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Some Economic Effects of Highway Improvement

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Some Economic Effects of Highway Improvement

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Contents

Economic Evaluation of Two Indiana Bypasses

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THIS paper has been developed from before-and-after studies conducted on two Indiana bypasses. The before part of the studies was made prior to the completion of the bypasses while the after part was conducted about 6 mo. after the opening of the facilities to traffic. The cities chosen for the studies, although differing in size, location, and traffic pattern, are similar to many others which are presently considering means of relieving local traffic congestion.

The effects of the bypasses on traffic, accidents, land use, land value, and business in each of these two communities are presented and compared. The methods used to obtain and evaluate the necessary information are also briefly discussed and the factors causing a demand for bypasses in Indiana are presented.

It is shown that these two bypasses have had significant, similar, and largely beneficial effects. The bypasses effectively routed through traffic around both cities, but eased congestion in the business district of only one of them. The bypasses accelerated the urban development of the rural areas through which they passed and within a few months increased the land value of that area by 50 percent. The majority of businessmen believed the bypasses were beneficial and had not had detrimental effects on their business. A few fringe-area businesses which were primarily dependent on transient trade did suffer considerably. On the detrimental side, the severity of accidents on the bypasses, with more injuries and fatalities, more than off-set the reduction in accidents which occurred within the cities.

It is concluded that a bypass facility should be constructed only after a thorough analysis of all local factors and that some method, such as limited access, should be employed to control development along the route so as to insure safer facilities and maximum economic return to the state and to the users of the facility.

● THE highway system of the United States, currently including about 3 million mi. of rural roads and more than 300,000 mi. of streets, was not projected or developed at one time, but has evolved over a long period to meet the increasing demands for adequate motor transportation.

More than 70-billion dollars have been expended by all levels of government since 1900 for a highway system that is considered by many to be inadequate for the currently estimated 500 billion vehicle-miles of annual travel by more than 52 million motor vehicles. Nearly all of this expenditure has been made since 1921. Annual expenditures for roads and streets have increased from about 375 million dollars in 1906 to an estimated 4.25 billion dollars in 1952.

The total rural mileage increased from an estimated 2.15 million mi. in 1904 to slightly more than 3 million mi. in 1952. Nearly 90 percent of this increase in rural mileage occurred prior to 1921. About 55 percent of the total rural mileage of today has some type of improved surface.

Available statistical records do not provide an accurate measure of the changes which have occurred in total and surfaced mileages of town and city streets during the past 50 years. While substantial improvements have been made, it is generally indicated that since 1921 the rate of improvement of city streets has not been as great as that for rural roads.

Most of the obstructive deficiencies existed on the rural roads when the Federal

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Highway Act of 1921 was passed. City streets were considered to be relatively ample in their traffic capacity. But during the 1930's when automobile traffic in the cities became more intolerable, and as the problems of congestion, vehicle-operating costs, accidents, and other measures of the inadequacy of the arterial streets became more evident, greater emphasis was given to urban remedial measures. Among the methods used to relieve this situation were the use of appropriate signs and signals, improvement of parking conditions, installation of one-way streets, and the development of parkways, expressways, freeways, and circumferential routes in or near the cities.

Although state highway funds were used in the 1920's and 1930's to relieve urban congestion, the most significant impetus to the extension, improvement, and development of the modern highway system in this country in general, and of the advanced type of parkways, freeways, and urban expressways in particular, was provided by the Federal Aid Highway Act of 1944 which authorized separate funds for construction within metropolitan areas. Each succeeding act has included a similar provision. The 1952 act provided supplementary funds by permitting the use of defense-access-road funds for the construction or improvement of a circumferential highway around a city, or a radial intracity route upon receiving proper certification as being essential for civilian or military defense.

Improved methods of administration, finance, and engineering have led to greater efficiency in developing the highway system. There are, however, certain serious deficiencies in this development. The failure to provide adequate rights-of-way has been a basic fault in highway practice. The failure to protect that right-of-way by control of access, by regulation of location and type of roadside use, by set-back lines and other devices has resulted in costly highways. Many states have the legal authority to protect the highway by the use of these methods, but in some cases it has not been used effectively.

This general description of the highway situation is applicable at both the national and the state levels. By January 1, 1952, the State Highway Commission of Indiana was responsible for a highway system of 10,616 mi. in various stages of improvement. The counties were responsible for more than 74,000 mi. of local roads and streets and the cities were responsible for more than 10,000 mi. of streets. It is only reasonable to assume that in Indiana the expenditures, vehicle-miles of travel, and motor-vehicle registrations represent their proportional share of the nation's respective totals.

The communities of Indiana are typical of those scattered throughout the United States. They began to feel the effects of traffic congestion in the 1930's. The State Highway Commission of Indiana began as early as 1923 to cooperate with the small communities in an attempt to solve the traffic problem. A legislative act in 1937 extended the service to all cities except Indianapolis, and in 1945 routes through Indianapolis were included. Bypasses have been constructed in Indiana as a means of diverting traffic around a community and as distributors of traffic to the arterials of the community.

The diversion of through traffic to a bypass facility is of benefit to through traffic and to local traffic. City streets, divested of through traffic, provide increased capacity for local traffic. Among the specific benefits claimed are: increased activity of business, increased value of property, more effective use of land, convenience of parking, increased safety and convenience to the pedestrian, reduction of traffic conflicts, expeditious movement of through traffic, reduction of operating costs, and simplification of local traffic control.

Common practice in highway administration requires that an engineering and economic study should be made of any proposed major highway facility to determine the need and the cost of the improvement and to establish the direct economic benefits to the motorist. Such an analysis is often used to justify the cost on the basis that the savings to be affected in terms of reduced maintenance costs, savings in vehicle-miles, and time will equal the cost of the service and amortize the cost of the improvement over a period of years. This method is

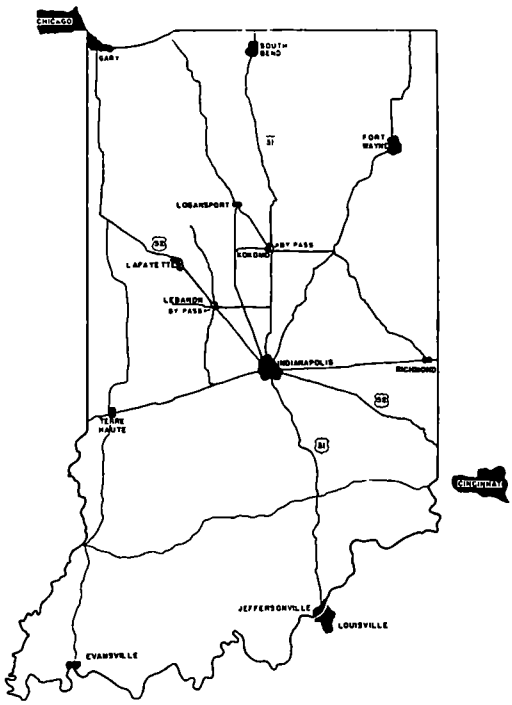

Figure 1. Principal highways connecting bypass areas with other parts of Indiana.

essential to insure proper investment of public funds and should result in benefit to the greatest number of people. These studies of direct benefits are often a standard procedure, but studies of the indirect effects upon a community have not received adequate consideration.

In 1950 the State Highway Commission of Indiana through the facilities and in cooperation with the Joint Highway Research Project of Purdue University developed a study to determine the benefits of a bypass to traffic and the effect upon business, land use, land value, and accidents. Commodity and passenger movements were also to be investigated. The bypasses, then in the process of construction at Lebanon and Kokomo, provided an opportunity to make a study of the problem before and after the facilities were opened to traffic. The facility at Kokomo was scheduled for traffic use within 60 days while the facility at Lebanon was scheduled for use within one year.

Kokomo is a rather typical Indiana city of about 35,000 population. Lebanon is a static community of less than 10,000 population. Highway transportation has become of real importance to each community.

The location of these cities with respect to the highway system of Indiana is shown in Figure 1. There were about 14,000 external trips at Lebanon and 25,000 external trips at Kokomo on a typical week day in 1951. The heaviest traffic at Lebanon is on US 52, which serves as a collector of traffic from Cincinnati and Louisville via Indianapolis to Chicago and other midwest areas. The heaviest traffic at Kokomo is on US 31 and US 35. The former route serves through traffic from Louisville via Indianapolis to the industrial cities of north-central Indiana and western Michigan. The latter route serves the industrial section of southwestern Ohio and the heavily industrialized region of northwestern Indiana.

The locations of the bypasses at Kokomo and Lebanon are shown in Figures 2 and 3. It may be observed that the bypass at Kokomo is on the outskirts of the city while the bypass at Lebanon is some distance from the city. Each bypass route

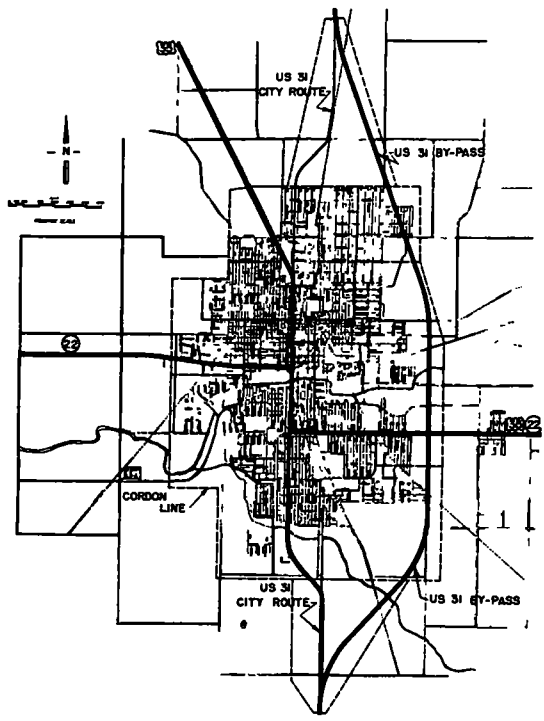

Figure 2. Kokomo Bypass and other state routes.

is slightly longer than the corresponding city route.

METHODS USED TO COLLECT DATA

The data used for an enumeration of the actual effects of the bypasses on (1) traffic, (2) accidents, (3) land use, (4) land value, and (5) business in each of the two communities were collected by several methods. The basic traffic data were obtained by two external-type, origin-and-destination surveys in each area. One of the surveys (before) was conducted prior to the completion of each bypass, and the second (after) approximately 6 mo. after the opening of each bypass to traffic. Each survey was of the roadside-interviewing type.

The before surveys included the roadside interviewing of occupants of vehicles as they crossed a cordon line which enclosed the developed area of each city. The standard questions of origin, destination, and trip purpose were asked; and when applicable additional information on number of persons, place of vehicle registration, commodity carried, and purpose of trip stop was obtained. These surveys, in conjunction with volume counts, travel-time runs, and other traffic studies, provided information relative to the traffic patterns and characteristics before the bypasses were opened.

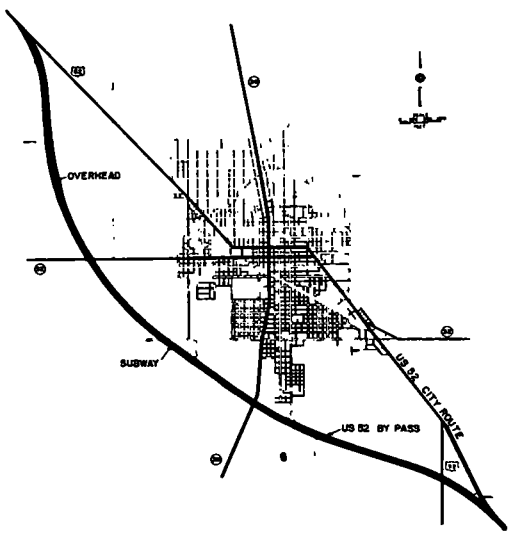

Figure 3. Lebanon Bypass and other state routes.

The after surveys, also of the roadside interviewing type, were conducted only within the bypass areas. Each bypass was enclosed with a cordon and traffic was interviewed as it departed from the bypass area. Data similar to those obtained during the before study were acquired and supplemented by asking each driver where he entered the bypass area. The data from these after studies were, after analysis, compared with a similar analysis of the before data to determine the changes in traffic patterns and the uses of the bypasses.

Accident data were collected from official accident records on file with enforcement agencies. The recorded accidents which occurred in each area during a full 6-mo. period prior to the opening of the bypasses were compared with those which occurred during a similar 6-mo. period after the opening of each bypass.

Land use in the area of each bypass was determined for three periods for the two bypasses. An estimate of the land use of the areas during a period approximately 10 yr. prior to the construction of the bypass was obtained from aerial photographs applicable to that period. The land use prior to any initial preparations for location of the bypasses in their present locations and the land use 6 mo. after opening of the bypasses were obtained from previous land-use surveys and field-reconnaissance notes.

The value of land in each bypass area was determined for periods (1) several years prior to the planning of the bypass, (2) prior to actual construction of the bypass, and (3) after opening of the bypass. These data were obtained primarily from several qualified real-estate dealers in each area. The actual sale and resale prices of tracts of land, as determined from their records or memory, for these various periods were collected during this phase of the study.

The effects on business in each city were determined from a survey of businesses located on or near the old routes. This survey was actually an opinion survey since all reported factual information of earnings of business, for example, income-tax records in Indiana, is confidential information. Each proprietor contacted was asked a series of questions

concerning his gross earnings during a period prior to the bypass and his earnings during a similar period after the opening. In order to minimize bias, the interviewer did not mention his connection with a transportation agency until the "earning questions" were answered. Each owner was finally asked to what he attributed his loss or gain and then his feeling on the effect of the bypass on his business.

EFFECTS OF THE BYPASSES

The influence of the bypasses on the two cities under consideration did not begin when they were opened to traffic. It began when the proposals for these bypasses were first submitted. The effects, moreover, will not end tomorrow but will extend far into the future. It is these effects which determine the value of a bypass to a community and the economic justification of it.

TABLE 1

DIVERSION OF TRAFFIC BY BYPASS FOR AVERAGE WEEKDAY TRAFFIC

Kokomo Traffic on US 31

	Before bypass	After bypass
Total traffic, south of city	5736	6050
Through trips (on US 31 only)	1315	1349
Number used US 31 bypass	----	1110
Percent used US 31 bypass	----	82 4%
Total traffic on city route (Business district)	14,055	12,830
Percentage decrease on city route	----	8 7%

Lebanon Traffic on US 52

Total traffic, south of city	6905	7298
Through trips (On US 52 only)	4064	4290
Number used US 52 bypass	----	4033
Percent used US 52 bypass	----	94 1%
Total traffic on city route (Business district)	9907	4797
Percentage decrease on city route	----	51 5%

Effects on Traffic

The primary purposes of a bypass are to divert through traffic around a city and to act as a distributor facility for local traffic. It is not surprising then that the most noticeable effect of these two bypasses has been on traffic. The actual diversion of through traffic is indicated in Figures 4 and 5. Both bypasses effectively routed approximately 90 percent of the through traffic on the route for which it was built around the city (see Table 1). The traffic of heavy trucks, which were engaged almost entirely in through movements, was almost completely eliminated from the former city routes. Almost 2,000 trucks at Lebanon and 300 at Kokomo which were engaged in the intercity movement of heavy products such as steel, processed food, general freight, and road-building materials used the bypasses.

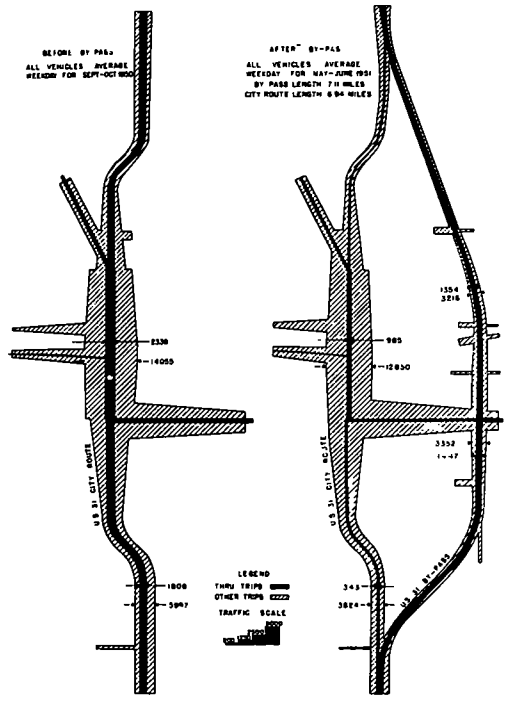

Figure 4. Traffic volumes for Kokomo before and after bypass.

The total volumes of traffic on the congested, former routes through the business districts, however, decreased variably. In Kokomo the volume decrease amounted to less than 10 percent. The differences in these volume reductions were due to differences in the volumes of through traffic that approached the two cities on the bypassed routes, 22 percent (about 1,300) of the traffic approaching Kokomo on the bypassed route desired to pass through the city while 59 percent (over 4000) of the traffic approaching Lebanon on US 52 (the bypassed route) was through traffic.

The volume reduction on the old route in Kokomo, therefore, was quite small and normal traffic increases will, within

a very short period, cause the congestion on this street to be worse than it was before the construction of the bypass. In Lebanon, however, the relief to congestion on the old route was very great and will be effective for many years. This comparison would indicate that although a bypass will effectively divert through traffic, the reduction of congestion on the old route will be quite small unless volumes, without allowance for increased traffic during the life of the bypass. A similar computation indicated a benefit-cost ratio of 2.61 for the Lebanon Bypass.

The bypasses also serve as new distributor facilities for local traffic destined to or from the cities. This local traffic is also shown in Figures 4 and 5 for the two cities. The major movement of traffic on the Kokomo Bypass is,

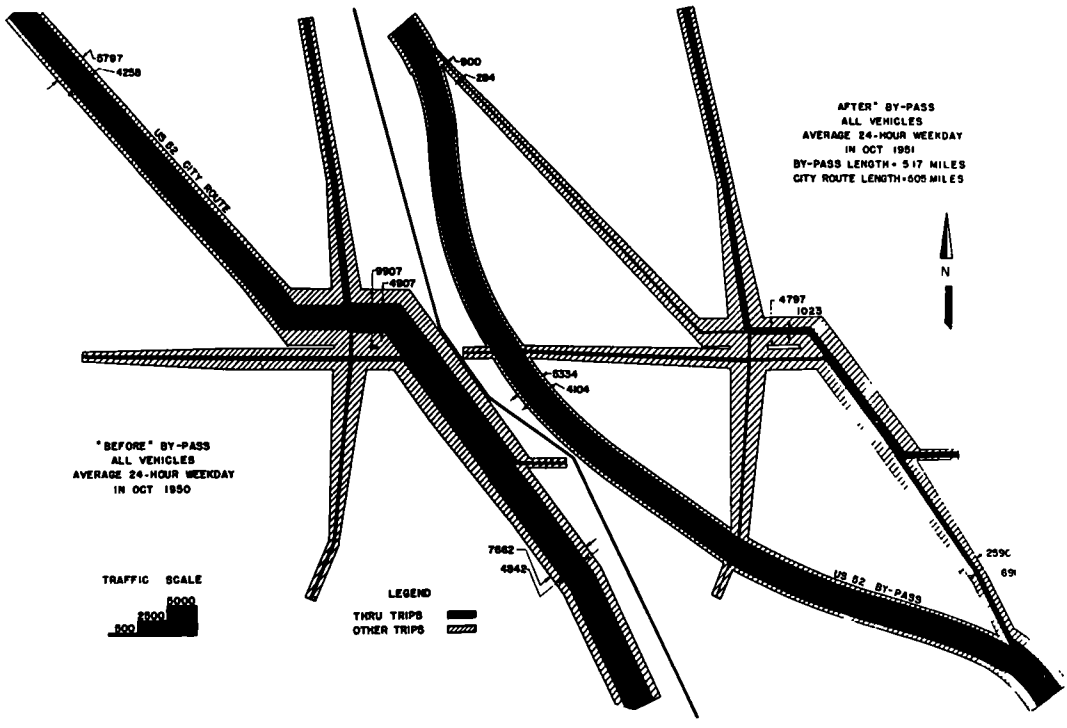

Figure 5. Traffic volumes for Lebanon before and after bypass.

the through traffic is a major portion of the total traffic on that route. If the through traffic is a minor portion of the total traffic, a bypass will have little effect on relieving congestion on the old route.

The savings, however, which accrue to through traffic, especially heavy trucks, in the form of lower operating costs and time saved may be of such economic value that a bypass would be justifiable even though it offered little solution to the downtown congestion problems. The savings to through motorists at Kokomo, for example, were of sufficient value to give a benefit-cost ratio for the bypass of 1.65 computed for 1951 through traffic in fact, by this type of trip. This movement is perhaps larger than normal in Kokomo because of a shortage of north-south streets. In both cities, however, this type of movement is primarily dependent on two important factors: (1) the amount of traffic destined for the city from outside the city and (2) the proximity of the bypass to the developed sections of the city.

Kokomo, because of its size, has many more trips than Lebanon whose origins or destinations are within the city. This naturally increases the use of the bypass at Kokomo by this type of trip. An equally important factor is the proximity of the bypass to the city. At Kokomo the by-

pass touches the edge of large developed sections of the city while at Lebanon the bypass is surrounded almost entirely by farm land. The use of the bypass at Kokomo by strictly local trips (those with both origin and destination within the city) illustrates this point (see Fig. 6). At Kokomo an important part of the total bypass traffic is composed of such trips (17.8 percent), while at Lebanon this movement is almost negligible (3.1 percent). Of all such local trips which used the bypasses, more than 90 percent had both termini of their trip within 1 mi. of the bypass. Lebanon had few such trips

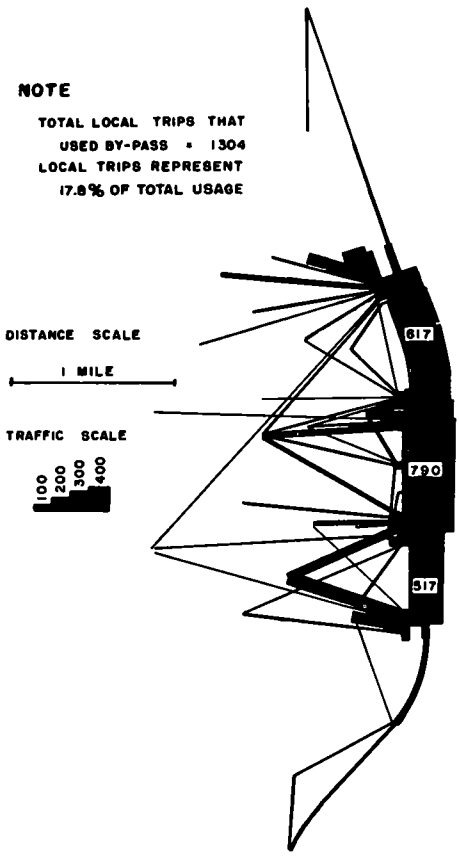

Figure 6. Local trip usage of bypass with location of termini for passenger cars and trucks.

that used the bypass, simply because there was an absence of popular origins and destinations that close to the bypass.

A considerable savings in travel time (4 to 5 min.) resulted for through traffic from both bypasses. A comparison of the travel times before and after are indicated in Figure 7. Less time was also required to travel on the old route through Lebanon after the bypass than before. The local drivers in Lebanon, even though they might not have used the bypass, also

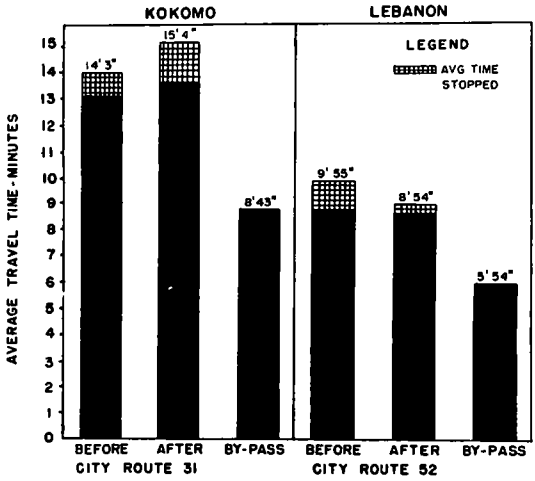

Figure 7. Average travel time.

received a benefit from the bypass in the form of this ease of movement on the city route. In Kokomo, however, it actually required a slightly longer time to travel through the city on the old route after the bypass was constructed than it did before. This is also shown by Figure 7. As has already been noted, the decrease in actual volume on the old route was quite small and congestion was still present during many hours of the day. Moreover, it is generally recognized that local traffic desires to travel slower in downtown areas than through traffic, and perhaps, after the "push" from through traffic was removed by diverting it to the bypass, the local traffic assumed a more-desired, "window-shopping" speed.

Wise foresight on the part of the planners of both bypasses has provided sufficient right-of-way for dual-laning whenever the use of the facilities warrants such improvement. Traffic increases that are presently occurring will necessitate the actual construction of the separated dual lanes within a very few years. This type of planning has affected every citizen of Indiana, since it provided eco-

nomically the right-of-way necessary for required construction.

Neither of the two bypasses, however, was constructed with limited-access provisions. The benefits which now actually are accruing, to particularly the through motorist in the form of the reduced operating costs and trip time, must be assured for the full life of the bypasses if the full benefits are to be realized. In computing the benefit-cost ratio, the total cost of the facilities was averaged over the expected life of the bypasses, and the benefits were computed on the basis of existing costs and conditions. In order to receive these benefits, the relative ease of movement that now exists on these bypasses must be maintained for the life of the facilities. Experience indicates that careful control of access might do much to maintain this ease of movement as development of the bypass areas continues.

Effect on Accidents

A tabulation of the accident data for both bypasses for periods of before and after is shown in Table 2. The accidents on the former routes through the cities were less in number after the bypasses than before them. The accidents which occurred on the bypasses in similar periods, however, reduce the encouragement indicated by such statistics. The number of accidents which occurred on the bypasses, when compared to the decrease in number of those which occurred on the old route, can be considered favorably with accident trends in other cities. Due to increased speeds on the open highway, however, the accidents which did occur on the bypasses were probably much more severe than if they had occurred on the old routes. The number of deaths, two on the Kokomo bypass and one on the Lebanon bypass within the first 6 mo. of

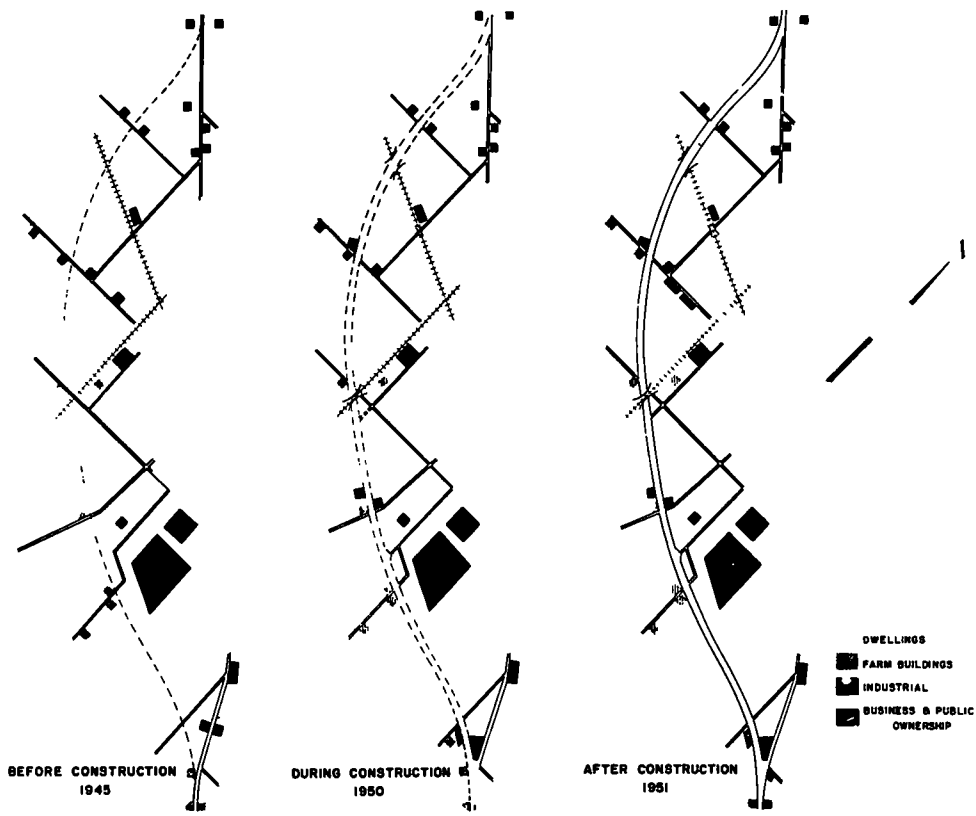

Figure 8. Land use of bypass area for Lebanon.

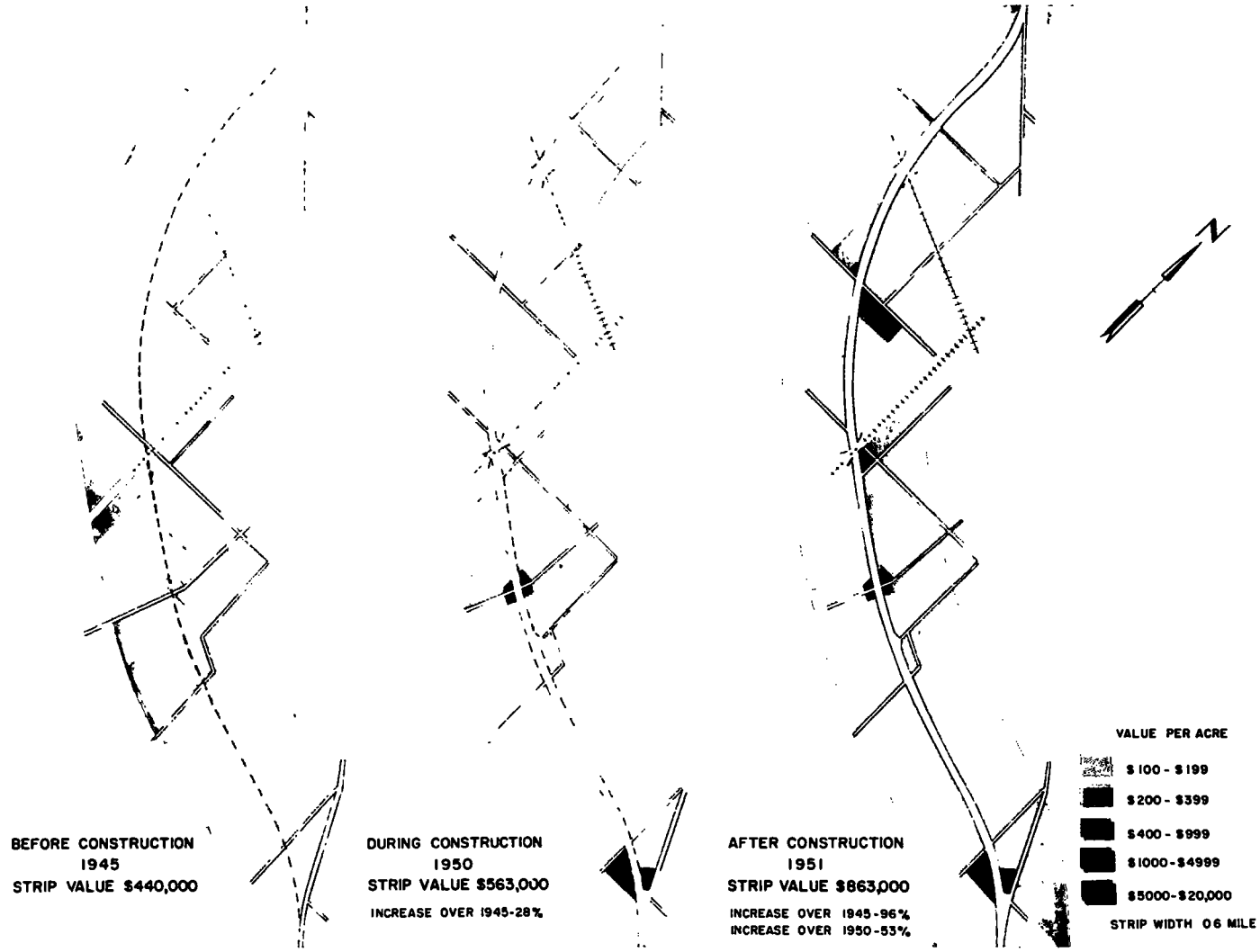

Figure 9. Land evaluation of bypass area for Lebanon.

TABLE 2

ACCIDENT COMPARISON ON STATE ROUTES
Before and After Bypasses

Lebanon

	In City		On	Total
	Before	After	Bypass	After
Number of accidents	44	29	27	56
Number killed	0	0	1	1
Number injured	8	3	11	14
Average damage	$184	$166	Severe*	--

All data for 6-month periods.

Kokomo

Number of accidents	205	185	33	218
Number killed	0	0	2	2
Number injured	23	23	9	32
Average damage	$126	$134	Severe*	--

All data are for 6-month periods

*Estimated damages were not available but police authorities stated many vehicles were demolished

on the new facilities. The land use of the bypass area at Lebanon for 1945, 1950, and 1951 is shown in Figure 8. This is very similar to the development which occurred at Kokomo. At both locations, development of the areas, which was only normally active prior to the bypasses, increased appreciably and is continuing rapidly. For example, three service stations, two restaurants, one motel, and one farm-equipment store were under construction before the Lebanon bypass was opened to traffic. At Kokomo, within 6 mo. of the opening of the bypass, four businesses were in operation at one intersection, and a residential area, whose only outlet is to the bypass, contained five new residences.

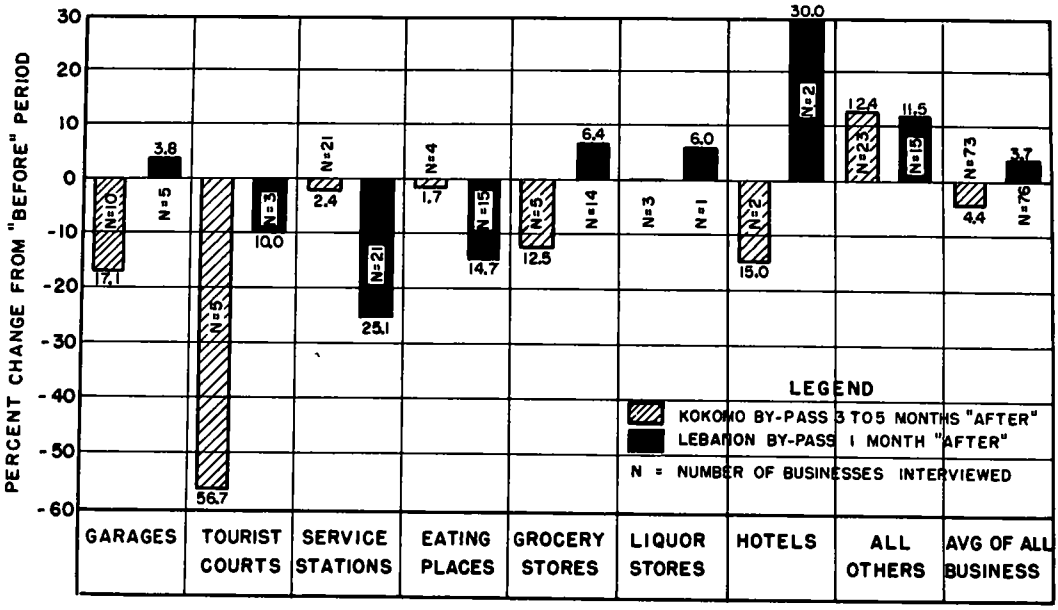

Figure 10. Gross-business comparisons of similar periods before and after bypass.

operation, certainly offset any economic benefits that resulted from the decrease in accidents on the city routes.

Effect on Land Use

Before 1945 the areas through which the two bypasses now pass were almost entirely farm land. As soon, however, as planning for the bypasses began, interested individuals began developing the land to fit the needs of the travelers

This rapid development of the area again emphasizes the problem of access control. Unlimited access increases the frictional movements between bypass users and can only result in a curtailment of the ease of movement for them. In the absence of any limited-access provisions, the Kokomo Planning Commission is attempting to control the development and the access points by the use of an intelligent zoning ordinance and a required platting procedure.

Effect on Land Value

The effect on land value, as expected, has been influenced by the development of the bypass areas. Not only does this hold true for those areas actually under development, but it also extends into all areas that border or are near the bypasses. A chart showing land values of the area along the Lebanon Bypass is shown for three different periods in Figure 9. The Kokomo effects were very similar. There the land without improvements was worth approximately $500 per acre during the period before the bypass was located. During the construction of the bypass, various parcels of land were offered for sale at about $750 per acre. As the bypass neared completion, the asking price for this same land, spurred up by some fabulous prices actually paid for choice locations, was increased to $1,000 per acre. Various real-estate men believed that this amount would be obtained if the area were zoned for business purposes. Since only limited areas are, however, zoned for business, these men believed that the average selling price of all land along the bypass would be about $750 per acre. They attributed the increase of from $500 to $750 per acre solely to the presence of the bypass and not to general increases in land values.

Effect on Business

The survey of effects of business was limited in both cities to those businesses which were located on or within a few blocks of the original route through the city. It was believed that the greatest adverse effect would certainly occur among this group. Some of the business men felt that the bypass had taken business away from them. Others felt that although the bypass had caused them to lose the business of through traffic, it had resulted in more local business for them. A few thought the bypass actually had helped them. The information as to the reported effect on gross earnings between periods both before and after the bypasses is summarized in Figure 10.

Some types of businesses reported overall decreases which they attributed to the bypasses. Some tourist homes, hotels, gasoline stations, restaurants, garages, and groceries reported a decrease in business during the first few months after the bypass from that for a similar period before the bypass. On the other hand, others reported increased earnings. Many of the owners of the businesses which suffered decreases were, however, in favor of the bypass. They were certain that it relieved congestion in their area and later expected to attract more local customers.

A few fringe-area businesses not located in the downtown business district but located on the old route near the junction points of the bypass and the old route suffered considerably. Many of these businesses catered to transient trade and now find themselves in locations where little of that type of trade can be expected.

In both cities a majority (68 percent at Kokomo and 59 percent at Lebanon) of all businessmen contacted were sure, 6 mo. after the bypasses were opened to traffic, that the bypasses had not hurt their business and were hopeful of obtaining more local customers. Those businesses that were most detrimentally affected were looking for more preferable locations, often on the bypass.

During the origin-destination surveys, data were collected on the number of through vehicles that actually did stop in the two cities and the purposes for which they stopped. A summarization of these data for the two cities is shown in Figure 11. These data indicate that less than 25 percent of the total through traffic desired to stop within the cities and that a large portion of this total, because of certain stop purposes, necessitated a stop in the city with or without the bypass. During the after study similar purpose of stop data indicated that a large percentage (60) of those who stopped to eat, get gas and oil, or for any purpose did not use the bypass but continued into the city. This information is shown in Table 3 for the Kokomo bypass. An analysis of this information indicates that the bypass should not adversely affect business on the former route. For example, the Kokomo business district, with 1,315 through trips

on US 31 of which 24.9 percent wished to stop in the city, lost the business of only about 130 vehicles (40 percent of 24.9 percent of 1,315).

CONCLUSIONS

The following conclusions are drawn from the analysis of the Kokomo and Lebanon By-Pass Surveys:

1. The effects of the bypasses on the two cities have been significant with benefits being received by the motorist (savings in time and vehicle operation), the land owner (increase in land value and easier access for some), and the community (alleviation of congestion, opening of a new area for development, and increased valuation for taxation).

2. The bypasses are effectively routing the through traffic (approximately 90 percent) on the routes for which they were built around the city.

3. The relief of congestion on the former city routes is only minor at Kokomo but is very appreciable at Lebanon. The difference of effect here is due to the differences in the percentages of through traffic in the before traffic volumes on the old routes. This indicates that bypasses are not always the answer to congestion problems.

4. The bypasses are used extensively as collectors and distributors of local traffic. The Kokomo Bypass is used more extensively for this purpose because of its close proximity to developed areas of the city.

5. More than 90 percent of all traffic whose origins and destinations were both within the cordon area and who used the

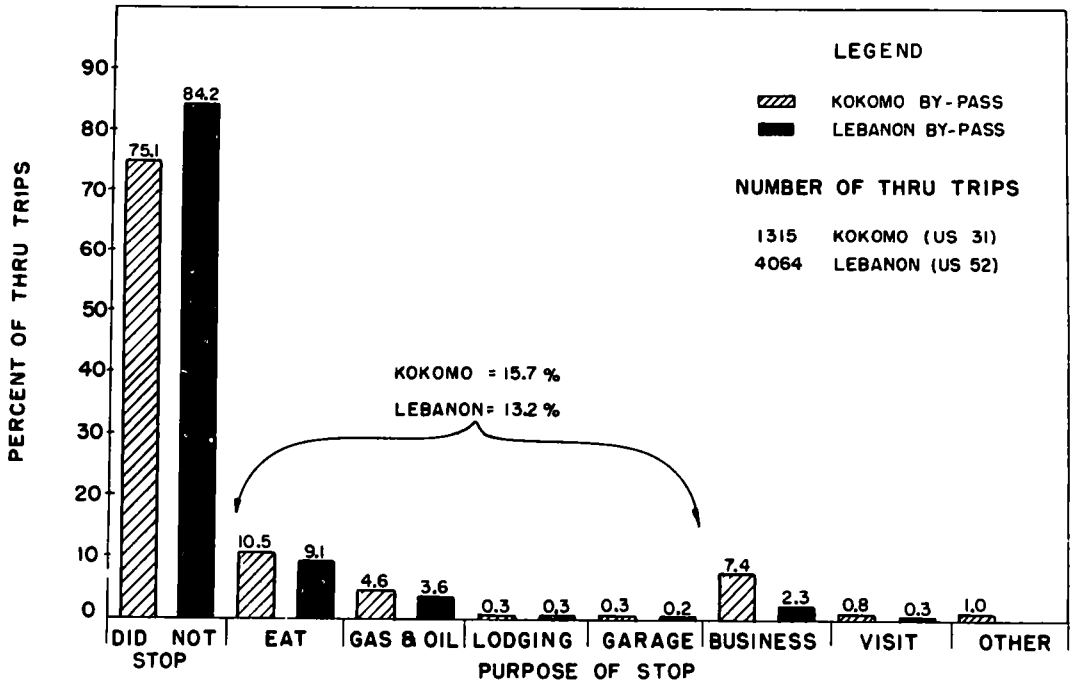

Figure 11. Stops by through vehicles.

TABLE 3

PURPOSE OF STOP VERSUS ROUTE TAKEN FOR ALL THROUGH VEHICLES ON US 31

Purpose of stop	Total no. trips	Bypass vehicles	Bypass percent	Through city vehicles	Through city percent
No Stop	1161	1035	89 1	126	10 9
Eat	86	46	53.5	40	46 5
Gas and Oil	37	22	59 5	15	40 5
Lodging	1	0	0	1	100 0
Business	50	5	10.0	45	90 0
Garage	1	0	0	1	100 0
Visit	11	2	18 2	9	81.8
Other	2	0	0	2	100.0
Total Stop	188	75	39.9	113	60.1

bypasses had both termini of their trip within 1 mi. of the bypasses.

6. Accidents decreased in number on the former city routes, but the number and severity of accidents on the bypasses appear to have offset this decrease.

7. The presence of the bypasses has increased the rate of development of the bypass areas. Quick action by local and state government is necessary to prevent a disorderly development of the area.

8. A method such as limited access appears to be necessary to assure continued ease of movement on the bypasses and thus to assure maximum economic return and safety.

9. The value of land adjoining the bypasses was increased about 50 percent because of the presence of the bypasses. It is reasonable to assume that increases in tax valuations and revenue for local government will follow.

10. The majority of businesses within the two cities have not suffered detrimental effects from the bypasses. A few types of business, especially if located on the old routes outside the central business districts, such as tourist homes, hotels, restaurants, and gasoline stations, have suffered some economic losses. A great majority of businessmen in both cities feel that the bypasses are definite assets to their cities.

11. The variations between the effects of the bypass on traffic in the two cities indicate that a bypass should not be constructed before a thorough analysis of all local traffic characteristics.

12. Future periodic surveys of the bypass areas would determine further effects of the bypasses and provide important information on the operation and control of such facilities.

ACKNOWLEDGEMENTS

Most of the data presented in this report was derived from a cooperative study by the Joint Highway Research Project of Purdue University and the State Highway Commission of Indiana. The supervision of the study was by R.M. Brown, in charge of metropolitan-area traffic surveys, State Highway Commission of Indiana; and K. B. Woods, associate director, Joint Highway Research Project.

Grateful acknowledgement for their helpful guidance is given to the membership of the Advisory Board of the Joint Highway Research Project, especially to R.H. Bower, chief engineer of construction; J.R. Cooper, engineer of bridges; J.T. Hallet, engineer of roads; F.F. Havey, engineer of materials and tests; and E.B. Lockridge, superintendent of maintenance, representing the State Highway Commission of Indiana.

The assistance given by field and office personnel in the collection and analysis of the data is appreciated. Special recognition is given to Richard McMillen for his assistance in conducting the business, land-use, and land-value studies in Lebanon.

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Socio-Economic Relationships of Highway Travel of Residents of a Rural Area

LORIN A. THOMPSON, Director, Bureau of Population and Economic Research, and CARL H. MADDEN, Research Assistant; University of Virginia

THIS paper is a progress report upon a study sponsored jointly by the Bureau of Public Roads, the Virginia Department of Highways, and the University of Virginia of the effects of a new manufacturing plant upon the economic pattern of a rural county of declining population and low income, and upon the pattern of employment, income, occupation, motor vehicle ownership, and travel habits of the residents.

A comparison of selected socio-economic characteristics with travel habits in two counties shows that (1) the amount of travel of a family varies proportionally with the size of the income; (2) travel varies directly with the socio-economic level; (3) there is little consistency between the age composition of the family and the amount of travel, however, each county seems to have its own pattern in this respect; (4) the amount of travel tends to be inversely proportional to the age or the vehicle; (5) livestock and poultry farmers travel more than general of subsistence farmers; (6) among the total population of each county, clerical, professional and government workers travel most and subsistence farmers travel least.

In Charlotte County there has been a diversification of farming since the plant started its operation. The relative income level has increased and this has been reflected in an increased volume of trade. Some of the workers have changed their residences since 1949. The change of residence, however, does not indicate any tendency for the workers necessarily to move any closer to the plant. Their movements thus far have been on to hard surfaced roads, even if such a move means increasing the distance of their residence from the plant.

● MEASURING future highway needs in urban and rural areas has increasingly engaged the attention of social scientists, as well as the engineers who have been primarily concerned with road construction and design. The present study is concerned mainly with an analysis of the changes in motor-vehicle ownership and travel habits of the population of rural counties as they may be related to changes in the pattern of employment, income, and occupation. Some 3 years ago the Bureau of Population and Economic Research of the University of Virginia undertook a study to trace the changes in travel habits of the people and their income, socio-economic status, occupation, and the like in a county which had acquired a new industry. Within the last year we have undertaken a similar study for a county in which there has been no new industry.

One reason for the interest in the development of rural industry is that it has often been suggested as a method of improving the income level of agricultural workers in the southeastern United States. It was also deemed to be of equal importance to study the effect of the new industry and altered economy upon road use and travel habits. From such study the facts would be developed to show the most likely pattern of future travel and this in turn would indicate the pattern of road needs.

The original concept of the study was to measure so far as possible the impact of a new plant upon various social and economic relationships, travel habits, and patterns of road use in a rural county by measuring these various attributes prior to the operation of the plant. The present plan is to repeat this same series of measurements after an interval of five

years to determine more precisely (1) what changes have occurred among the population of the area with respect to such characteristics as occupation, income, travel habits, motor-vehicle ownership, and the like and (2) the changes in the business structure of the county.

The project has developed as a series of case studies. The first county chosen was Charlotte, a rural county in the Southside Virginia Bright tobacco belt with declining population and few off-farm job opportunities but with a new industrial plant. The new plant, the Drakes Branch Plant of Pacific Mills, manufacturers of textiles, employs around 400 people, predominately females. This employment is from a county population of 14,057 and a county labor force of 4,922, or it is about one tenth of the labor force.

In designing the study the problem of isolating changes in the county attributable to the new plant from other changes in the county has been attacked by the use of a control county. Buckingham County, Virginia, similar to Charlotte in many respects, was chosen as the control county since no industry like Pacific Mills has yet been located in it. The arrangement of the studies in the project as a whole has been to measure (1) the social and economic characteristics of the study area and the travel habits of the people prior to the establishment of the new plant; (2) the changes in social and economic characteristics of the area following the establishment of the plant; and (3) the economic and social characteristics of the area some 5 years after the establishment of the plant and to analyze the changes resulting during the interval.

The method employed in making the studies has been the home-interview survey of a 25 percent sample of the dwelling units in the county, secured by the selection of every fourth house on each road and street in the county, including both public and nonpublic. In this connection, Virginia is one of the states where the responsibility for administering rural roads lies in the hands of the state highway department in all counties but two, Henrico and Arlington. Public roads are, in general, those that in the opinion of the county government officials acting under state policy render a public service and have sufficient traffic to justify state highway-department maintenance. Nonpublic roads include private driveways and property-entrance roads, as well as some few multiple-family roads with very few occupied dwelling units per mile of road. Nonpublic streets include those not constructed to highway-department standards.

The final results of this project must wait upon the completion of the after part of the study. Meanwhile, information has been revealed by the work thus far that might be of interest. The present paper, a kind of progress report, has as its purpose that of discussing some of the socio-economic relationships associated with the travel of the residents.

The paper will first describe briefly the character of the rural areas studied and the nature of the travel patterns found in them. Then, the variation of travel among residents with different socio-economic characteristics will be discussed and the relationships of travel patterns and socio-economic characteristics of residents will be examined.

The areas under study, Buckingham and Charlotte Counties, are rural Piedmont counties of low population density, neither having any place larger than 1,000 people. Relatively heavily wooded, with poor soil, limited in natural resources and water supply, they derive their chief source of income from agriculture and forest products, and the agriculture of both has traditionally been centered around tobacco. In Charlotte County about three fourths of the population live on farms. In Buckingham about half of the population is on farms and another 30 percent depend for their livelihood upon timbering and slate mining.

They have both been areas of declining population since the turn of the twentieth century, each having lost around 10 percent of its population between 1940 and 1950 while the state gained around 24 percent.

The white population has shifted from about 50 percent of the total in 1900 to about 60 percent in 1950 as the Negro has migrated to nearby cities faster than the white. The population of both counties is young when compared with that of the state; the adults have on the average a year's less education than in the state as a whole; family income and level of living are lower. The low-income farm families, the

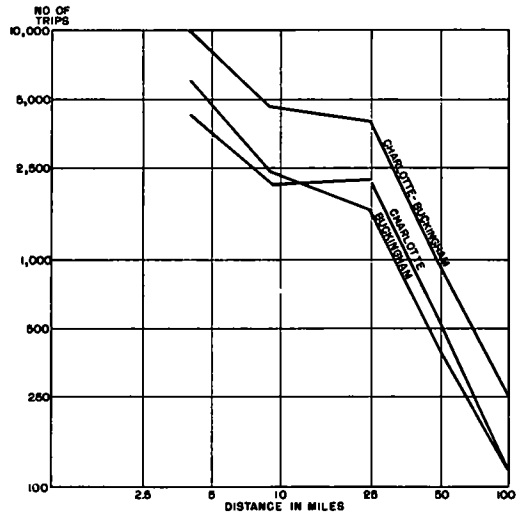

Figure 1. Number of trips by length of trip, home-interview survey, Buckingham and Charlotte counties, February to March, 1949 and 1952.

5 to 9 percent subsistence farm families, and an 11 percent smaller number of females in the county labor force than in the state all indicate potential off-farm employables in the labor force.

The location of each county in the state system of highways is similar; their geographical centers are over 40 mi. from any city of 25,000 or more and they are both about the same distance from Farmville, a trading center of some 4,500 people. Both counties are traversed by US-numbered highways, Buckingham by Routes 15 and 60 and Charlotte by Routes 15 and 360.

Thus the two counties are fairly similar and each is representative of the low-income rural area of declining population in the Southeast. Now, what was found regarding the travel habits of the sample families in these areas?

First of all, average trips and miles per day found in Charlotte County, if corrected from 1949 to 1952 by an assumed annual increase of 8 percent per year,[1] would be close to those in Buckingham in 1952. They would be 2.1 and 2.2 trips per day and 14.9 and 15.6 mi. per day travelled for the sample families in the respective counties. Average length of trip was 9.7 mi. in Charlotte as compared with 7.0 mi. in Buckingham.

Over half the trips reported in the Buckingham home-interview study were less than 5 mi. in length, and around 95 percent of them were less than 30 mi. in length. In Charlotte County 43 percent of trips of home interview families were less than 5 mi. long and 80 percent were less than 15 mi. long. In addition, the distribution of the number of trips of different lengths in the two counties seems similar. If logarithms of trips are plotted against logarithms of distance of trip, as shown in Figure 1, the shapes of the curves are similar. The pattern of trips by purpose was similar in both counties. In each, business trips made up the largest share of total trips and work trips were next in importance. In both counties shortest trips were made to church and trips for medical purposes were among the longest.

Next we turn briefly to road use. It is clear from maps of traffic volume in these two counties that the US-numbered highways carry most of the traffic. In Charlotte County, US 15 and US 360 carry over half, and in Buckingham US 15 and US 60 carry 80 percent of the daily vehicle-miles travelled on all primary routes. Much of this traffic is through traffic. This means that any increase in traffic of the residents of the county arising from such a development as a plant employing one tenth of the existing working force would probably affect total traffic volume on these roads only slightly. It is the traffic of the residents, the traffic of the local

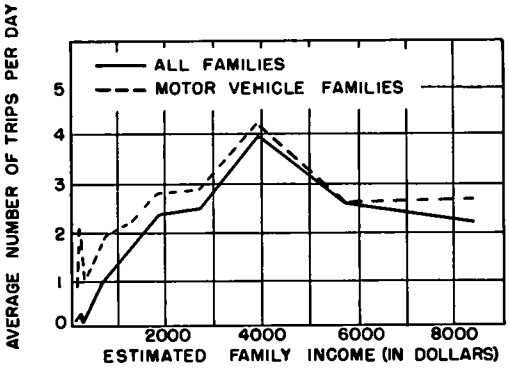

Figure 2. Average number of trips per day for the 783 home-interview families classified by estimated family income, Charlotte County.

[1] The amount Virginia highway engineers estimate travel increases annually in the state

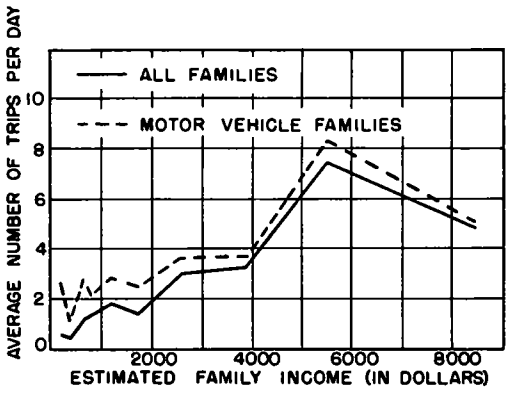

Figure 3. Average number of trips per day for the 687 home-interview families by family income, Buckingham County.

road system, not total traffic on the roads in the counties that is being analyzed intensively. This viewpoint has led in this project to the study of the variation of traffic of county residents with changes in socio-economic status.

To study the socio-economic characteristics of families in relation to their travel, families were classified by income, socio-economic status, and family-cycle status. Particular attention was given to farm families to show the travel by type of farm, major source of income, or economic land class. In addition, travel has been studied by color of family, vehicle ownership, and occupation.

First, a word about the measures used. The data on income in both counties were estimates made by local tax officials using their knowledge of families and data collected during the surveys. The estimates for Buckingham County for 1951 income were compared with the 1950 Census income data secured by a 20-percent sample. The estimates of the local officials gave a median income of around $1,600 as compared with a census median of around $1,200. Whether this difference is due to an actual increase in income from 1949 to 1951 in Buckingham or is the result of technical differences in the methods employed is impossible to determine at this time.

Socio-economic status is a measure of the standard of living based upon the ownership of material goods. Since it reflects saving and the accumulation of capital goods, this scale appears to be a more stable indication of a family's social and economic position in the community than annual income, which may fluctuate for many reasons. Essentially, it is a method of ranking people by weighting the ownership of different items in proportion to the incidence of their ownership in a larger population like the United States.[2] The eight items included in this scale in this study were: construction of house, rooms per person, lighting facilities, water piped into house, electric refrigerator, radio, telephone, and automobile other than truck.

Cycle status refers to the stage of development of the family. The family goes through stages as children are born, grow up, then leave the household. The family-cycle-status classification provides a method of systematically taking these changes into account.

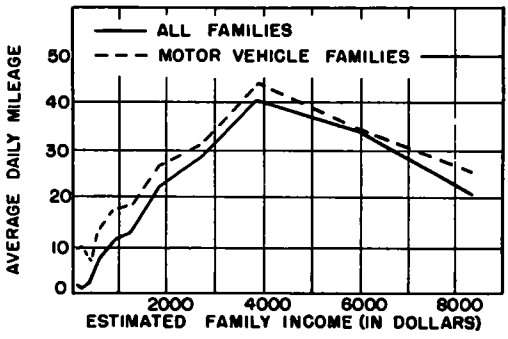

Figure 4. Average daily mileage for the 783 home-interview families classified by estimated family income, Charlotte County.

The results found by the two studies follow. Although there are exceptions for small subgroups, travel in both counties is directly related to income and socio-economic status, both trips and miles per day, as Figures 2 through 5 indicate. In both counties trips per day increase with income up to a level of about $4,000 in Charlotte County and about $5,500 in Buckingham County. Therafter travel decreases with increasing income. The pattern of daily mileage for Charlotte

[2] This socio-economic scale is a short form of the Sewell scale Eight of the fourteen items which he used were available from the county studies. See William H Sewell's "A Short Form of the Farm Family Socio-Economic Status Scale," Rural Sociology, Vol 8, No 1 (June, 1943), pp 161-170

County families shows the same peak at an income level of $4,000. In Buckingham County the relation between income and mileage is direct for all incomes. In both counties the number of samples in the high-income group was small; thus sampling errors probably contribute to the difference found for these groups. The irregularity in the low-income groups is a result of fine graduation of the income scale for incomes less than $1,000. Among low-income families the greater difference between the travel of motor-vehicle families and all families results because fewer low-income families are motor-vehicle owners, and low-income families without vehicles travel very little.

Socio-economic status is also directly related to travel, as reference to Figures 6 through 9 reveals. The peak in Buckingham County for motor-vehicle families with socio-economic status scores of 29 through 31 may be due partially to sampling errors, since only 13 families were observed in this group.

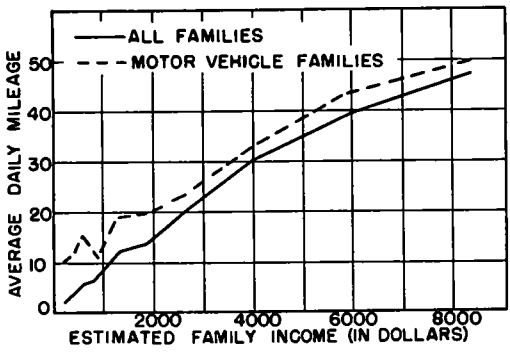

Figure 5. Average daily mileage for the 687 home-interview families by estimated family income, Buckingham County.

The evidence on the variation of travel with the stage or age of the family group is ambigious as Figures 10 and 11 show. The high-travel families in Charlotte County were the two-generation-type families with the oldest child over 36 years of age living at home; in Buckingham County they were younger families with children up to 35 years of age and living at home. The occupational structure in the two counties may affect this relation. In Buckingham the timbering industry employs young and vigorous man and requires much travel.

Among the various occupations, families engaged exclusively in farming travel the least miles while professional, clerical, and government workers travel most in both counties. Owner-operators of established businesses were also high-travel families. Vehicle ownership is directly related to travel; the more cars a family has and the newer they are, the more the family travels. For families with one vehicle, however, whether it is a car or a truck does not affect travel. Age of vehicle is inversely related to travel but there are seasonal variations in this relation.

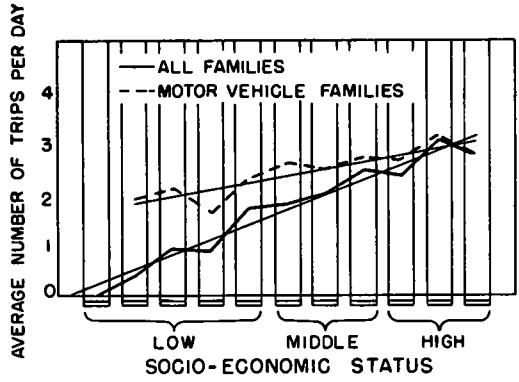

Figure 6. Average number of trips per day for 783 home-interview families and the 516 motor-vehicle families classified by socio-economic status with linear least squares relationships plotted, Charlotte County. Low: 23 to 37. Middle 38 to 46. High 47 to 55.

The pattern of farm-family travel in both counties is similar. Livestock, dairy, and poultry farmers travel most; sub-

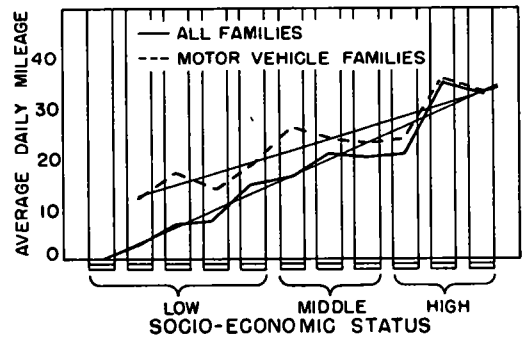

Figure 7. Average daily mileage for the 783 home-interview families and the 516 motor-vehicle families classified by socio-economic status with linear least squares relationships plotted, Charlotte County.

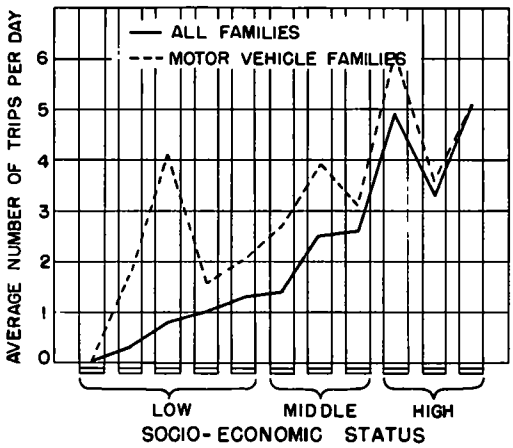

Figure 8. Average number of trips per day for 687 home-interview families and 430 motor-vehicle families by socio-economic status, Buckingham County.

sistence farmers travel least. Part-time farmers and nonfarm families are also relatively high-travel families. Though the evidence is not clear, it appears, too, that travel increases according to the level of appraised value of land of the residents.

To find out whether these relations are stable and to trace seasonal changes in travel, seasonal surveys were made during 1950 and 1951 of a smaller sample in Charlotte County of 125 motor-vehicle owners stratified by income. The sample was again interviewed in 1952. These surveys indicate the stability of the relations over the period involved. They also show that the economy of Charlotte County is becoming more diversified. Since 1945,

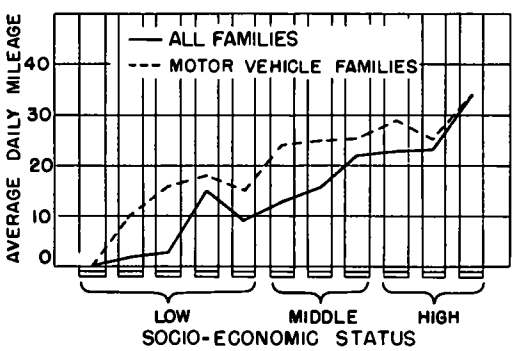

Figure 9. Miles per day for 687 home-interview families and 430 motor-vehicle families by socio-economic status, Buckingham County.

there has been a decline in the number of farms in the county as in the state. Also there has been as increase in the importance of livestock, dairy, and poultry farms and a decline in tobacco farms. Income and level of living have increased in the county, and families with members employed at the new plant have the largest percentage of families with increased income. Trade and commerce have increased, and the pattern of retail sales in the county has changed. Between 1948 and 1950 the share of open-country stores in Charlotte County retail trade declined while that of the towns increased. In Buckingham County during the same period, with an increase in income the reverse

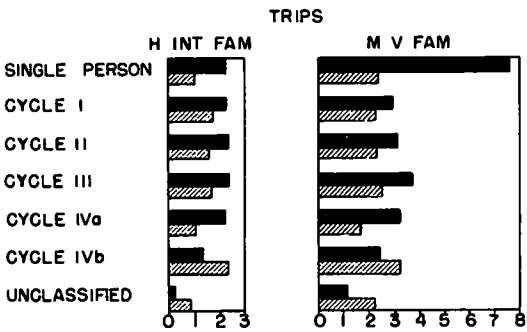

Figure 10. Trips per day of home-interview and motor-vehicle families by cycle status compared in Buckingham and Charlotte counties. Cycle I: Childless couple, wife less than 45 years of age. Cycle II: Family with oldest child less than 14 years of age. Cycle III· Family with oldest child between 14 and 35 years of age. Cycle IVa: Childless couple, wife 45 years of age or over. Cycle IVb· Family with oldest child 36 years of age or over. Unclassified. Childless couple, age of wife unknown. Solid bars represent data from Buckingham County, and shaded bars represent data from Charlotte County.

tendency has occurred; the share of open-country stores on secondary roads in the county retail trade is increasing in importance there.

Changes in the residence of workers in the new plant have been followed since 1949. They show no tendency for movement closer to the plant; on the contrary, there has been a tendency for as increase in the number of workers living from 5 to 10 mi.

from the plant. At the same time, of course, the density of workers decreases with distance from the plant in a regular manner, as would be expected. There has also been noted a tendency for workers to move towards all-weather roads whether the movement takes them nearer to the plant or farther from it by a few miles.

The method to be employed in the after study in the project will be to compare the changes that have occurred in Charlotte County during the 5-yr. period between 1949 and 1954 with changes over a comparable period in the control county.

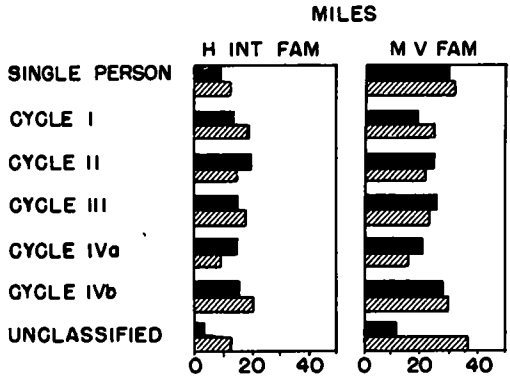

Figure 11. Miles per day of home-interview and motor-vehicle families by cycle status compared in Buckingham and Charlotte counties.

Factors such as employment, income, occupation, motor-vehicle ownership, and travel habits need to be compared before an analysis can be made of the effect of the plant during the time interval involved. But some of the findings—the movement of workers in the plant, the change in the type of farming, the increase in income of the plant workers—are already fairly clear.

Certain other problems which go beyond the scope of the present case studies remain to be investigated. It is uncertain as to whether case studies such as the present ones will indicate the pattern of future highway needs in rural counties.

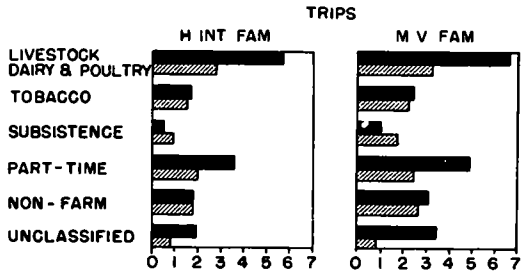

Figure 12. Trips per day of home-interview and motor-vehicle families classified by type of farm in Buckingham and Charlotte counties.

Modifications in travel habits with respect to shopping centers indicate the changing importance of different roads in the county system. If travel for business and social purposes follows similar patterns, then the relative amount of local travel would reflect the increasing or diminishing importance of each road. Questions have also arisen regarding the relation of traffic volume and population density, of the relation of classes of roads to relative sizes of the places they connect. The present study will undoubtedly show the roads which are indispensable for trade, work, and other social contacts between and among residents of a county, and how road use has changed with shifts in the economic pattern. Some suggestions may also emerge as to how the road requirements of local residents may be better integrated into intercity and interstate road needs.

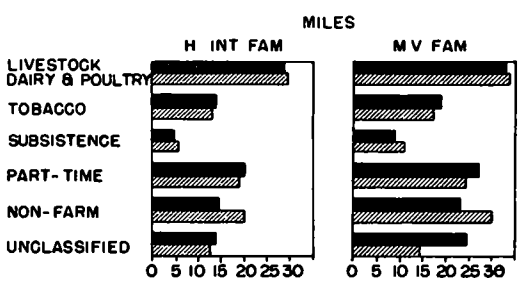

Figure 13. Miles per day of home-interview and motor-vehicle families classified by type of farm in Buckingham and Charlotte counties.

H R B Bulletins

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