

# Traffic Growth Patterns on Rural Highways

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In the review of travel forecasts presented at the 36th Annual Meeting it was found that in about two-thirds of the cases investigated the actual increases in traffic were at rates more than two times greater than had been predicted. This poor record was due largely to gross misinterpretation of past trends.

This paper takes another look at past traffic trends, especially those on rural highways, interpreting them and using them as a guide in forecasting traffic. It reports the results of a study of factors affecting the variation of traffic increase rates on rural highways. Proximity to an urban place is an important factor that produces the highest increase rates and also the most erratic. Since traffic increase rates in and near urban places are so greatly affected by the expansion of the urban area, the data from such areas were excluded from this study. Forecasting of traffic increases in those areas are being studied from a land use basis.

For the rural highways located beyond the direct urban influence, the type of traffic service was found to be the factor influencing the variation in increase rates. Those roads carrying the greatest percentage of interurban and interregional traffic had the greatest increases.

Increase trends were summarized in four categories in descending order of traffic increase rates. At the top with the greatest increase were the interstate highways carrying the largest percentage of interurban and interregional traffic. At the bottom with the least increase were the roads carrying mainly rural to rural, and rural to urban traffic. Between these two extremes were two increase categories carrying intermediate volumes of interurban and interregional traffic. The rates of increase projected 20 years ranged from 210 percent for the interstate system down to 50 percent for the roads carrying mostly local rural traffic.

Increase rates on secondary roads seemed to coincide with the degree of improvement in the surface. When the improvement was from plain gravel to a bituminous surface the increase in 10 years averaged 200 percent. An improvement that bettered but did not change the surface type brought an average of 80 percent increase in 10 years. Roads on which the surface type and condition were merely maintained had an average increase of only 50 percent in 10 years.

● THAT A further study is needed of trends of traffic and of all of its components is evident in the review of travel forecasts reported in a paper presented at the 36th Annual Meeting. In that review it was found that in about two-thirds of the cases investigated, the actual increases were at rates more than two times greater than had been predicted.

As the title of this paper indicates it deals with traffic growth on rural highways but by way of introduction mention is made of similar treatment being given urban places in comparatively numerous papers. The tremendous concentration of population and traffic in urban areas poses the greatest problems and also provides a large field for the development and application of usually involved techniques. The work being done in the Chicago Area Transportation Study is an example of what is being done in Illinois with respect to urban places. However, this paper reports the results of a study of

past trends covering the various rural conditions encountered. These past trends were plotted and simply projected visually. The difficult part of the study was in determining the variables that caused the differences in the rates of traffic increases on the different road systems and on different roads within each system.

The Problem

Interest in past trends is mainly in the fact that they may reflect what the future might be. Future traffic estimates are essential for the intelligent planning and design of highway improvements. The rural primary system has about 10,000 miles and the rural secondary highway system about 20,000 miles in Illinois.

For the rural primary highways traffic estimates are needed as at present, at 10 years, and at 20 years. This information is needed first for long-range planning and later for design purposes. For secondary roads only the 10-year projection is usually needed.

The latest available traffic volume figure is usually the beginning point from which traffic is projected on existing roads. For new roads and for existing roads where improvements are of such magnitude as to divert traffic from other alternate routes, the amount of diversion that would take place in the current year is estimated and included in the basic figure which is to be projected. The techniques by which these traffic volumes are determined and the technique by which the amount of diversion is estimated have been previously reported in other papers and are therefore not included here.

For design purposes traffic volumes must be expressed as design hour volumes and the volume or percent of truck traffic in the design hour volume. The 30th maximum traffic hour is usually accepted as the design hour volume.

The relation of the design hour volume to ADT varies considerably on rural highways. It is as low as 10 percent and as high as 30 percent in extreme cases. The higher percentage occurs on roads leading to large recreational areas and the lower figure occurs on highways passing through built-up areas. This percentage runs as low as 8 percent on some urban arterial streets and expressways.

The directional movement must also be estimated and this is expressed as a percentage that the major directional movement is of the total design hour volume. This percentage varies from 50 percent to 80 percent, the larger percentage occurring on roads leading to recreational areas and to large industrial areas. On the typical rural primary highway the major directional movement is usually 60 percent of the total design hour volume.

Truck traffic on rural primary highways is increasing at a faster rate than passen-

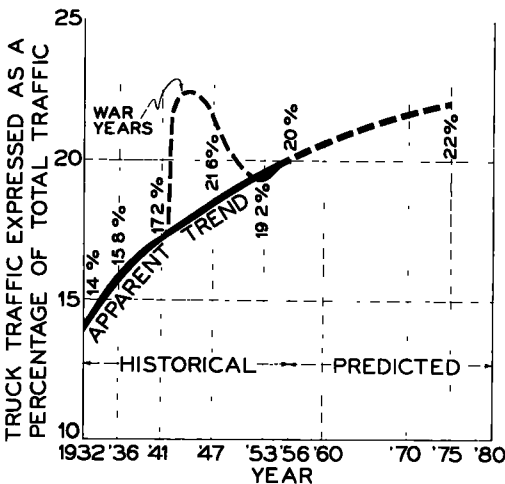


Figure 1. Relationship between truck traffic and total traffic on rural primary highways.

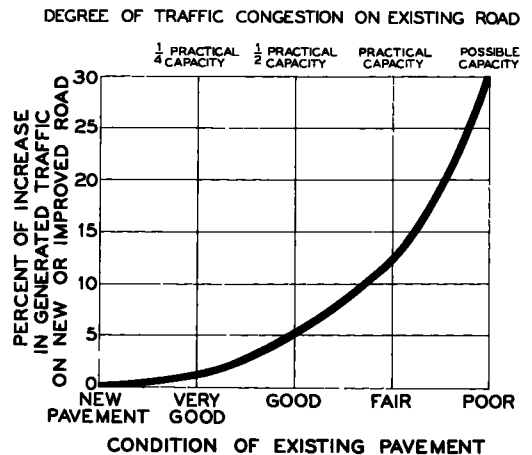


Figure 2. Traffic increase curve showing predicted generated traffic for new or improved highways.

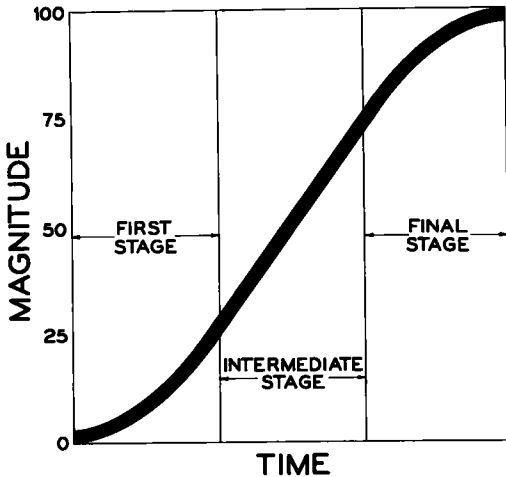


Figure 3. General growth concept.

ger car traffic. While truck traffic was only 14 percent of total traffic in 1932, it was 15.8 percent in 1936, 17.2 percent in 1941 and had reached 20 percent in 1956. This trend has been interpreted and projected and it is estimated to be 22 percent by 1975.

It is generally conceded that a new or improved highway facility will generate trips that otherwise would not have occurred on the original network of highways. From the rather meager information that is available the chart shown in Figure 2 was developed for estimating the generated traffic. Assuming that there is a traffic demand for each new or improved facility, it is believed generated traffic is proportional to the degree of improvement as shown here. This chart is being used until something better can be developed by further research on generated traffic.

### General Trends and Projections

General trends were studied and projections were made first before any attempt was made to break down trends by systems and by routes. The estimates of the amount of all travel were made by projecting component trends namely populations, persons per vehicle, and miles per vehicle.

According to the general growth concept, a slow but constantly accelerating rate in the early years is followed by a period of rapid and steady growth, then a decelerating rate until the curve continues on a very minimum growth rate when a saturation point is reached.

The length of time required to pass through each of these periods varies considerably for different things, in fact it varies even in the components from which the amount of travel is derived. The length of time required for population is much longer, perhaps hundreds of years, while the length of time for other components, person per vehicle and miles per vehicle will apparently be much shorter.

The population of Illinois apparently has been and still is in the middle stage of rapid and steady growth. The miles per vehicle show signs of having reached a point near the end of the last stage as there has been no appreciable increase since 1941.

One of the principal component forces affecting the trend of many other components including traffic is population. It is a factor for which good information is more readily available over a long period of time.

For Illinois the population increases have been quite uniform for a long time. If the population of 1850 had been projected at a rate of increase of 800,000 in each decade the estimate would have been very accurate to and including the last census taken in 1950. The actual population has deviated from such a projection only slightly, sometimes being above and sometimes below. The indications are that the 1960 population will be slightly above such a projection.

This historical background leads to the belief that for Illinois the population projection should not deviate much from a straight line, but because of the apparent upward sweep of the population curve in the last 20 years the Bureau of Census population estimates were used without change. These give a slight upward sweep to the projected trend curve for the next 25 years. This is looked upon as only a short term deviation from the long-range trend and it is estimated that Illinois is still in the intermediate stage of population growth. Population is the first of several component trends that were used to develop the vehicle miles of travel.

A second component is the persons per vehicle or it could be expressed directly as

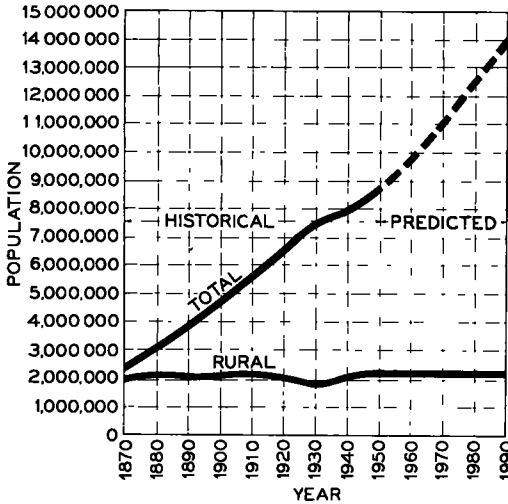


Figure 4. Population trends in Illinois.

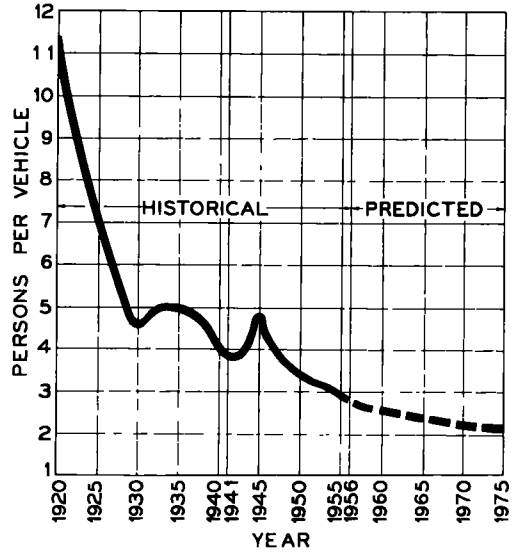


Figure 5. Persons per vehicle in Illinois.

number of vehicles. For this and the other components there is available a relatively short period of historical background. This component is evidently still in an early stage of development and when expressed as number of vehicles registered the trend would be showing an upward sweep of the curve.

A third component is gallons of gasoline or vehicle miles per vehicle. In a relatively short period of time this component has evidently passed through all three stages and has seemingly reached a point of stability for the last several years. On this basis this component is projected horizontally on a straight line without change.

Having developed these components separately by projecting past trends a projection for vehicle mile of travel can be developed by starting with population, dividing by number of persons per vehicle to obtain number of vehicles, and finally multiplying by the vehicle miles per vehicle to arrive at the vehicle miles of travel.

These general trends are shown as a part of this paper to give background to the

study and trends on rural highways. While the general trends were projected by what is generally termed an analytical method, the projection for rural roads were derived by simply projecting past trends of traffic directly.

Before describing the analysis that was made of past trends on rural highways, it should be noted that there was no indication in the longer term trends that rural traffic was increasing at an accelerating rate, or that the rate of increase was compounded periodically. Such a condition would have produced a trend curve with an upward sweep.

The voluminous historical record that was available on traffic volumes on rural highways in Illinois indicated the great increases that have taken place but if the dips caused by the depression of the early 30's, the World War II period and the immediate post-war period, are discounted as abnormal, the increases have been more

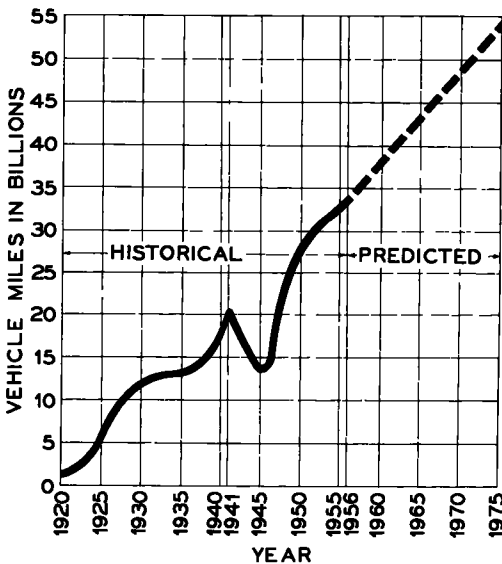


Figure 6. Vehicle miles of travel on all roads and streets.

nearly in a straight line. Since the purpose of this study was to obtain information on future traffic estimates for design purposes rather than for revenue, the straight line projection was preferred.

If the highway systems had been determined on the basis of type of traffic service as has been done in some cases, it probably would have been possible to develop and use one set of traffic increase factors for each system. Since the highway systems in Illinois were not selected in that way the study indicated a very wide variation in increase rate within each rural highway system. Therefore the use of an average rate of increase for each system must be very limited. In general the primary system increased at a slightly faster rate than the general increase, the secondary system increased at a slightly greater rate than the general increase, and the local rural roads had a lower rate of increase than the general increase.

#### Variation of Traffic Trends on Rural Primary Highways

The wide variations in traffic increases on the primary highways outside of the corporate limits of cities indicated a need for the study to determine what circumstances caused these differences. It has already been stated that this variation did not coincide with highway systems. In the search for possible factors affecting the traffic increase rate, the following were studied:

1. Geographic location
2. Type and width of pavement
3. Proximity to urban area
4. Character of service
  - a. Interurban
  - b. Interregional
  - c. Rural to urban
  - d. Rural to rural

There seemed to be little or no uniformity in rates of increase on these factors but it was very clear that the larger increases were occurring in the areas immediately surrounding the larger cities. This is understandable when cognizance is taken of the fact that all of the increase in population in Illinois in the last 100 years has been urban and that the rural popula-

tion has remained nearly constant at about 2,000,000 since 1860.

It was quite evident that the trends in these areas close to urban centers were being controlled by the expansion of the urban area. The increase was not only higher than in rural areas but also varied over a wide range of values. It was plain to see that some other method of attack would be necessary in developing either trends or future traffic projections in urban areas so all of the information from such areas close to cities was isolated and left out of any further analysis. A method of analysis involving present and future land use is being developed for use in making predictions of traffic in urban areas.

The data for the remaining rural areas away from urban influence was studied. A comparison on geographic location showed only slightly greater increase in northern than in southern Illinois. Type of pavement seemed to make no difference. Roads with wider pavements did have the greater increases but it was plain to see that the wider widths were the effect rather than the cause of the greater increase. Looking at this now from hindsight, it may seem that this should have been obvious but nevertheless it seemed necessary to examine the data to see if the ease of travel provided by a multiple lane highway as compared to a two lane highway would have an appreciable effect on the rate of traffic increase.

There was considerable data available on character of traffic service from the many origin and destination studies, from the truck weight studies, and from traffic classification counts made in Illinois.

For this study the character of service was in four categories, interurban, interregional, rural to urban, and rural to rural. The character of service was expressed as a percentage of traffic in each category. Origin and destination data were not available at all of the 300 locations studied and reliance had to be placed in some cases on other sources of information, usually classification counts. The volume or percent of out of state vehicles at many of these locations denoting interregional character of service was the determining factor in classifying a section of a highway.

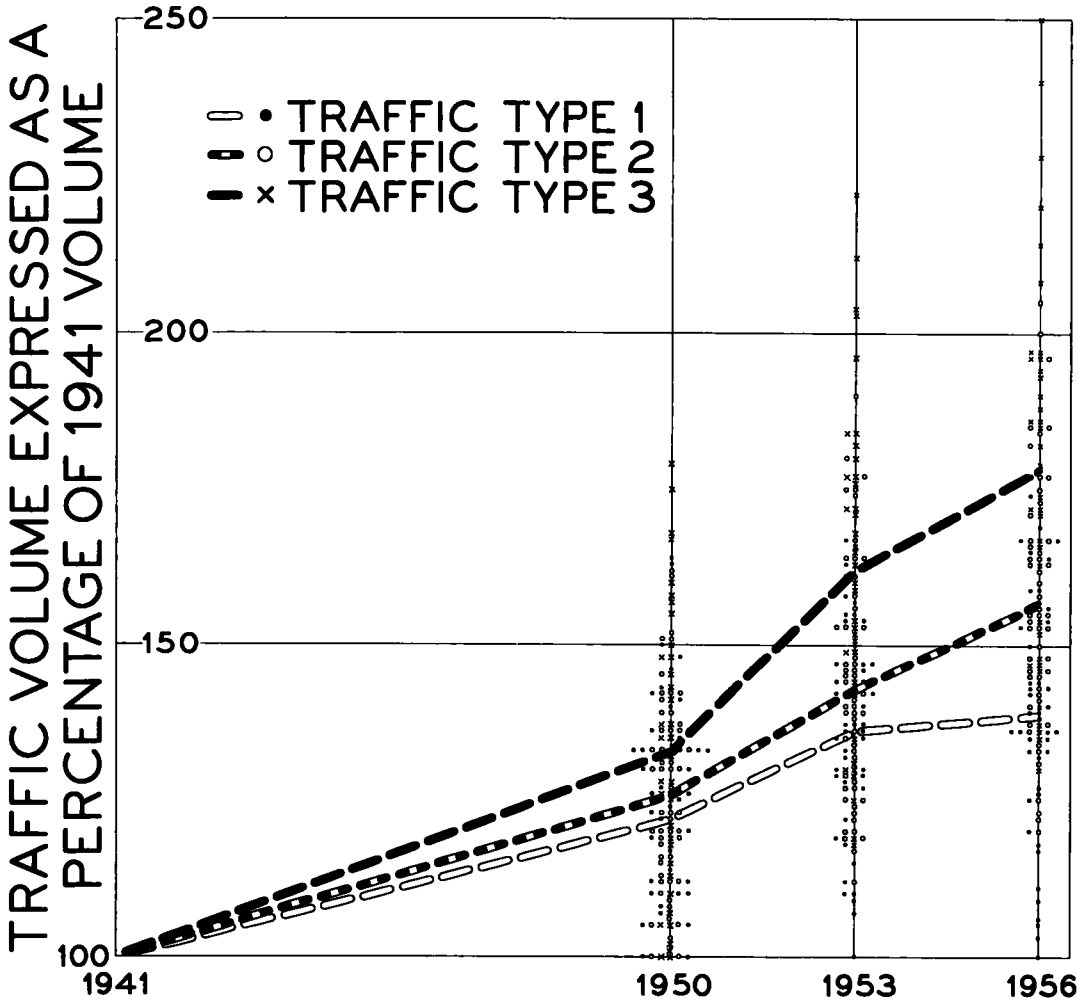


Figure 7. Traffic increase trends on rural primary highways from 1941 to 1956.

#### Projected Trends on Rural Primary Highways

In plotting of rates of traffic increase based on character of service, the highways giving the greatest amount or percentage of interurban or interregional service had in general the greatest increases. The interurban category did not include travel between a metropolis and its suburbs because as explained previously these suburban areas were not included in this study.

There was no well defined division in the plotted points between these four categories and there was considerable overlapping. In some cases the overlapping was later found to be due to misjudgment in classifying the character of service on inadequate information. Much of the overlapping was probably due to localized influences which could not be detected.

While in some cases a short-term trend seemed to indicate an upward sweep of the increase curve, the long-term trend was definitely a straight line increase. To be of practical use these trends were projected in straight lines as three separate primary road use types according to character of service as shown in Figure 8.

The roads giving the greatest interurban and interregional service showing the greatest increase fall in Type 3 at the top in Figure 8.

The roads carrying largely local traffic of rural to urban and rural to rural character

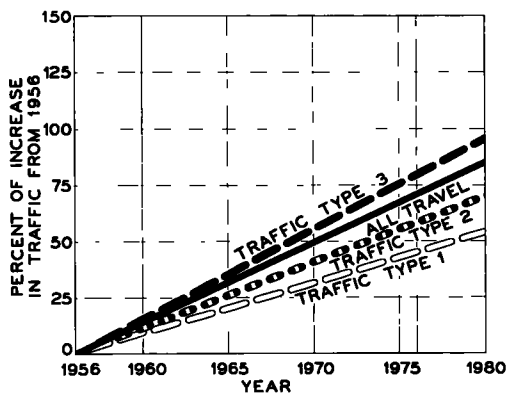


Figure 8. Traffic type curves showing predicted increase in motor vehicle travel in Illinois on rural primary highways.

with a predicted increase greater than anything known before as shown in Figure 9.

The interstate system is to be built largely on new locations paralleling the presently most important routes. Obviously the new route will draw much traffic from old existing route in each case and will usually relegate the old route to a class mainly serving local traffic. Where it was estimated that the existing route would have a high rate of increase as in Type 3, the road will in most cases revert to a Type 1 with a relatively small increase. Again it must be emphasized that this is true only on rural sections away from the influence of urban build up.

With the interstate system the primary road network increase in traffic in Illinois is estimated to be as shown in Figure 10. All future traffic estimates on primary roads outside the influence of urban places are being made accordingly.

#### Traffic Increase Trends on Rural Secondary Roads

Traffic increase trends on rural secondary roads were also studied and again it was necessary to exclude the data from locations near urban places because of the large and erratic percentage increases obtained there. Because this deals with relatively low volumes, the percentages of increases are scattered through an even wider range than for primary roads.

The need for future traffic estimates was in cases where an improvement in a road was being contemplated so the analysis was pointed at the problem of making such an estimate. The varying rates of increase that were obtained were summarized and the following were the conclusions:

1. When an improvement was from plain gravel to bituminous surface the increase in 10 years was 200 percent. Much of this increase occurred immediately after the improvement, obviously being due partly to traffic being diverted from other routes. Since diverted traffic is a component of the total traffic increase, it is preferable to have origin and destination data for an estimation problem like this but since that was not often practical the 200 percent increase was used in most cases. It should not be expected that an increase of anywhere near that magnitude would be obtained if the entire system in a given area were so improved.

had the least increase and fall in Type 1 at the bottom in Figure 8. Roads giving a moderate amount of interurban and inter-regional service fall in Type 2. This set of predictive curves or straight lines as they turned out to be have been used in predicting future traffic increases on rural primary highways in Illinois, until 1957 when the interstate highway planning came into the picture.

Revisions in this map are made periodically as new and better information becomes available. A major revision was necessary last year (1957) due to the activation of planning for the interstate system of highways. The rate of traffic increase on this system of highways is expected to be very high. The effect has been that it adds a fourth increase curve

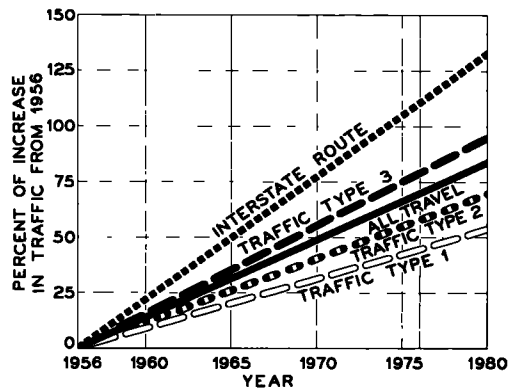


Figure 9. Traffic type curves showing predicted increase in motor vehicle travel in Illinois on rural primary highways.

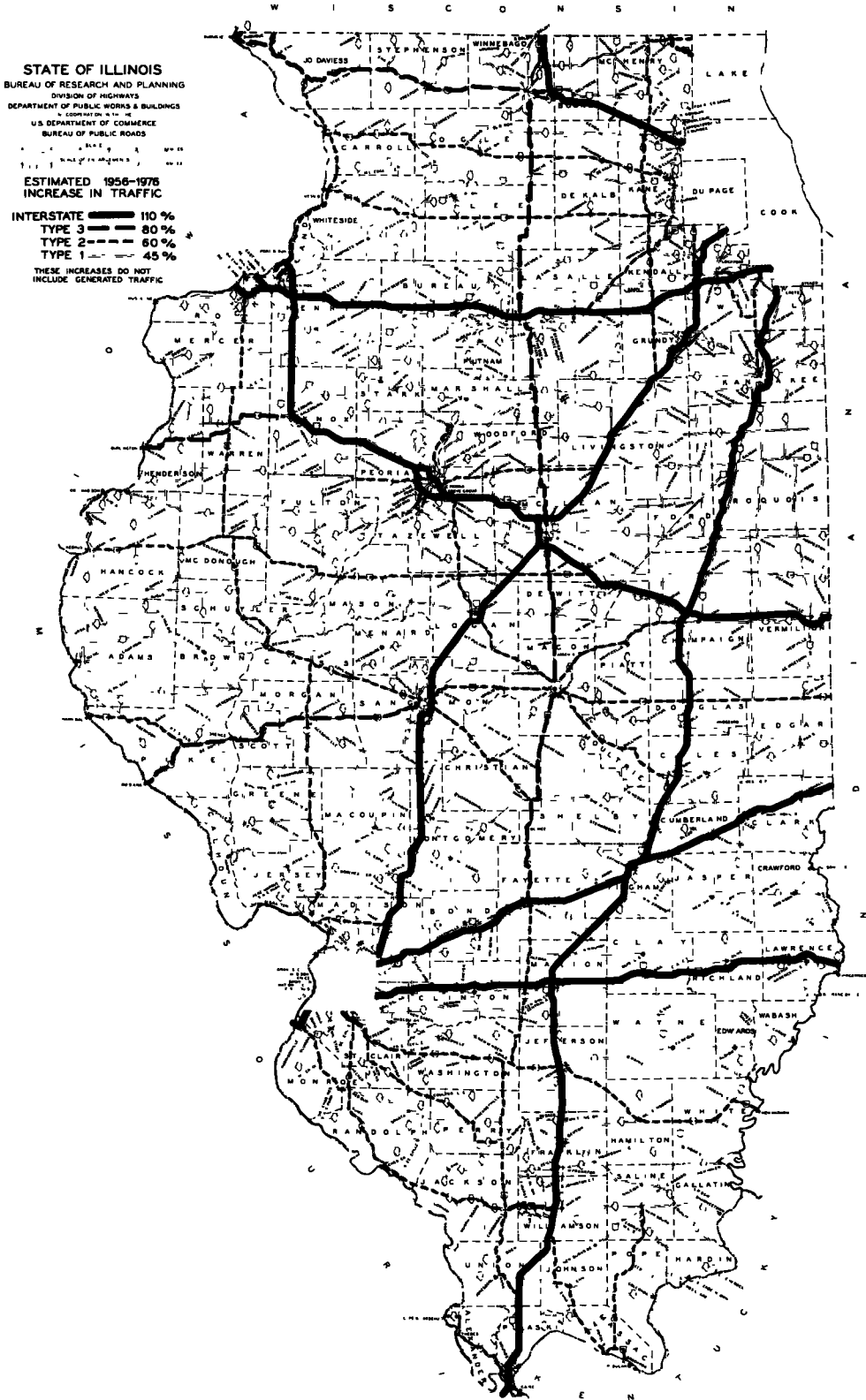


Figure 10.



2. When an improvement merely bettered the surface with a comparable type the increase after 10 years was 80 percent. Again much of the increase occurred immediately after improvement.

3. When the only improvement a road received was merely in the nature of maintaining the present surface type and condition, the traffic increases were low corresponding to Type 1 curve for the primary highways.

It should be noted that the percentages of increase as summarized above for the secondary system included any traffic that might have been diverted to the road as a result of the surface improvement. The summary indicates a direct relationship between the degree of improvement made and the percent of increase in traffic. In full recognition of the possibility that this may be to a large degree an effect rather than the cause, it has been assumed that traffic on secondary roads will increase as it has in the past depending upon the degree of improvement.