduced recreational automobile traffic and also created a reluctance on the part of the person being interviewed to tell about trips of this character Since the restrictions have been removed, it is probable that the inclusion of data concerning week-end travel will enhance the value of the results

Work is being done on the development of a revised manual of procedures based on the experience which has been gained so far in this work It is expected that the members of the committee will assist in this and it is hoped that during the coming year a manual, endorsed by the committee, will be prepared which can be made available to any city wishing to undertake work of this kind In addition to describing the procedures used in the survey, such a manual would include an exposition of analysis techniques and a discussion of the methods of presentation and the uses of the data.

## DISCUSSION ON ORIGIN AND DESTINATION SURVEY TECHNIQUES AND USES

JOHN T. LYNCH, *Discussion Leader*

MR. LYNCH· This meeting is for discussion of procedures by members of the committee, and others who may have had experience with origin and destination surveys, to see what improvements can be made in techniques and, now that we are getting away from the conditions which existed during the war, what changes can be made that will make the results more useful.

I suppose everyone here is more or less familiar with the type of survey which has been made in a large number of metropolitan areas during the past two years First, a representative sample of the dwelling units within the area was selected, and by interviews in those dwelling units, information was obtained concerning all trips made on the preceding day by each person residing there. Questions were asked concerning the origins and destinations of the trips, and the purposes of making the trips, besides other questions which varied somewhat from city to city The data were expanded on the basis of the relation between the number of dwelling units in the sample and the total number of dwelling units in the area

To secure information concerning trips made by people who lived outside of the area, roadside interviews were obtained at stations in the area surrounding the city.

Trucks registered within the area were sampled from the registration list From this list, a certain percentage of the trucks were selected and the trips made by each on a designated day were recorded. Expansion was made on the basis of the total registration.

The expanded total of all trips obtained from these three sources which passed a point or crossed a line were compared with ground counts to check the accuracy of the survey

The size of the sample varied from about 10 per cent in the smaller cities to about 1 in 20 or 5 per cent in larger cities. In fact 1 in 30 was used in the Newark Area The samples from several cities were analyzed for statistical accuracy to aid in determining the size which should be used in subsequent surveys Figure A shows the standard error of estimate for trips destined to different zones in Savannah, Georgia The sample was 10 per cent and the curve indicates that for trip groups of about 4,000, the sampling error would not exceed 6 per cent in two cases out of three, but that for trip groups as small as 1,000, the standard error would be about 14 per cent.

Mr. John W Hossack, Acting Manager of Nebraska Highway Planning Survey, who has been in charge of numerous origin and destina-

correspondingly reduced. In addition to the supplying of the seasonal coverage, this would permit more careful selection and training of the interviewers. As another example, no information has been obtained on the week-end travel because the restriction in effect during the war greatly reduced recreational automobile traffic and also created a reluctance on the part of the person being interviewed to tell about trips of this character Since the restrictions have been removed, it is probable that the inclusion of data concerning week-end travel will enhance the value of the results

Work is being done on the development of a revised manual of procedures based on the experience which has been gained so far in this work It is expected that the members of the committee will assist in this and it is hoped that during the coming year a manual, endorsed by the committee, will be prepared which can be made available to any city wishing to undertake work of this kind In addition to describing the procedures used in the survey, such a manual would include an exposition of analysis techniques and a discussion of the methods of presentation and the uses of the data.

## DISCUSSION ON ORIGIN AND DESTINATION SURVEY TECHNIQUES AND USES

JOHN T. LYNCH, *Discussion Leader*

MR. LYNCH· This meeting is for discussion of procedures by members of the committee, and others who may have had experience with origin and destination surveys, to see what improvements can be made in techniques and, now that we are getting away from the conditions which existed during the war, what changes can be made that will make the results more useful.

I suppose everyone here is more or less familiar with the type of survey which has been made in a large number of metropolitan areas during the past two years First, a representative sample of the dwelling units within the area was selected, and by interviews in those dwelling units, information was obtained concerning all trips made on the preceding day by each person residing there. Questions were asked concerning the origins and destinations of the trips, and the purposes of making the trips, besides other questions which varied somewhat from city to city The data were expanded on the basis of the relation between the number of dwelling units in the sample and the total number of dwelling units in the area

To secure information concerning trips made by people who lived outside of the area, roadside interviews were obtained at stations in the area surrounding the city.

Trucks registered within the area were sampled from the registration list From this list, a certain percentage of the trucks were selected and the trips made by each on a designated day were recorded. Expansion was made on the basis of the total registration.

The expanded total of all trips obtained from these three sources which passed a point or crossed a line were compared with ground counts to check the accuracy of the survey

The size of the sample varied from about 10 per cent in the smaller cities to about 1 in 20 or 5 per cent in larger cities. In fact 1 in 30 was used in the Newark Area The samples from several cities were analyzed for statistical accuracy to aid in determining the size which should be used in subsequent surveys Figure A shows the standard error of estimate for trips destined to different zones in Savannah, Georgia The sample was 10 per cent and the curve indicates that for trip groups of about 4,000, the sampling error would not exceed 6 per cent in two cases out of three, but that for trip groups as small as 1,000, the standard error would be about 14 per cent.

Mr. John W Hossack, Acting Manager of Nebraska Highway Planning Survey, who has been in charge of numerous origin and destina-

tion surveys in that State, has been requested to present some of the Nebraska data

JOHN W. HOSSACK, *Acting Manager, Nebraska Highway Planning Survey* In the conduct of a successful origin and destination study there are four distinct phases: the selection of the sample—the conduct of the survey —the coding, expansion and tabulation of data —and the presentation of these data in such a manner that others may find them useful in planning street and highway improvements

Following the experience gained in conducting special O and D surveys in a number of cities, the manner of selecting the sample and the general methods to be followed in conducting such surveys are pretty well standardized.

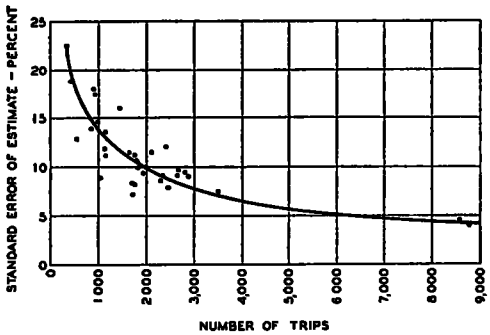



**Figure A. Savannah, Georgia, Metropolitan Area Survey—Standard Error of Estimate of Trips Destined to Different Tracts**

Information relative to these phases is available in memoranda prepared by the Public Roads Administration, in papers read before various groups, in magazines, etc While there are a few rough spots in the technique covering these phases which perhaps should be polished a bit, a city embarking upon an "O and D" study would find ample instruction relative to these phases

Information concerning the remaining phases of the survey, however, has been conspicuous by its absence. Since most of these surveys have been conducted by organizations with experience on other statistical surveys, the preliminary analysis was not too difficult. The various items of information were assigned numerical codes, and the data punched on cards for mechanical tabulation. The expansion of the sample to the whole followed a more or less standard procedure Thus the determination of factors probably needed but little explanation Having the cards punched the natural thing was to prepare numerous tabulations comparing the various items of information one with the other With the tabulations prepared, however, what next?

The most important phase of the survey still lay ahead—that of presenting the data to the ultimate user in such a fashion that he could properly interpret and apply these data to the problems at hand. No matter how well the foregoing sections of the survey had been conducted the information would prove of little value unless it could be presented to those in a position to use it, in such form as to be understandable and of use to them

Those who have been connected with these urban area surveys know that presentation of these data in such fashion is not easy Since the first of these studies dates back less than two years, a number of the States arrived at this problem of presentation almost simultaneously, and inasmuch as the method of approach was relatively new they all had to proceed on their own, as they did not have the benefit of the experience of others.

In Nebraska we are now in the midst of the analyses of the metropolitan studies conducted at Lincoln and Omaha, and I am sure that many of the problems which we encountered are in common with those of other States. In many of the States the planning organizations are working hand in hand with well staffed planning commissions, or with consultants retained by the city, and thus the data are utilized and the general plans prepared right in that office. In Nebraska the Highway Planning Survey is expected to compile and present the data so that not only our own design department, but the cities and other interested agencies may make use of it Instead of dealing with planning organizations and people more or less familiar with this type of survey, the data must be in such form as to be understood by city commissioners, citizen's planning committees, etc. To present the picture so that these individuals will grasp it, and still retain the detail necessary for application of the data to specific problems is indeed difficult

Since this problem of presentation is one in which a number of States and cities are now engaged, I believe that a discussion of it will prove of value. In order to show concrete

examples of the various types of illustration charts are presented which are in various stages of preparation for use in the report of the Omaha-Council Bluffs metropolitan study. These charts are not offered as models, as we realize that they fall short of the mark on several points. I should like to use them, however, to explain the manner of approach which has been followed in the analysis of the survey in Omaha, and to form a basis for the discussion which is to follow.

In preparing reports covering various external surveys we found that if the facts could be presented in pictorial rather than tabular form, they were much more effective, as tabulations, especially lengthy ones, are difficult to grasp. We also found that the charts had to be fairly simple and self-explanatory as other wise many fail to catch their significance In planning our report of the Omaha-Council Bluffs study we therefore felt it would be wise to rely on a pictorial presentation of the facts to as great a degree as possible, augmenting these charts with such tabulations as would be necessary for later detailed study Previous to the time we started charts for our Omaha study, we had an opportunity to see a few of the preliminary reports made by other cities Some points in these reports were not exactly clear and perhaps not so complete as they should be Thus we gave considerable time and study to our method of presentation hoping that it would be clearer and more complete. Now that our report is nearing completion, we realize that there are still several points which are confusing

At first we tentatively prepared several charts showing the desired lines of automobile travel for inter-zone movements of various magnitudes. Chart 1 shows all inter-zone, or external station to zone, movements of 250 or more vehicles per day Chart 2 shows those inter-zone movements of from 100 to 250 vehicles per day. While these charts do illustrate the location of a few focal points of traffic and the general direction of a few of the greater movements, they are very confusing and much too difficult for the average individual to grasp. The passenger car movements of less than 100 vehicles per day amount to approximately 43 per cent of the total passenger car traffic. This is partially due to the fact that the area is broken down into numerous small tracts While these movements individually are small, many of them proceed in the same general direction as others, so that an analysis using only the heavier movements leaves out a considerable portion of the traffic. Several of the charts which I will show later illustrate this point effectively. Were we to extend the desired lines of travel to smaller increments (say to 50 or 25 vehicles per day) we would have even more of a "hodgepodge" of lines, and the picture certainly would not be clarified

The system which we had used for illustrating the movements into and through the area in the reports of our external studies, had been well received and in general fairly clear to those to whom it has been presented I might show you a few of these charts

Chart 3 shows the zone of origin or destination for traffic entering or leaving the area on US Nos 6, 275, and 30 (Alt) west of Omaha. This is the heaviest traveled highway entering Omaha, and we had to resort to a different scale on this chart than that used on the remaining external illustrations You will note that the cross-hatched portion of the band shows the traffic for an average week day in the autumn of 1944, the period of our survey, while the superimposed solid black band shows the estimated 24-hr annual average traffic in the immediate postwar period. This latter estimate was based largely upon conditions immediately prior to the war at which time traffic in our State was at an all time peak. By referring to Charts 1 and 2, we find for this same highway one desired line of travel above 250 (actually 540) vehicles per day, and one of from 100 to 250 vehicles per day, these account for but 34 per cent of the total volume By dropping to 50 vehicles per day on the desired lines of travel at external stations, we would still show but 60 per cent of the traffic at this station

Chart 4 is similar and shows the distribution of passenger car traffic from Nebraska Nos. 50 and 31 southwest of the city. The desired line chart showed no movements of more than 100 vehicles per day from these stations By dropping to 50 per day 20 per cent would be accounted for Chart 5 shows the distribution of the traffic from US Nos. 73 and 75 south of the city You will note this fact from the band into that area Again, other than a line of 300 vehicles per day from the south to the bomber plant, there are but two lines of

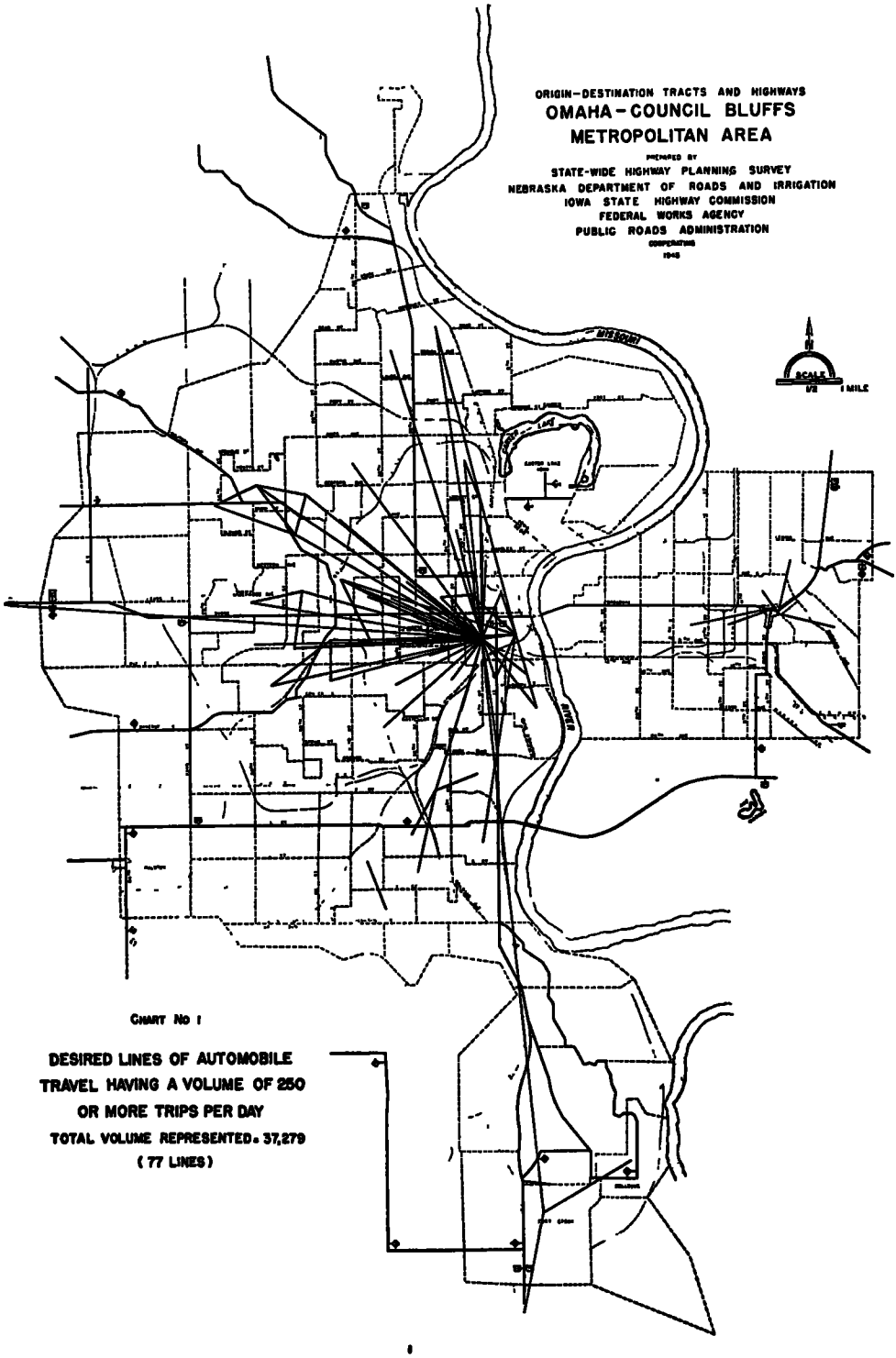
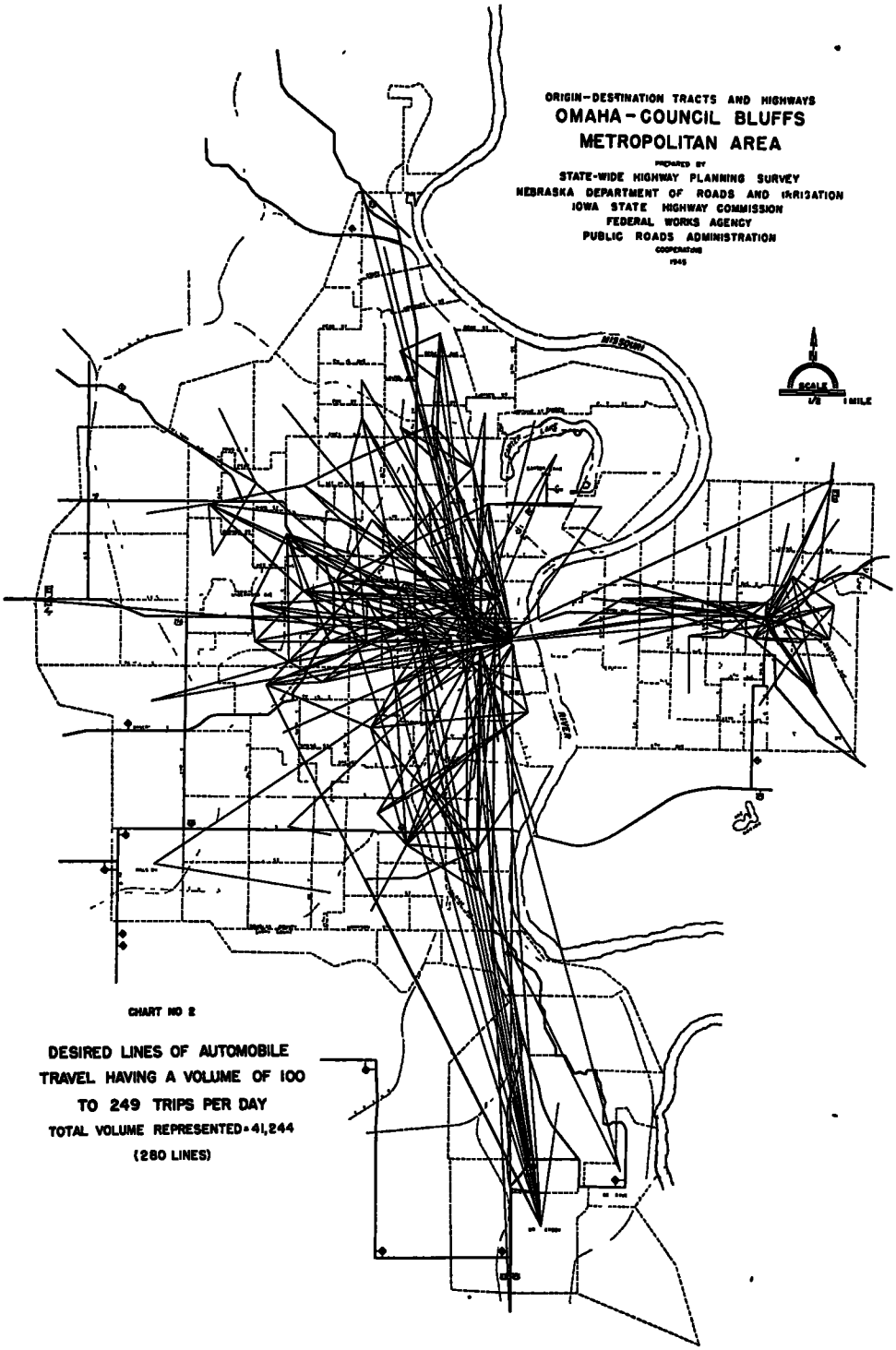



CHART NO 1

DESIRED LINES OF AUTOMOBILE TRAVEL HAVING A VOLUME OF 250 OR MORE TRIPS PER DAY

TOTAL VOLUME REPRESENTED = 37,279

( 77 LINES )


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA-COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IOWA STATE HIGHWAY COMMISSION
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
COOPERATING
1945
SCALE
1 MILE
CHART NO 2
DESIRED LINES OF AUTOMOBILE
TRAVEL HAVING A VOLUME OF 100
TO 249 TRIPS PER DAY
TOTAL VOLUME REPRESENTED = 41,244
(280 LINES)

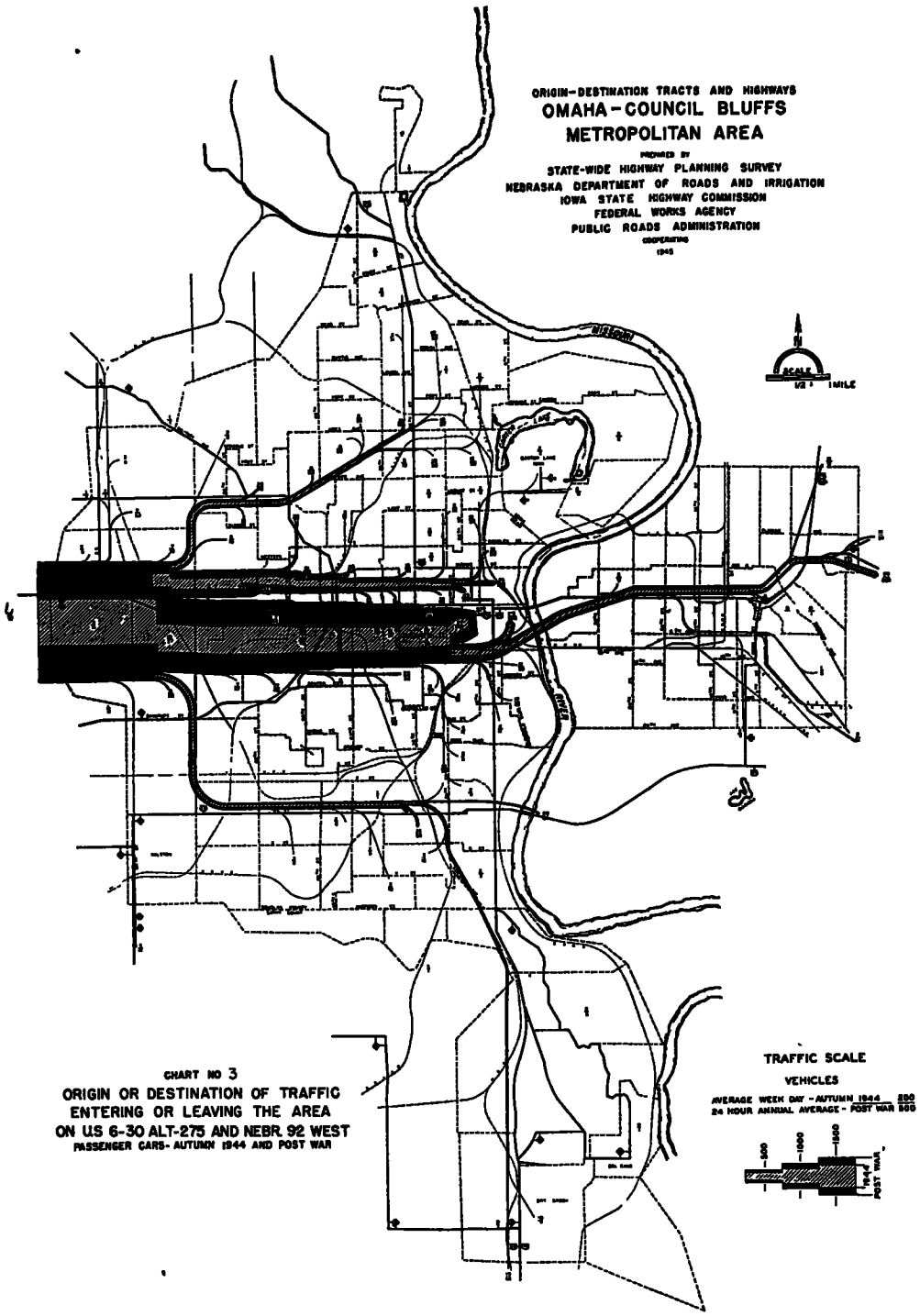
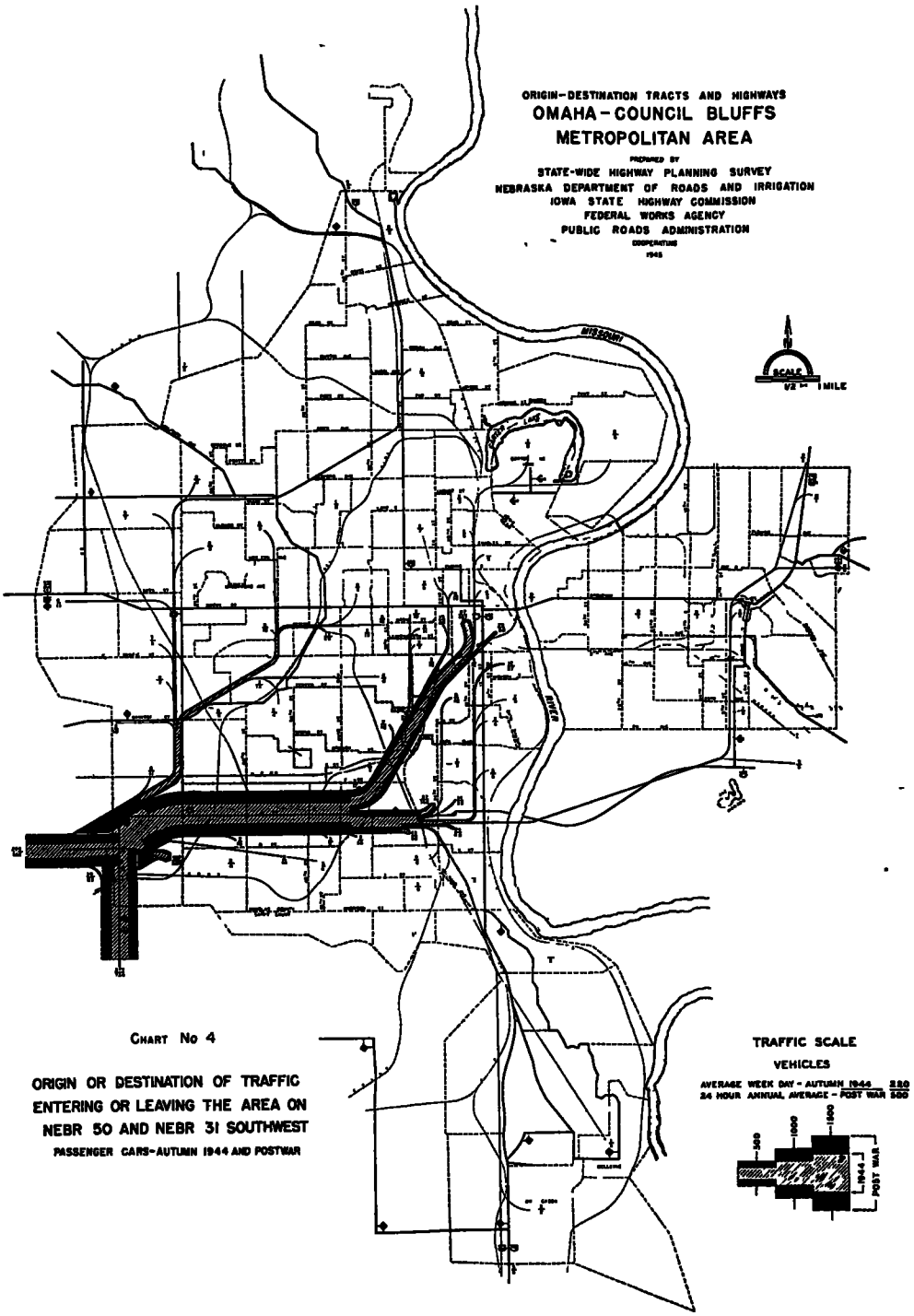



CHART NO 3

ORIGIN OR DESTINATION OF TRAFFIC ENTERING OR LEAVING THE AREA ON US 6-30 ALT-275 AND NEBR 92 WEST

PASSENGER CARS- AUTUMN 1944 AND POST WAR


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA-COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IOWA STATE HIGHWAY COMMISSION
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
COOPERATING
1945
SCALE
½ 0 1 MILE
MISSOURI
RIVER
CHART No 4
ORIGIN OR DESTINATION OF TRAFFIC ENTERING OR LEAVING THE AREA ON NEBR 50 AND NEBR 31 SOUTHWEST
PASSENGER CARS-AUTUMN 1944 AND POSTWAR
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944 250
24 HOUR ANNUAL AVERAGE - POST WAR 500
500
1000
1500
1944
POST WAR

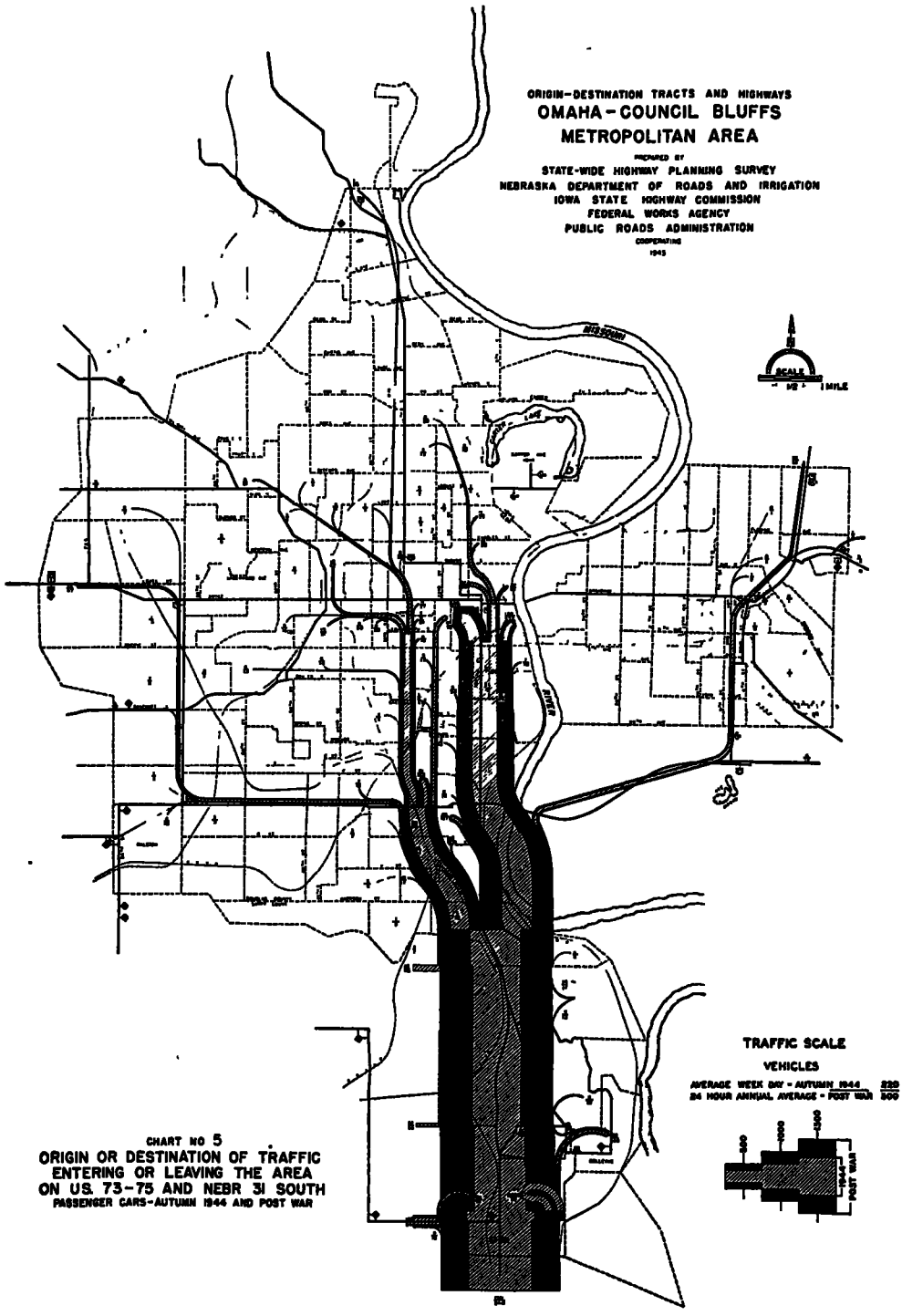



CHART NO 5
ORIGIN OR DESTINATION OF TRAFFIC ENTERING OR LEAVING THE AREA ON U.S. 73-75 AND NEBR 31 SOUTH
PASSENGER CARS-AUTUMN 1944 AND POST WAR

from 100 to 250 vehicles per day appearing on Charts 1 and 2, these accounting for 48 per cent of the traffic, actually only 33 per cent of the other than war traffic. Movements above 50 vehicles per day represent 39 per cent of the total normal traffic on this route.

Since flow charts used on the external portion of the survey seemed to be fairly satisfactory, we decided to prepare similar ones showing the origin and destination of traffic going to or from the various zones within the city. In order to lay out the zones which should be considered we studied tables showing the number of "to work" and "to shopping" trips destined for each tract. Following this we subdivided the city of Omaha into 11 zones, six of major importance, five of minor. These 11 zones were the origins or destinations of 84 per cent of the external passenger car trips entering the area, and 93 per cent of the internal passenger car trips Fifteen per cent of these internal trips were intra-zone. Chart 6 shows the tract of origin or destination for all traffic going to or from the central business section of the city. These charts were all prepared on the basis of 1944 autumn week day travel, and thus any war time distortion due to restrictions or war plant activity is reflected therein. The traffic from the various tracts is consolidated into bands and builds up as it approaches the central business section of the city Chart 7 shows similar information for traffic to or from the mid-town commercial and apartment district Note here the movements from this district to the central business district; these were also shown on the preceding chart. Since each chart shows all the traffic to or from that particular zone, certain movements are duplicated on other charts; this duplication must be taken into account when using the data. Chart 8 shows traffic to and from the belt line industrial district, and Chart 9, that to or from Benson, a residential suburb Chart 10 depicts the traffic entering the South Omaha industrial and business district. In Omaha the tracts which were used were in general, census tracts, although some of the larger of these were subdivided Therefore, in setting up zones many are of odd shape and of necessity include considerable area devoted to purely residential use. Were we to conduct another survey it would be an advantage to set up the tracts on a use basis and thus the zones could be considerably reduced in size and would give a more representative picture. Since these zones are large and rather irregular in shape, it would appear desirable to show the distribution of traffic entering the zone among the various tracts within the zone We have, therefore, been toying with ideas for presenting this distribution on these same charts In South Omaha, the Union Stock Yards and two of the larger packing plants occupy tract "A", one packing house is in "B" and one in "C". The business section of the suburb is located in tracts "D", "E", and "F" with most of it being concentrated near point "G". There is also some scattered industry at various other points within the zone. As an experiment we have drawn a "pie" diagram, showing as the pie the total traffic into the zone. This was spotted at approximately the center of gravity as computed for origins or destinations within that zone Each of the pieces of pie represent the portion of traffic to or from the various tracts. I am not sure that this manner of presentation will be used as it may be confusing to some who will use the chart Chart 11 shows the traffic for the Martin bomber plant and its origin and destination This indicates something of the magnitude of this traffic during the war, and the portions of the city most affected This installation was of permanent construction, but has been abandoned as an airplane factory, and is available for other uses It probably will be used in the postwar period, but certainly on a greatly reduced scale.

We believe that these and the other flow charts which are not presented here give the picture of the desires of automobile traffic within the city, and upon roads approaching the city very well. They are numerous, however, and there are some movements duplicated on various charts, to get an over-all picture is a bit difficult. We felt it would be well, therefore, to consolidate the various charts into one, drawn along the lines which have shown up as most important on the various individual charts. To do this necessitated following each of the individual tract to tract movements through the area, and assigning them to various sections of the net-work of major flow lines appearing on the preceding charts These lines, incidentally, were selected entirely independent of the street system, although naturally some of them lie in close

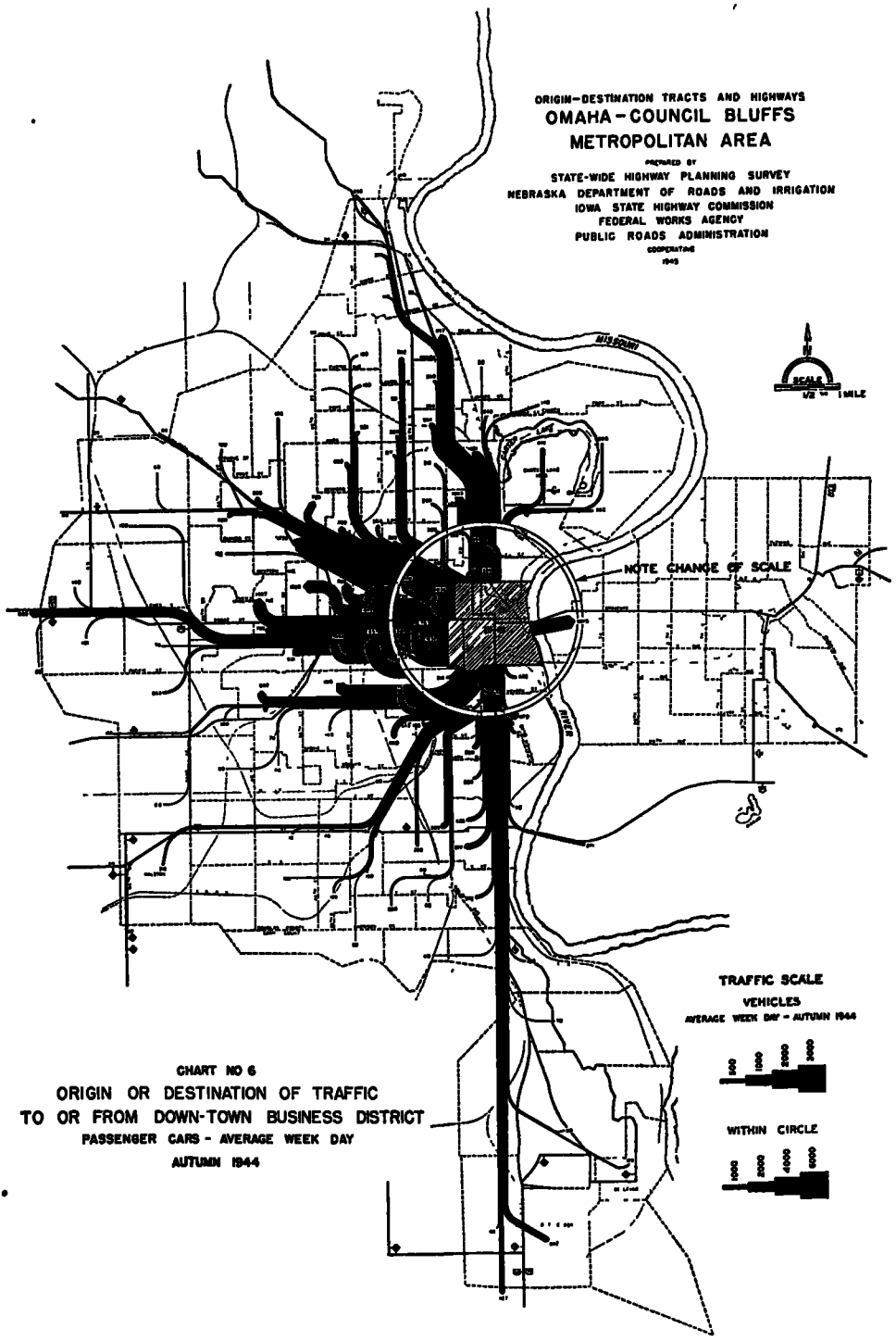
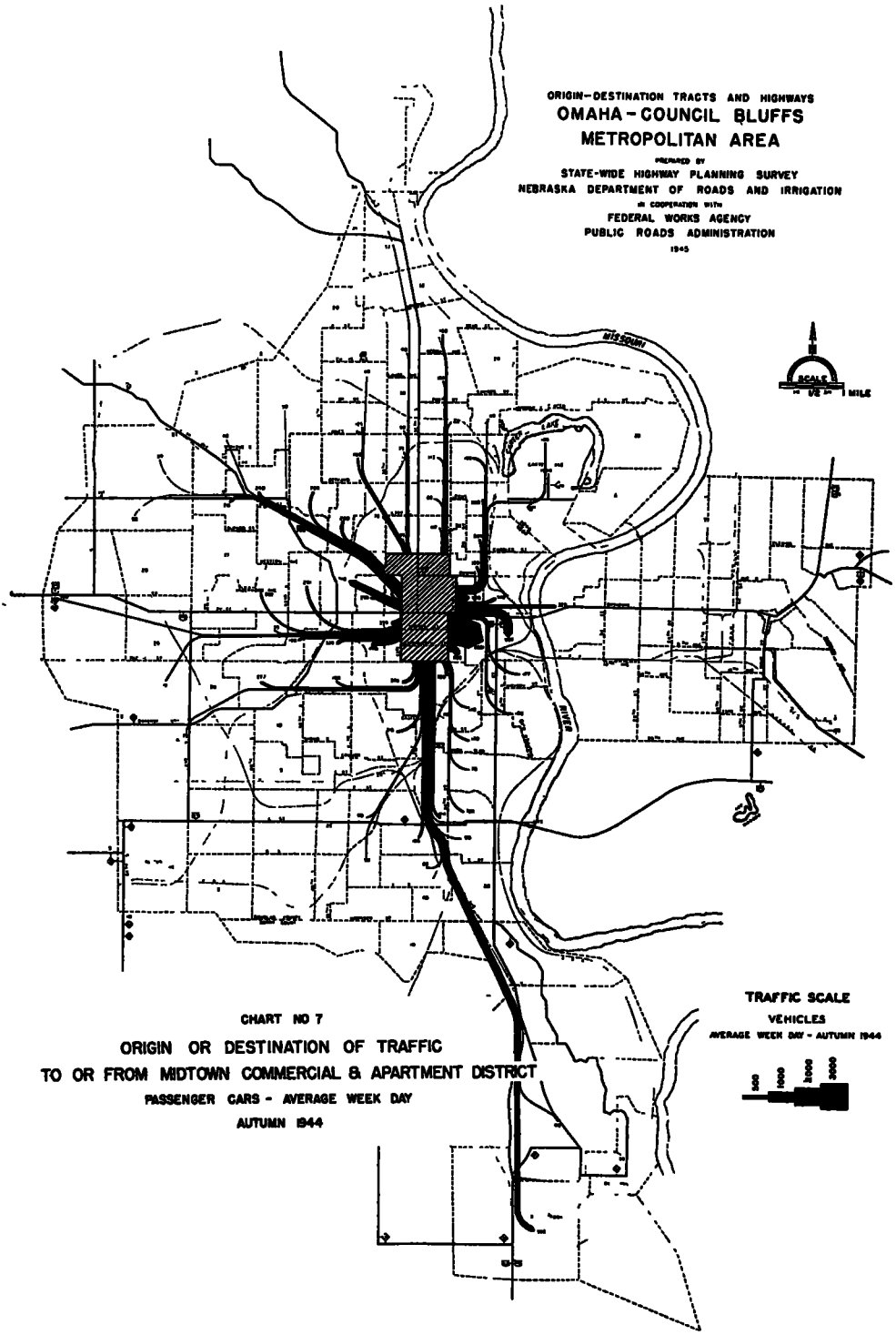


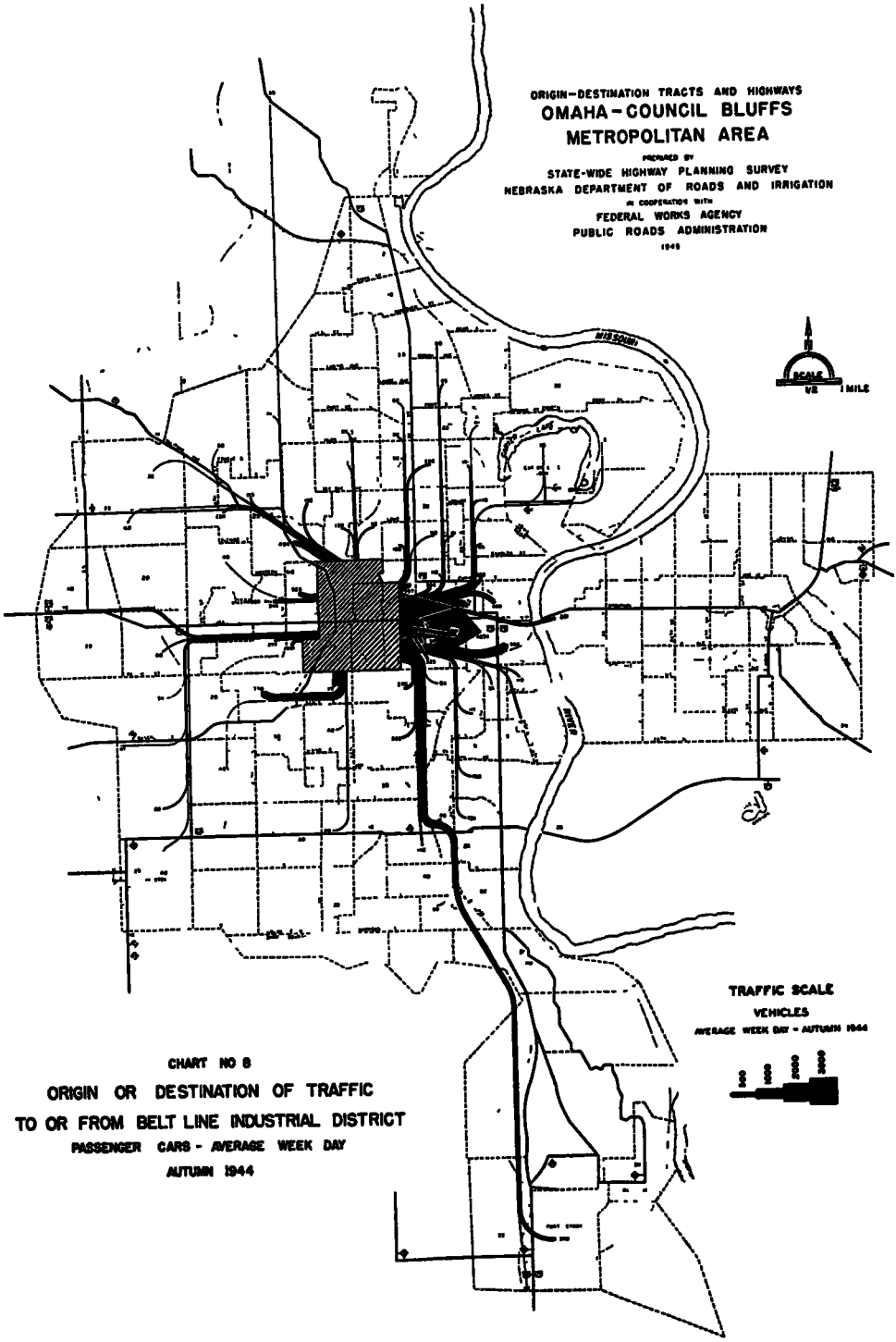

CHART NO 6

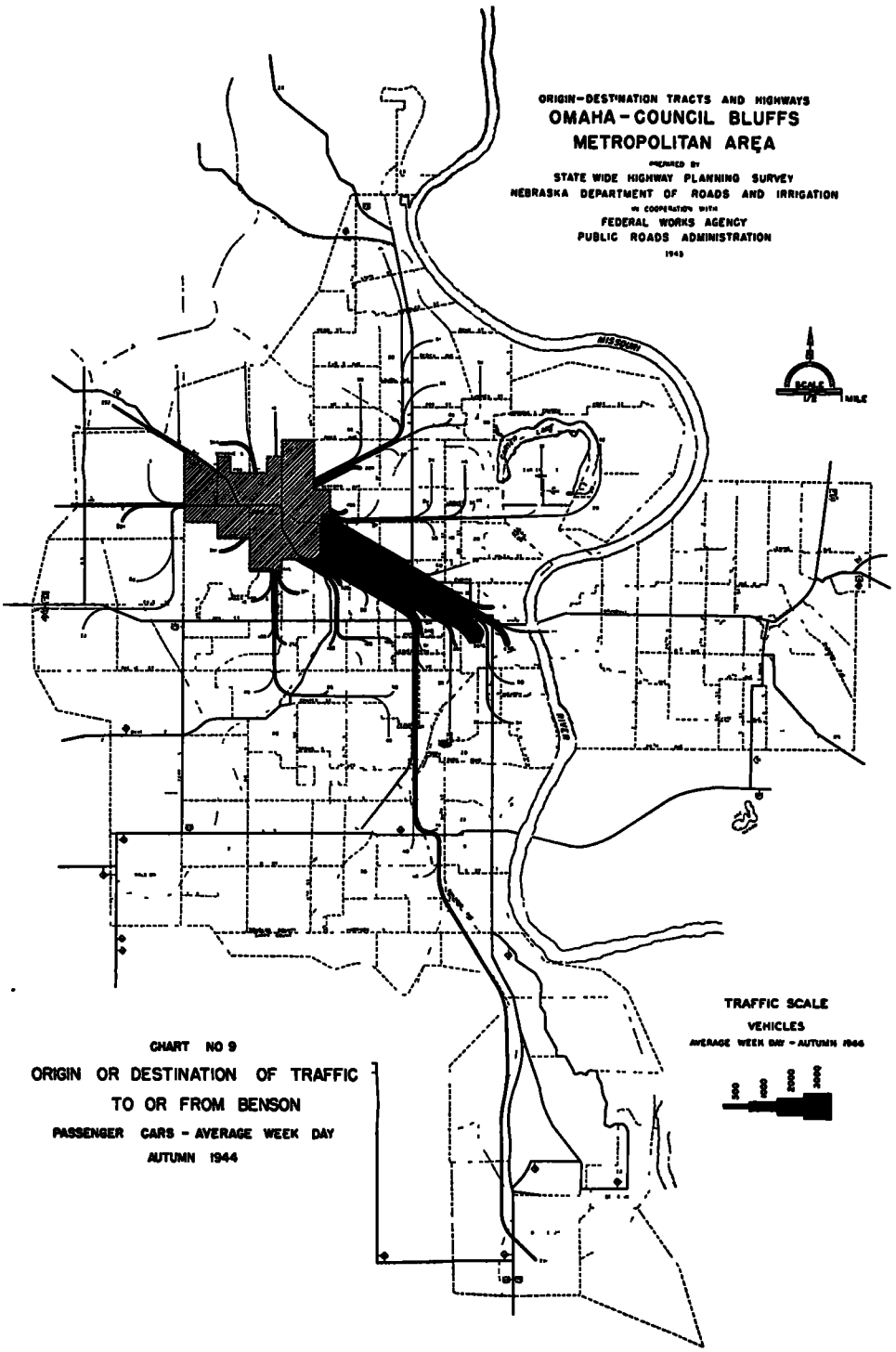
ORIGIN OR DESTINATION OF TRAFFIC
TO OR FROM DOWN-TOWN BUSINESS DISTRICT

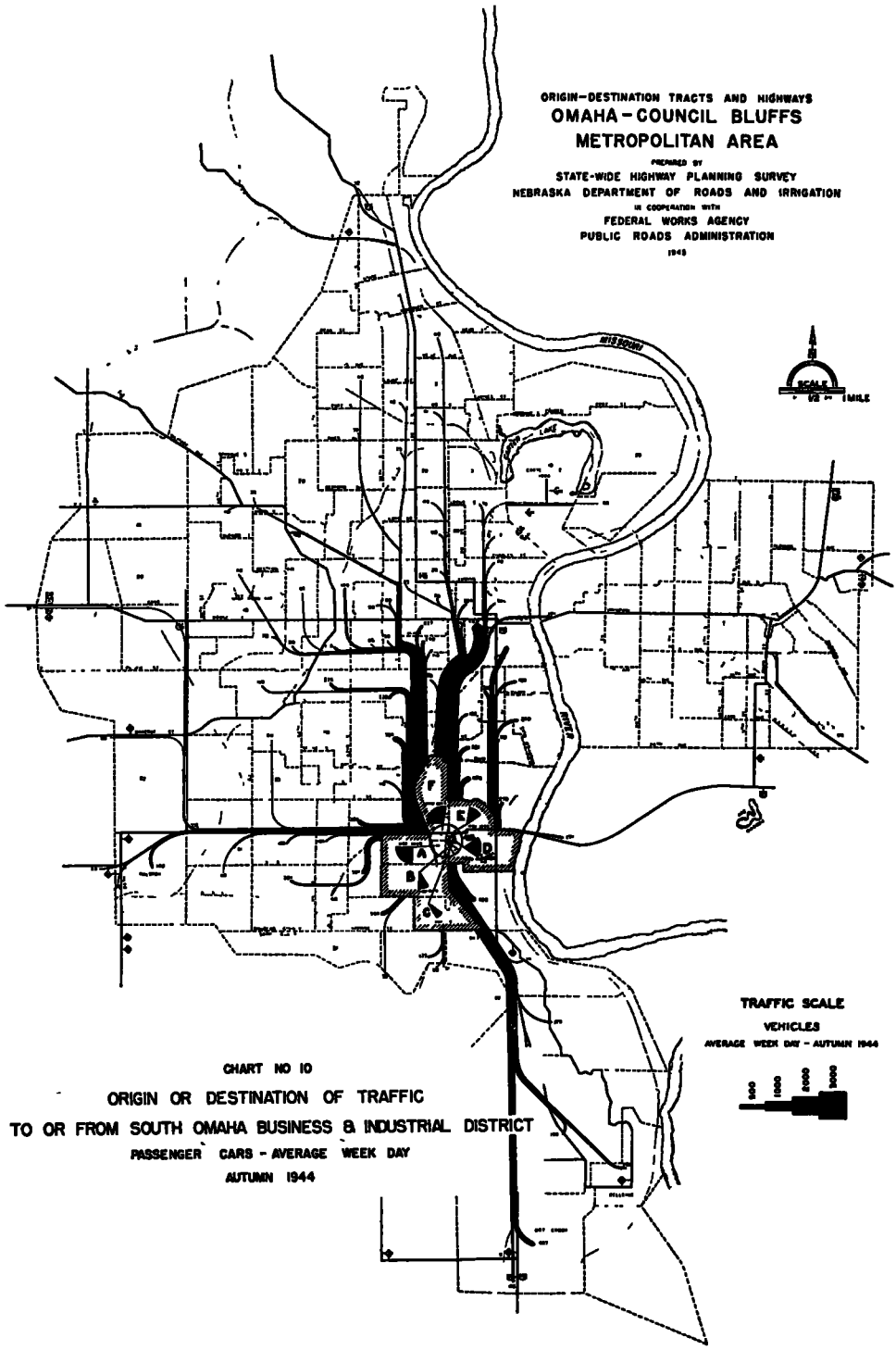
PASSENGER CARS - AVERAGE WEEK DAY

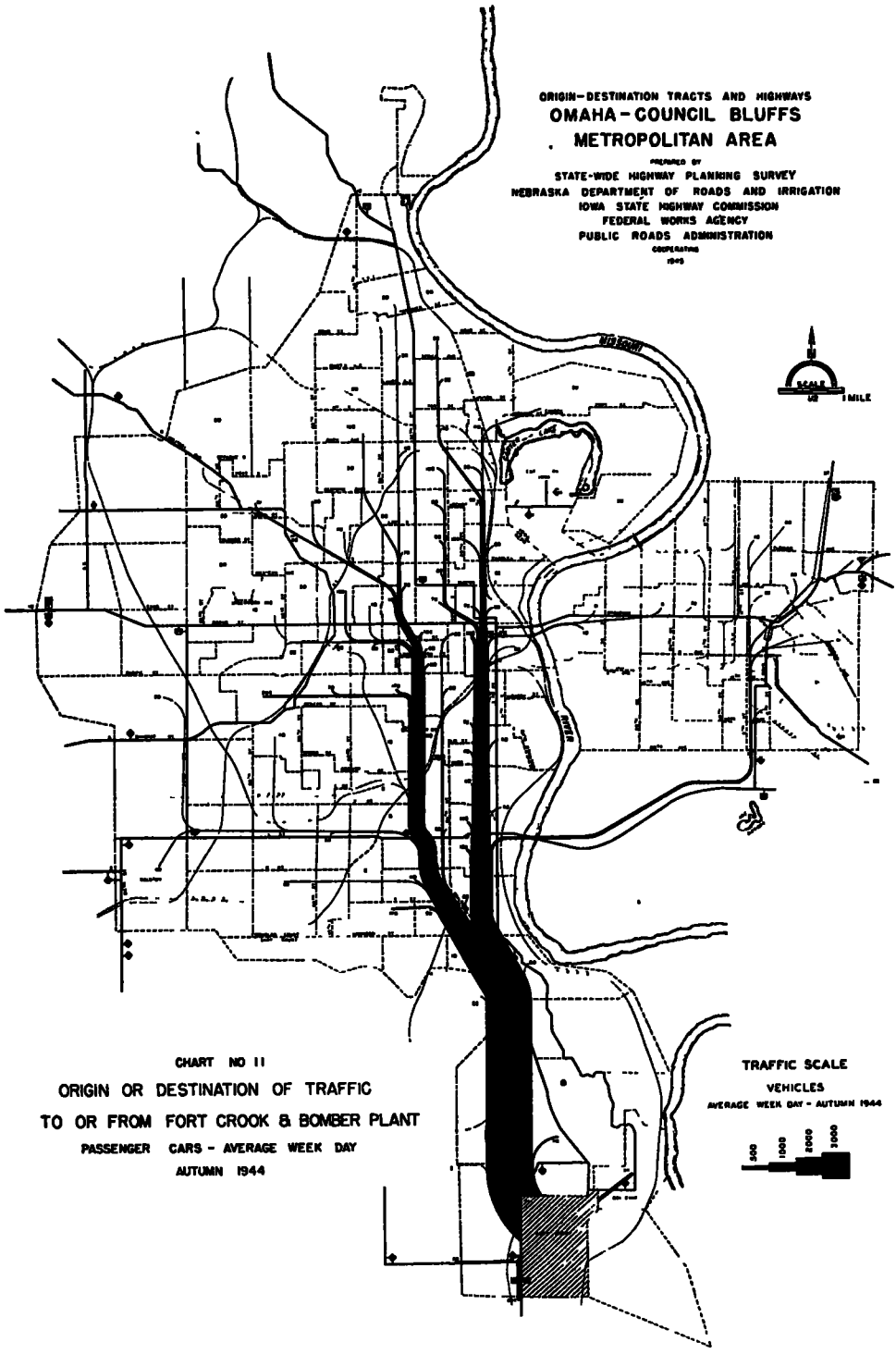
AUTUMN 1944

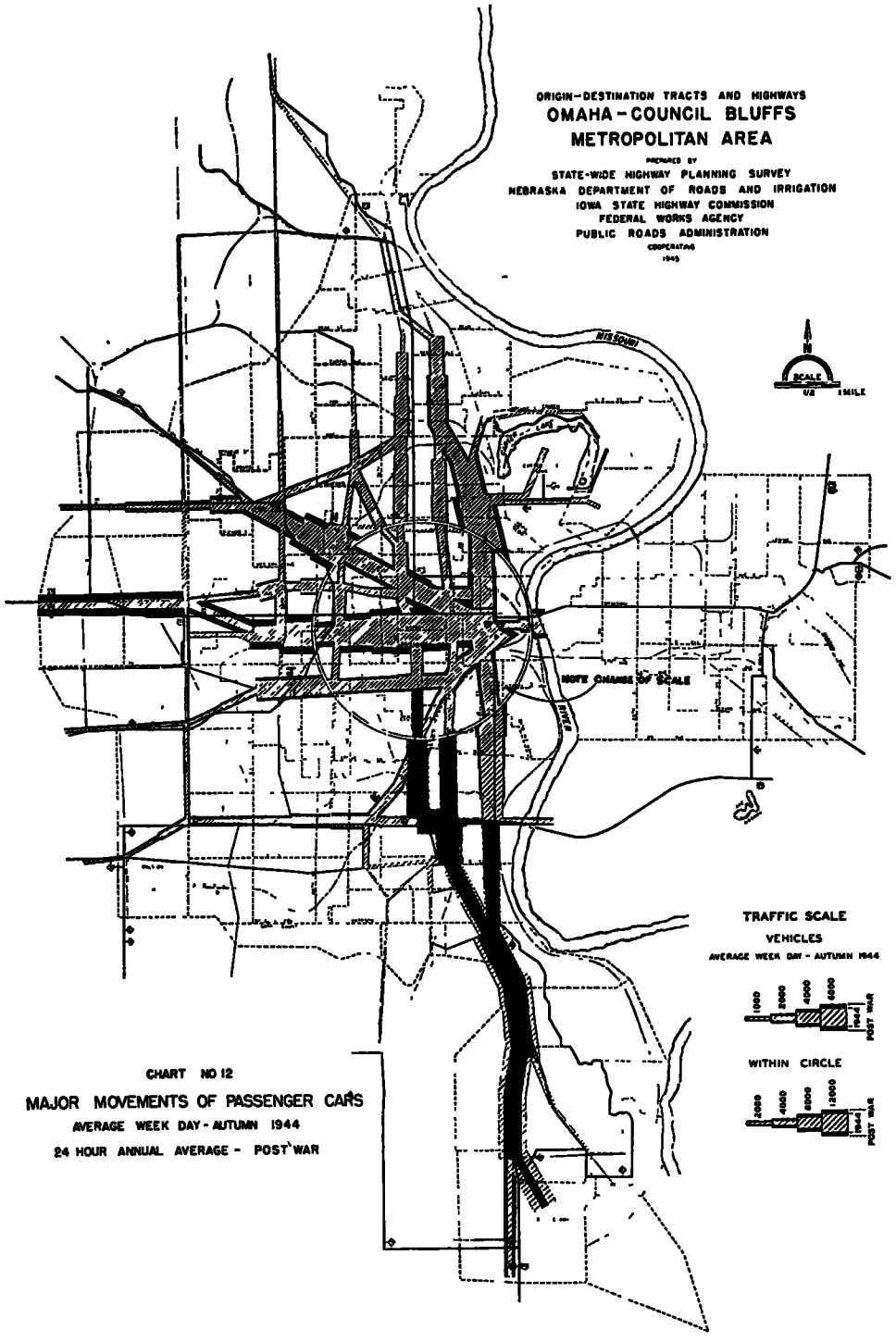

ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA - COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IN COOPERATION WITH
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
1945
SCALE
1 MILE
MISSOURI
RIVER
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944
500
1000
2000
3000
CHART NO 7
ORIGIN OR DESTINATION OF TRAFFIC
TO OR FROM MIDTOWN COMMERCIAL & APARTMENT DISTRICT
PASSENGER CARS - AVERAGE WEEK DAY
AUTUMN 1944


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA-COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IN COOPERATION WITH
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
1945
SCALE
1/2 1 MILE
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944
CHART NO 8
ORIGIN OR DESTINATION OF TRAFFIC
TO OR FROM BELT LINE INDUSTRIAL DISTRICT
PASSENGER CARS - AVERAGE WEEK DAY
AUTUMN 1944


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA - COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IN COOPERATION WITH
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
1945
MISSOURI
SCALE
MILE
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944
CHART NO 9
ORIGIN OR DESTINATION OF TRAFFIC
TO OR FROM BENSON
PASSENGER CARS - AVERAGE WEEK DAY
AUTUMN 1944


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA-COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IN COOPERATION WITH
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
1945
SCALE
1 MILE
MISSOURI
RIVER
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944
500
1000
2000
3000
CHART NO 10
ORIGIN OR DESTINATION OF TRAFFIC
TO OR FROM SOUTH OMAHA BUSINESS & INDUSTRIAL DISTRICT
PASSENGER CARS - AVERAGE WEEK DAY
AUTUMN 1944


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA-COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IOWA STATE HIGHWAY COMMISSION
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
COOPERATING
1945
SCALE
1 MILE
CHART NO 11
ORIGIN OR DESTINATION OF TRAFFIC
TO OR FROM FORT CROOK & BOMBER PLANT
PASSENGER CARS - AVERAGE WEEK DAY
AUTUMN 1944
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944
500
1000
2000
3000


ORIGIN-DESTINATION TRACTS AND HIGHWAYS
OMAHA-COUNCIL BLUFFS
METROPOLITAN AREA
PREPARED BY
STATE-WIDE HIGHWAY PLANNING SURVEY
NEBRASKA DEPARTMENT OF ROADS AND IRRIGATION
IOWA STATE HIGHWAY COMMISSION
FEDERAL WORKS AGENCY
PUBLIC ROADS ADMINISTRATION
COOPERATING
1945
MISSOURI
SCALE
1/2 1 MILE
NOTE CHANGE OF SCALE
TRAFFIC SCALE
VEHICLES
AVERAGE WEEK DAY - AUTUMN 1944
1000
2000
4000
6000
1944
POST WAR
WITHIN CIRCLE
2000
4000
8000
12000
1944
POST WAR
CHART NO 12
MAJOR MOVEMENTS OF PASSENGER CARS
AVERAGE WEEK DAY - AUTUMN 1944
24 HOUR ANNUAL AVERAGE - POST WAR

proximity to existing streets They are lines of direct travel connecting the travel centers of the various tracts, and should be considered as schematic diagrams rather than actual route locations.

Chart 12 shows the over-all picture obtained by combining all of these movements The scale here is 6,000 vehicles per inch rather than 3,000 as on the preceding charts In the circle the scale is 12,000 vehicles per inch The cross hatched band illustrates autumn week-day traffic of 1944 while the super-imposed solid black band gives an estimate of the traffic in the immediate postwar period This postwar estimate for internal traffic is the sum of the 1944 traffic, and 75 per cent of those transit and auto passengers who indicated that they would ordinarily have driven cars on the trips in question. The estimate for intracity traffic is probably low as it makes no allowance for recreational and other types of trips which may have been entirely missing during the period of the survey Based upon prewar counts within the city it would seem that this estimate of purely intracity traffic may be from 10 to 15 per cent low The postwar traffic to or from the Martin Bomber Plant was reduced to one fifth its war time volume, and this accounts for the fact that in the band leading into Fort Crook, the black portion is within the shaded width, indicating that post war traffic is expected to be less than that in 1944.

This chart does not include any intra-tract movements or any movements between adjoining tracts as these movements were so short as to be difficult to assign to any one band. The chart includes 70 per cent of all movements within the area, and of those not shown 20 per cent are between adjoining tracts

Chart 12 illustrates the importance of retaining the smaller increments of traffic when studying potential traffic flow. For example at point "H", Chart 12 indicates a potential traffic volume of 7700 vehicles per day. Using Charts 1 and 2 there are 3 lines of over 250 vehicles per day which could be considered as part of this route, and but 10 lines of from 100 to 250 vehicles per day. These constitute 3600 vehicles per day or less than 50 per cent that shown on Chart 12 At point "J", is shown a potential 1944 volume of 4300 vehicles per day. From Charts 1 and 2 we find that this includes two lines of more than 250 vehicles per day, and but eight of from 100 to 250 vehicles per day. These account for 2900 vehicles per day or approximately 67 per cent of that shown on Chart 12

The diagonal route at "K" (Fig. 12), has 2100 vehicles per day. From Charts 1 and 2 we find no lines of more than 250 vehicles per day and three lines of from 100 to 250 vehicles per day. These account for 375 vehicles per day or approximately 18 per cent of that shown on Chart 12.

These three points were selected at random, but comparisons at other points would probably indicate similar results

The matter of laying out the net-work of veins upon which the movements are to be concentrated is, of course, a matter of judgment. The chart, since it ignores existing improvements is not an exact flow map of the traffic which could be expected on any particular street were that street to be improved It does, however, illustrate the over-all needs of traffic in the area, and should lend itself well to planning additional improvements for an area, or to laying out a major street system. When the actual routes for improvement are selected, estimates of the traffic which could be expected to use them should be prepared taking into account the usage of those improvements in conjunction with the existing street system.

Charts similar to those shown for passenger cars are being prepared for truck movements. Charts relative to transit passengers and to means of travel to and from work, shopping and recreation are also being prepared. These, however, will not be in such detail.

MR JOHN PICTON, *Planning Commission, Kansas City, Missouri:* Do not the existing highways have an influence in Chart 6?

MR HOSSACK The lines along which the bands are drawn were laid out to follow the centers of gravity of tracts (that is, center of gravity for origins and destinations) to as great a degree as possible. Actually the main street of Omaha, Dodge Street, lies East and West, several blocks to the North of the major flow band shown on this chart We tried to steer off existing streets as much as possible,

unless they happened to fall on the desired line. Of course we did use the location of the external stations as a focal point.

MR. ROY E. JORGENSEN, *Connecticut State Highway Department:* Is it your opinion, or have you made any deduction, as a result of your survey, to the effect that knowing where traffic bound for the central business area originates gives the basic data needed for the rest of the traffic? It is very striking to note from Chart 6 and from previous illustrations that the large volumes of traffic you are bound to think of in relation to express highways are all concentrated on a focal point which is the center of the city.

MR HOSSACK: I think the other illustrations will indicate that. These bands look pretty large, however you will find heavy bands in evidence on other charts also.

MR. ROY E. JORGENSEN: If you ignored the other zones and found only the origin of traffic bound to the central business area, would you have the picture you need in planning express highways?

MR. HOSSACK: This illustration shows only the traffic which has either its origin or destination in the central business district.

MR R H. BALDOCK, *Oregon State Highway Commission:* You stated that the 1944 traffic volume was approximately twice that of 1941.

MR. HOSSACK That is for the external traffic, not internal.

MR R. H. BALDOCK: What was the relationship on internal cases?

MR. HOSSACK: We have no exact data on that. On the rural roads we have had numerous prewar traffic counts Until recently, however, we didn't delve in city problems. A rather extensive traffic survey was conducted by the city of Omaha during 1939 From a check of the counts made in that survey, and those made recently, it would appear that present internal traffic is approximately 75 per cent of prewar

Another thing I forgot to mention is that this series of charts is entirely based upon 1944, autumn week day average traffic, that is, the traffic during the period of our survey.

MR. R. H. BALDOCK: Don't you think that the changes of the traffic pattern due to location of war plants are reflected in the charts?

MR. HOSSACK: I think they are, and on Chart 11 you will note the effect of our major war plant on traffic On that chart all bands to the south are materially affected.

PROF. BRUCE D. GREENSHIELDS, *Yale University:* Several years ago E P. Goodrich published a paper in *Civil Engineering* in which he showed that the population pattern of cities followed the bell shaped curve which portrays what is known as a "normal" distribution. In the charts shown here it will be noticed that there is a concentration of traffic about the generating centers which grows less as the distances increases. Is there not a normal pattern of city traffic which can be used as a guide in city planning? Different types of industries and concentrations of population generate certain traffic which in turn needs certain streets and arteries to carry it. Traffic planning is analogous to designing a water supply system First the demand is calculated and pipes and conduits of the required capacity installed. To design traffic-ways of adaquate capacity one must be able to accurately estimate the demand

MR E. H. HOLMES, *Public Roads Administration:* What is the volume represented at the widest lines at the center in Chart 12?

MR. HOSSACK: About 16,000 vehicles per day on 1944 basis

MR. HOLMES: What is the volume of traffic on the heaviest street in that direction?

MR. HOSSACK: I do not know for sure; Dodge Street, which is several blocks to the north of this band, carried around 15,000 to 18,000 vehicles per day.

I am not sure as to the volume of traffic in the downtown district. There can only be about so many vehicles on any street of a certain width When one street becomes congested, traffic moves to nearby streets.

Thus you have dispersion of traffic on several streets in the downtown area

In studying Chart 12, it might be well to note some of its limitations. Were arterial streets, or expressways, to be built upon the approximate lines of all the various bands shown on this chart, it is probable that the traffic movements would be approximately those shown However, if but a few of the routes were to be improved, as undoubtedly would be the case, then further traffic estimates on those routes would be necessary, as the improvement of any route to higher standards would very probably attract some traffic which has been assigned to another band, that is, of course, assuming that no new improvements along the line of the other band were contemplated For example, we have assigned traffic traveling from Benson (Northwest of "H") to the central business district to the diagonal route between these two points. At present, no route exists along this line. In case an expressway was constructed approximately straight west from the business district, and no improvement was made on this diagonal route, some of the traffic between these two bands would naturally be attracted to the other route. Thus we should need to make a new estimate of traffic.

At this point it might be well to point out that in assigning traffic movements to the various veins we have tried as much as possible to keep traffic away from the congested central area. For instance, traffic from the northern section of the city and west of 30th Street which was destined south of Omaha or to Fort Crook was assigned to the vein just to the west and parallel to 30th Street. However, were an expressway to be constructed along the general lines of the band running north from the business district and then to the northwest, that route would attract a considerable portion of such traffic. Therefore, once you have selected the system of streets which are to be improved, a new analysis of the traffic which could be expected to use those routes should be made This would necessitate reassigning the various movements to these routes giving due weight to service offered by them as compared to that offered by existing streets. Chart 12 gives a composite overall picture from which to start planning. You will note that on Charts 3 to 11, inclusive, the numbers of trips represented by each movement are shown. Thus if you question the vein to which a movement is assigned, the numbers are all there, and you can assign it as you see fit.

On Chart 11 the numbers are the expanded vehicles per day to or from each tract, with the other end of the trip at Fort Crook or the Martin bomber plant. In drawing the chart we tried to assign movements to a direct route insofar as practical We did, however, consolidate these movements on more or less of a trunk as they proceeded toward Fort Crook.

MR. BURTON W. MARSH, *American Automobile Association*: What sort of a basis have you in mind for estimating the traffic volume for a certain part of a route, that you would be expected to have 20 years from now? Are you going to seek from the city planning people their ideas as to what will be the development in certain areas? Or what criterion will you use to measure the large growth which will be expected in many of the radial directions and which in some way must be estimated to determine the capacities for which you will build the new highways?

MR. HOSSACK: The City Planning Commission has information relative to land use and the portion of the city they expect to build up in the next 20 years, but frankly, as to means of projecting the traffic into the future we are seeking ideas.

MR. BALDOCK It is my idea that what you are now presenting are basic data which can be used in the future to project and design a system of express highways and arterial routes, either through or around Omaha, to serve that city, not only for the present, but for some reasonable time in the future. It is our custom in Oregon to assume an amortization period of 30 years; therefore to project the traffic 15 years hence, and we have been rather loathe to use any data secured in the war years, or this immediate post-war period, because the economy is entirely out of gear. For a time we experienced a war economy, now we are in a conversion economy from war to peace. I believe it is better to use traffic data secured in 1941, which was the last normal year, except in those cities where the impact of the war has developed certain industries

which will have lasting social and economic effects upon the City. I understand you intend to use these data leading to the major objective of the design and construction of arterial highway routes; to make the studies of movement of traffic from a certain origin to a certain destination and to design a facility to serve that movement

MR. HOSSACK That is correct Incidentally the traffic on rural highways was based upon 1941 traffic counts. We have taken the liberty of calling this the post-war traffic, as we are approximately back to that traffic now

MR. BALDOCK: Won't you find that when you do make a projected design of a certain arterial road, that that arterial, if built correctly, will steal traffic from roads adjacent to it, and also will generate traffic that never existed before?

MR. HOSSACK I think that to be true. I very much doubt, however, that Omaha is thinking in terms of expressways They are thinking in terms of further improvements to existing streets, and perhaps the construction of certain extensions and cross connections which are needed. In other words, with our highest traffic volumes approximately 20,000 in the heart of the city, super highways are perhaps a little beyond the needs of the cities in the mid-west Consequently at the present you don't hear people in a city of the size of Omaha talking much about super-highways. The time is coming, when they will be interested in that type of development, but before that time comes, information may be gathered on normal conditions, so as to have available the more exact data which is necessary

MR MARSH: Do you not believe there is some volume beyond which it becomes more economical to construct a freeway than to provide the needed capacity through street widening?

MR HOSSACK: I certainly think so, although it may be doubtful whether Omaha has reached that stage. Unless the economy is self-evident the average individual balks at the expenditure of so many millions of dollars right off the bat It is a process of education and must be gradual.

MR MARSH: Isn't that a job to be done, to show that at some volume economy makes a freeway justifiable and to sell that fact to the people?

MR HOSSACK: You still must keep your feet on the ground. Nebraska only gets $700,000 per year of urban funds and that doesn't all go to Omaha.

My point is that with only $700,000 to spend, and with limited funds available to the City of Omaha, we in Nebraska are not in a position to embark upon a 20 or 30 million dollar super-highway program We had better take the money available and fix some of the rough streets we have With these funds we could improve some of those streets, resurfacing and widening certain streets for arterials, and building such cross connections as necessary The funds spent for such improvements as these will give greater service per dollar than they would if spent on a minute fragment of an expressway system As for the survey, I think that it will have a long time value The city planning commission doesn't have too large an organization or much power at present but through their reports and through the Chamber of Commerce and Citizens Planning Committees over a period they have an effect. I think that the recommendations which they will make and the use they will make of this report, in recommending a long time program, will sometime lead to an integrated system of arterial streets and super-highways. We aren't to that stage yet We need the money for littler things

MR. LYNCH: I may be able to shed some light on the point made by Mr Baldock with reference to the use of data obtained during the war. Figure B shows how traffic was projected on a proposed expressway in Tulsa, Oklahoma. The traffic from zone to zone was analyzed on the basis of speed on existing streets and that assumed for the expressway. I am not sure of the exact relationship but believe that it was assumed that traffic would move about three times as fast on the expressway as on existing streets in congested areas, and about twice as fast as on other streets The number of trips is indicated by the width of the band

There is an aircraft plant in zone H-3 and

trips to that plant are shown below the narrow band representing the proposed expressway location and all other trips are shown above the line. You see the aircraft plant traffic increases as the west city limit is approached, and other traffic increases as the downtown area is approached

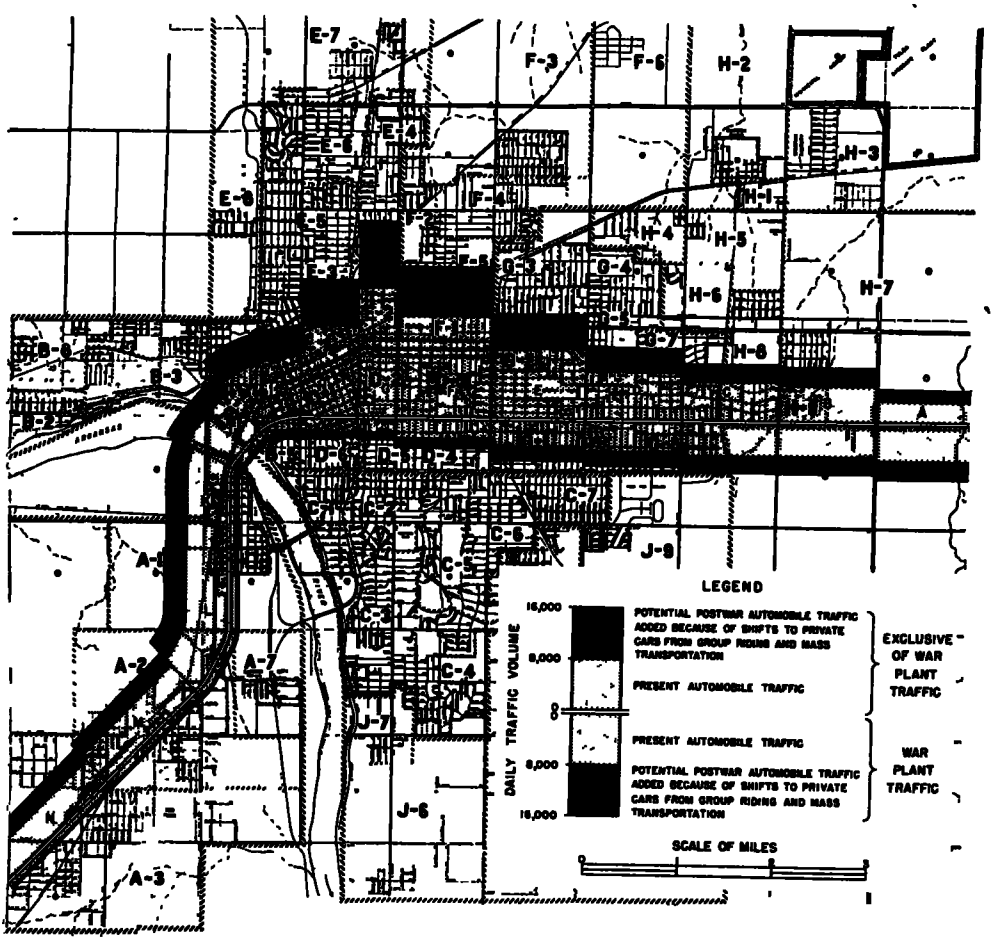



**Figure B. Estimated Volume of Existing Automobile Traffic that Would Use an Expressway Located Approximately as Shown in Tulsa, Okla., and the Amount of Increase That May be Expected in the Immediate Future**

The dark shaded portions on the outside are trips made as passengers in automobile, streetcar, and bus, by people who said they would have used their own cars if it had not been for war time conditions This represents potential automobile trips when restrictions are removed. With this method of analysis, it was possible to take into consideration probable post-war changes in the automobile traffic volume

MR. BALDOCK: I believe that it is one of the functions of the Highway Research Board to point out to city authorities the necessity for the correct location of expressways, to encourage discussion and to create public sentiment, so that, as rapidly as possible, the city authorities will reserve certain

areas by zoning or purchase of needed right-of-way, as, otherwise increase in property values may prevent the building of such facilities at the time they are absolutely needed.

In most cities it is almost always true that by the time the money is available the opportunity is gone, because of lack of planning.

MR. LYNCH. The Kansas City survey was made jointly by the State highway departments of Missouri and Kansas and the analysis was coordinated under the direction of Mr. Picton, Chief Engineer of the Planning Commission, Kansas City, Missouri Mr John F Harbes, Planning Engineer, State Highway Commission of Kansas, will tell us something about that survey.

MR. HARBES: I should like to add a bit to the discussion before reading my remarks The approach in our survey was to project the reported origin-destination of traffic as the crow flies, so to speak. In other words, straight line diagrams, or desire lines were developed. We have given little attention to present routings.

We have felt that we are little concerned in this type of study with travel habits at the present time. What we want to know is how they desire to travel? A few of the details of the approach to the analysis are as follows:

We first prepared the straight line diagram from which we think we have a reasonably good idea of the pattern of movement within the city From that pattern we have selected certain routes of travel that seemed to best fit the pattern. We have selected not only one route, but alternate routes

After those selections were made, they were plotted on a map of the city. Based on rough calculations we then decided which of these routes would be of sufficient importance to warrant their serious consideration as expressways. For those routes to receive further consideration, probable ingress and egress points were decided upon

After this work had been completed we went into the city and drove each street to determine the approximate speed at which vehicles now travel and as a result a speed was established for all streets.

In assigning speeds we took into consideration certain future facilities which are now planned by the city as strictly city financed improvements It was felt these facilities would, when constructed, have an effect on the traffic using the expressways.

In our actual projection work we took each trip according to assigned speed for the streets used and figured which was the quickest, most economical way, for that person to make that trip. In other words we took each trip and put them on the proposed expressway at the most advantageous ingress point and took them off at the best egress point Trips projected to the expressway were, of course, only those trips that could use the facility to advantage.

It is amazing to me that such consistency can be attained on a 5 percent sample in figuring one route against another. In our case we have two possible alternate, competing limited access facilities We first considered one as normal access, and the other as limited, and then we switched them about. It is surprising how consistant the results came out We have learned in traffic work, generally speaking, that unless you have a rather peculiar situation, and that situation is quite obvious, you will find the flow in one direction about equal to the reverse flow. So that we now have considerable confidence in the results

Generally speaking, the Kansas experience in urban origin and destination surveys is limited to the survey and analysis of the data for Kansas City, Kansas, and to some extent, Kansas City, Missouri The greater metropolitan area involves a population of approximately 600,000 people. The Kansas portion of the total survey represents only about 35 per cent.

The method used in obtaining external origin-destination traffic data was, I believe, the usual method, wherein 100 per cent of the traffic moving on the principle roads adjacent to the area was intercepted and interviewed at the site. The internal phase of the survey followed the technique developed by the Public Roads Administration commonly referred to as the "home interview" type. The analysis of the data obtained at both the external traffic stations and through the home interview is believed to indicate conclusively the wisdom of giving much

attention to the matter of zoning the area. While the analysis of the Kansas City data is only partly completed, it is evident that there is a good possibility (at least a try would merit consideration) of reducing the voluminous amount of work involved in projecting traffic to certain preliminary lines or proposed facilities which have resulted from the overall pattern established from straight or desire line diagrams and that a more comprehensive presentation of these straight line diagrams can be made.

It appears that in zoning a city consideration should be given to the geographically natural barriers, culture make-up of the city, size of zones and density of population in each zone. Major streams, railroads, industrial areas, retail business sections, apartment-house sections and elite residential areas should be zoned so they may be easily identified. It is not intended that this type of zoning should be a substitute for the lot, block and tract breakdown generally proposed for this type of survey, but would be in addition to it. More particularly, in ordinary residential and business sections it may be found desirable to denote by zoning the limits of blighted sections or the price range of residential property in given areas

Examination of the straight line diagrams developed in connection with the Kansas City survey will show that oftentimes the true importance of a movement is difficult to evaluate because of the wide variation in areas of zones and densities of population within the zones. For this reason it appears that an effort should be made during the zoning process to establish an easily identified relationship between zone areas and population densities. If this relationship is known, along with full knowledge of the character of development (residential, business or industrial), then the graphic presentation could be more properly evaluated Under the method adopted in the Kansas City survey a high volume of traffic exchange may prove to be of less importance than a smaller volume of exchange when the zone size and population density is considered

A proper zone classification may also simplify the correlation of present traffic volumes with anticipated future increase or decrease in volumes resulting from probable future population changes. As a result of the cooperative effort on the part of the City Planning Commission and city industrial leaders, an estimate of probable future residential development, as well as industrial development, has been made for Kansas City, Kansas These estimates show the probable distribution of population and industrial employment by 1970. The probable changes to take place in the city by 1970 are highly significant and will unquestionably have a substantial bearing on final recommendations for expressway and boulevard facilities.

The traffic data obtained from the survey have now been projected to certain alignments under consideration. However, the technique to be employed in giving consideration to the probable changes in population as they may affect these alignments is still in the stage of conversation In this instance a large part of the increased population will be in areas now virtually undeveloped. The population in these areas at present and for which automobile trips have been recorded, obviously is not of sufficient size to permit direct application of the pattern of these trips as a pattern of distribution for the probable increased population.

The brightest ray of hope seems to be the possibility of analyzing the metropolitan area as to classification of development and to determine from such an analysis where employment is most likely to be provided for the class of people that would live in the newly developed area The condition prevailing in Kansas City may be considered as the unusual one; however, this situation suggests the refinement of survey technique in anticipation of such conditions It is believed that careful zoning may be worthwhile in that it would possibly provide a partial index in making necessary adjustments in the traffic projections to fit probable future population changes.

Another observation concerns the purposes of trips during the peak hours (morning and evening) as projected to the alignments under consideration. Approximately 80 to 95 per cent of the trips projected to the alignments under consideration during the morning and evening peak hours was found to be to and from work, as compared with 65.3 per cent for all trips recorded during the survey.

While these findings are perhaps not greatly different from those expected, the verification

of this fact seems to suggest the advisability of giving consideration to a simplified procedure in obtaining the field data, particularly if it is consistently found in similar surveys that the work trips are overwhelmingly predominant during the peak hours

TABLE 1
PERCENTAGE OF WORK TRIPS OF TOTAL AUTO DRIVERS DURING 4 HOURS FROM 7-9 AM & 4-6 PM

| | AM | PM |
|---|---|---|
| | % | % |
| State Limited | 91 | 92 |
| Balance of Projected Trips | 87 | 82 |
| Ridge Limited | 80 | 78 |
| Balance of Projected Trips | 91 | 90 |
| S W. Boulevard Limited | 96 | 84 |
| Balance of Projected Trips | 86 | 89 |
| Trips occurring in period but not projected | 82 | 80 |
| Average of all trips (Auto) during period | 87 | 85 |
| | 86 | |

MR. JORGENSEN: Was the traffic projected on expressways on the basis of saving in time only or was it also based on other economic evaluation?

MR. HARBES: We had a great many discussions on just how that should be done and the best proceedure we finally developed was to allow a certain distance to be traveled on ramps entering and leaving the expressway, the speed on the ramps to be the same as that assigned to the approaching street This is a debatable point but the more it was discussed the more we became convinced the procedure was right We figured the equivalent of a quarter of a mile in time, so it really is on time, yet it does take distance into account automatically. We allow a quarter of a mile getting on and a quarter of a mile getting off the expressway The overall process used in the project is relative and we felt that as long as we were consistant in method, we did not need to worry too much about determining the relative factors of the two facilities

In the report, cost estimates on the different alternate routes will be included

MR. BALDOCK: It seems to me that in order to sell these things to the people, the monetary benefits gained by the improvements must be shown, and after all, I do not believe we can wait for all the money to come from Washington. Many studies have been made which indicate that the annual benefits far exceed the annual costs It is good business to build such projects, and if the people of a city can be convinced that they are losing large sums of money annually by using old facilities, it may be possible to finance the needed improvements locally.

MR LYNCH: Oklahoma has been one of the pioneers in this origin and destination survey work Two of the first city surveys to be made were in Tulsa and Oklahoma City and in addition to that they have done quite a lot of work on external surveys around smaller towns and cities in the State We have so far discussed the surveys in the larger cities, and it will be interesting to know something of the work in smaller cities So far as I know, Oklahoma has made the only origin and destination survey of a whole route of considerable length, which is the route from Oklahoma City to Tulsa. Mr. Hicks, who had charge of that work, will tell us about it.

MR CLARENCE HICKS, JR, *Oklahoma State Highway Commission:* The Oklahoma Highway Planning Survey made a traffic study between Oklahoma City and Tulsa, a distance of approximately 119 miles.

In the presentation of the traffic survey data between Tulsa and Oklahoma City, each of the 12 station locations is set out, the dates and hours, the number of interviews, the percentage of interviews and volume expanded to 24 hr. Separate tables are given for each station showing the direction of traffic flow, number of vehicles, percentage of through and local traffic, origin and destination and percentage of passenger cars and commercial vehicles. The volume of traffic found was compared with that of 1941, 1942 and 1943 where possible

The analysis was made first for traffic using U S. Highway Number 66 from each of five cities along the route, Edmond, Chandler, Stroud, Bristow and Sapulpa, and a further analysis with regard to traffic on the same highway between Oklahoma City and Tulsa followed

Counts for turning movements were also

made where principal county roads and other State Highways joined U S. 66 and were presented in tables showing the count by hours and percentage of the total for each hour. A plat showing the turning movements was also made.

it may not have reached either Tulsa or Oklahoma City The percentage of through traffic is rather large in each of these cities, indicating that a realignment of the highway would be justified where the distance would be shortened

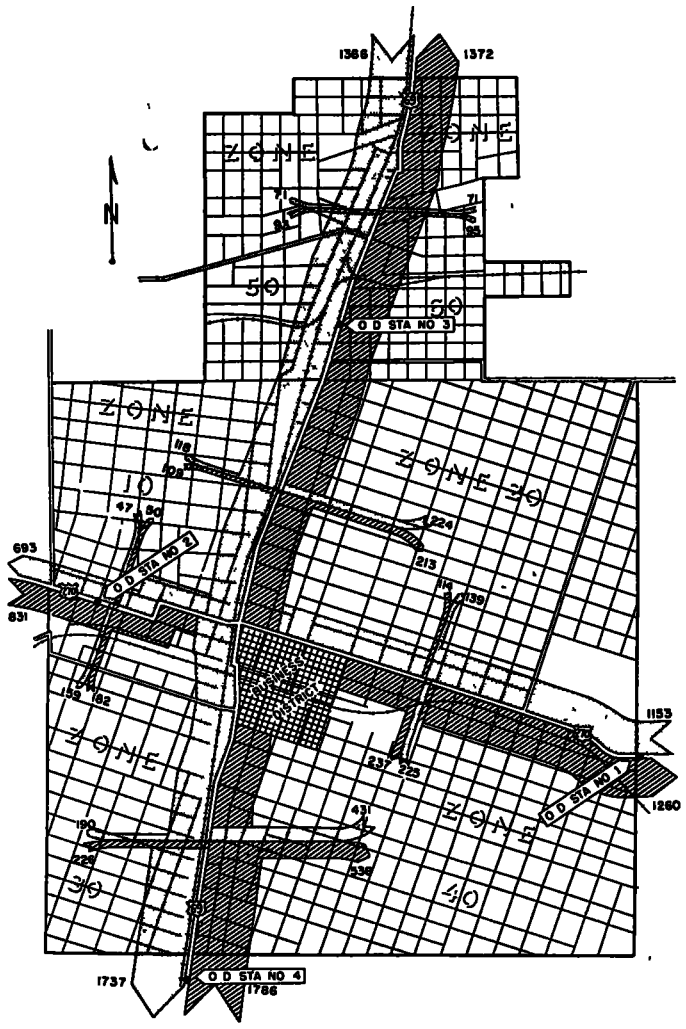



**Figure C. Volume of Traffic on State Highways within McAlester, Okla., Having Origin or Destination or Both Outside the City**

In this study, through traffic is taken as that going from Tulsa to Oklahoma City or from Oklahoma City to Tulsa, excepting in the study of individual towns previously named where through traffic has been taken as that going through the city non-stop though

The heaviest traffic is between Tulsa and Sapulpa, 4,327 vehicles, while the lightest is in the vicinity of Chandler with 1,626 vehicles. The through traffic from Tulsa to Oklahoma City is 716 and from Oklahoma City to Tulsa, 544, making a total through traffic of 1,260

vehicles. Present traffic is approximately 68 per cent of the 1940 traffic.

MR. LYNCH: I too have a few figures for McAlester, Oklahoma, which will show the method used in analyzing the traffic there might possibly be by-passed, but this is misleading because a good deal of the traffic stops in the city.

Figure D shows the traffic passing a station at the north edge of the city. The right-hand shaded band is north bound traffic; the other

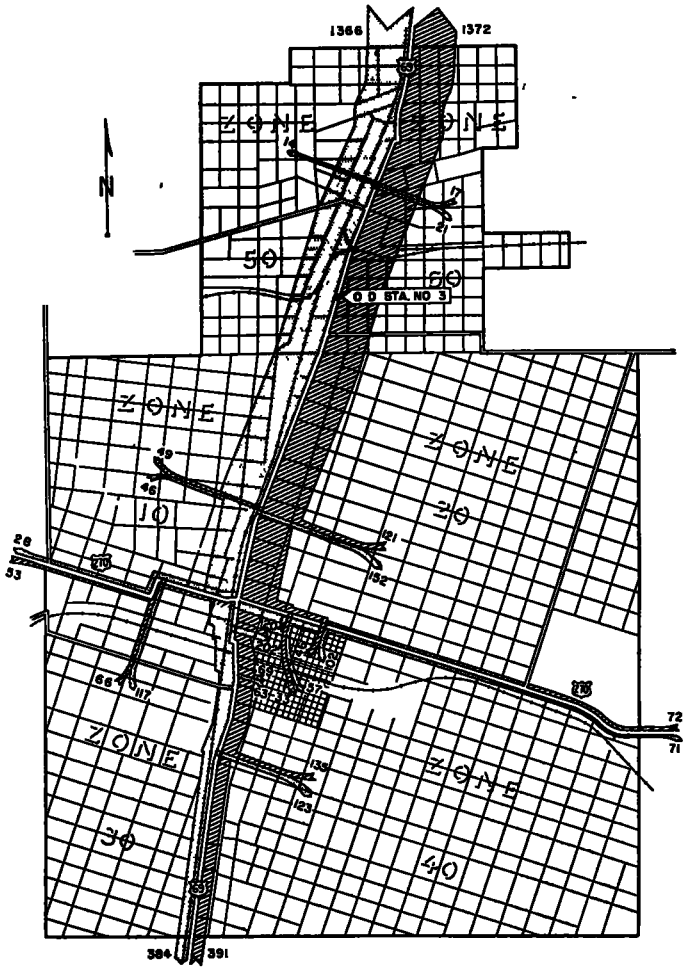



**Figure D. Distribution within and through McAlester, Okla., of In-Bound and Out-Bound Traffic Passing the North City Limit on U S 69**

Perhaps they will clarify a little the kind of surveys made between Oklahoma City and Tulsa.

The bands in Figure C represent State Highway traffic, that is, traffic that has origin or destination outside of the city. The impression is gained from this chart that there is a large amount of through traffic which is south bound traffic. It shows how the traffic tapers off when it gets in the center of the city

Figure E shows the traffic passing a station at the south end. Most of it also feeds out near the center of the city, and the uniform band in Figure C was made up of these two wedges of traffic superimposed upon each other

Similar surveys were made in each of those little towns

MR. JORGENSEN: How do you account for the difference in traffic going between the two cities, one direction having 700 and the other direction having 500?

MR. HICKS: I assume more business is transacted in Oklahoma City than in Tulsa. We take a 16-hr. count at a station. If we start a count on Monday at 1, we can only take 8 hours. The following week we take the other 8 hours and we start at 6:00 o'clock in the morning, and work from 6 till 2, and the following Monday from 2 until 10 We think that we get comparable counts if taken on the same day of the week.

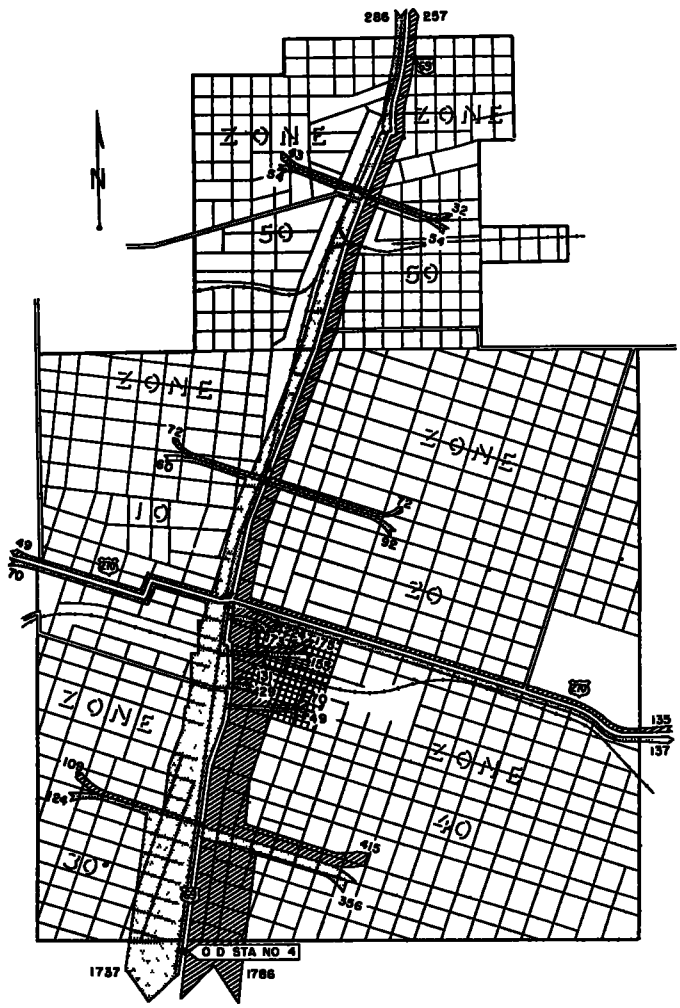



**Figure E. Distribution within and through McAlester, Okla., of In-Bound and Out-Bound Traffic Passing the South City Limit on U S 69**

MR. LYNCH: Detroit has had experience in analyzing origin and destination data. Their survey, based on the analysis of group ride questionnaires was one that we studied in setting-up the home interview type survey. Mr Lloyd Braff, a member of our Committee, was closely connected with that work, and we should like for him to tell us something about it

MR LLOYD BRAFF, *DeLeuw Cather and Company:* I agree with Mr. Marye that it is the practical application of the origin-destination surveys which is important and that the survey is only a means to an end. In Detroit we were working toward an objective and not the application of a survey technique.

In Detroit we were faced with a traffic congestion problem prior to the war Most of the major thoroughfares were loaded during peak hours beyond their capacity. As an example, on a one-way street at a point approximately three miles from the downtown area, the peak hour traffic was in excess of 4500 vehicles. Several other major thoroughfares were carrying 50,000 or more vehicles per day. The City of Detroit was faced with the problem of providing traffic relief Based on its experience in street widening, the city knew that such a program introduced more problems than it cured It was evident, therefore, that a network of expressways must be planned to relieve the city's street system.

The problem, therefore, was one of determining where the expressways should be located to serve the needs of the motorists, and of laying out a major thoroughfare plan in conjunction with the expressway network.

Severe traffic problems are created in Detroit because of the heavy concentration of employment in small areas. More than 70 per cent of all Detroit's industrial employees work in plants having more than a thousand persons Because of the interdependence of one industry upon another, industrial plants are grouped in small areas. There are approximately 10 so-called industrial areas scattered throughout the city Each attracts as many persons as downtown areas in cities of several hundred thousand population.

The development of the network of expressways, therefore, required origin-destination data which we did not have. We did, however, have a complete picture of the residence location of all industrial employees in plants employing more than 500 persons which was obtained during the swap-ride program This information included the location of the plant, the shift the employee worked and his mode of transportation It was ideal information to be worked up as an origin-destination survey

To this information we supplemented a study made prior to the war on the origin-destination and mode of transportation of downtown employees. The industrial information and central business district data were combined and used as a basis for our origin-destination material It was a very complete picture except for the information on outlying retail centers

The information was transcribed to flow charts similar to those shown this afternoon. The central business district of Detriot is located on the shores of the Detroit River here and extends approximately 8 to 10 miles to the east, north and west Its industrial areas are located on a 3- or 4-mile circuit from the downtown area in these approximate locations.

We divided the city into areas of approximately 1 sq mile each which were called origin areas. For each industrial area, therefore, we knew the number of employees who lived in each origin area From these data, we drew flow charts—one for each industrial area and a composite of the entire city From the composite chart, we attempted to locate a network of expressways which would hit the center of gravity of the heaviest flow bands throughout the metropolitan area

After laying out such a network, we applied the origin-destination data to determine the volume estimated to use each of the roadways This was done by taking into consideration for each individual origin area its location with respect to its destination, the existing major thoroughfare system between the two points, the travel time which could be saved by using the expressway, and the location of the expressway with respect to the industrial plants. In some areas, for example, as much as 100 per cent of the automobile trips were assigned to the expressway, while in others close to the industrial area, no vehicles were assigned to the expressway system. In intermediate areas, varying percentages were assigned depending on the benefits to that area under study. The study of the entire system, therefore, involved more than 10,000 combinations of possible trips. The result of this analysis was a flow map indicating the estimated traffic volume on each portion of the expressway as well as the estimated use of each ramp throughout the entire network. In the downtown area the application of the same data made it possible to determine the location of ramps which would best serve the public.

The downtown area itself was broken into

10 areas and the origin-destination gave an indication of the routes vehicles would probably take in trips to their ultimate destination.

The origin-destination data, therefore, was used to locate the network of expressways, estimate the traffic volume on each of the routes, determine the location of ingress and egress ramps and provide sufficient information to determine traffic control methods in the central business district. The next step which is as yet uncompleted is an economic study of the entire problem

# ANALYSIS OF SHORT COUNT METHODS IN MEASURING TRAFFIC FLOW

By H. E. Cunningham, *Highway Engineer Economist,*
*Public Roads Administration*

## SYNOPSIS

How short may a short count be? This perplexing question frequently occupies the traffic engineer's attention particularly on occasions when planning extensive studies of traffic conditions. Not only must the engineer be assured of obtaining reasonably accurate traffic information but the cost of the undertaking should be kept to a minimum. The purpose of this paper is to report on an analysis of short-counts varying in duration from 5 to 60 min. each and selected under carefully controlled schedules.

Data from three mechanical counters geared to produce counts in 5-min. intervals and operated for a full year period provided the basic material for the analysis. Roads of dissimilar travel and volume characteristics were selected; station 240 being located on a U. S. numbered highway carrying 3790 vehicles daily, station 124 on a well traveled State highway carrying 667 vehicles daily and station 114 on a low density State highway or what normally might be a well traveled county road carrying 248 vehicles a day. Results of applying 1440 schedule combinations of short counts in various 7-hour periods from 10 A M. to 8 P.M. are summarized as follows

*Effect of varying the number and duration of short-counts on the average percentage error of estimate of average 24-hour traffic*

| Duration of count min. | 28-count schedule | | | 56-count schedule | | |
|---|---|---|---|---|---|---|
| | Sta. 240 % | Sta. 124 % | Sta. 114 % | Sta. 240 % | Sta. 124 % | Sta. 114 % |
| 60 | 4.06 | 3.86 | 6.81 | 2.64 | 3.13 | 4 58 |
| 30 | 4 07 | 4.59 | 8.95 | 2 78 | 4.10 | 6.48 |
| 20 | 3 60 | 6.24 | 10.08 | 2 74 | 4.91 | 7 37 |
| 15 | 3.76 | 6.36 | 9.48 | 2 24 | 5.18 | 8.50 |
| 10 | 4.24 | 7 99 | 13.17 | 2.59 | 5.84 | 10.24 |
| 5 | 5 27 | 11.31 | 19.25 | 3.56 | 7.74 | 14.27 |

These figures demonstrate the effect of changes in number and duration of short counts on the accuracy of estimating average daily 24-hr. traffic The magnitude of the traffic stream to be measured also has an important bearing on the selection of a schedule as can be seen by reference to the figures for individual stations. In actual practice, however, where a short-count schedule is insufficient within itself to reproduce the universe, adjustment factors must be borrowed from a related station. The effect of this adjustment on the resultant accuracy of the work is shown in the following summary using short counts taken during the most favorable 7-hour counting period (from 1 P.M. to 8 P.M.) and under a 28-count plan·