Engineering
Recommendations
for Adequate Road
and Street Systems

A HIGHWAY PROGRAM FOR KENTUCKY

W.W. Sanders

a highway program for KENTUCKY

and Street Systems

Engineering Recommendations For Adequate Road

Prepared by the

AUTOMOTIVE SAFETY FOUNDATION

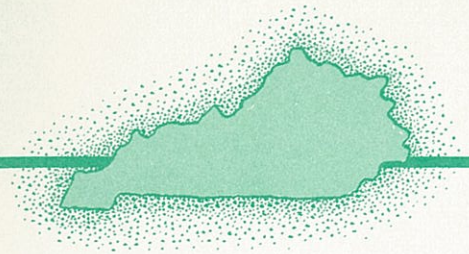
in cooperation with the

COMMONWEALTH OF KENTUCKY — DEPARTMENT OF HIGHWAYS

and the

U. S. DEPARTMENT OF COMMERCE — BUREAU OF PUBLIC ROADS

A Federal-aid



A Report to . . .

THE COMMONWEALTH OF KENTUCKY

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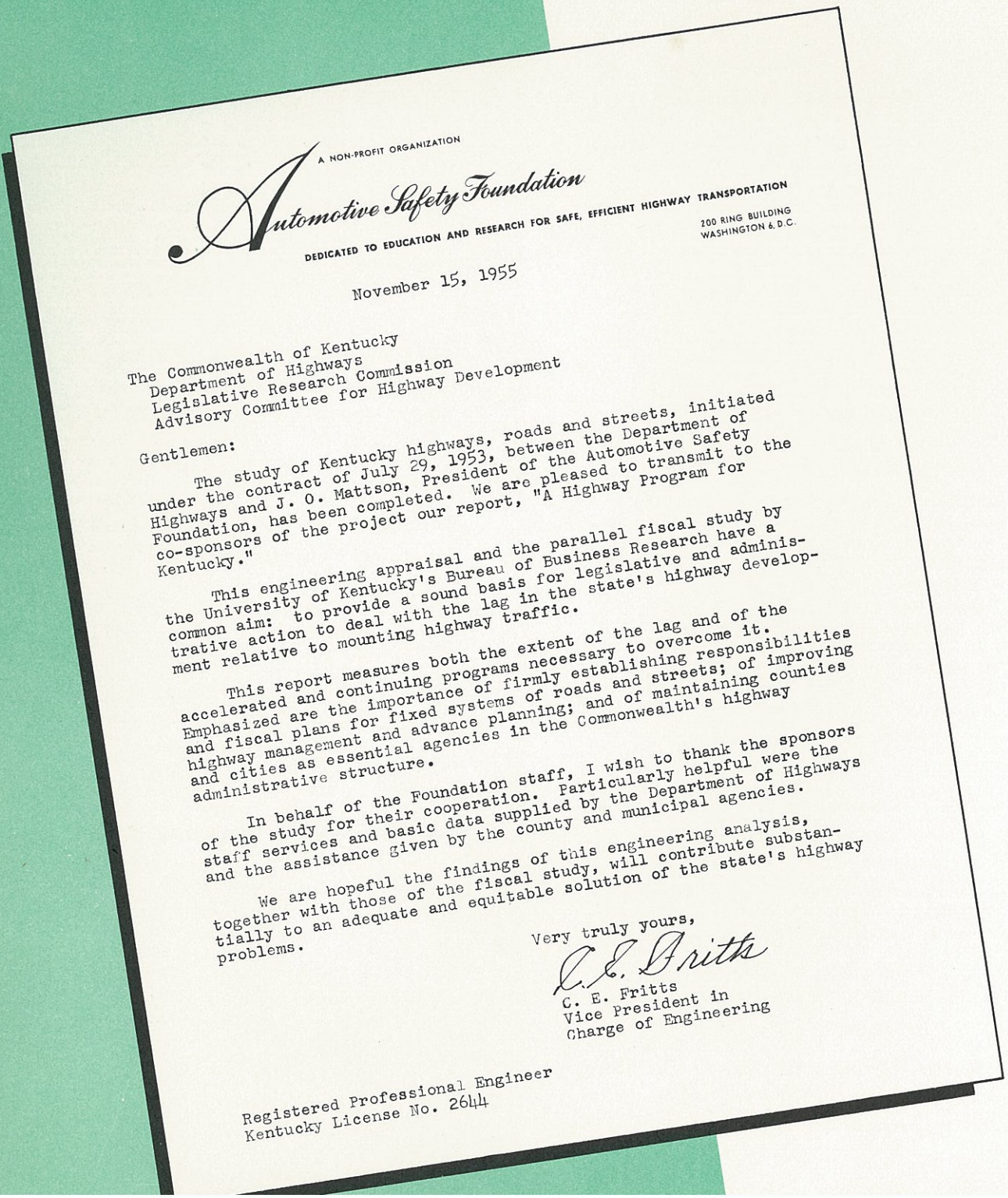

A NON-PROFIT ORGANIZATION

Automotive Safety Foundation

DEDICATED TO EDUCATION AND RESEARCH FOR SAFE, EFFICIENT HIGHWAY TRANSPORTATION

200 RING BUILDING
WASHINGTON 6, D.C.

November 15, 1955

The Commonwealth of Kentucky
Department of Highways
Legislative Research Commission
Advisory Committee for Highway Development

Gentlemen:

The study of Kentucky highways, roads and streets, initiated under the contract of July 29, 1953, between the Department of Highways and J. O. Mattson, President of the Automotive Safety Foundation, has been completed. We are pleased to transmit to the co-sponsors of the project our report, "A Highway Program for Kentucky."

This engineering appraisal and the parallel fiscal study by the University of Kentucky's Bureau of Business Research have a common aim: to provide a sound basis for legislative and administrative action to deal with the lag in the state's highway development relative to mounting highway traffic.

This report measures both the extent of the lag and of the accelerated and continuing programs necessary to overcome it. Emphasized are the importance of firmly establishing responsibilities and fiscal plans for fixed systems of roads and streets; of improving highway management and advance planning; and of maintaining counties and cities as essential agencies in the Commonwealth's highway administrative structure.

In behalf of the Foundation staff, I wish to thank the sponsors of the study for their cooperation. Particularly helpful were the staff services and basic data supplied by the Department of Highways and the assistance given by the county and municipal agencies.

We are hopeful the findings of this engineering analysis, together with those of the fiscal study, will contribute substantially to an adequate and equitable solution of the state's highway problems.

Very truly yours,

C. E. Fritts

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CONTENTS

FOREWORD

KENTUCKY'S HIGHWAY PROBLEM is caused for the most part by conditions which confront the entire nation.

American agriculture, business, industry and people in general depend on highway transportation to a great and increasing degree. As the country's economic activities increase, more traffic is generated. And as traffic grows, expanding services and requirements of highway transportation stimulate the national economy.

The vital significance of highway transportation is reflected in the parallel growth of American production and highway travel. In the period of 1940 to 1953, both highway travel and the gross national product advanced almost 80 percent.

For nearly half a century this two-way chain reaction between highway travel and the economy has been a prime factor in altering the patterns and raising the standards of life both in Kentucky and in the country at large. However, in Kentucky, and in the nation, highway development has failed to keep pace with mounting traffic demands.

Results of this failure are now so plain and so serious that the highway problem has become a primary concern of administrators and legislators.

The lag in highway development created such grave conditions that Congress ordered a special study made of all road and street needs. The recent study, based on data provided by all state highway departments, brought to light a large backlog of deficiencies which must be corrected if highways are to do their part in the nation's economy and defense.

The Kentucky Situation

Kentucky's highway situation fits typically into the national picture. Influenced by the marked expansion of industrial activities, travel on Kentucky highways has more than doubled since 1940. Although the Commonwealth's highway expenditures have increased, they have not been sufficient to advance highway improvement at the rate demanded by the increased traffic load. Deficiencies are accumulating rapidly.

This engineering analysis was undertaken to determine the extent and causes of deficiencies and to recommend programs and measures for correcting them.

The Kentucky Highway Needs Study

This study of highway needs in Kentucky was begun in 1953 on the initiative of the Commissioner of Highways because highway deterioration had reached a critical point. On some of the most important rural routes traffic had grown beyond the ability of existing facilities to provide efficient and safe service. Trunkline and arterial streets in many cities had become congested beyond tolerable limits. In most parts of the Commonwealth many county secondary and local roads were not dependable.

Efforts to remedy those deficiencies were seriously handicapped by certain basic conditions which concern financing, jurisdictional assignment, and management of road and street functions.

Establishment of the Engineering Study

It was determined that a new, impartial and thoroughly professional engineering analysis of the whole highway situation was required as a first step toward the solution of Kentucky's highway problem.

Upon invitation of the Commissioner of Highways, the Automotive Safety Foundation of Washington, D. C., in June, 1953, agreed to direct an engineering study of Kentucky's highways, roads and streets. The Foundation is a non-profit organization dedicated to education and research for safe and efficient highway transportation.

The study was accepted as a Federal-aid highway planning project by the U.S. Bureau of Public Roads which shares the cost with the state. Meanwhile, the Kentucky Legislative Research Commission took action to join the Department of Highways in sponsoring the study project. Subsequently, the Governor of Kentucky appointed eight citizens representative of the Commonwealth's industrial, agricultural and governmental interests to serve as an Advisory Committee for Highway Development with which the directors of the study could consult from time to time.

The agreement specified that a separate study of highway finance would be instituted. This fiscal study was undertaken by the Bureau of Business Research of the University of Kentucky, Dr. James W. Martin, Director; the findings to be presented in a separate report.

Organization and Operation of the Study

The engineers of the Automotive Safety Foundation were responsible for general direction of the work, for the standards and procedures followed, for interpretation of the data, and for the contents and recommendations of this report. Throughout, the Foundation's staff had the counsel and active cooperation of the engineers and officials of the Department of Highways, county engineers and fiscal courts, and city governments.

Three engineering advisory committees, selected to represent, respectively, the Department of Highways, the counties and the cities, aided in establishing the standards and procedures by which deficiencies were determined on each of the three jurisdictional classes of roadways. Studies in the field were performed by personnel of the state, county and municipal highway agencies; in many instances, however, field work on county roads and city streets was done by Department engineers because of lack of engineering personnel in local agencies.

Construction, maintenance and operating data in the files of the Department, and various highway planning data made available by the Department's Division of Planning, were used wherever pertinent. Planning personnel performed the necessary staff work.

Valuable advice and cooperation were received also from other agencies and organizations, including the Bureau of Business Research, University of Kentucky; the Kentucky Agricultural and Industrial Development Board; the U.S. Department of Commerce, Bureau of Public Roads; the Kentucky Municipal League; and the Kentucky County Judges Association.

Objectives of the Study

Although accomplishment of this engineering analysis has involved many complex and technical engineering and statistical operations, the objectives of the work are simple. They are:

1. To determine the importance of highway transportation to Kentucky business and people, and the amounts and routes of present and future travel.
2. To determine, on the basis of their services, how Kentucky roads and streets should be grouped for efficient management, development and operation.
3. To examine highway management in Kentucky and recommend such changes as may be required for a future highway program.
4. To establish highway standards adequate for present and future traffic; to determine deficiencies now existing and accruing in the future; and to estimate average annual expenditures required under alternative 10, 15 and 20-year programs, these expenditures to include the costs of correcting both existing and accruing deficiencies and the costs of annual maintenance.

Results obtained in those principal phases of the engineering analysis are presented in the four main sections of this report. Highlights of the report, including the most important recommendations, are summarized on two following pages.

This report is aimed and designed to provide administrators, legislators and the public with full information regarding the needs of Kentucky roads and streets. Pertinent data have been made available to the University of Kentucky's Bureau of Business Research for use in its study of highway finances and in formulating its recommendations concerning highway support. The reports of the engineering analysis and of the fiscal study, taken together, will give Commonwealth authorities the factual information necessary for their decision regarding the most appropriate measures for dealing with conditions here presented.

The mass of detailed information and data gathered for this study have been deposited with the Department of Highways' Division of Planning. This material can be used by engineers and officials responsible, under the proposed programs, for actual design and construction on the Commonwealth's highways and streets.

Summary of Facts and Findings

HIGHWAY TRANSPORTATION service is a vital part of Kentucky's economy and life, but today the highway plant is deficient and great effort is needed to make it adequate.

Travel grows with economic progress. In 1954, Kentucky highways carried 8.25 billion vehicle miles of travel, or 128 percent more than in 1940. It is estimated that by 1975 expanding activities will further boost traffic 72 percent.

Increasing traffic requires parallel highway improvement, but for 40 years highway development has lagged. Kentucky's roadway network is not grouped into functionally workable systems. Many local agencies are weakly organized and financed and are shifting their road responsibilities to the Department of Highways. This has handicapped that more efficient agency in improving the state's main transportation routes.

The result is that more than half of Kentucky's roads and streets, including two-thirds of its main traveled highways, are not adequate. Within 20 years nearly all roadways will need some kind of improvement.

System Classification

Highway travel is of three distinct kinds—statewide, community and local. Specific road and street systems should be selected, managed and developed to serve each kind. The General Assembly should require the Department of Highways to classify roads and city streets into systems determined by this study as follows:

- Rural State Trunkline System, including Interstate System routes, consisting of not over 5,300 miles classified for statewide traffic service, which would carry three-fourths of all rural travel
- County Arterial Systems, consisting of not over 14,500 miles for community service
- County Feeder Systems, consisting of the remaining 37,000 miles of roads for local service
- The Department also should be required to select not over 375 miles of State Trunkline extensions on city streets, and to aid cities in selecting Arterial Street Systems totaling not more than 725 miles. Remaining streets should be the City Feeder Systems.

Those several systems should remain unchanged except as indicated by engineering analysis. The General Assembly and local agencies should establish firm fiscal plans based on the needs of each system.

Appropriate existing agencies should be assigned responsibility for the systems and should be strengthened for their important duties.

Department of Highways

The Department of Highways should have complete responsibility for the State Trunkline System, rural and urban, and for the County Arterial Systems, including extensions into fifth and sixth class cities.

The Department's organization should be revised to centralize over-all policy control, to decentralize operations and supervision, and to emphasize advance planning. The Commissioner of Highways should have two Deputies—a Business Manager and a Chief Engineer—with responsibility, respectively, for the business and operating functions of the Department. Zone offices should be merged with District Offices which should have direct management of the County Arterial Systems and increased authority over state trunkline operations. Districts should be divided into residencies with a resident engineer in each.

A Planning and Programming Division should aid the Chief Engineer in preparing a five or six-year program based on needs with job priorities determined within budget limits. Land, Public Relations and Personnel Divisions should be established to perform the important functions in those fields. Procedures for right of way acquisition should be facilitated and a revolving fund set up for the advance purchase of land.

A civil service system and a retirement plan are strongly recommended to help remedy existing difficulties in procuring and retaining competent engineering and other personnel.

County Road Agencies

Counties should be kept in the road picture because local agencies are most responsive to local needs. County Fiscal Courts should have basic financial and administrative responsibility for the County Feeder Systems. Present maintenance by the Department with financing from the Rural Highway Fund should end.

Counties should have the commission type government or establish a three-member Road Board. Those with inadequate resources should combine to form Road Districts. Each county or district should employ a qualified road engineer or superintendent with full management authority over road operations.

If the General Assembly should decide state interest in feeder roads warrants state aid, funds should be granted on condition of compliance with the above recommendations. In addition, road programs should be approved, road work inspected, and expenditures audited by the state.

Municipalities

Cities should retain basic responsibility for their Arterial Street and Feeder Street Systems. State law should require all cities of over 2,500 population to prepare arterial street plans and long range programs based on engineering stu-

dies. Such planning should be in cooperation with the Department of Highways.

Should the General Assembly decide that the general usage of arterial streets creates a state interest in them, state aid could be granted on condition that plans be approved and expenditures audited by the state.

Needs, Costs and Programs

The backlog of existing deficiencies was determined by comparing roads and streets, section by section, with design standards of the American Association of State Highway Officials as modified to fit Kentucky conditions. Deficiencies accruing in the next 20 years were determined with reference to estimates of traffic growth and the service life of existing facilities. However, no roadway now delivering tolerable service was judged deficient.

Vehicle size and weight limits partly control types of needed facilities, and existing highway conditions in turn partly control those limits. It is recommended that vehicle lengths and gross weights be increased to nationally recommended standards, but the Commissioner of Highways should be permitted to restrict limits where facilities are wholly inadequate.

Alternative programs, based on 1953-54 prices, were prepared for meeting needs on each system. Each program includes the estimated cost of remedying the existing backlog, of correcting accruing deficiencies, and of maintenance and administration of the system. Shorter programs would speed up improvement, although at higher annual costs in the early years. Over a long period, costs would be about the same.

- In view of their unique importance and in keeping with national policy, Kentucky's Interstate routes need construction, all on new locations, of 439 miles of four-lane and 102 miles of two-lane highway in rural areas and 38 miles in two cities, all to freeway standards—without cross roads or traffic signals. This construction will cost $368 million.

The Interstate System should be built in 10 years, with costs extended over such period as may be dictated by Congressional action or Commonwealth policy. Costs would range from $41.8 million annually for 10-year payment, to $22 million over 20 years, including maintenance.

- On state trunkline routes other than the Interstate System, 60 percent of the 4,939 miles of roads and streets and 47 percent of the structures are now deficient. In the next 20 years, work will be needed on nearly all the remainder.

Proposed corrective measures involve the construction of 366 miles of new roads, including bypasses and route relocations. Average annual program costs range from $63.7 million over 10 years, to $44.1 million over 20 years.

- On the County Arterial Systems, 6,913 miles of the 14,320 miles of road and 2,019 of the 3,535 bridges are now deficient. Average annual program costs range from $43.8 million to $31.8 million for 10 and 20-year programs, respectively.

- On the 37,263 miles of the County Feeder Systems, 20,540 miles of road and 6,151 bridges are deficient.

Because the rate of actual future correction of deficiencies on those roads depends heavily on individual county action, program estimates are given for a 20-year period only. Average annual requirements for construction, maintenance and administration in all the 120 counties would be $31.7 million.

- Only about 21 percent of the 708 miles of city arterial streets are now deficient, but in the next decade deficient mileage will almost double. In the next 20 years, 532 miles will need resurfacing or reconstruction and nine miles of new streets and 82 bridges must be built. Louisville accounts for a quarter of the arterial street needs. Average annual program costs range from $9.7 million to $6.6 million for 10 and 20-year programs, respectively.

- On the basis of an inventory of all 2,390 miles of city feeder streets, annual costs for development and maintenance were computed. These amount to about $8 million per year.

Combined Review

The 20-year construction needs for all systems total about $2.1 billion. About 17 percent are for needs within incorporated places.

In that same period, expenditures proposed on systems recommended for full responsibility of the Department of Highways would average $97.9 million per year, or about 68 percent of all road and street costs.

Highest priority should be given to Interstate and other state trunkline routes. Backlog needs on them are so great that special studies were made to suggest top priority projects.

Over-all, 20-year needs on all systems total $144 million annually, compared to an estimated income from present sources of $118 million. The needs are the equivalent of about 1.2 cents per vehicle mile of travel, or about 12 cents per day per person. All programs set proper goals for achievement, but must be considered in relation to fiscal feasibility, under separate study by the University of Kentucky.

CHAPTER I

Highway Travel and the Economy

KENTUCKY CAN ILL AFFORD to have inadequate highways. Roads and streets and the vehicles that use them are basic equipment of the state's economic and community life. The people of the Commonwealth up to now have invested roughly $2.5 billion in that equipment.

Efficient operation of the highway plant is vital to the functioning of Kentucky industries and activities of Kentucky people, yet the state's transportation service is hampered by widespread highway deficiencies recorded later in this report.

Some deficiencies are of long standing and are attributable to the state's rugged terrain. Others are accumulating because of the failure of highway improvement to keep pace with the growth and wear and tear of traffic. Contributing to this lag is the fact that Kentuckians, although spending an estimated billion dollars a year for highway transportation, allot less than one-tenth of their outlay to roads and streets which must carry their vehicles.

Examination of highway transportation in relation to its service to Kentucky industries and people, and in relation to demands for road facilities, provides a measure of the importance and gravity of the state's highway problem.

BASES AND GROWTH OF ECONOMY AND TRAVEL

Kentucky's widely varying topography and soils have strongly influenced the state's economy and are basic factors in the development of highways to serve that economy's transportation needs.

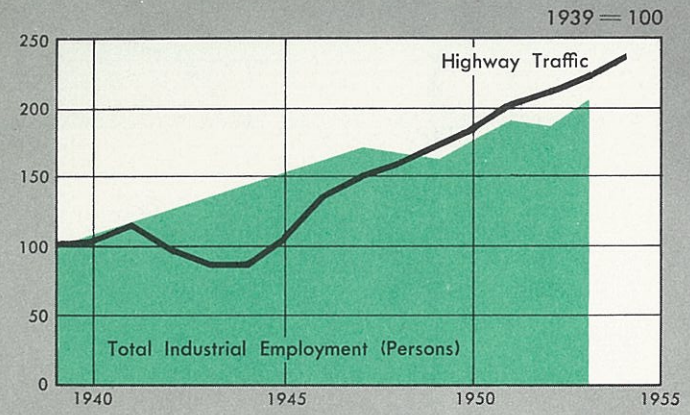
Central Kentucky is a region of rolling land, including the famed Bluegrass country, which accounts for about half of the state's area. The generally fertile soils of the region invited early settlement and with the rich farm lands in western Kentucky, are the basis of the state's prosperous agricultural industry. Availability of water transportation along the Ohio river led to the founding of a number of towns several of which have become principal industrial cities. The rich coal deposits and extensive stands of timber in the rugged eastern mountain region and in northwestern counties have attracted a considerable population.

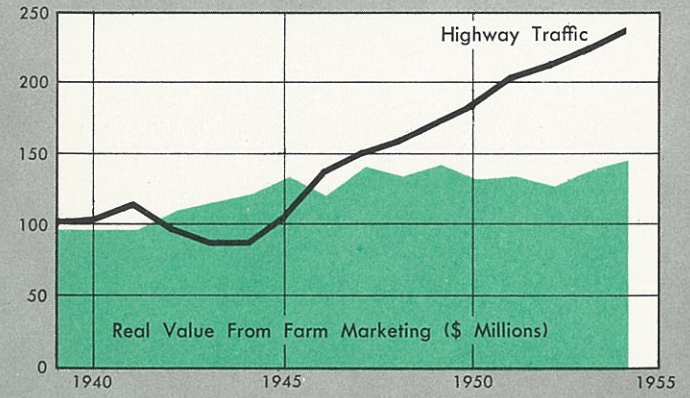
Most Kentuckians live in rural areas and in cities and towns of 2,500 population and less. Only 37 percent are city dwellers as compared with 64 percent in the nation at large. However, from 1940 to 1950 urban population increased by 16 percent while the number of rural people declined by nearly two percent.

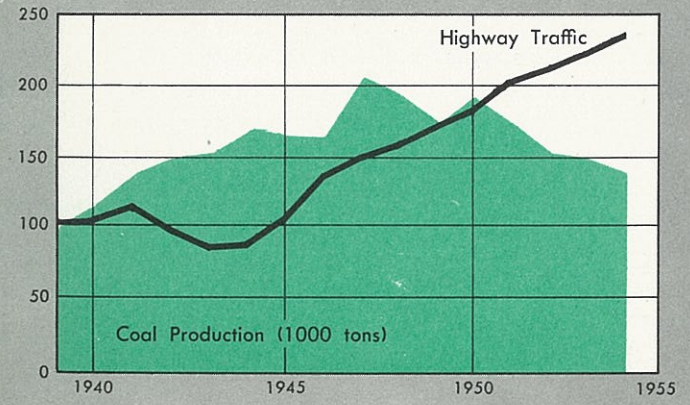
There are 15 cities in the state with populations of more than 10,000 and of these, seven have more than 25,000 people, three have more than 50,000, and one, Louisville, has a population of about 370,000. Eight cities, representing most of the state's manufacturing capacity, are located along the Ohio River. They include all but one of the places with populations of more than 25,000. Contrasting with this concentration of urban populations are 29 counties which have less than 10,000 people apiece.

Kentucky's major highway needs are dictated by transportation requirements of business and people in these differing regions and cities. Be-

Highway Travel Is Economy in Motion







Congestion and delay, shown in the photograph at the right, are not only city ailments. Rural and suburban areas, shown in the photographs above and below, also suffer traffic frictions where unplanned and unrestricted development of business occurs.

The generally rising production in each activity reflects the stimulating effect of highway transportation. As economic activity increases, more highway traffic is generated, and need for highway service is intensified.

cause of Kentucky's central location in the nation, its highways also serve a considerable north-south interstate movement. Interstate travel in east-west directions is hindered by the eastern mountain barrier.

How Travel Has Grown

Motor vehicles and the improvement of roads have encouraged industry, agriculture and people in general to adapt their activities to highway transportation. At the same time the rising productivity of the factories, the farms, and other enterprises of the state, due in part to the efficiency of motor transport service, has caused and paid for a tremendous expansion of highway travel.

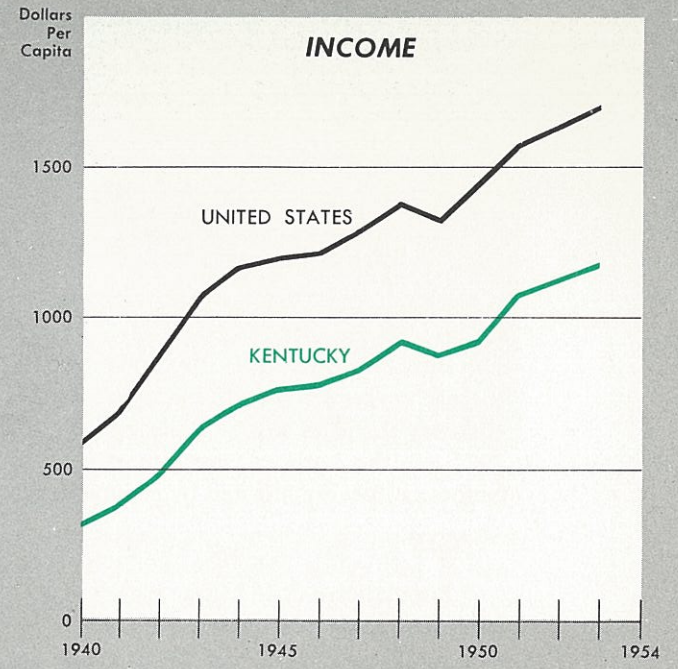
The charts on page 10 present a series of graphic comparisons between the course of production in the Commonwealth's three principal activities—agriculture, manufacturing and mining—and the companion increase in travel on Kentucky's highways.

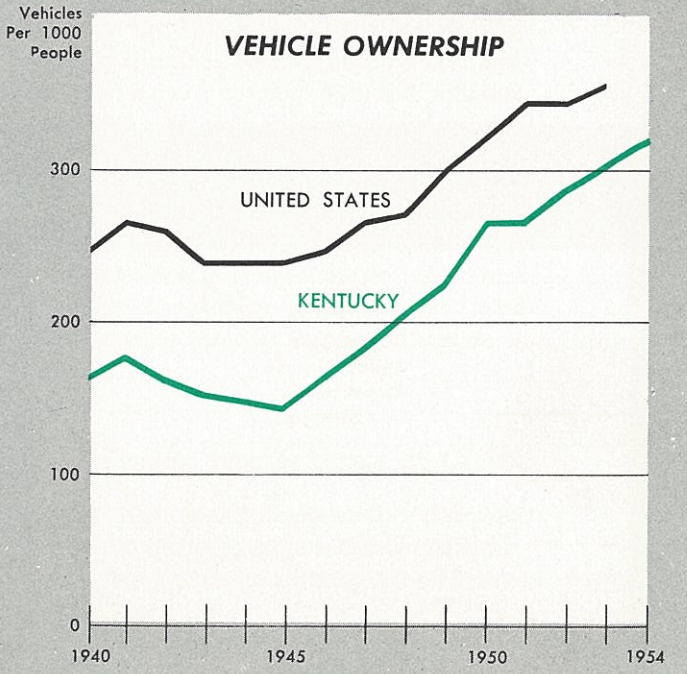
The operations of Kentucky industry and business and the movement of Kentucky people rolled up a total of 8¼ billion vehicle miles of travel in 1954. This traffic has grown by 128 percent since 1940 and continues to increase.

One of the basic ways in which rising prosperity has directly promoted more highway travel is illustrated in the chart on this page. It shows clearly the essential connection between the upward trend of average individual income and the increasing ownership of motor vehicles.

In 1940, there were only 162 motor vehicles for every 1,000 men, women and children in Kentucky. Today the ratio has nearly doubled—more closely approaching the increasing national figure. In the same period, individual income in Kentucky grew nearly four times—a rise more rapid than for the U. S. as a whole.

Rising Income Helps Double Vehicle Ownership





Traffic in the Future

As Kentucky's economic activities continue to enlarge, highway travel also will continue to grow. If expanding volumes of motor vehicle travel are not to overwhelm completely the state's highway facilities, it is necessary to estimate and prepare for future growth.

Estimates of highway travel depend on three factors: the number of people, how many of them own motor vehicles, and the number of miles the average owner drives his car or truck in a year. Highway travel in Kentucky has been forecast to 1975 on the basis of separate studies of those factors as they are affected by economic prospects.

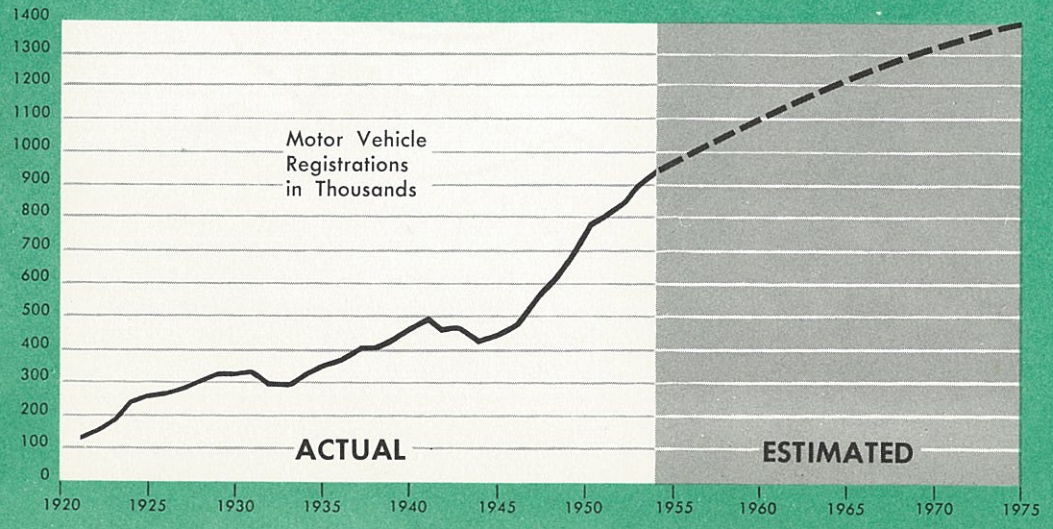
These are the forecasts for 1975:

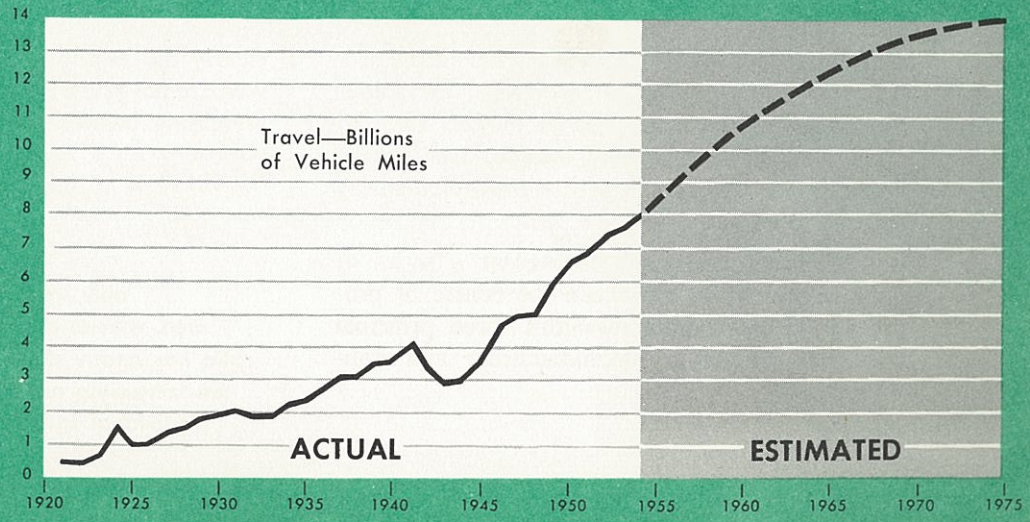
* Population—3,437,000, a gain of 17 percent over the 2,944,806 people in 1950.

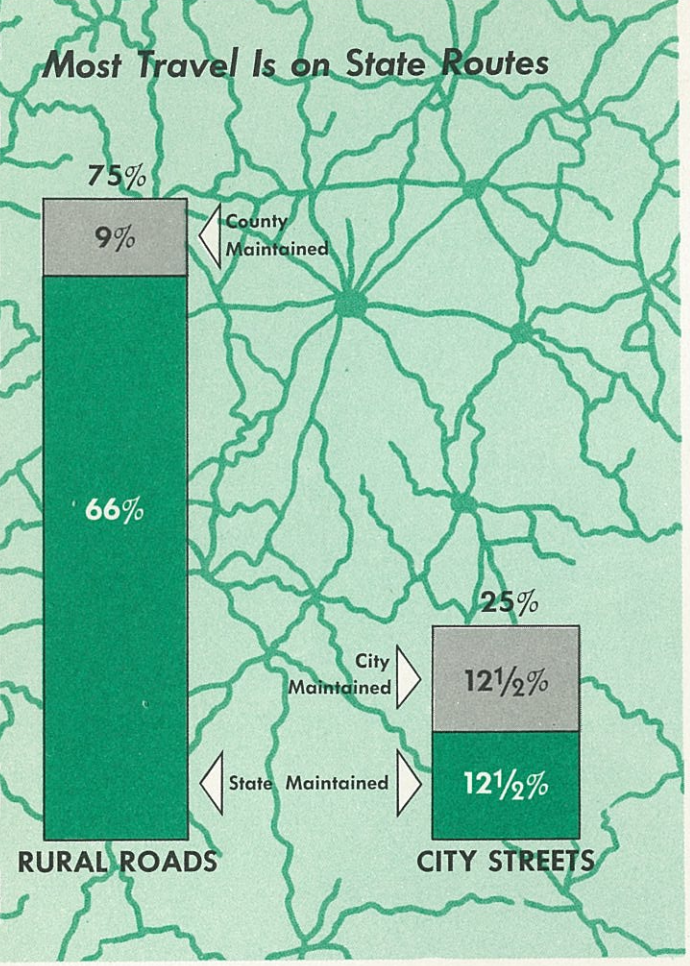
* Ownership—415 motor vehicles per 1000 persons, a gain of 34 percent over the 310 per 1000 in 1954.

All employees at this plant, one of Kentucky's famed distilleries, come to their jobs in motor cars.

With More Vehicles, Highway Traffic Soars





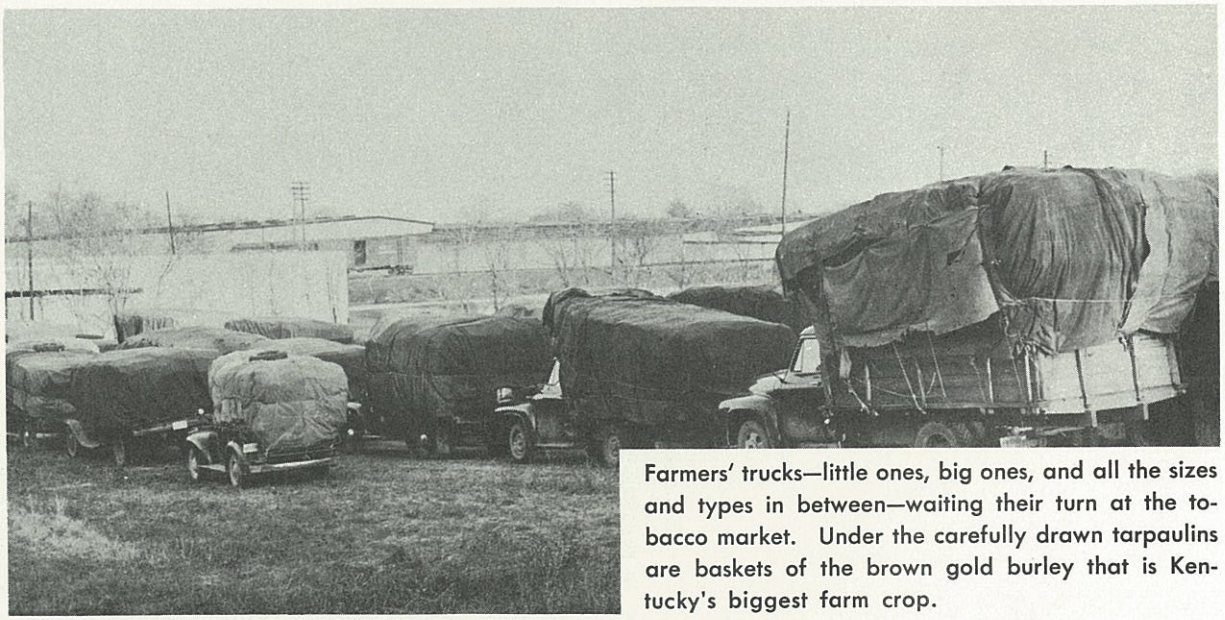


* Vehicles —1,430,000 cars and trucks, an increase of 52 percent over the 944,692 registered in 1954.

* Travel —9,900 miles annually by the average vehicle, a 13 percent gain over the 1954 average.

The estimates for 1975 produce a forecast of 14.2 billion vehicle miles of travel in Kentucky. This is an increase of 72 percent over total traffic in 1954.

That estimate of future traffic is predicated on the assumption facilities necessary not only for the estimated traffic volumes, but for the continued growth of the Commonwealth and its economy, will be provided.



Farmers' trucks—little ones, big ones, and all the sizes and types in between—waiting their turn at the tobacco market. Under the carefully drawn tarpaulins are baskets of the brown gold burley that is Kentucky's biggest farm crop.

THE ECONOMY'S TRANSPORTATION PATTERN

The total traffic movement generated by the transportation needs of Kentucky is carried on the state's 62,863 miles of public roads and streets. Rural roads which account for 95 percent of this total mileage, carry three-quarters of the travel. City streets, only five percent of the roadway mileage, carry a quarter of all travel.

There are 59,462 miles of rural roads. The volume of traffic carried by each route depends on the amount of transportation required in its service area and on its usefulness for that service. In January, 1955, the Department of Highways maintained 16,905 miles of rural highways which carried about seven-eighths of all rural travel. Only about one-eighth of rural traffic is carried on the 42,557 miles of local roads managed by counties.

The map on page 14 illustrates by width of bands, average daily traffic on rural highways against a background indicating the geographic distribution of certain basic economic factors. The flow bands represent the pattern of the total transportation movement resulting from the activities centering in cities, farming, natural resource operations, and travel for individual purposes.

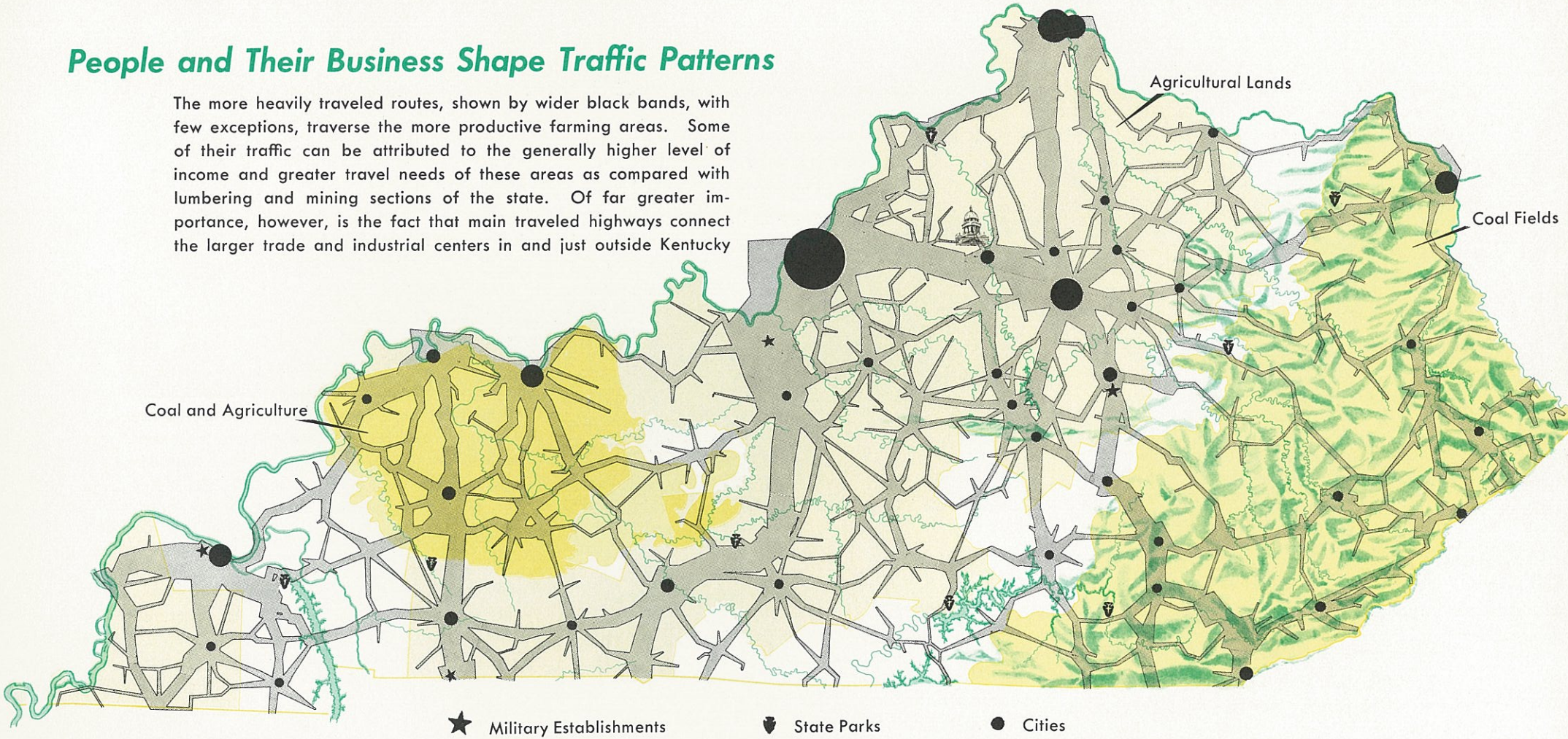
Traffic shown is made up mainly of the longer trips between major cities and regions of Kentucky, and between principal places and areas within those regions. On some main routes travel of vehicles passing entirely through the state is significant.

Traffic Importance of Cities

The traffic map clearly demonstrates cities not only are centers of highly concentrated traffic activity, but have a predominant influence in gener-

People and Their Business Shape Traffic Patterns

The more heavily traveled routes, shown by wider black bands, with few exceptions, traverse the more productive farming areas. Some of their traffic can be attributed to the generally higher level of income and greater travel needs of these areas as compared with lumbering and mining sections of the state. Of far greater importance, however, is the fact that main traveled highways connect the larger trade and industrial centers in and just outside Kentucky



ating traffic on highways in rural areas. It is estimated as much as two-thirds of the traffic on state-maintained rural highways is bound for or is coming from cities. The most striking feature of the traffic flow pattern is the high degree of consistency with which volumes of traffic carried on various routes are proportionate to the size of cities the routes connect.

Highways connecting Louisville with Frankfort and Lexington, with Covington and Cincinnati, and with Nashville, are the major traffic routes of the state. The next most heavily traveled highways are those linking the Covington-Cincinnati area with Lexington and with Chattanooga and Knoxville. Those are Kentucky's major routes; about 500 miles in the state now carry volumes which require more than two-lane pavements—yet only about 100 miles of rural highways have been improved to that capacity.

Paducah, Henderson, Owensboro, Maysville and Ashland all are focal points of traffic on Kentucky highways, both because of their industrial and merchandising activities and because they are Ohio River bridgeheads. Other places—like Pikeville, Hazard, London, Bowling Green, Madisonville, Hopkinsville and Mayfield—have special traffic significance as market centers for well defined and often extensive trade areas.

Cities and towns not only have more than a third of Kentucky's population, they are the centers for professional, governmental and recreational personnel, institutions and establishments. Also they are the places where nearly all the manufacturing and most of the marketing and mercantile establishments are located. Manufac-

turing industry and trade not only attract much traffic, but both depend heavily on highway transportation for their operations.

Manufacturing and Highway Transportation

Manufacturing is a great and growing part of the Kentucky economy. In 1953 its 2,800 plants with nearly 160,000 employees and $2 billion of products made the largest contribution to the state's income. One hundred and sixty plants, representing an investment of over $500 million employing 16,000 persons, have been established in the last six years.

Most manufacturing plants depend on highways for much movement of materials, parts and products. Two of the most important industries—tobacco manufacture and whiskey distilling—receive large proportions of their raw materials by trucks. About three-quarters of tobacco products are shipped by highways as are all intrastate and 40 percent of interstate shipments of whiskey.

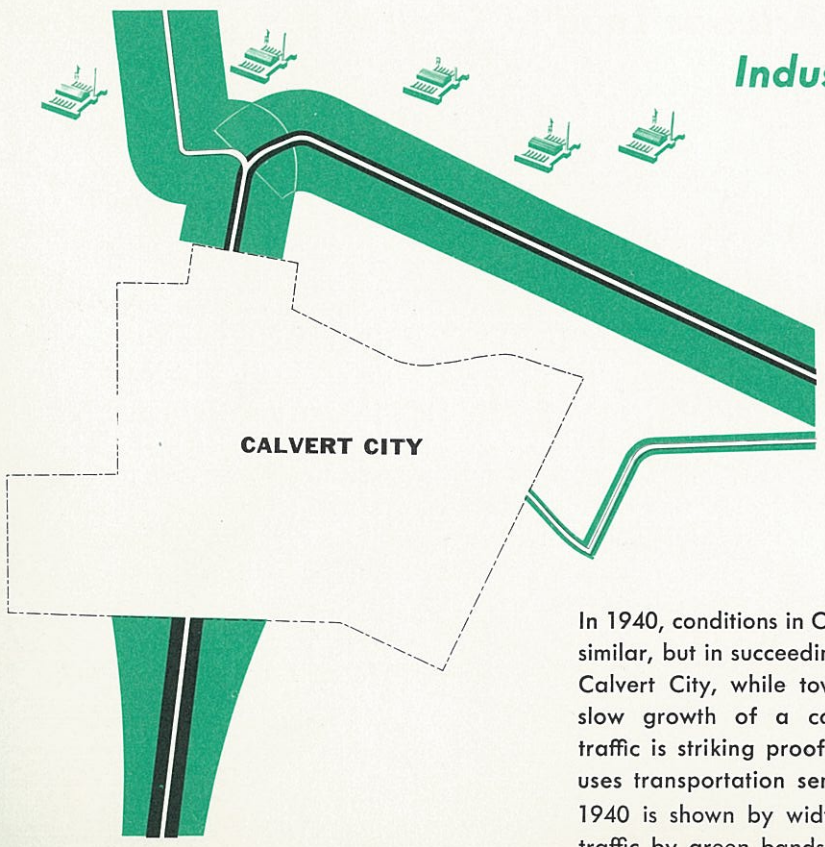
The service of highways to industry in the field of employee procurement is a distinctive phase of motor vehicle usage. Available data indicate that 84 percent of the workers in all Kentucky manufacturing establishments travel to and from their jobs in automobiles, as do 94 percent of employees in the tobacco plants and 96 percent of employees in distilleries.

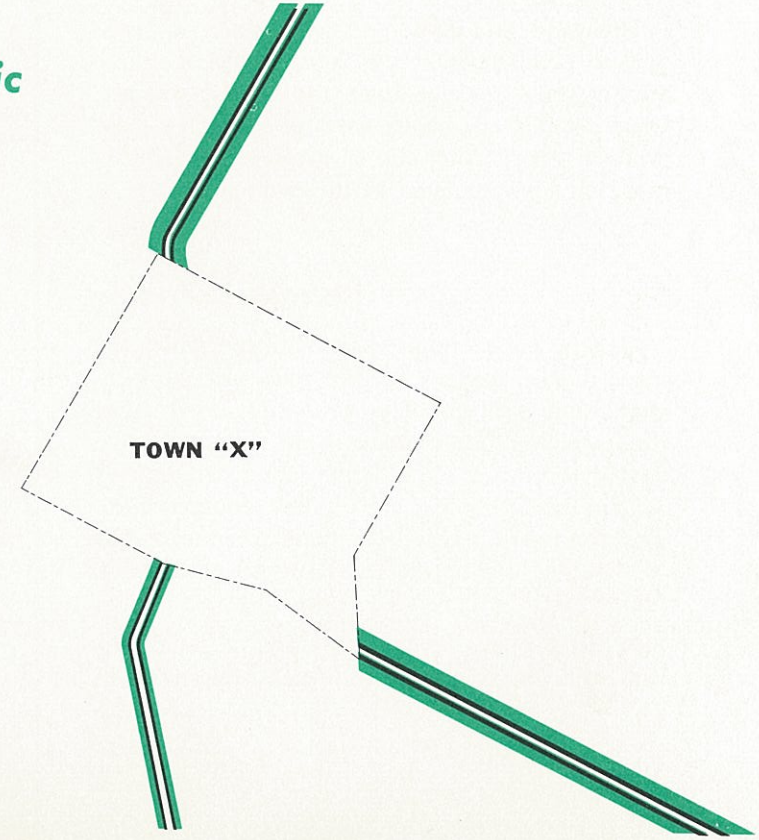
CALVERT CITY EXAMPLE

The influence of industry in generating traffic is proved by the experience of Calvert City, a small town (1940 population, 319) about 20 miles east of Paducah. During the last seven years six great American industrial companies chose this location for branch plants. Four plants are in operation and the other two are scheduled for completion this year. There was a daily average of 1,177 employees on the payrolls in 1953. Full production will require about 3,000.

Calvert City's population has grown to an estimated 1,200, but since it is still a small place, many of the workers engaged in construction and operation of the new plants commute to their jobs from outside points. As a result of plant activities and this employee movement, motor vehicle travel on highways radiating from Calvert City has jumped to more than four and a half times its 1940 level. This increase is nearly triple that of

Industry Generates Traffic





In 1940, conditions in Calvert City and town "X" were similar, but in succeeding years industry developed in Calvert City, while town "X" experienced only the slow growth of a country town. The effect on traffic is striking proof of how industry creates and uses transportation service. Average daily traffic in 1940 is shown by width of black bands, and 1953 traffic by green bands.

Universal use of the motor car has encouraged the establishment of suburban shopping districts. Those, like this one, with off-the-highway facilities for customer movement and parking, create little traffic interference and provide maximum service to patrons.

comparable places in the same area where no industrial development has occurred.

Highways and motor vehicles made it practical to build the plants in a strictly agricultural area at some distance from urban labor sources. Once established, plants generate traffic in their production operation and as a result of the business activity stimulated in the community.

Highways and Trade

General use of motor vehicle transportation has made drastic changes in some phases of the merchandising business. The vastly increased areas from which retail customers are attracted have tended to draw trade into the larger centers and to limit the function of the old-time country store. The massing of people in outlying urban areas has led to establishment of large suburban shopping centers.

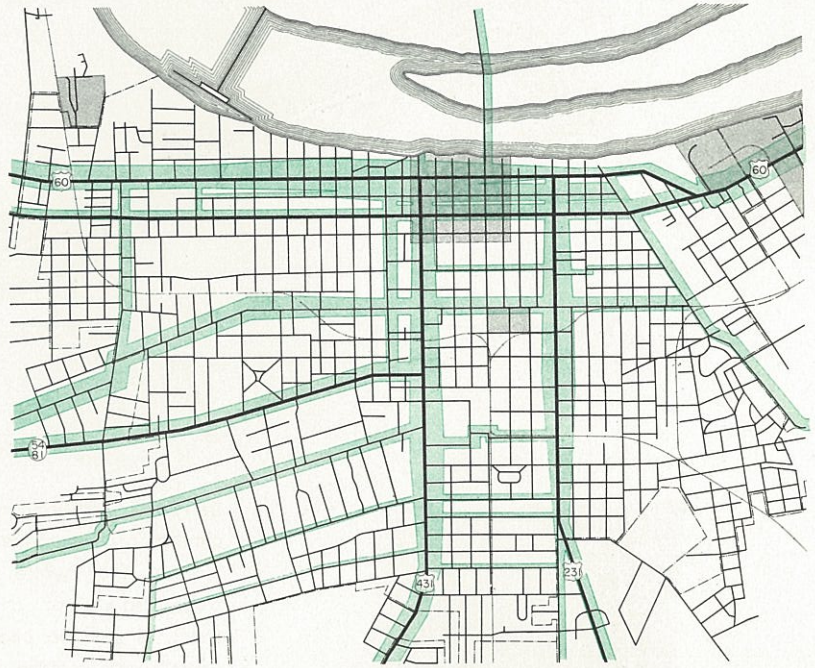
Wholesale and retail distribution of goods utilizes one out of every five trucks registered in Kentucky. Such trucks account for a fourth of total truck traffic on state roads and streets. The flexibility of highway transport service assures ready and frequent access to sources of merchandise supply. In consequence, warehouse requirements of the wholesale distributor and the stock-on-shelf requirements of the retail merchant are reduced to a minimum. This means a rapid turnover of goods which is highly advantageous to the consumer.

City Street Use

Because cities — particularly central business districts—are focal points to which traffic is attracted from wide areas, streets are used by many other than city people. Vehicles owned in rural

Heaviest Traveled Arteries Lead to Central Business District

Traffic originating in the city and coming in on rural highways uses major arterial streets, especially state routes shown in heavy black lines, to reach the principal destinations of traffic such as the central business district, major industrial districts, and main connecting rural roads. On the average, traffic flow, shown in green bands, on major streets is five times that on other streets, as illustrated in this map of Owensboro.



areas account for about 38 percent of total travel on the streets of incorporated places.

Trips into cities from their trade areas and daily shuttling of suburban residents into and out of the city produce marked accumulations of traffic on main highway approaches. Suburban shopping districts frequently are developed along main highways, where they cause a further extension of some of the same constricting conditions which impede traffic movement on downtown streets.

Trips into and out of cities and towns account for 53 percent of the traffic on urban streets. The other 47 percent of street traffic is made up of trips within the corporate limits.

Because the economic pattern funnels so much traffic into urban areas and onto principal city arteries, and because the operation schedules of industry, business and daily living concentrate so much of this funnelled traffic into brief periods of the day, some of Kentucky's most critical highway conditions are on trunkline streets. In some instances, the amount of traffic merely passing through an urban area is sufficient to contribute significantly to the congestion.

Rural Highway Travel

Rural people—those who live on farms and in smaller towns and city suburbs—roll up about 54 percent of all highway travel in the state. What roads do they use and where do they go?

About five-sixths of their travel is on rural roads because these are their direct means for contact with neighbors, school, church and city market centers; one sixth of their travel is on the city streets. Since state maintained highways lead to most destinations, rural people use them for about 85 percent of their travel.

Rural roads serve most of Kentucky's traffic movement—three-quarters of all travel in the state. Who contributes this travel to the rural roadways?

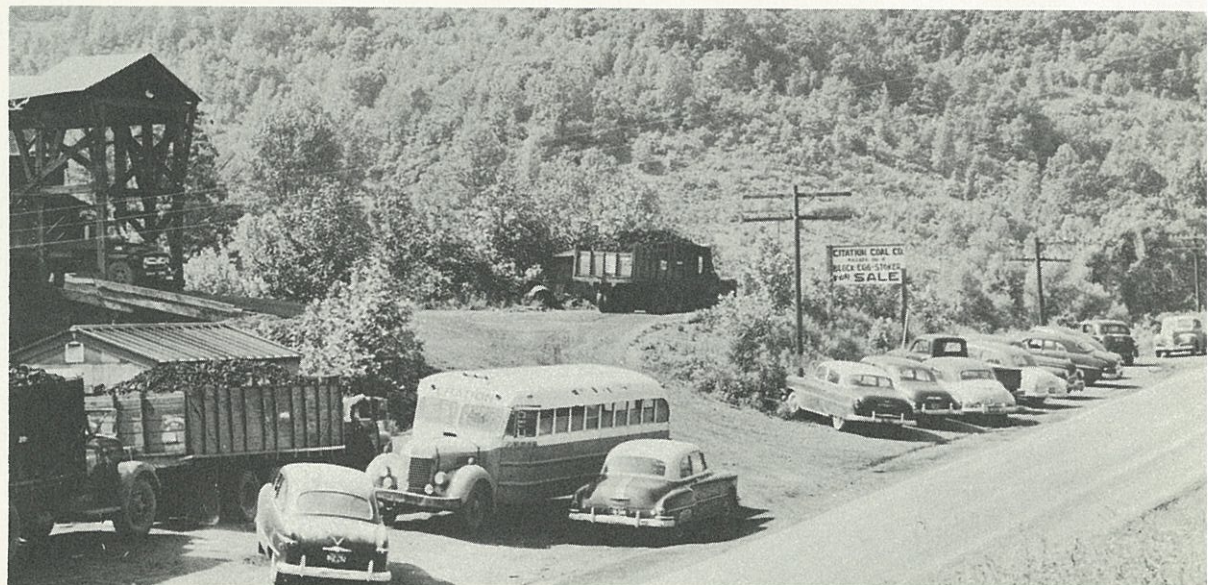
Cars and trucks owned by dwellers in rural areas make up 58 percent of the traffic stream on state maintained highways; the other 42 percent consists of vehicles owned in urban places. Rural vehicles account for 85 percent of all traffic on the other rural road now maintained by the counties.

Between their principal termini, main highways contact and serve scores of smaller cities and towns as well as rural country along the way. The function of less heavily traveled roads is to connect the other places and areas with major routes.

Differing functional services of rural roads—a few as major transportation routes, many as connecting arteries leading to those routes, and hundreds as access roads to widely spaced farms and homes—are reflected in wide differences in the amount of their usage, as shown by the following tabulation:

Traffic	*Miles of Rural Road*
Over 700 vehicles per day	5,937
From 100 to 700 vehicles per day	13,244
Less than 100 vehicles per day	40,281

School time is bus riding time for over a quarter million Kentucky children. Motor bus transportation has brought greatly improved educational advantages to many rural sections of the Commonwealth, to some where even the little red schoolhouse was a rarity.



Passenger cars and buses as well as trucks are vital to Kentucky's coal industry. Hundreds of truckloads of coal are hauled daily from many mines.

The verdant Bluegrass Country, with its white fenced horse farms and prosperous dairy industry, is favorite cruising and vacationing territory for tourists.

Farming Areas

Highway service in farming areas consists largely of providing access to and from market centers. In these centers crops are marketed, supplies are obtained, and various professional services and recreational opportunities are available. Transportation to the centers is essential to agriculture and to people who make their living from it.

Kentucky's half billion dollar farm income is derived in approximately equal parts from field crops and from livestock and dairy products. Tobacco, by far the most important item in the field crop group, is all hauled from the curing barns to the state's 32 tobacco markets by trucks. Larger trucks carry much of it on to processing plants. Practically the entire marketed portion of corn and other farm crops is transported to town on the highways.

Records of Kentucky's livestock markets show that 98 percent of the animals brought in from farms, and 73 percent of those shipped out to packing plants, travel in trucks. Transport in the dairy industry is almost completely motorized; milk is brought to central dairy plants in tank trucks which travel 10,000 miles daily; other trucks take dairy products to retailers and to a large proportion of the consumers.

Such services widen the farmer's access to markets, increase the efficiency of his operations, and help raise the standards of rural living. Of equal significance in improving conditions and opportunities of rural families, are rural free mail delivery and the consolidated school with its essential accessory, the school bus. The Department of Education reports that during the year 1952-53, 2,859 school buses traveled 150,700 miles and carried 229,177 students every school day.

Coal Fields

The bituminous coal mining industry, in spite of recurrent problems, is a vital element in Kentucky's economy particularly in the producing areas. Transportation is so important a factor in coal mining operations that mines are classified according to whether coal is shipped from the shaft head by rail or by truck.

The 1952 report of the Department of Mines and Minerals states that from 89 percent of the state's 2,243 underground mines, and from many of the 124 strip mines, coal is transported by highway to processing plants or to rail forwarding points. Most truck mines are the smaller producers; in the industry as a whole, rail mines account for 80 percent and truck mines for 20 percent of the state's total coal tonnage.

However, several truck mines transport as much as 2,500 tons per day over highways. Coal hauling is essential traffic, but since it usually occurs on highways in areas where steep grades often slow heavy carriers to a crawl, it creates special and difficult problems in highway design and traffic operation.

At some mines 95 and even 100 percent of all employees commute by car from distances up to 60 miles. At one large mine, 65 percent of the workers travel an average distance of 50 miles from the shaft head. This work habit is affecting the pattern of settlement in coal regions, in that it permits workers to live in established homes and eliminates the need to provide worker housing at every new mining development.

Lumbering Industry

Kentucky has 11,446,000 acres of commercial forests from which 500 to 600 million board feet of lumber are cut in an average year. In 1950, forest products had a value of $100 million.

Currently all logs are hauled from forests to the state's more than 2,000 sawmills by truck. This has enabled lumbermen to adopt much improved logging practices. In the days of water and log train transportation, small scale operations were considered to be uneconomic. Lumbering was a cut-out, get-out process. Today, with low cost logging roads connecting with the highway network, timber can be cut again and again in the same area as trees mature. Forests are now a continuing resource rather than, as formerly, a one-time bonanza.

Recreational Industry

The tourist and resort business ranks high among the state's sources of income. Kentucky's wealth of varied scenic attractions, its many places of historic interest, its horse farms and racing events, and its lakes and waterpower developments attract recreational travelers, both from within and from outside the state.

In 1953 more than 3,260,000 people came to the 24 state parks, 500,000 of them to Mammoth Cave alone. In addition, 688,000 sportsmen took out licenses to hunt or fish. It is estimated in that year establishments serving tourist and vacation travelers grossed a total of $462 million.

The recreational industry is predominantly a highway business. It has developed to its present proportions as highway travel has increased. Further growth can be expected as highways are improved.

Other Traffic Factors

The mere numbers of Kentucky vehicles traveling the state's highways do not tell the whole story of the service those highways are required to deliver. Important in planning an efficient highway system in the Commonwealth is the amount of travel in Kentucky by vehicles owned outside the state and the composition of total traffic, particularly the proportion of heavy commercial vehicles in the traffic stream.

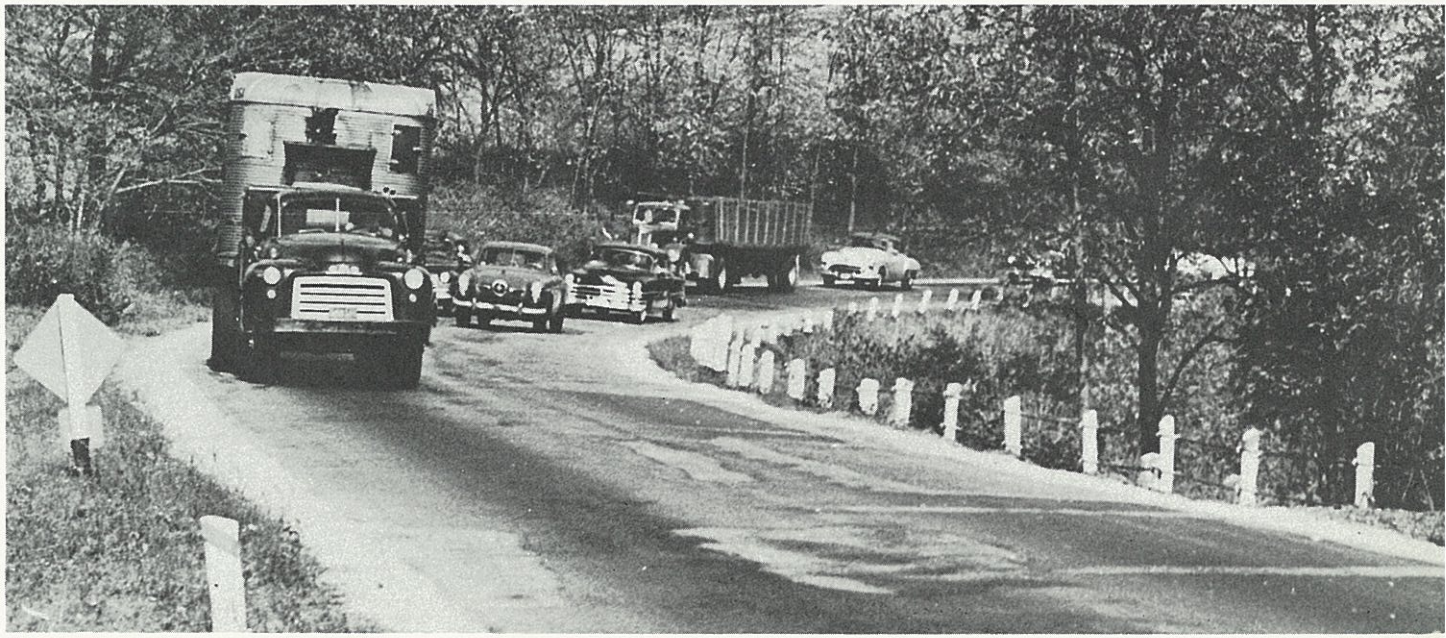
Travel by Foreign Vehicles

Several Kentucky highways are indispensable routes for travel between the north-central and southern states. Louisville and Covington, and to a less extent Henderson and Paducah, are important portals along the Ohio River for through traffic bound to or from Memphis, Nashville, Knoxville and points south.

On southern sections of several north-south routes, through trips between termini outside Kentucky make up from 23 to 47 percent of the traffic. Some of those routes carry a large proportion of transport trucks and on certain highways as high as 57 and even 87 percent of freight carriers are making through trips.

It is estimated that through trips, together with travel of vehicles visiting Kentucky from other states for business or recreational purposes, may account for as much as 20 percent of the traffic on the state's rural highways. On the other hand, Kentucky owned cars and trucks do 22 percent of their annual travel outside the Commonwealth.

Expanding travel by both private and commercial vehicles on many main traveled routes creates demands for modern facilities which have not yet been fulfilled. On this major highway between Cincinnati and Lexington the curving alignment, short sight distances and narrow surface cause serious delays and hazards.



Truck Traffic

The unusual degree to which highway transport is utilized by Kentucky's economic activities is indicated by the large proportion of vehicles operated for commercial purposes. In the state as a whole, no less than 28 percent of all travel is by commercial vehicles, including panel and delivery cars. The national average of such traffic in 1953 was 19 percent.

Movement of single trucks and heavy trailer combinations on major highways amounts to about 12½ percent of total traffic, about the national average. Dimensions, weight and operating characteristics of such vehicles demand special consideration in highway design, especially in areas where topography creates problems of highway alignment.

KENTUCKY'S STAKE IN HIGHWAY TRANSPORTATION

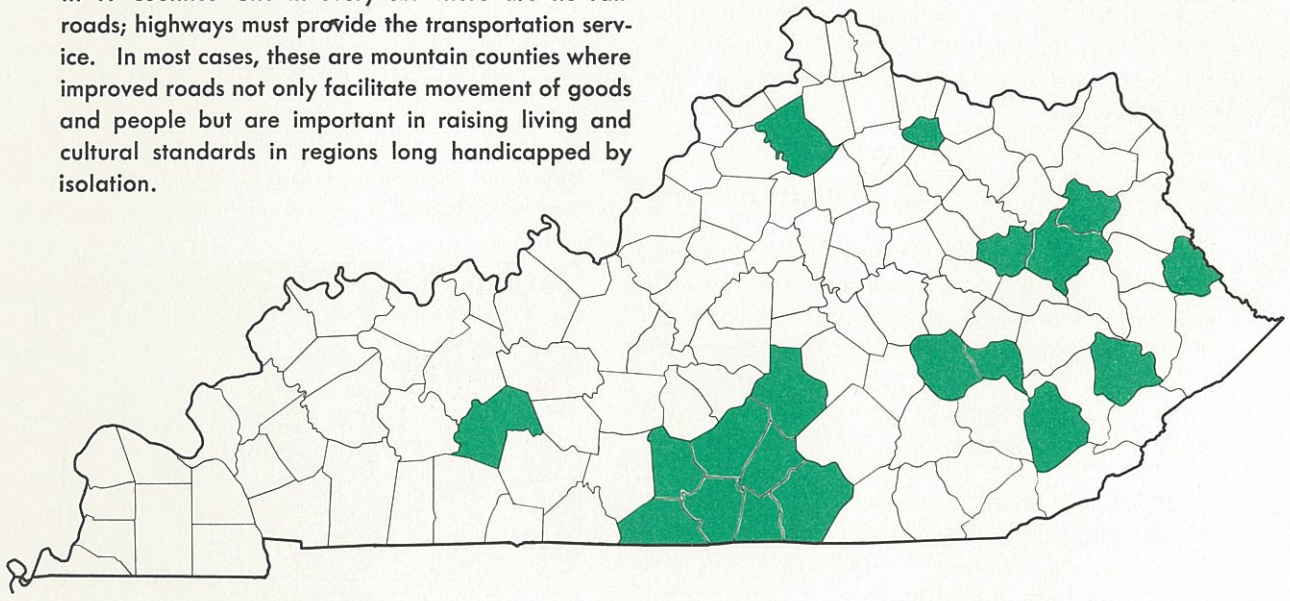
The economy and people of Kentucky are committed to the use of highway transportation. The operations of industry, trade and agriculture and the basic habits of living are all geared to highway service. The development of cities and the provision of essential services in all parts of the state are based on the availability of motor vehicle transportation. Even railroads, airlines, and water transport all depend on highways to make their services accessible and complete. Today, 19 whole counties and scores of small towns and post offices have no other means of land transportation.

Kentucky's current highway problem is the inevitable consequence of the growth of highway travel which, during a long series of years, has consistently out-distanced highway improvement. Great and growing volumes of traffic have been imposed on highways and streets originally designed for entirely different usage and only in a few cases revised for their motor vehicle carrying function. As a result, the transportation service, which Kentucky economy and people depend upon most intimately, is seriously handicapped.

Moreover, traffic volumes are still growing and will continue to grow. It is estimated that by 1975 travel will have increased by over 70 percent. The demand then will be for good highway facilities for 17 motor vehicles where each 10 are today.

Good Highways End Isolation

In 19 counties—one in every six—there are no railroads; highways must provide the transportation service. In most cases, these are mountain counties where improved roads not only facilitate movement of goods and people but are important in raising living and cultural standards in regions long handicapped by isolation.



CHAPTER II

Highway Classification

FOR 35 YEARS, Kentucky has experimented with the division of road and street mileage and cost between county, city and state. Today's conditions show that a satisfactory balance of all factors has not yet been achieved. This report recommends a stabilized solution which would remove uncertainties, clarify future programs and fix financial and administrative responsibilities.

Since the establishment of a 4,000-mile state primary system in 1920, additional road and street mileages have been transferred from county and city to state jurisdiction. In recent years transfers have been made at a vastly accelerated rate, and without a consistent plan. As a result, the Department of Highways is now responsible for more than four times the original mileage.

From the beginning the Department has been faced with a task that was growing faster than its resources. Today mounting traffic on primary routes is making demands for improvements that cannot be met, partly because of statutory commitments which require spreading expenditures over the greatly expanded system.

These questions arise: Has the limit been reached in the transfer of roads to the state? Is the state eventually to have control of all roads? If not, exactly which roads should the state handle, and how should the remaining roads be organized? What costs are involved, and how should they be paid?

Those questions vitally concern not only the over-burdened Department of Highways, but the counties and the cities which also are adversely affected by the present situation. All agencies urgently need to have the extent of their responsibilities clearly defined and fixed on a consistent basis. Equally they need to have stable criteria for determining the relative requirements and priorities of the roadways which are in their charge. All this points to the urgency of a proper classification of Kentucky's roads and streets.

Why Classification?

To effectively attack Kentucky's highway and street problems, it is necessary to make a clear and thorough determination of which roads deliver which services and of what agencies should be responsible for what systems. This calls for highway classification based on a sound engineering analysis of the function of each roadway in the total highway transportation picture. Following such a classification, the different systems can be properly and firmly established and can be assigned to the agencies of government principally concerned. By so doing:

- The systems can be efficiently managed by the state, county and city agencies
- Suitable design, maintenance and operations procedures can be established
- Long range improvement and finance plans can be formulated and put into operation.

This chapter describes how highways and highway administration have evolved in Kentucky and how the existing setup diverges from accepted engineering and management principles. It presents an engineering classification of the Commonwealth's roads and streets and recommends a grouping of the roadways into classified systems.

HIGHWAY DEVELOPMENT AND MANAGEMENT

Kentucky has recognized the fundamental principles of highway responsibility from time to time, but unfortunately they have not been adhered to. Several starts have been made to select the roads of primary importance and to set them apart for state support and supervision, but in no case was this course consistently followed. Today, in the absence of a settled policy, the whole highway management is drifting toward highly centralized control.

Responsibility for Early Roads

In the earliest days of the Commonwealth when most roads were left to local initiative, the state government several times announced its special interest in and assumed limited responsibility for certain principal routes. These were roads opened up to bring settlers into the new state or to carry products to Ohio River shipping points. Later the state encouraged construction of roads—many of them turnpikes—linking cities and towns.

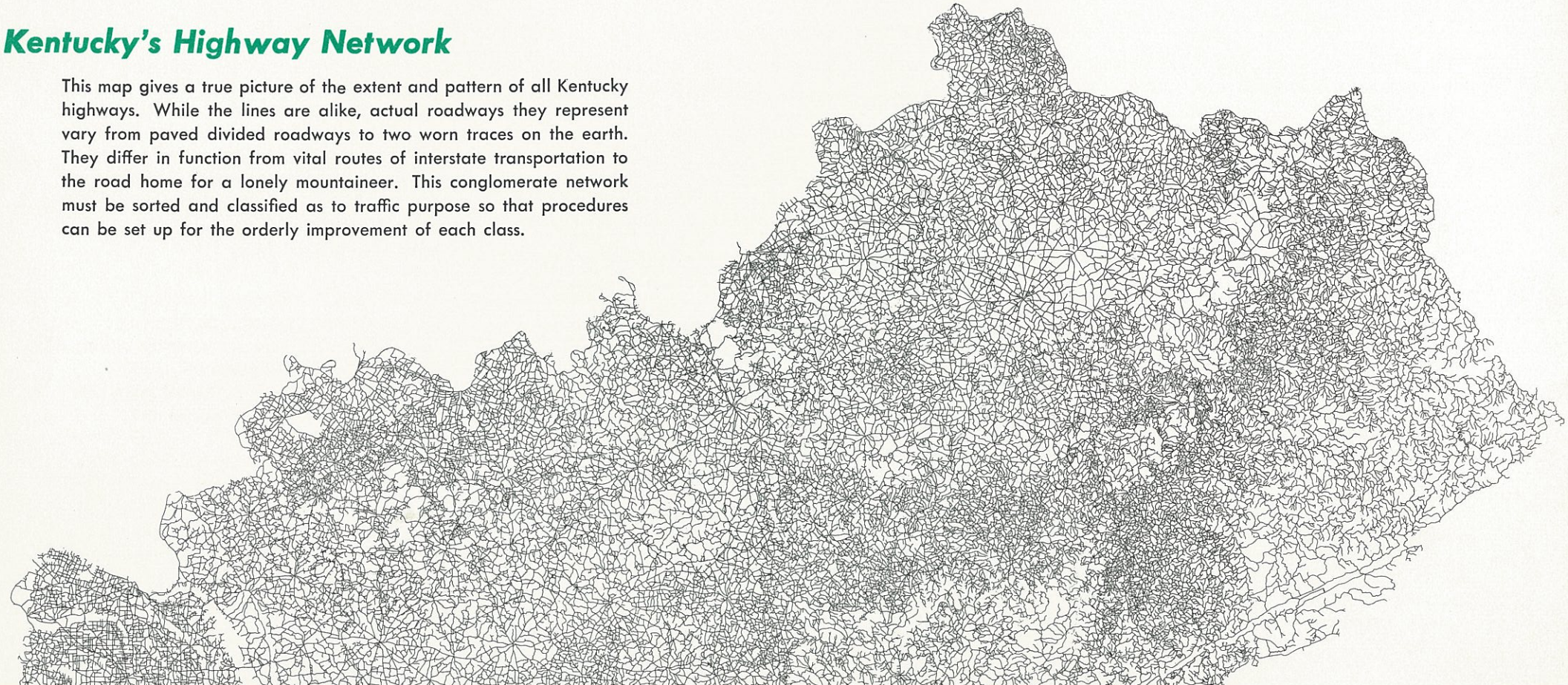
Around 1850, railroad building ended this phase of highway development. State interest in highway transportation remained dormant until the early 1900's when motor vehicles gave a new meaning to the term. During that long period, the entire responsibility for rural public roads devolved on the counties.

The Motor Vehicle Era

In 1912 when the increasing use of motor vehicles had created a strong demand for better roads, the General Assembly set up a Department of Public Roads to assist county authorities in road improvement. By then there were already some 58,000 miles of public roads in Kentucky.

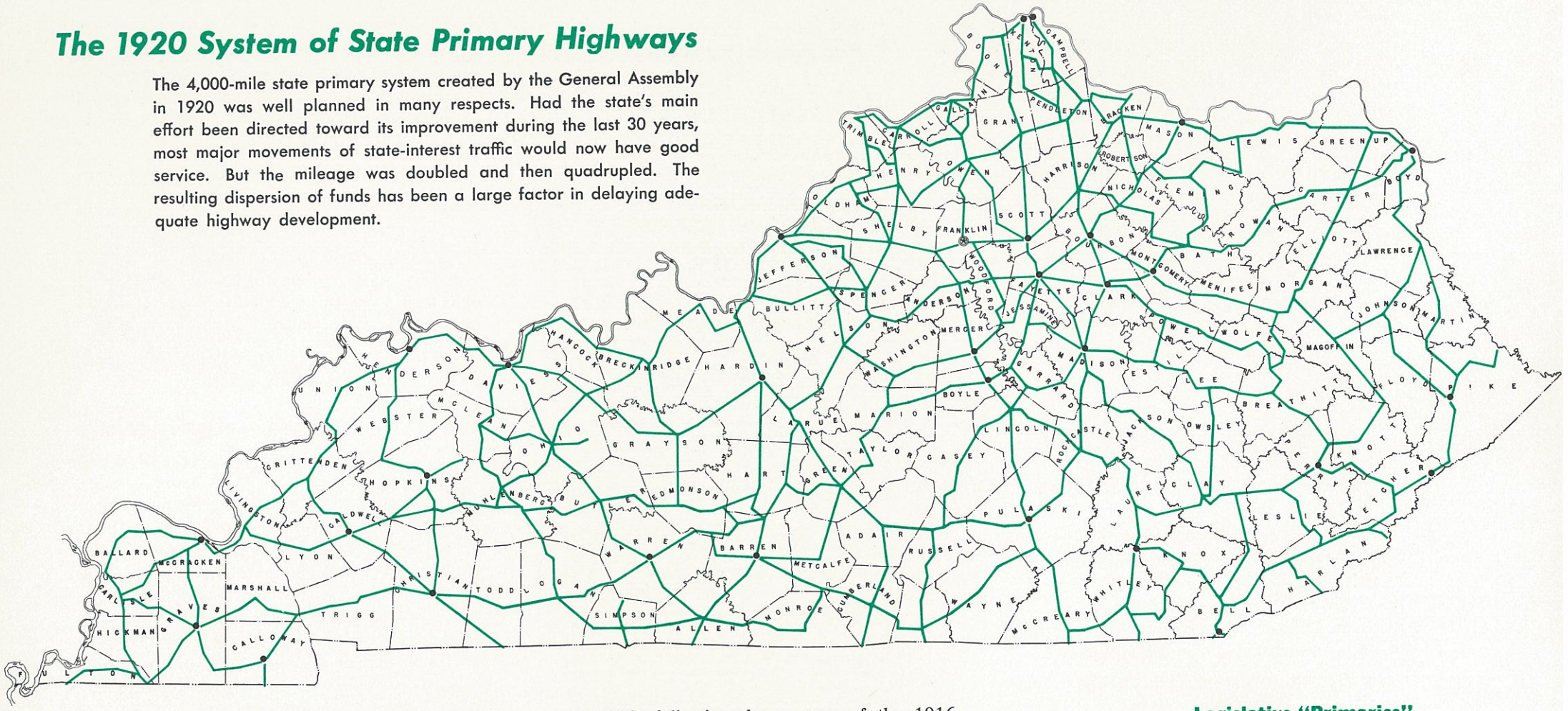
Kentucky's Highway Network

This map gives a true picture of the extent and pattern of all Kentucky highways. While the lines are alike, actual roadways they represent vary from paved divided roadways to two worn traces on the earth. They differ in function from vital routes of interstate transportation to the road home for a lonely mountaineer. This conglomerate network must be sorted and classified as to traffic purpose so that procedures can be set up for the orderly improvement of each class.



The 1920 System of State Primary Highways

The 4,000-mile state primary system created by the General Assembly in 1920 was well planned in many respects. Had the state's main effort been directed toward its improvement during the last 30 years, most major movements of state-interest traffic would now have good service. But the mileage was doubled and then quadrupled. The resulting dispersion of funds has been a large factor in delaying adequate highway development.



Turnpike companies had built most of the better improved roads and were still collecting tolls on 300 miles of them.

Early Steps in Classification

In 1914, Kentucky adopted a policy of state aid to counties. The General Assembly declared that roads connecting the county seats of adjoining counties would be eligible for state funds and should be known as "public state highways." However, the counties were unable to develop connected statewide routes and the system proved to be unsatisfactory.

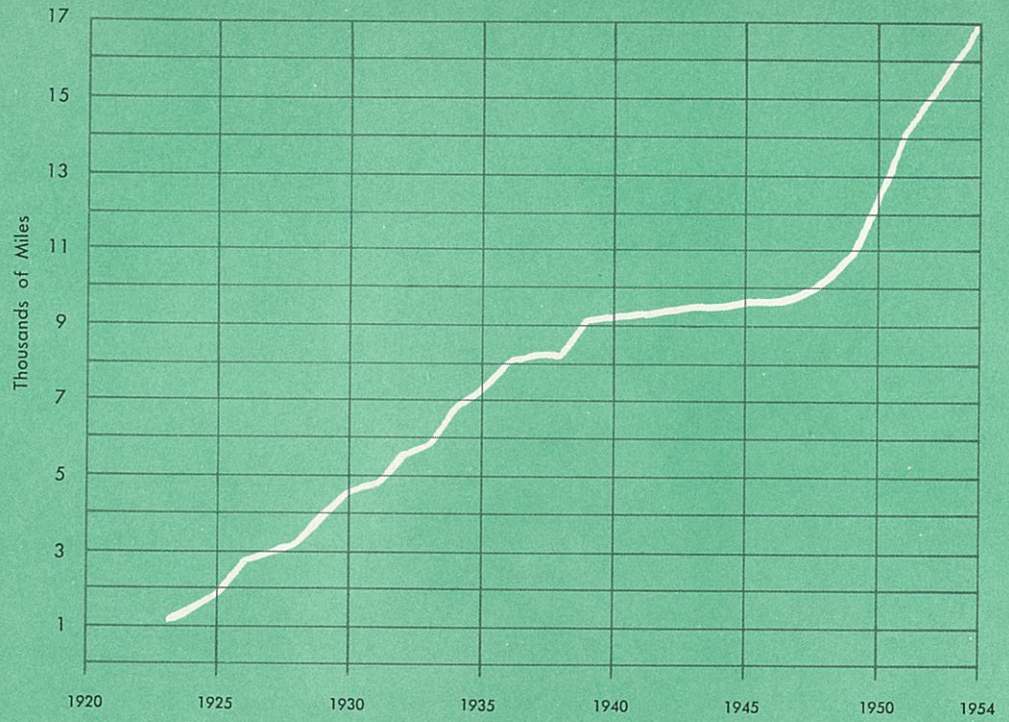
In 1920, following the passage of the 1916 Federal-aid Highway Act and state legislation conforming to it, the General Assembly completely revised Kentucky's highway procedure. State aid was abolished and a 4,000-mile system of state "primary highways" to be financed by the state, was created. Expenditure of Federal aid and expanded state highway funds was to be limited to this system. The Assembly also established a new state highway agency—the present Department of Highways—and gave it direct charge of all operations on the state primary system.

Legislative "Primaries"

The Assembly acted properly in giving these roads, intended to serve state interest travel, the name "primary highways." "Primary" is a word with a specific meaning in the highway engineering field, and denotes routes of first class importance. However, strict observance of this meaning of the term was short lived.

The 1920 act establishing the state primary highway system provided that all roads not included in that system should be maintained by the counties. But legislators in successive ses-

State Mileage Doubled Since 1938



sions created additional "primary highways" which were added to the state system without much regard for their fitness for state highway service. In 1922, 10 roads were added; in 1924, 141 roads; in 1926, 132 roads; in 1928, 327 roads; in 1930, 320 roads; and in 1932, 396 roads.

In 1938, when the mileage of the state maintained rural system had reached 8,000 miles, double its original size, the General Assembly consolidated the results of this rather haphazard process. It declared that "all roads and highways heretofore established as a part of the primary system of highways and all other roads within the Commonwealth now or hereafter (so) established" should be a part of the state system of primary highways.

Expansion of State Responsibilities

In 1948, the Assembly passed the so-called "two-cent law" which further accelerated the transfer of county roads to "primary" status and state responsibility. This act increased the gasoline tax rate by two cents per gallon and appropriated the revenues to the Department of Highways for the improvement and maintenance of roads recommended by county fiscal courts for transfer to the state primary system.

Both the 1938 and 1948 statutes contained provisions intended to enable the Department to limit its acceptance of roads to those which served state interest travel and to maintain a balance between the Department's income and its mileage responsibilities. The 1938 law stated "that nothing in this act shall be construed as requiring the Department of Highways to construct, reconstruct, improve or maintain any public highway except as may be determined by the Department of Highways in the exercise of its discretion." The 1948 statute gave the Department somewhat similar freedom of action.

However, in spite of those legal safeguards to the integrity of the state system, the Department of Highways has found it necessary to accept many miles of roads which do not qualify for statewide system service. One of the purposes of this study is to aid the Department in establishing a reasonable and consistent basis for "the exercise of its discretion", in keeping with its finances.

Between 1938 and 1948, mileage was added to the state primary system at an average rate of about 200 miles per year. During the last six years such additions have averaged more than 1,000 miles annually. In 1954, the Department maintained a total of 16,905 miles of rural highways and 716 miles of city streets.

PRESENT GROUPING OF HIGHWAYS

For the most part, the existing classification of Kentucky roads and streets is solely on the basis of jurisdiction, with little regard to service performed. It is merely the current status of a long process of shifting highway responsibilities from one agency to another. Except for the Federal-aid systems, the present grouping of highways and assignment of responsibilities does not meet the needs of traffic or comply with sound principles of highway management.

Federal-aid Highway Systems

Establishment of the Federal-aid highway policy in 1916 and later Congressional acts modifying and broadening it, have had important effects on highway management and development in Kentucky. Selection and establishment of the systems created by those acts was a form of classification of the more important routes. Design standards adopted to serve traffic on the various Federal-aid systems have established consistent goals for highway improvement. Regulations

governing the expenditure of Federal aid and state matching funds have tended to direct state financial and engineering resources toward development of high priority routes.

Federal-aid Primary System

The 1921 Federal-aid highway act prescribed that not more than seven percent of the mileage of rural roads in a state could be included in the Federal-aid Primary System. At the end of 1954, the Federal-aid Primary System in Kentucky consisted of 3,565 miles of the more important routes and 226 miles of urban extensions.

The present system carries more than half of all motor vehicle travel in the state.

National System of Interstate Highways

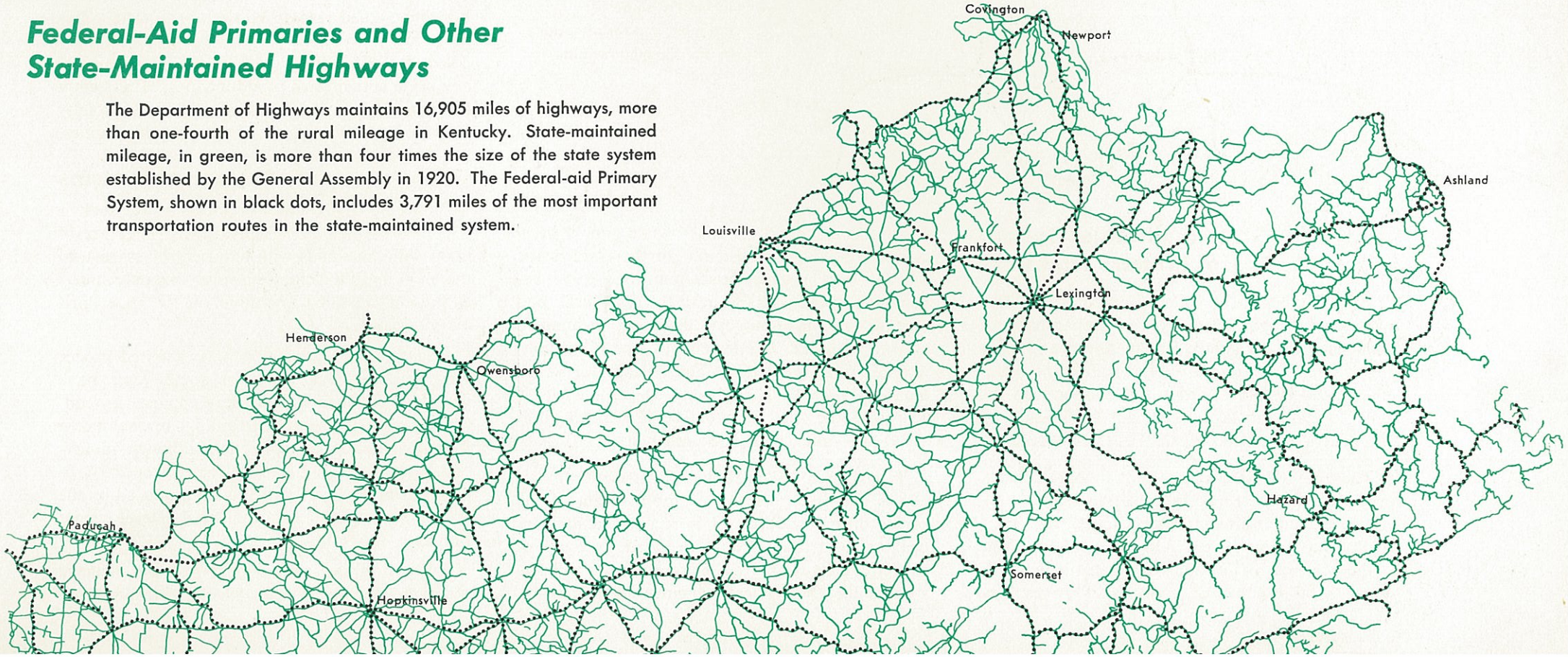
Key routes of nationwide travel are included in Kentucky's Federal-aid Primary System. Of these, 641 miles have been designated as parts of the National System of Interstate Highways. Interstate routes in the state are composed of 561 miles of rural roads and 80 miles of city streets. Among the highest volume highways on the Federal-aid system, the Interstate routes have great importance to the economy as well as to national defense.

Federal-aid Secondary System

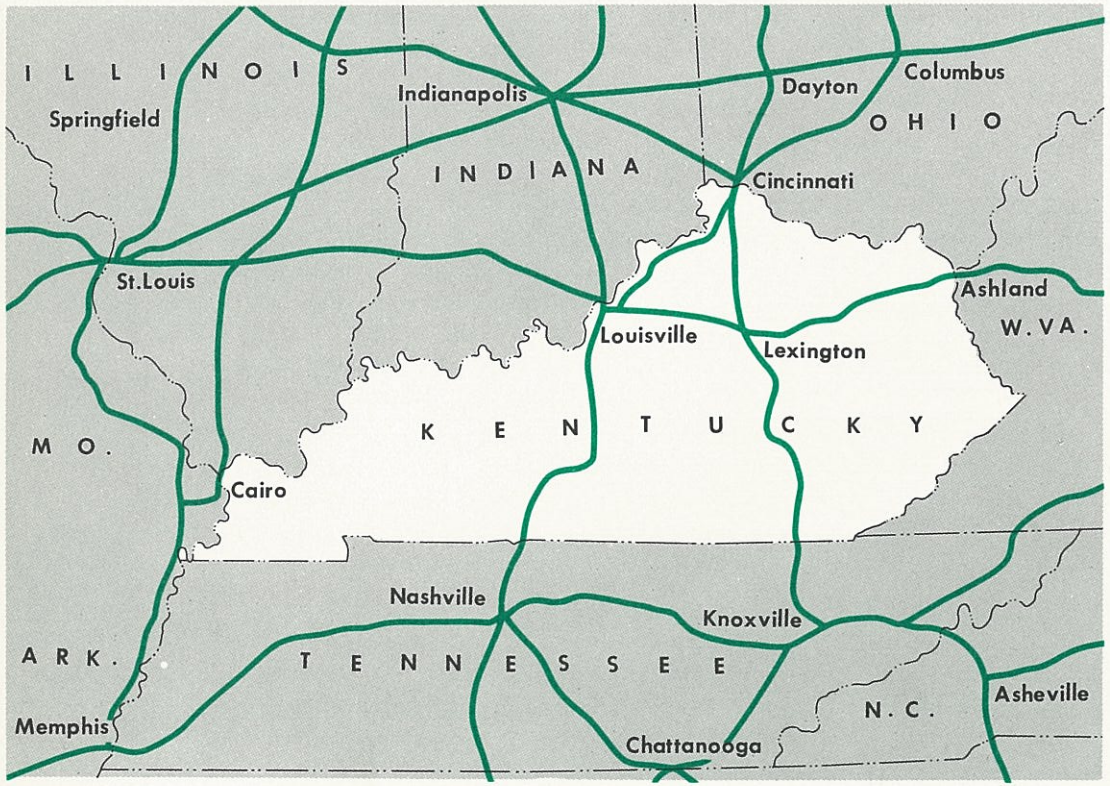
Kentucky began the selection of Federal-aid Secondary roads soon after the passage in 1934 of the act extending Federal aid to those roads. At the end of 1954 a total of 14,881 miles were on the Federal-aid Secondary System in Kentucky, of which 10,292 miles are in the state-maintained system and 4,589 miles remain on the county systems. In the state-maintained system, these roads are second only to the Federal-aid Primaries in their service to traffic; those on the county systems are principal routes under county jurisdiction.

Federal-Aid Primaries and Other State-Maintained Highways

The Department of Highways maintains 16,905 miles of highways, more than one-fourth of the rural mileage in Kentucky. State-maintained mileage, in green, is more than four times the size of the state system established by the General Assembly in 1920. The Federal-aid Primary System, shown in black dots, includes 3,791 miles of the most important transportation routes in the state-maintained system.



The Interstate Highway System in Kentucky



The National System of Interstate Highways contains 40,000 miles of routes vital to the nation's economy and defense. Routes in Kentucky total 641 miles, including some of the most important roads in the Commonwealth.

State-maintained System of Primary Highways

All of the 17,621 miles of rural roads and city streets maintained by the Department of Highways are designated by law as state primary highways. The system is often called the state-maintained system. Within this state system the only formal classification is that established by the selection of routes for the Federal-aid systems.

The present state-maintained system includes practically all the rural routes serving state interest travel, but it also includes a large mileage of roads which have little statewide travel function. If the practice of the other 43 states which still retain local control of local road systems is taken as a standard, Kentucky has a greatly over-extended state rural system. In those states the average system under state control in 1953 accounted for only 15 percent of the total rural road mileage, but in Kentucky the state maintained system includes 27 percent of the Commonwealth's rural roadways. The mileage for which the Department of Highways is responsible is nearly double what it would be if Kentucky followed the practice of most other states.

The need to channel the Department's major efforts and resources to the improvement of the routes of statewide travel is recognized and endeavors in that direction are aided by Federal-aid requirements. Nevertheless, extensive mileage spreads the Department's engineering and financial resources so thin that highway construction and improvement have not kept pace with traffic needs.

County Road Systems

All the 42,557 miles of county roads are by legal definition "public roads"; there is no other classification of these roads by degrees of importance and function except for those selected as Federal-aid secondaries. Most counties lack programs for road improvement, largely because the systems are not classified. This leaves the county fiscal courts without adequate protection against various distracting pressures.

Scanty funds for public services in some counties probably started the trend toward shifting county road responsibilities to the state. This process has so depleted many counties of principal routes as to seriously lessen the importance of and pride in their own road functions. Frequently the main effect, if not the objective, of county road policy is to get rid of road responsibilities.

City Street Systems

There are 3,401 miles of streets in Kentucky's 333 incorporated cities and towns. They are of many different kinds with a variety of usage. In the majority of the cities, however, the only streets at present classified are those on the state "primary" system.

Louisville and Lexington have adopted master arterial street plans and for some years have programmed their street development in conformity with them. Other cities have not taken formal action in this direction although in several, street work is guided to some extent by proposed plans, some of which were produced by the state Agricultural and Industrial Development Board.

Efficient street improvement and maintenance are hampered in the cities which operate without

benefit of planned arterial street systems based on sound street classification. Many have limited street funds which should be channeled into major projects rather than dissipated among a multitude of minor ones. Practically all cities are growing and need such plans to fit their expansion into a logical city pattern. Moreover, city street agencies, like county road authorities, are subject to pressures which can best be resisted where improvements are based on planned development.

ENGINEERING CLASSIFICATION OF HIGHWAYS

A sound classification of roads and streets is a primary requirement in Kentucky. In an engineering study it is impossible to determine the adequacy of any highway except in relation to the service demanded of it. One of the first steps in this engineering analysis, therefore, was a complete classification of all rural roads and urban streets.

The Service Basis

Highway classification is a common sense method of obtaining more efficient highway management by arranging roads and streets in groups according to the kind of service given. While highway travel involves several types of vehicles and all sorts of purposes, the actual movement is of three basic kinds:

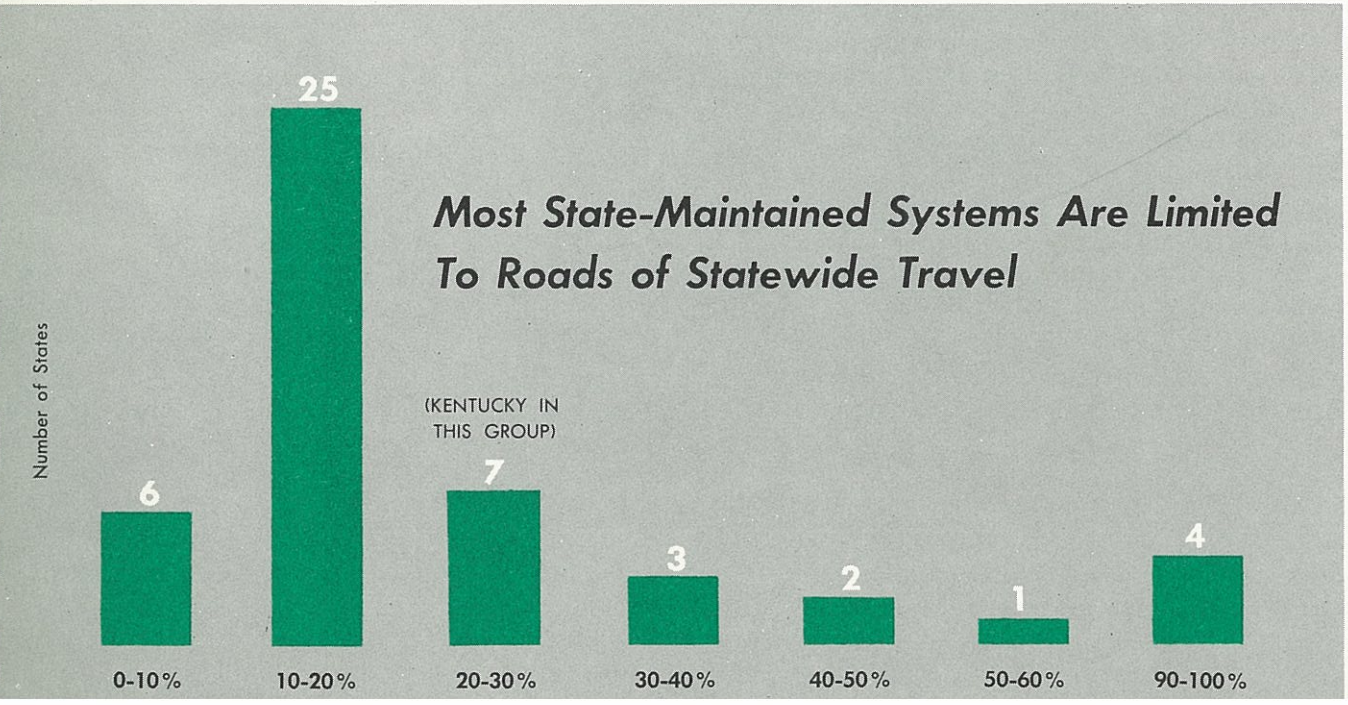
State-interest traffic, which is the longer distance, higher speed travel generated by the inter-relations of economic and individual interests in different parts of the state

Community-interest traffic, consisting of the major movements largely confined within cities, counties and other community areas

Local-interest traffic, which is the short-trip, low speed travel that links individual homes, farms, shops, etc., with the operations and services of the community. Since this travel usually merges at some point with one of the other types, it is sometimes called feeder traffic.

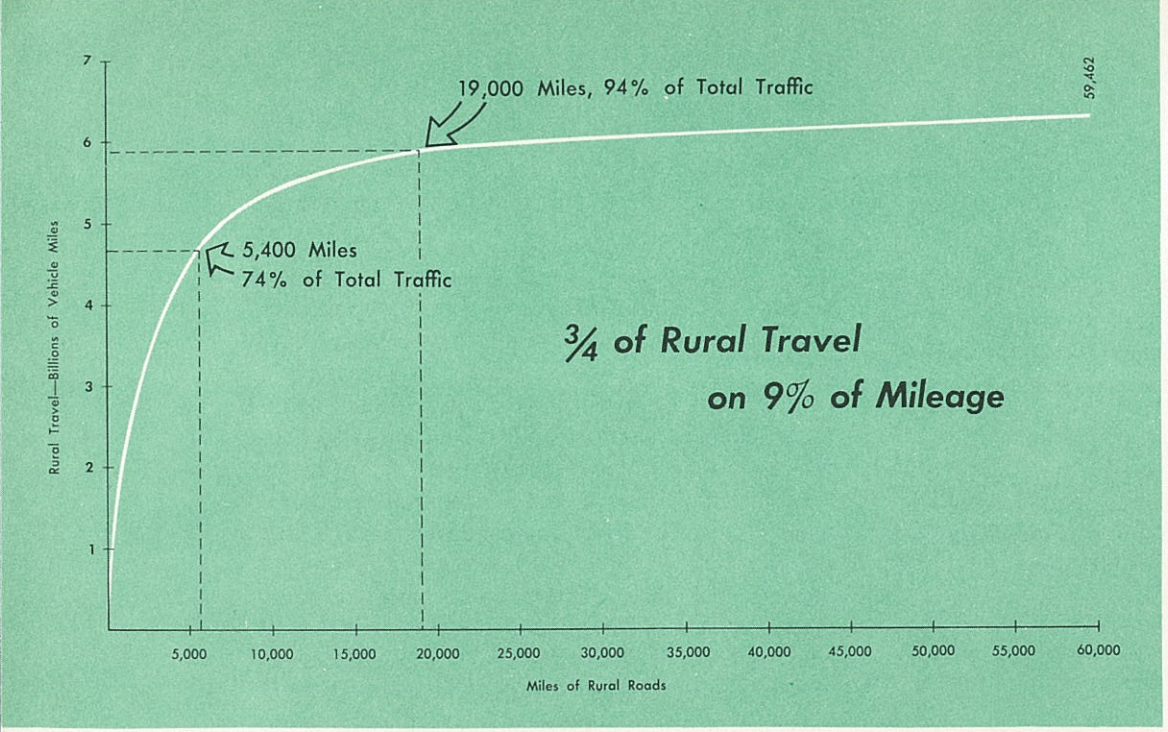
In general, each kind of traffic habitually travels on certain roads and streets best suited to its purposes. Statewide traffic requires highways which lead with some directness from one main traffic center to another, which provide the alignment and facilities for rapid travel, and which so far as possible avoid interference from heavy local traffic movements. Community-interest travel requires convenient roadways for moving freely from one part of a county or city area to another and linking these areas with the main routes of statewide travel. Local-interest travel must have roads and streets which give access to the individual units of traffic origin and destination and which connect with the routes for community and statewide travel.

Most roadways carry more than one sort of traffic, but in practically every instance one kind predominates and stamps its character on the road or street. The fact that people may live along a major cross-state highway and use it for many of their local trips, does not change its status as a route developed for and used by state-interest travel. Nor does the fact that most state-interest trips start or end on a farm road or a residential street affect the predominantly local function of such roadways. And on all these public ways, the kind of usage and the minimum standard of service required are essentially alike on all the routes within each classification.



METHOD OF CLASSIFYING RURAL HIGHWAYS

In this study, rural highways were classified by a method widely approved and utilized by highway engineers and agencies. It determines the relative importance of routes according to the amount and kind of traffic that desires to use them



This chart guides the limits of mileage which should be on the state trunkline system. It shows that relatively few miles carry most of the traffic. As more miles are added to the system they serve less and less traffic per mile of road.

as indicated, not only by the traffic volumes they now serve, but by the traffic importance of the places they connect. The initial step required by this method is determination of the relative traffic attraction of all places which are significant origins and destinations of travel. After that, its order of procedure is to select first the trunkline routes of statewide importance and then the arteries serving county or community areas; the remaining roadways are local or feeder roads.

Once the desired routes of travel have been ascertained, the specific locations for trunkline and arterial highways are determined by choosing the shortest reasonable route that will serve places along the way, by the terrain, and by the state of improvement of existing highways. Existing duplications due to diagonal or parallel routes are avoided. Finally, the selected systems are revised to provide continuity of routes and an integrated network with adequate geographic spread and service coverage.

On the basis of an analysis of various economic and other factors, nearly 200 Kentucky cities and places were classified, the places in each class having similar traffic attraction characteristics. Recognition also was given to many rural areas which have marked traffic importance, and to out-of-state cities which influence interstate traffic in the Commonwealth. Ordinarily routes connecting the cities in the first class are of greatest statewide service; those linking places in the other classes are successively of less importance.

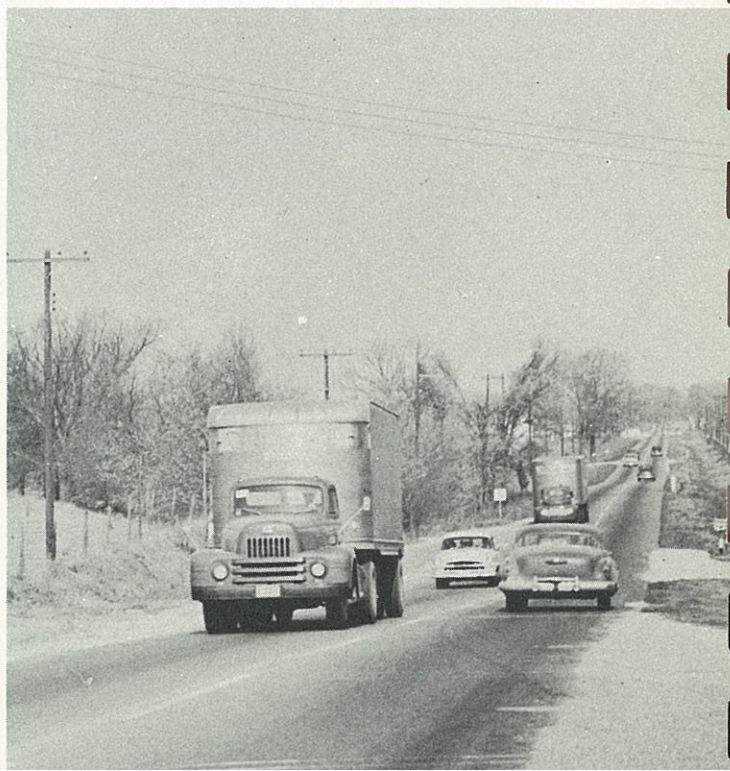
Use of this method produced an objective and impartial classification of rural highways and their assignment to highway systems planned for rational and efficient service. The classification is based firmly on sound engineering principles; it takes cognizance of the practical factors involved in serving each kind of traffic, but it is unaffected by local interests and pressures.

Trunkline Routes for State-Interest Travel

Principal routes were classified with reference to the places within and outside the Commonwealth which are major focal points of state-interest travel. Those routes serving this travel to the greatest degree were selected to comprise a basic state system.

This basic network comprises 5,135 miles of highway and provides routes, as direct as topography permits, for all of the considerable movements of statewide and interstate travel. It directly serves all the counties of the state and all but 12 of the cities and towns with populations of as much as 1,500 persons. Most places not directly on the selected trunklines are located in mountain valleys or in river bends inaccessible by through routes. The network represents nine percent of all rural road mileage yet it would carry about three-fourths of total rural travel.

This network constitutes the most logical primary trunkline system. It should be firmly established as such and steadfastly improved and operated for that service.



The state trunkline highways carry the

County Arterials for Community-Interest Travel

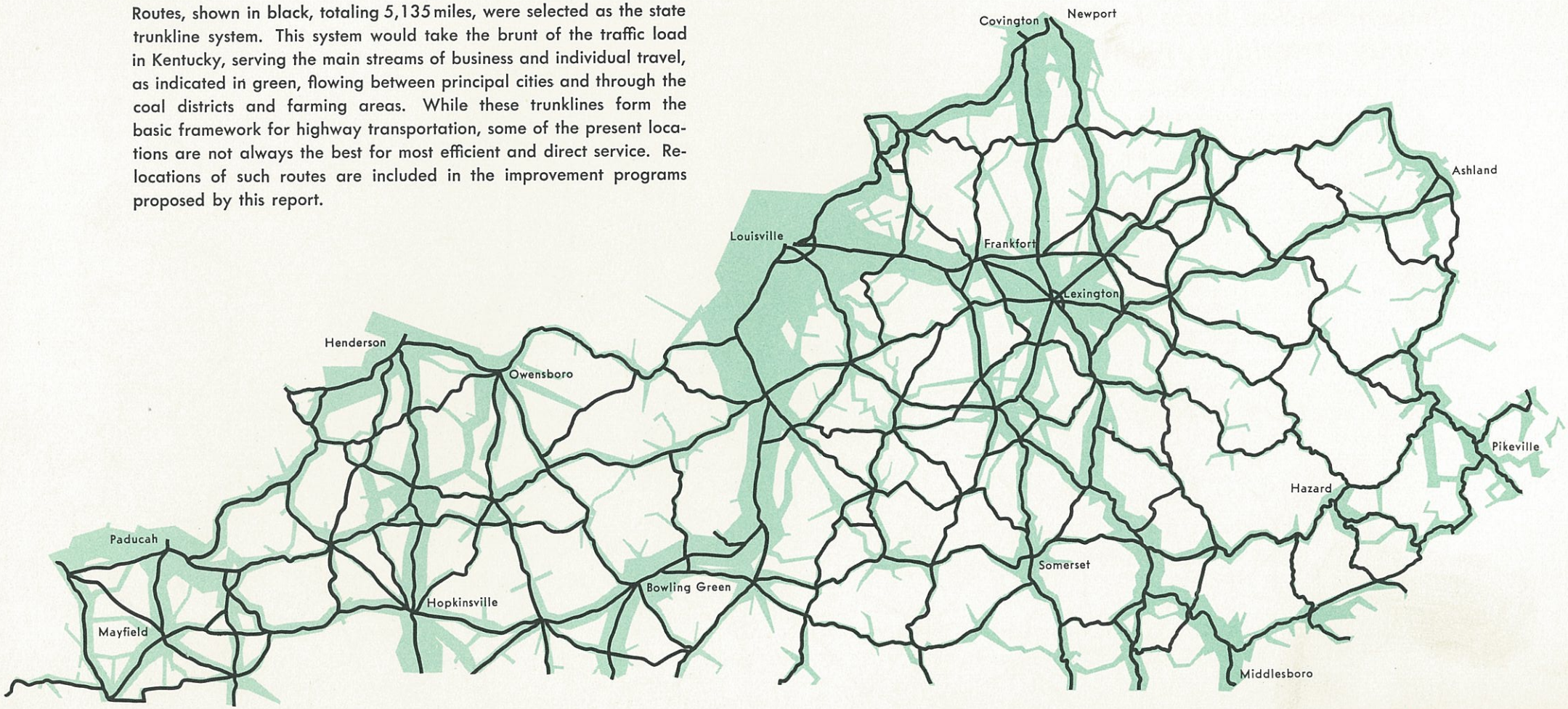
Complete highway service throughout the state demands a system of arterial roads whose scope and usage are intermediate between the statewide trunkline system and the local roadways. The arterial system must provide the necessary routes for main traffic movements within and between counties and for convenient access from these to the state trunkline system.

Routes of the county arterial system were selected with reference to the distribution of population, volume of traffic, location of market centers, mail and school bus routes, and existing road development. County arterials were classified and selected in cooperation with, or with the approval of, the county officials of the counties involved in each case.

The selected county arterial system totals 13,628 miles of highways whose importance in traffic function and usage is secondary only to the selected state trunklines. Comprising approximately 23 percent of the total mileage of rural roads in Kentucky, it would serve 20 percent of all rural travel.

Recommended State Trunkline System

Routes, shown in black, totaling 5,135 miles, were selected as the state trunkline system. This system would take the brunt of the traffic load in Kentucky, serving the main streams of business and individual travel, as indicated in green, flowing between principal cities and through the coal districts and farming areas. While these trunklines form the basic framework for highway transportation, some of the present locations are not always the best for most efficient and direct service. Relocations of such routes are included in the improvement programs proposed by this report.



The classified rural state trunklines and county arterials add up to 18,763 miles of rural roadway — almost one-third of the total rural mileage. They would extend service to practically every city, town and settlement. In rural areas, their service would be available within a mile of nine of every 10 farms or homes. They would carry 95 percent of total travel on all rural roads.

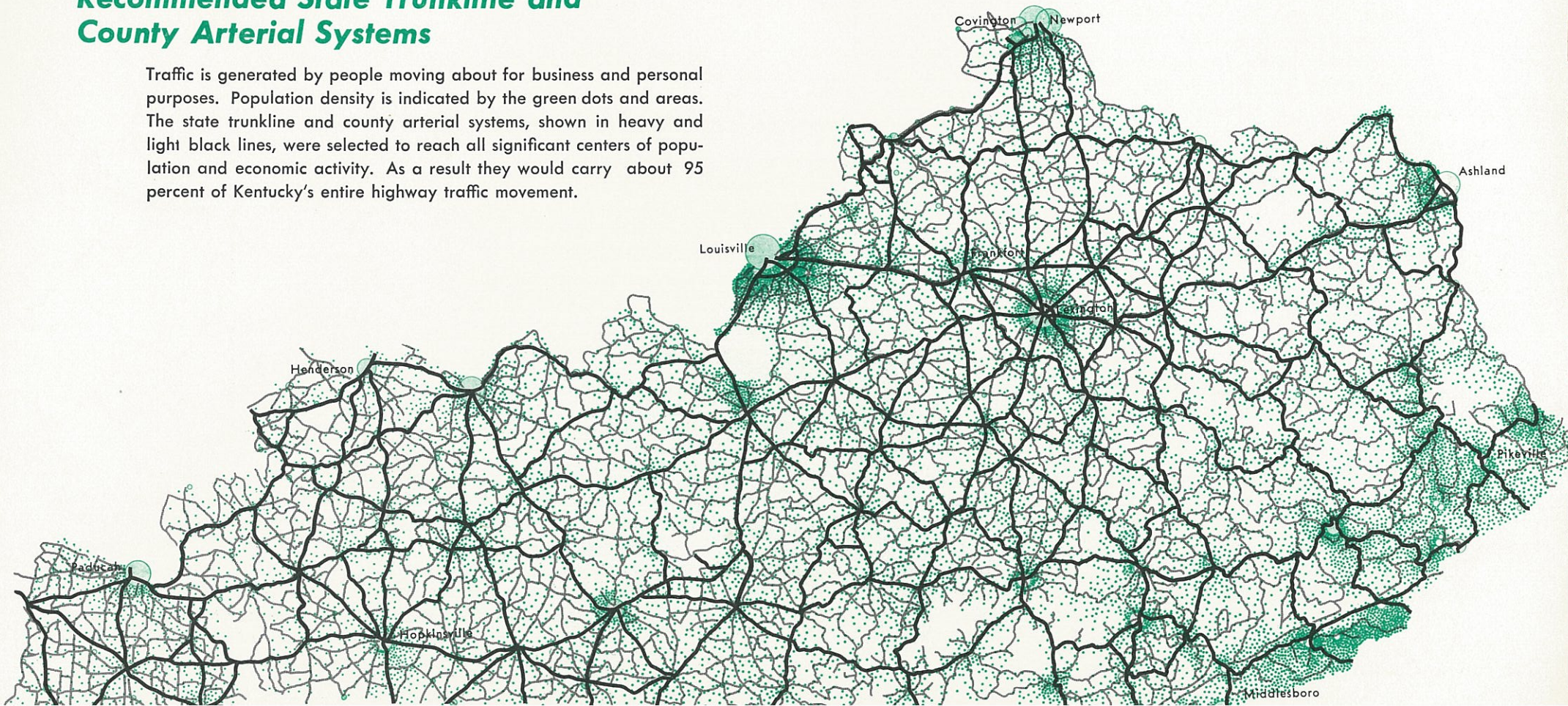
County Feeder Roads for Access Trips

The 120 county feeder road systems are the rural roads remaining after the trunkline and county arterial routes were classified and selected. They total about 40,700 miles of the least used roads in the state's rural areas. The basic service of the feeder roads is to provide access to the scattered farms and homes located off the main highways. On the average road this service would generate traffic amounting only to about 19 trips per day. Thus, while the feeder systems account for about two-thirds of Kentucky's rural road mileage, they would carry only five percent of the state's rural traffic.

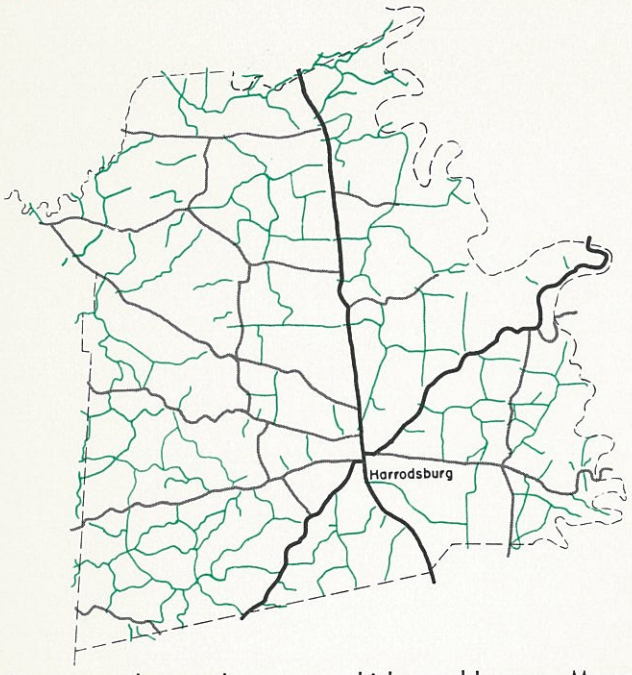
Such roads are important parts of the essential physical equipment for family and community life, but their function as local access roadways is distinct and different from the transportation service delivered by the classified trunkline and arterial highways.

Recommended State Trunkline and County Arterial Systems

Traffic is generated by people moving about for business and personal purposes. Population density is indicated by the green dots and areas. The state trunkline and county arterial systems, shown in heavy and light black lines, were selected to reach all significant centers of population and economic activity. As a result they would carry about 95 percent of Kentucky's entire highway traffic movement.



Road Systems in Mercer County



Here are the road systems which would serve Mercer County, as an example, under the recommended classification plan. State trunklines, in black, provide direct routes to any city or section of the Commonwealth and nation. County arterials, in gray, serve the principal traffic movements between all parts of the county and the county seat, to adjoining counties, and to the state trunkline routes. County feeder roads, in green, are links between these principal places and routes and the more remote farms and homes in the rural areas.

CLASSIFICATION OF CITY STREETS

Classification of streets in the larger cities was accomplished, as in the case of rural roads, by two processes of selection. The first was the designation of urban routes for the classified state trunkline highways. The second was the setting up of systems of arterial streets. Both these processes were accomplished in close cooperation with city street authorities.

Trunkline Streets

Urban trunkline routes were selected with the dual objective of providing for the movement of through trunkline traffic with as little local interference as possible, and of affording access to the principal destinations for trunkline trips going to points within the city. In certain instances these objectives were attained by selecting a main bypass route and providing an alternate route to the central point of the city. In cities where no bypass was prescribed but where there was marked congestion on the streets of the central business district, the trunklines sometimes were routed along the edge of the downtown area. In all cases, the trunkline routes were integrated with the arterial systems.

A total of 356 miles of city streets were selected and classified as state trunkline urban routes.

Arterial Street Systems

In some smaller cities and towns, the selected state trunkline routes constitute the entire arterial system. In centers of medium size and larger much study was given to selection of systems of arterial streets which would accommodate and facilitate the major traffic movements in those places.

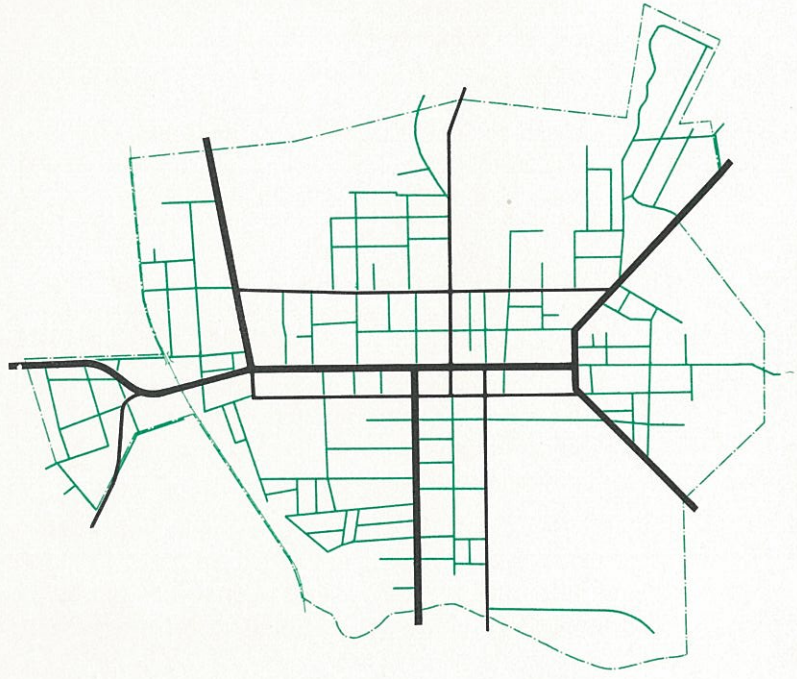
Where arterial street plans had been adopted or were on file, these were examined and, when necessary, revised to suit needs as revealed by an analyses of traffic. Land use patterns and trends of urban development were carefully considered, as were existing street improvements and conditions affecting future street widening or extension.

These studies resulted in the selection and classification of 706 miles of arterial streets in Kentucky cities. Together with the mileage of selected state trunkline streets, these classified arteries account for 31 percent of the total urban street mileage.

Local Streets

As in the case of the feeder roads in rural areas, the streets classed as local were the remainder after the selection of streets of higher classification. But unlike rural feeder roads which are all access roads with slight traffic usage, local streets differ widely in the volumes of traffic carried.

Street Systems in Danville



Streets selected as state trunklines, in heavy black lines, shown by this Danville example, give access to rural systems which link the city with its suburbs, its trading area, and with more distant places. Together with the city's own system of arterial streets, in thin black lines, they provide for the principal streams of the urban traffic movement. Traffic on this main arterial grid is collected and dispersed over the local system of access streets, shown in green.

By far the largest portion of local street mileage is made up of residential streets and has only the comparatively light traffic load generated in that service. However, the local classification also includes some business and industrial access streets and these frequently are required to handle large volumes of sometimes heavy traffic.

RECOMMENDED SYSTEMS

To provide for the orderly organization of highway facilities and management, the entire road and street mileage in Kentucky should be organized into systems. Each system should consist of roadways providing a like trunkline, arterial, or local and feeder service, as described in this chapter. The extent and composition of each system should remain substantially unchanged with only such additions, deletions or transfers as are justified by engineering analyses of traffic and classification factors.

Rural Road Systems

The General Assembly should create state trunkline, county arterial and county feeder systems, and empower the Department of Highways to designate these systems.

The rural state trunkline system, including Interstate routes, should be limited in extent to 5,300 miles and it should consist initially of the 5,135 miles of highway classified for state trunkline service by this engineering study.

The county arterial system should be limited in total extent to 14,500 miles and should consist initially of the 13,628 miles of highway classified for county arterial service by this engineering study.

The remaining approximately 40,000 miles of rural roads and rural subdivision streets not included in the rural state trunkline and county arterial systems, should make up the county feeder systems.

City Street Systems

The General Assembly should require the Department of Highways to select those streets in cities and towns which are necessary extensions and connections of the rural state trunkline highways and to incorporate them in the state trunkline system in line with the systems developed by this study. Mileage should not exceed 375, including Interstate routes.

In each of the larger cities, the Department should be authorized to cooperate with the municipal street authorities in the selection of an arterial street system, also in keeping with the results of this study. Mileage should not exceed 725 miles in all incorporated municipalities.

The streets remaining after the state trunkline and arterial streets have been selected, should constitute the local street systems.

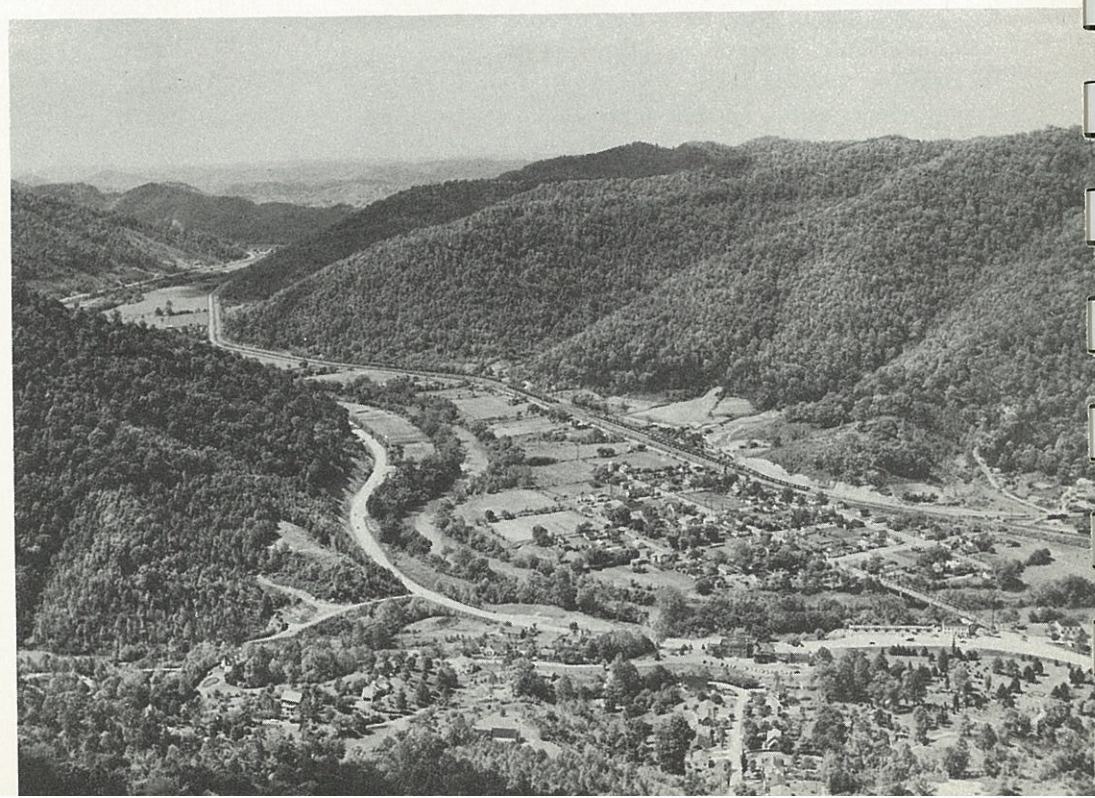
Assignment of Responsibilities

Once highways have been classified, their management should be assigned, so far as possible, to agencies whose competence and interest are logically related to the functional character of the traffic each system serves.

In so doing, the principle of specialization —long and successfully applied in industry, business and the professions—is introduced into the practices of highway engineering and administration.

The following chapter proposes an assignment of highway responsibilities in Kentucky in keeping with that principle. The last chapter shows improvement and maintenance costs for each of the recommended systems.

The significance of highway classification in the field of highway finance is dealt with in the separate fiscal study.



A section of Kentucky's highway network in rugged Bell County. U.S. 25 emerging from Pineville to follow the Cumberland River valley is the central artery of the whole area. In the towns, streets are connected with it and in the open country, county arterials and feeder roads take off to climb the hills to isolated settlements and homes.

CHAPTER III

Highway Management

MANAGEMENT PROBLEMS have been major factors affecting the whole development of Kentucky's highway network. They are at the forefront of the state's highway problem today.

From the time modern highway transportation began, legislators and people of the Commonwealth have been plagued by questions of how highway responsibilities should be distributed among their governmental agencies and of how those agencies should be organized to effectively administer highway duties. Now, more than ever before, competent management is essential for setting up and directing the expanded programs which this report proposes.

The preceding chapter recommends arrangement of Kentucky's mileage of roads and streets in classified systems. This chapter proposes an assignment of management responsibilities for the systems and makes recommendations for the organization and performance of highway duties. The proposed assignment and recommendations are based on an examination and analysis of the character and functioning of present highway agencies.

Legislative actions are necessary to place some of the proposals in effect. Others can be made by direct administrative action.

MANAGEMENT UNDER EXISTING AGENCIES

Responsibility for management of Kentucky's highways, roads and streets is distributed among the Department of Highways, the 120 counties, and the 335 municipalities.

Efficiency varies greatly among these agencies. Differences are attributable to: extent and usage of the systems; amount and quality of engineering talent available; adequacy and economic basis of financial support; and degree of public interest in highway development.

Highway administration is basically an engineering job, but to the extent that engineering is affected by poor political decisions regarding policy, finances and personnel, the quality of highway development and maintenance in each jurisdiction is adversely affected. This condition differs among classes of agencies, among agencies of the same class, and in the same agency at different times.

Department of Highways

The Department of Highways administers those rural highways which through laws have become responsibilities of the Commonwealth. It also is responsible for certain city streets, for the most part extensions of principal rural routes. In addition, the Department does much of the actual field work involved in state aid to county roads.

Throughout its 35-year history, the Department has been under various commissions or commissioners appointed by the governor. The Department's organization, technical resources and methods of operation have been revised from time to time to reach its present status.

For the first 10 years after its establishment in 1920, the Department of Highways was in charge of a four-man bipartisan State Highway Commission which appointed a State Highway

Engineer to direct the Department's operations. During most of that period good progress was made toward assembling an engineering staff and formulating a constructive highway program.

However, in 1930 the State Highway Commission was enlarged to eight, and later to nine members. All were of one party, each appointed from a separate congressional district. Individual members assumed direction of highway affairs in their respective districts. From 1933 to 1936 the Department either had no state highway engineer at all, or had one who had little effective authority. By the end of this era, more than two-thirds of the Department's early employees had been replaced.

Reorganization of state government in 1936 brought this phase of highway administration to a close. The office of Commissioner of Highways was created with complete authority, under the governor, over the state highway agency and system. At first there was an advisory highway body, but soon even this vestige of the commission system of management was abandoned. The current form of state highway administration dates from that reorganization.

Operating Procedures

The Commissioner of Highways is assisted by two Deputy Commissioners — one for general administration and one for Rural Secondary Highways.

Directly under the Commissioner, the State Highway Engineer is the chief executive officer of the Department of Highways. He, with three assistants, directs 11 headquarters divisions—Administrative Services, Bridges, Construction, Design, Equipment, Maintenance, Materials, Research (at the University of Kentucky), Planning, Rural Highways and Traffic—each of which represents one of the Department's engineering or administrative functions. A fourth assistant supervises urban programs, principally for Louisville.

Operations and duties in the field are performed or supervised through six Zone Offices and 11 District Offices. Many Department business transactions, including purchases and personnel procurement, are controlled by the state's Department of Finance.

The Commissioner of Highways is responsible for determining policies and formulating programs. Selected improvement projects are assigned by the State Highway Engineer through the Division of Design to the proper zone offices which are responsible for surveys, location and right of way acquisition. Plans are completed by the Division of Design which also prepares the contracts and takes bids. Contract awards must be approved by both the Commissioner of Highways and the Commissioner of Finance. Actual construction operations as well as maintenance and traffic engineering duties are supervised by central office divisions and directed in the field by district office staffs.

The Department of Highways is the largest highway engineering organization in the Commonwealth. It is not an ideally efficient agency but, as reorganized and strengthened during the last 18 years, it has administered the development and operation of the expanding state-maintained system in a generally satisfactory manner. However, the enlarged programs and responsibilities needed in the future call for greater emphasis on advance planning, and for certain revisions of its organization and operating methods.

County Fiscal Courts

From early in Kentucky history, the fiscal courts have been the administrative agencies of county government. As such, they were for many years in charge of all rural roads, but since establishment of the state highway system, county roads have been transferred to state responsibility at a gradually accelerated rate. However, a large rural mileage still remains in the jurisdiction of the state's 120 counties. The average fiscal court now manages about 350 miles of road although the systems vary in extent from Robertson County's 85 miles to nearly 1,200 miles in Pulaski County.

Ordinarily the fiscal courts are made up of a County Judge, who is the presiding officer, and from three to eight Justices of the Peace (called Magistrates). All are elected from districts. In such courts it is the practice to divide road funds and responsibilities among the members and their districts. However, 13 of the counties have adopted a commission form under which a County Judge and three County Commissioners are elected at large and roads are managed on a countywide basis. In either case, the officials are elected for four-year terms and the turnover of fiscal court membership is rapid.

Existing laws provide that the County Judge, with the consent of the Court, may employ a county road engineer or a county road supervisor. The former must be a registered engineer and supervisors must be qualified by experience and examination. Only 10 of the 120 counties have road engineers and only 15 have road supervisors. Although law permits two or more counties to employ such officials jointly, in no case has advantage been taken of this provision.

Increasing dependence of farms, mines and logging on passenger cars and trucks, as well as growth of recreation business and suburban living, demand reasonable development and maintenance of all-weather local or feeder roads. Yet in 94 counties road work is handled directly by members of the fiscal court who generally have little technical knowledge or mechanical equipment.

Although perhaps adequate for horse and buggy days, the real job ahead calls for more specialization, technical supervision and equipment than generally provided by present methods of administration.

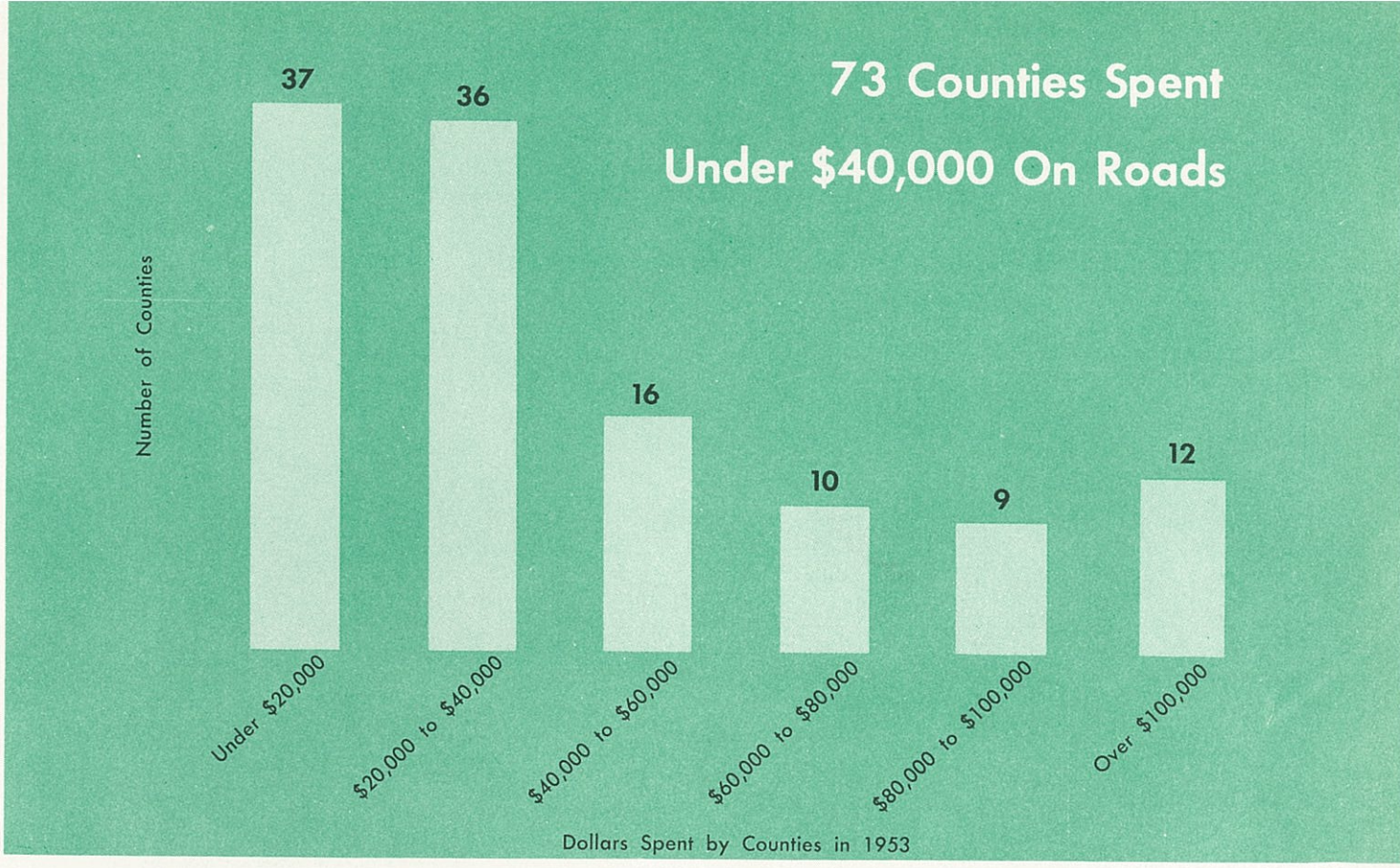
Functions and Performance

In the majority of counties the management functions of the fiscal court consist largely of making decisions regarding work to be performed on county roads by the Department of Highways. Only a minor part of the road operations within its jurisdiction is carried out by county road forces.

The fiscal court decides which county roads shall be maintained or improved by the Department of Highways each year with the county's share of the $5 million of motor vehicle tax revenues alloted for this purpose by the 1936 Rural Highway Act. The court also selects the county roads which it proposes to transfer to the state-maintained system for improvement by the Department with the county's share of the $12-to-$13 million of gasoline tax revenues provided by the 1948 Rural Secondary Act — the so-called Two-cent Law.

The county's own operations are limited to such maintenance or improvement as can be accomplished with income from local property levies and its share of the truck license tax. Expenditures charged to roads in 1953 totaled less than $55,000 in the average county and ranged from $7,000 in Leslie County to $643,000 in Jefferson County (Louisville).

Responsibilities of the fiscal courts are somewhat greater in the 10 counties which have a county road engineer. The 1936 Rural Highway Act provides that the allotments for such counties may be delivered in the form of materials to be applied by the counties' own forces.



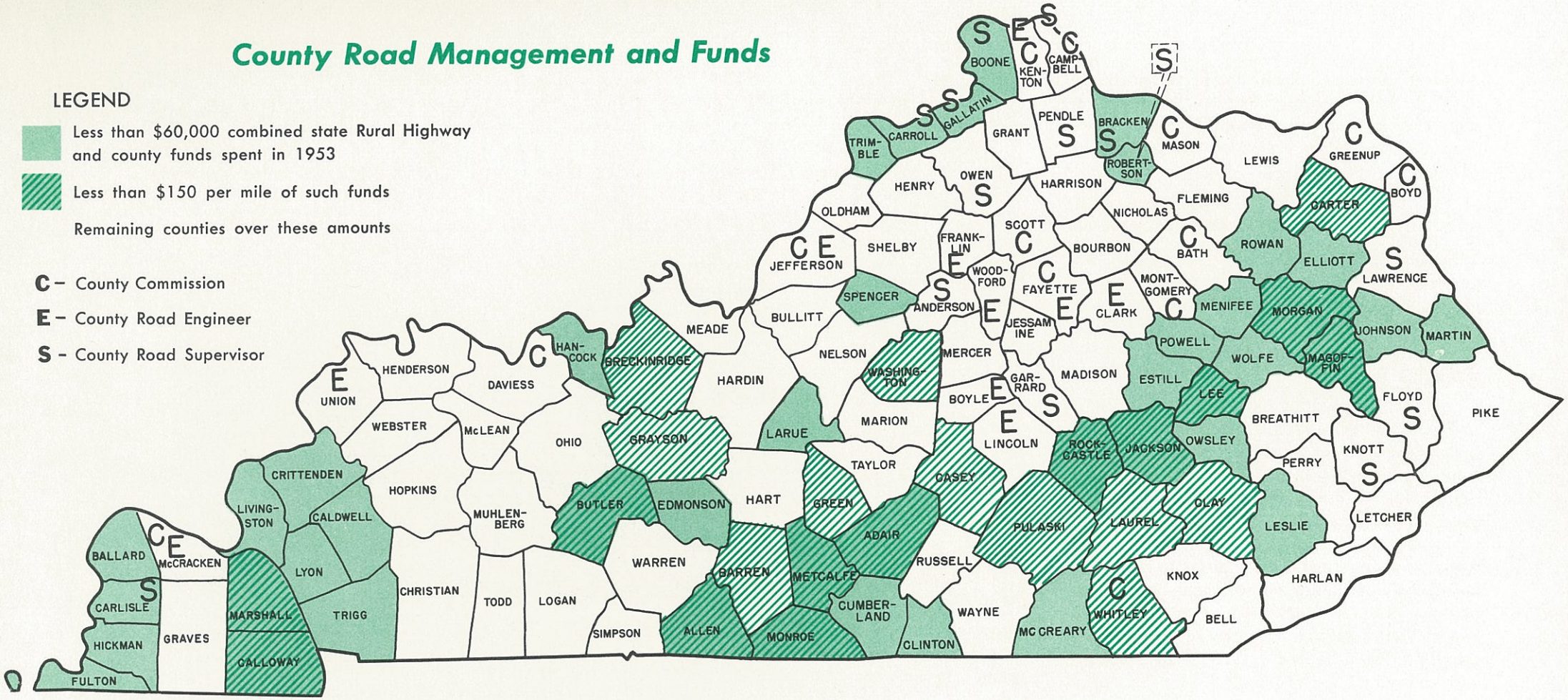
Direct expenditures on county roads by counties themselves in 1953 ranged from less than $20,000 in each of 37 counties to more than $100,000 in each of 12 counties. Such funds were obtained mainly from the county's share of truck license fees and from local taxes.

In such counties, road work is fairly well done, although only Jefferson County and possibly two or three others have engineering organizations of sufficient size and ability to survey and plan a county road system.

In the counties with road supervisors, roads are usually maintained satisfactorily and a few reconstruction or improvement projects are undertaken. In most of the counties, however, no consideration is given to the future planning of an over-all county system or to potential traffic needs. Distribution of operations is frequently dictated by personal interest or by the political significance of a road; lacking these, important county arterials are apt to be neglected.

Inadequate funds is a major factor limiting county operations. In 1953 there were 43 counties which each had less than $60,000 available from state and local sources for county road work. In 11 of those counties, and in 12 others, funds amounted to less than $150 per mile of county road system. Also, the small mileage of roads in the systems of many counties makes it impractical for them to maintain adequate equipment and road forces. The systems in 52 counties have less than 300 miles of road and 19 of

County Road Management and Funds



them have less than 200 miles. Also important is the general lack of interest in, and support of, county road agencies and their work.

Municipal Street Management

Kentucky cities and towns are responsible for all streets in incorporated places except routes maintained by the Department of Highways. Management of the urban systems takes different forms in different communities.

In most cities street policy is determined by the mayor and council, with a councilman assigned the duty of giving first attention to street matters. A few municipalities have a city manager who handles administrative affairs including street management, but with the council making policy decisions. In either case, street operations are supervised by a city engineer, a superintendent of public works, or a street foreman.

All Kentucky cities of over 5,000 population employ a city engineer. Many of the smaller cities retain a consulting engineer to plan and supervise major street construction projects.

Generally speaking, however, there is a lack of planned street improvement. Congestion and parking are particularly troublesome problems which in most cases are not given adequate attention.

ASSIGNMENT OF RESPONSIBILITIES

Through custom and long experience, Kentucky's three established classes of highway agencies — the Department of Highways, the county fiscal courts and the municipalities — are the natural managers of the Commonwealth's

highway systems. They are the agencies to which the responsibilities for the systems as classified and recommended in this report, must be assigned.

Essential to the success of any assignment of management responsibilities are firmly established fiscal plans suitable for each of the road and street systems. Amounts should be based on the needs of the respective systems as determined in this, or succeeding engineering studies. Means by which the needed funds can be raised and how they should be distributed are to be presented in the separate fiscal study.

State Trunkline System

The Department of Highways should have complete responsibility for and full authority over the entire proposed State Trunkline System, rural and urban. The Department should be empowered to add and delete routes from the system, within limits, as the need is indicated by engineering classification studies.

The Department's responsibility should include the determination and location of routes, design of facilities, construction of roadways and structures and pertinent facilities, and maintenance and operation throughout the entire designated system. ***Control should extend to the full width of the right of way in both rural and urban areas with certain exceptions for locations within corporate limits.*** These exceptions concern law enforcement, parking regulation where parking is permitted by the state, public utility installations, maintenance of sidewalks and street illumination, construction and maintenance of sanitary and storm sewers, and street cleaning.

The Department should be permitted to contract with cities having competent engineering organizations to do work on state trunkline routes under Department supervision, and a city should be permitted to contribute cash to the Department to accelerate work on such streets. In cities with a qualified traffic engineer, the Department should be authorized to delegate such of its powers of traffic regulation and control as may be desirable.

County Arterial Systems

The service characteristics of the County Arterial Systems point clearly to the county fiscal courts as the agencies whose jurisdictions and interests coincide most closely with the average range and purpose of rural arterial travel. But, while there are a few counties whose road agencies are capable of assuming responsibility for their arterial systems, as pointed out earlier, most counties in Kentucky have not developed road organizations equal to this task. They would find it difficult to do so rapidly. Moreover, the state has already taken over two-thirds of such mileage under existing laws and financing.

Because of those conditions, and provided an appropriate financing plan is arranged, ***responsibility for all of the rural County Arterial Systems should be assigned to the Department of Highways*** as the agency most competent for over-all management of important secondary roads. ***The Department should be given the same complete responsibility and authority pertaining to construction and maintenance of them, as is proposed in the case of the State Trunkline System.***

In addition, the Department should build and maintain extensions of County Arterial System roads into and through fifth and sixth class cities to the nearest and best connection with a State Trunkline route, since smaller cities usually are not well equipped to provide adequate through service.

The Commissioner of Highways should be given final authority, within specific mileage limits, to select the routes comprising the County Arterial Systems. Inasmuch as this recommended assignment increases the mileage responsibility of the Department, ***the Commissioner should be allowed a period of not more than two years to permit official designation of the systems and organization of the Department to better handle its increased duties. Once established, routes should not be altered for at least five years.*** Selection in each county should be based on criteria established and routes classified as "arterial" by this study, with subsequent changes permitted mainly in cases where trunkline relocations make a readjustment of arterial mileage necessary.

In recognition and support of better county road administration, ***the Department should be permitted and encouraged to delegate operational functions on any arterial system to an approved county which employs a registered engineer and which agrees to act for the state.*** Such delegation of powers should be embodied in a formal agreement based on a fixed budget with the Department paying the entire cost, including administration, and giving general supervision to the work.

County Feeder Road Systems

Every effort should be exerted to retain complete county responsibility for local roads, and to work out methods to increase county efficiency and provide means to do a reasonable job. It is important to keep counties in the road picture,

Counties can satisfactorily improve and maintain local roads, as indicated by this example in Franklin County. Counties should retain responsibilities for their own feeder systems, but need to improve their management.

despite their apparent desire to retire from it, for these reasons:

- County authorities are familiar with and responsive to local road conditions and needs
- Full county responsibility would permit direct action by local authorities to meet quickly any urgent problems which on a statewide basis might have very low priority
- The need for improvement and maintenance is apt to be met by counties themselves on a more realistic basis than if under remote control by the state
- Moves to weaken, rather than strengthen, local governments by reducing their responsibilities unduly is not in keeping with the traditional and effective American system
- While the state is already financing and directly controlling a much greater share of road mileage in Kentucky than in most other states, the proposed plan for state responsibility of the County Arterial Systems would increase it
- Further increase in state responsibility would present unwieldy administrative and financial problems, disperse the productive effort of engineers and administrators too widely and force the state into thousands of minor decisions in which the state as such has little interest.

Accordingly, ***it is recommended that the county fiscal courts should have basic administrative and financial responsibility for all roads and structures on the County Feeder Systems. The present policy of direct maintenance by the Department of Highways financed from the Rural Highway Fund should be abandoned,*** eliminating present confusing and inefficient dual responsibilities by both county and state.

Although the state's first financial responsibility is to roads and streets which it directly manages, should the General Assembly decide the state has a continuing interest in the county feeder roads, it could provide cash grants in aid to be paid directly to the counties, in lieu of the direct expenditures by the state under the Rural Highway Act. Amounts should be in proportions which the General Assembly may determine properly reflect the degree of state interest. In that case, funds should be audited by the state and controlled in a manner insuring protection of state interest. The separate fiscal study should provide helpful information.

Any offer of state funds should be made, like Federal aid to the states, on condition that counties meet certain standards of administration and comply with acceptable construction and maintenance standards. Details of conditions and standards suitable for this purpose are presented in the recommendations for improving county management later in this chapter.

Mileage reduction in many county systems resulting from the recommended transfer of roads to the County Arterial Systems, and cancellation of unused trails, will decrease significantly the load on county fiscal courts. Moreover, the concentration of sole responsibility for a county's rural feeder roads in a single agency, which must live and work closely and continuously with the people served, should have a double advantage. It should result in higher standards of road work and create a keener interest in, and perhaps an increased local support, of feeder road improvement and maintenance.

City Arterial Streets

Because cities are better able to finance and manage their own affairs, and since it is proposed

that the state continue its full responsibility for trunkline routes in cities, ***it is recommended that maintenance and construction on all Arterial Streets in cities of the first four classes should remain basically the complete responsibility of the municipalities.***

Currently, the state is responsible for some of the streets classified as arterial in this study, and the number is increasing. Preceding recommendations would confine full state responsibility in cities of the first four classes to the proposed State Trunkline System which would thereby reduce the extent of the present state-maintained urban mileage. In lieu of further state control of non-trunkline streets, the General Assembly could provide grants in aid for all Arterial Streets in cities of the first four classes. Such action also would give recognition to the fact that people from all over the Commonwealth use these urban arterials, though to a less extent than they use the state trunkline routes.

Were such funds provided they should be limited to construction of the Arterial Street Systems, perhaps on a matching basis. On all construction projects involving state funds, expenditures should be approved and audited by the state. Traffic engineering measures on streets so benefited should be approved by the state.

Municipal Feeder Streets

Historically, local streets have been financed by property owners and city general funds. Because of the cities' ability to do work at a lower cost per capita than is possible in most rural areas, ***it is recommended that Municipal Feeder Streets should be controlled entirely by the cities. They should be completely responsible for all construction and maintenance. Statutory provisions should be made for smaller cities to contract with the county or the Department of Highways for maintenance and improvement of these streets.***

ORGANIZATION OF HIGHWAY MANAGEMENT

Highways are one of the most fundamental services provided by governments. In terms of annual expenditures, construction and maintenance of the Kentucky highway plant is the biggest single item of public business in the Commonwealth. To assure adequate road and street transportation and as a matter of sound governmental policy, highway management should be conducted with the same foresight and efficiency required in private enterprises of similar magnitude.

Kentucky's highway agencies have had long experience in management of the state's road and street systems, but in several respects they have not perfected their organization structures and methods of operation to the standards required for the job. Administrative inadequacies should be corrected as an essential part of the Commonwealth's highway improvement program of the future.

Department of Highways

The duties of the Department are so large and varied that special and continuing care must be taken to make it work as effectively as possible. The Department not only should assume responsibility for an increased mileage of state-managed highways and serve as administrator and supervisor of the state's interest in the county and municipal systems, but it should at the same time undertake the extensive improvement program proposed by this report.

All this calls for a careful examination of the Department from top management to routine field duties. Such an examination does not imply any criticism of past performance, but it does evaluate the Department's administration, organization and operation in relation to the work to be done.

The Department's principal weakness, as disclosed by this study, is the serious lack of advance planning which results in a dispersion of efforts and resources and an increase in the cost of all operations. There are also other conditions which limit engineering and administrative efficiency.

The present appraisal has found some dangers and weaknesses in the over-all administrative organization, too great centralization of operations management, less than full utilization of engineering personnel, and a growing problem of personnel management and recruitment. Also, it is noted that, while political influence has some effect on appointments and assignments to duty, there is much ability and much loyal and intelligent effort in all ranks and operations of the Department.

Top Management

The existing arrangement of a single Commissioner of Highways has several important advantages. It centralizes administrative authority and responsibility in one office, it makes possible quick and positive decisions, it is in some measure responsive to popular will, and so far it has worked well in Kentucky. But there are also some grave drawbacks. Because the Commissioner is appointed by the governor and because no Governor can succeed himself, there has been a new Commissioner of Highways at least every four years. Short tenure of office handicaps long-range planning and there is always risk that a

Heavy construction, such as this in Breathitt County, requires much advance planning, careful location and design and good supervision on the job. More district office responsibility is recommended.

political upheaval will disrupt the Department's engineering staff.

An alternative would be a small commission with members appointed for staggered terms which would select a commissioner or director of highways and from there on, would have only a policy-making function. By making it impossible for one governor to change the entire complexion of the commission, this would tend to stabilize and give continuity to highway policy and organization. However, in some cases a commission has proved to be a cumbersome and inefficient agent for managing highway affairs.

There is strong historical evidence in Kentucky against return to any form of commission control and a majority of those most familiar with the state's highway problems and history favor retention of the present type of administration. In the final analysis, good management depends most heavily on the competence of the people involved, rather than on a particular plan of top control.

Control of Operations

The function of deputy commissioners is to relieve the chief of the pressure of details coming from all parts of the organization. In most state highway departments this is accomplished by giving each deputy commissioner general supervision of several related divisions, such as those concerned with the department's business or engineering activities.

Functions assigned to the Deputy Commissioners in Kentucky's Department of Highways do not follow that pattern. The Deputy in charge of general administration, except when he assumes the Commissioner's duties during his absence, is actually an administrative assistant. The Deputy for Rural Highways is concerned only with county relationships which would be of an entirely different character and importance under the proposed redistribution of highway responsibilities.

The Department's basic duties are actually tightly centered under the State Highway Engineer. He is not only a policy-making official, but the direct supervisor of much of the business and engineering operations in the headquarters divisions and in the zone and district offices.

This system channels an immense load of detailed responsibility into the office of the State Highway Engineer. To handle the work, three Assistant State Highway Engineers and an Engineer-Manager of Urban Development are on the staff. The duties of the office, aside from certain urban matters, are handled by a somewhat elaborate plan under which the State Highway Engineer and the three Assistants each has responsibility for certain divisions and even parts of divisions. For instance, different sections of the Division of Design are assigned to three of these officials, and responsibility for each of three other divisions is divided between two of them.

It appears that the three Assistant State Highway Engineers are in fact heads of super divisions and that their work more or less overlaps that of the engineers and directors in charge of the 11 individual divisions. With lack of clear lines of authority, the existing arrangement gives rise to some confusion and much lost motion; it tends to weaken the initiative of division leadership when too many individuals are involved in decisions.

Reorganization of Headquarters

The Department of Highways' present organization "works," but its operation depends too largely on individual understandings and relationships and on specially devised lines of authority. Achievement of the program for modernizing Kentucky's highway system demands a clear-cut grouping of the Department's forces and the most efficient utilization of its engineering personnel. Most of all, the Department's top management

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must be relieved of its present burden of operating detail and left free to do the advance planning and programming which is its primary responsibility.

To accomplish this ***it is recommended that the present organization of the Department be changed to a plan which will decentralize both operations and operations direction, but at the same time strengthen centralized control.***

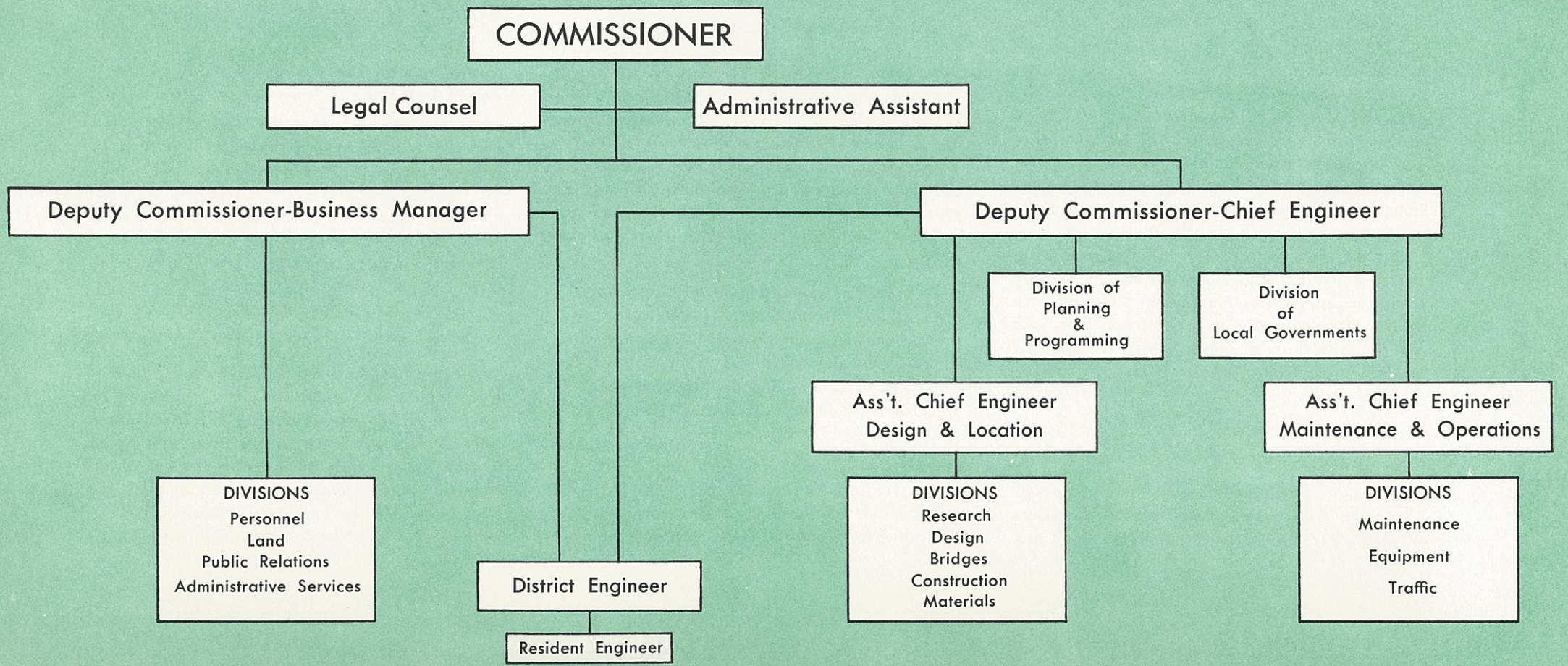
The accompanying organization chart presents the main features of the recommended plan and suggests distribution of departmental functions under it. Such a revision of top management would eliminate existing duplication of duties and effort, and would provide a rational basic framework for the orderly arrangement of all Department functions and forces.

The Commissioner of Highways should have an administrative assistant and a legal counsel. The duties of the present Deputy Commissioner of Rural Highways should be combined with those concerning the Department's relations with municipalities in a new Division of Local Governments.

In the headquarters offices the recommended plan assigns the several divisions, after some desirable rearrangement of functions, to two Deputy Commissioners, one a Business Manager and one a Chief Engineer.

It is contemplated that the divisions would be given greater responsibility and autonomy in doing work involved in their respective duties. This work should be done at the direction of the Deputy Commissioners, but should not require their direct supervision.

Proposed Organization • Kentucky Department of Highways



The plan groups the essentially business and budget control duties of the Department under the Deputy Commissioner - Business Manager. Recognizing the importance of land acquisition, public information and personnel procurement and management, ***it is recommended that new Land, Public Relations, and Personnel Divisions be established and included in this group.*** The business functions of the Department are all incidental to its engineering objectives and the divisions which perform them constitute a service section operating in aid of those objectives. The Land Division in particular should operate in closest conformity with the requirements of the design and location engineers.

The engineering job of the future is so large that it demands the full attention of the Chief Engineer, whose time should not be spread thin on many other matters. Therefore, a carefully considered arrangement of the Department's engineering functions is proposed. ***It is recommended that the operating divisions be grouped under two Assistant Chief Engineers, one for Design and Construction and the other for Maintenance and Operations.*** This would enable the Deputy Commissioner-Chief Engineer to give personal attention to major problems—importantly, advance planning. Under the plan, ***a Planning and Programming Division would report directly to the Deputy Commissioner-Chief Engineer. Coordination of the Department's work policies with, and aid to, local governments would be handled by the Local Governments Division.***

Advance Planning and Programming

Advance planning is the only means through which the day by day, year by year operations of a highway agency can be coordinated to produce an adequate highway system. The organization can be shaped for known requirements. Location and design can be scheduled most efficiently and large savings made in right of way costs. Public confidence and support are strengthened when an agency demonstrates its efficiency and ability.

There is little advance planning in the Department of Highways, even though it has objectives and short-range programs. Throughout the Department there is a sincere desire to build a modern highway system. Annual programs are influenced by Federal-aid requirements which tend to concentrate major projects on some of the most-traveled routes. But there is no long-term program for system improvement and little detailed knowledge of what next year's projects will be.

The Division of Planning should be the Chief Engineer's organization for mapping the development of the system. It should be charged with the task of working out a program for five or six years in advance, based on demonstrated needs and with priorities determined and assigned within budget limits. The program and priorities should be given constant study to keep them always consistent with and applicable to current conditions.

To fit the Division of Planning for this increased responsibility, its staff must be built up for engineering analysis. In its work, the planning force should enlist the aid of all divisions under the Chief Engineer, as well as the proposed Land and other divisions under the Business Manager.

Thus all essential information would be brought together, coordinated and furnished in analyzed and useful form for the Chief Engineer. He would then be able to exercise the necessary judgment within the framework of facts. Advance planning, to be effective, requires that the General Assembly and the Commissioner of Highways lay down a firm fiscal policy. Moreover, once a plan or program is formulated and adopted, it will be up to the Commissioner to stay with it despite unwarranted pressures. If this study results in nothing more than a serious and conscientious beginning of advance planning and programming, it will be well worth the effort and money expended. The fact remains the program for highway improvement which is proposed cannot be carried through without such continued planning.

Relations With Local Governments

Coordination of state and local agencies' interest is a top-level duty and should be performed by a staff directly under the proposed Deputy Commissioner-Chief Engineer.

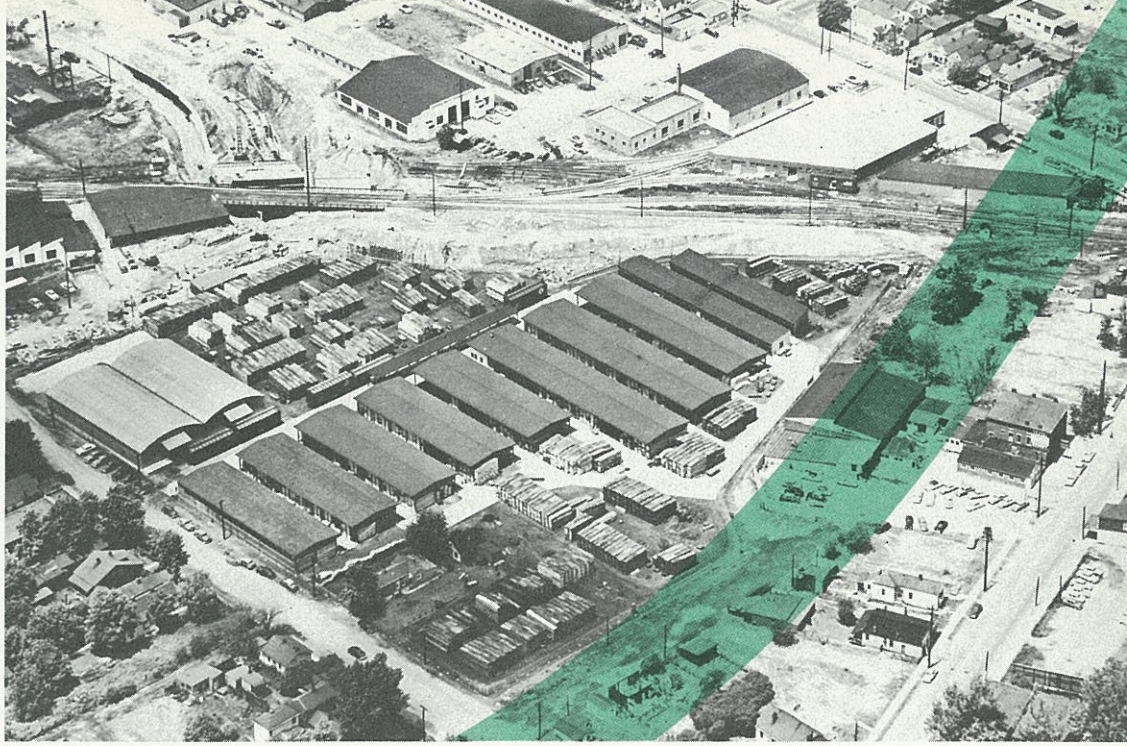
The proposed Local Governments Division should act for the Department in projects it might undertake in cooperation with a county or city. Through this division, engineering assistance or counsel should be extended to local agencies by Department forces. Should the General Assembly adopt a policy of state aid to local roads or streets, the division should administer whatever duties of inspection or approval the Department might be charged with under the law. It would act as the state's correlating agency for the development of an integrated system of highways, roads and streets.

It is recommended that the urban phase of the Department's engineering functions be pushed vigorously and that qualified engineers cooperate with every municipality in setting up arterial street plans. In like manner they should aid county road agencies in special problems. The Local Governments Division should work closely with other parts of the

Department to properly coordinate planning, design and construction operations in these areas.

The Divisions

Some changes in headquarters divisions are proposed to provide better performance or integration of certain of the Department's functions. New divisions, described below, are needed to give weight to important functions. In addition, some changes in methods of operation and a few revisions of laws concerning the divisions' functions and authority are proposed.



The North-South Expressway in Louisville, being built to relieve traffic pressure on established business arteries, follows a new route shown in green. Right of way procurement is a difficult and costly operation.

Land Division

It is recommended that a new Land Division be established to replace the present right of way section in the Division of Design. The Land Division should have its own law section which would handle legal phases of land acquisition and property management. The Assistant Attorney General's staff which now does this work could be materially reduced with its duties limited to serving the Commissioner of Highways in general legal matters. A representative of the Land Division should be attached to the staff of each district office.

In several respects the laws and administrative methods concerning land acquisition and management should be broadened and strengthened to avoid present handicaps which slow down highway development and increase costs. Details of proposed statutory revisions are available as a supplement to this report.

Controlling statutes should state in detail the purposes for which land can be acquired, including that of future use when definite locations are established. Statutes should make provision for a special right of way revolving fund for the purchase of land for future use. Large sums can be saved by such a fund which would be replenished by regular Department funds at the time of actual construction. In California, this practice has saved some $100,000,000 in four years, particularly in expanding metropolitan areas. ***Another device which could be developed as an alternative to, or together with, the advance purchase fund is a legal reservation which has the effect of freezing present use of right of way, with payment made when it is actually acquired in the future. It is recommended that the state study methods used in other states and develop such a plan for consideration in Kentucky.***

Statutes should provide for quicker and more efficient land acquisition in fee simple through a choice of proceedings in the circuit, as well as the county, courts; right of immediate possession with proper compensation and safeguards should also be granted to the Department.

To improve and standardize the new division's operations, ***it is recommended that special programs for training right of way personnel be initiated and that a manual of right of way laws and procedures be compiled.***

Special care should be taken to effect close cooperation between the proposed Land Division and the engineering functions it is intended to serve. Failure to achieve good working relationships would not only result in an undesirable division of responsibilities between business and engineering functions, but severely handicap advance planning and construction programs which will involve a great expansion of right of way acquisition and reservation.

Public Information Division

The Department has an Office of Public Relations, but it is under-staffed and its activities are severely limited by the fact that a Division of Publicity in the Department of Conservation

is designated as the state's official source of public information. The latter distributes road maps but it is mainly concerned with promoting tourist travel. However, highway progress and development itself is of great public interest and concern. The public should be kept intimately informed on those matters, and all Department employees should better understand policies, programs, problems and accomplishments.

It is recommended, therefore, that a Division of Public Information be established in the Department with a qualified director and small staff. Its function should be to keep the people of the Commonwealth advised about highway matters and problems and about the Department's plans for meeting its responsibilities. It should enlist the interest and cooperation of all employees in this work, arrange for the appearance of spokesmen before clubs and other organizations, and make effective use of the press, television, radio, and other means of communication.

Traffic Division

Traffic work in the Department is generally well performed; however, there is need for sharpening of duties and improvement of administrative procedures. ***The Division of Traffic should have control of intersection design in subdivisions when adjacent to a state trunkline route. It should have the responsibility for approving and issuing permits for highway entrances and exits, and have standard plans for guidance of builders. Statutes covering these matters should be strengthened, clarified and enforced.***

Analysis of accident reports, now done by the Division of Planning, should be transferred to the Traffic Division and should include spotting locations of accidents to aid study of preventive measures. All construction plans should be inspected routinely by traffic engineers for traffic control and safety measures. The division should compile a manual of standards and specifications for traffic control devices and make it available to traffic control personnel in highway jurisdictions throughout the state.

Personnel

There is no real manpower shortage in the Department of Highways, but there are serious problems concerning qualified personnel, particularly in the engineering classifications. These problems are basic factors in the whole field of Department management and ***a Personnel Division should be established*** to deal with them.

The Department of Finance, which has overall charge of personnel management in Kentucky state government, often assigns people directly to the Department of Highways. The latter agency accepts applications for employment and usually can get Department of Finance approval, particularly for technically trained persons. Within the Department of Highways most personnel matters and records are now handled by the Division of Administrative Services.

Employees of the Department are not under a civil service or merit system and there is no retirement plan. An attempt is made to maintain a file of employee rating reports in the State Highway Engineer's office, but the impression is general that this has small influence on promotions.

Personnel Problems

In 1955 there were a total of 619 men on the Department's engineering staff, accounting for a little less than 10 percent of its average peak employment.

However, only 127 of those listed as highway engineers are graduates of an engineering school. Another 138 are registered as professional engineers but are not college graduates. The remaining 354 are neither graduate nor registered engineers.

An undue proportion of the better qualified members of the engineering staff are stationed in, or work out of, the main offices of the Department. This is reflected in the professional status of the engineering management in the field. Only a fifth of the Resident Engineers are graduate engineers. Only one of the 11 District Engineers, as now assigned, is college trained, and none of the six Zone Engineers has had such training.

That is not to say that a college degree guarantees a capable engineer, or that lack of one is automatic evidence of inability. Nevertheless, practically all large public and private engineering organizations recognize the value of a good educational background and will pay a premium to get men who have it, knowing that their work is likely to prove more productive in the long run.

The Department's engineering staff is aging, and there is not enough infusion of young blood. The records show that of its 619 engineers, 374, or over 60 percent, are more than 40 years old. Even in the classifications of instrumentman and junior engineer, which should be the training ground for young engineering recruits, the average age is nearly 40 years. Only 13 of the 182 engineers in these groups are college-trained.

Needed Changes

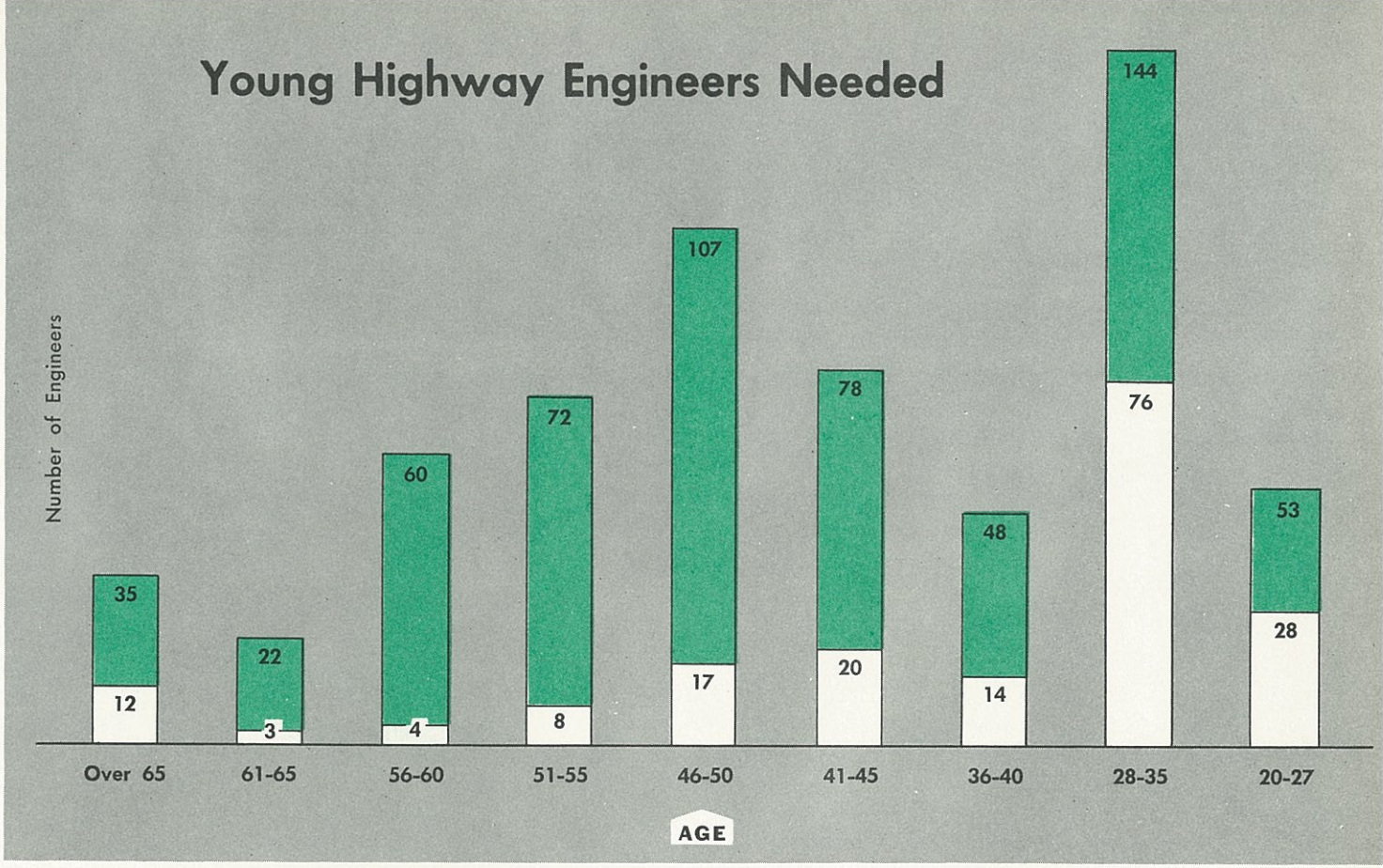
Of first importance in remedying the Department's personnel problems is establishment of a soundly organized and administered civil service or merit system for all personnel. This would give all employees greater confidence in their careers and job tenure. Job security and assurance of merit advancement on a pre-determined basis as opportunities arise would

encourage college graduates and other well qualified people to accept Department employment.

A retirement plan also should be installed so that the Department, with good conscience, can retire its older employees. This would give younger qualified people a chance to advance and would aid the Department to compete with private industry for the services of college-trained employees. Much work has already been done to devise a proper plan for the Department. It is recommended strongly that a sound, attractive plan be adopted.

The Personnel Division should step up the recruitment program and at the same time set up an aggressive on-the-job training program. The latter should give the newly employed engineer a rounded experience in the Department's activities instead of, as now, often being kept on one job for the period of his employment.

While it would take time for these measures to become effective in remedying the existing shortage of trained engineers, yet the Department's management can take immediate steps for better utilization of engineers now available. The proposed reorganization and decentralization would make available a number of headquarters assistant engineers in various categories. These capable and experienced men could be usefully employed directing the proposed expanded activities of the district offices.



An undue proportion of engineers is in older age groups, as shown by the bars. In the lowest two grades, shown by the white areas, only 13 of the 182 men are college graduates.

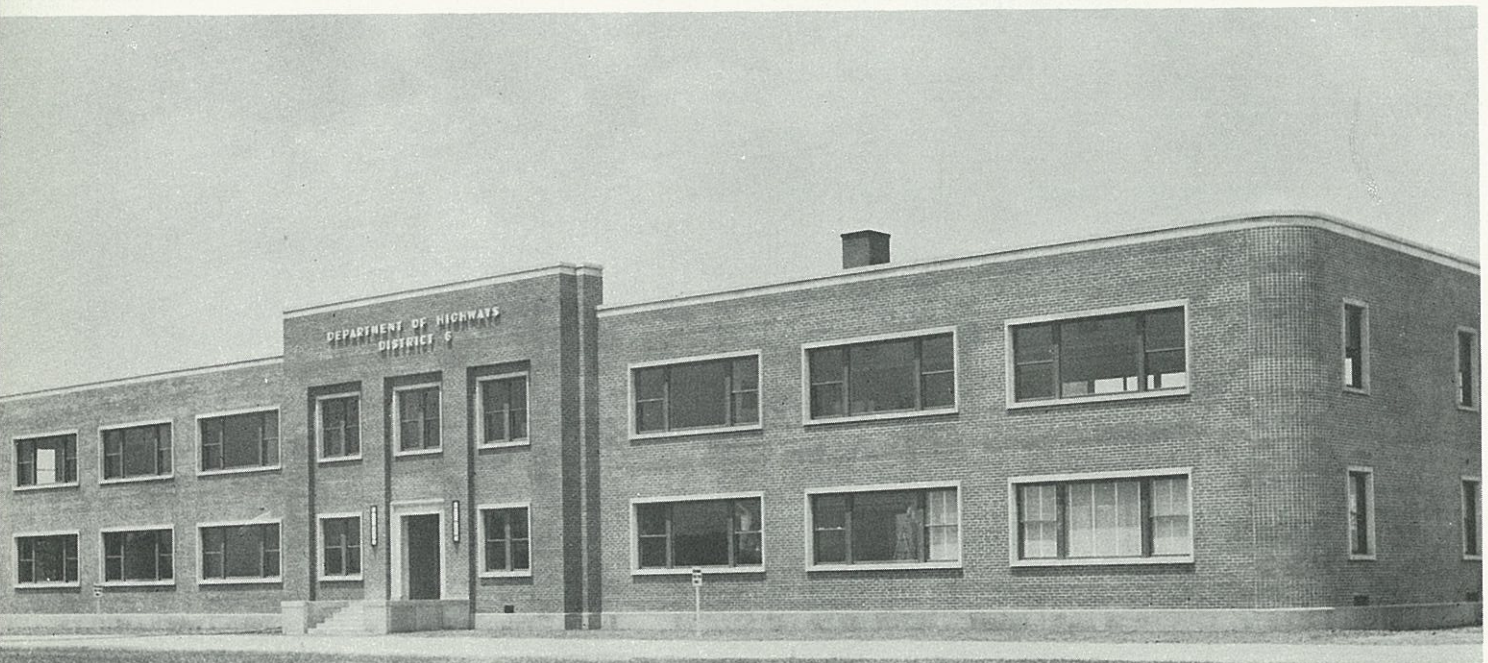
Reorganization of Field Offices

Field offices of the Department are under immediate direction of the Frankfort headquarters. The six Zone Offices which are responsible for surveys, locations and details of land acquisition, are virtually sections of the Division of Design. The 11 District Offices which supervise construction, maintenance, traffic control and materials work, operate under the close direction of the State Highway Engineer's office, as well as of the headquarters divisions represented on their staffs. It has been observed that the district engineers and other district staff not only look to main office people for all major decisions, but often are hesitant about deciding routine matters.

Decentralization of the existing organization to place more direct responsibility in the field is required for more efficient operation, especially in management of the proposed County Arterial Systems. For these systems, a close-to-the-people viewpoint is essential, with a high degree of full district responsibility.

The Zone Offices should be discontinued and their duties taken over by District Offices, the needed number of which should be re-examined. Moreover, in addition to the surveys, location and right of way work now performed by the Zone Offices in connection with projects on all state-maintained routes, ***the District Offices should do the designing for all road projects on the recommended County Arterial Systems.*** Because of the more elaborate roadway

District offices are the administrative centers for highways in extensive areas of Kentucky. Efficient operation demands that they be suitable and convenient for the purpose. The new headquarters building in Lexington, the lower photograph, provides such accommodation. The makeshift quarters in Jackson do not. New buildings are needed in eight of the 11 districts.



facilities and statewide continuity required on the recommended state trunkline routes, design of these and of all bridge structures would remain in the headquarters offices of the Division of Design.

Revision of the field organization should be accompanied by drastic decentralization of supervisory responsibility. The District Offices would have a large degree of autonomy in the management of the County Arterial Systems and increased authority for operating functions on the State Trunkline System. These duties should be performed in accordance with policies and criteria laid down by headquarters authorities, but there would be sharp curtailment of the constant patrol of the districts by headquarters supervisors, characteristic of the present centralized organization.

All this would greatly increase the responsibilities of management in the districts. To better handle the heavier work load, ***it is proposed that district forces be organized in sections representing the required duties, with two Assistant District Engineers, one for design and construction, and one for maintenance and traffic control. An office manager should also be provided to supervise the business management of the district.***

The increased duties of a District Engineer would require an upgrading of his qualifications. He should have thorough professional training and experience, and ample administrative ability. He should be selected to serve as the state's highway spokesman and manager in his area. As such he should have full backing and support from the Commissioner and the Department.

The enhanced importance of the district offices, as here proposed, calls attention to the condition of their present housing. Of the 11 existing offices, eight are quartered in totally inadequate buildings, two are in buildings that should be remodeled,

and only one is in reasonably satisfactory quarters. ***District headquarters should be permanently established, and state-owned accommodations should be constructed or rebuilt where required.*** Offices for the district engineers and their staffs should be in buildings separate from the headquarters garages.

District Maintenance

District organizations for maintenance are headed by Assistant District Engineers, usually two in each district, who have under them a total of 350 district superintendents, county foremen, county sub-foremen and foremen of special crews.

In actual operation, the Assistant District Engineers for Maintenance bypass the 53 district superintendents and give orders directly to the county foremen. The latter, with the aid of sub-foremen, supervise the routine maintenance work on a countywide setup. The special crew foremen are skilled by experience in such work as asphalt resurfacing, bridge maintenance, heavy grading, pavement patching and emergency repairs. They work out of district headquarters and are by far the most capable supervisory people under the Assistant District Engineers' command.

Existing district organizations for maintenance should be streamlined and strengthened to properly discharge the increased duties involved in the proposed reassignment of responsibilities. In the district headquarters, it is recommended that there be only one assistant for maintenance. The qualifications for assistant district engineers, like those for district engineer, should be sharply upgraded. High competence in district leadership would make possible a substantial reduction in the six central office Assistant Maintenance Directors, three of whom now supervise field operations.

Resident Engineers

A revision of the internal organization of the districts is also necessary for maintenance and for other field operations. ***It is proposed that each district be subdivided into residencies with a resident engineer established in each.*** He would supervise the work of the foremen on maintenance and routine construction—especially of the County Arterial Systems — in his area; the District Engineer would assign a special Resident Engineer to major construction projects. ***Establishment of residency areas is important and should be studied in relation to maintenance work load, natural topographic boundaries, ability of the engineer and other factors; county borders may or may not be the proper dividing lines.***

For the performance of maintenance duties it is recommended that definite patrol sections be established and that each be assigned to a foreman with the necessary equipment, tools and labor. This would give the foreman and his men a tangible job whose progress they can observe and take pride in. It should result in more efficient and economical performance of maintenance work.

County Fiscal Courts

Road work by counties ranges from good to very poor, the principal factors accounting for the differences being management and money, in the order named.

Road operations in the counties with road engineers or superintendents are usually good to fair. The results may also be fair even without these special supervisors, where there is a commission form of county government with something more than minimum financial resources. But in counties which have neither an engineer nor a superintendent, and where roads are run by the magistrate type of fiscal court, almost invariably there is an exceedingly wasteful dispersal of resources. In the poorer counties of the latter type, there still are areas not accessible by car and existing roads are considered "good" if they are passable in dry weather — in one such county, equipment has not covered all roads in five years.

The counties which have engineers or superintendents are capable of maintaining their feeder road systems, although the present practice of magistrates of "passing equipment around" from one magisterial district to another severely handicaps good road work. In most of the rest of the counties where magistrates are in direct control, there is neither the equipment, organization or conception of the job to provide good maintenance service, even were sufficient funds available.

Needed Changes

Basic and difficult revisions of county road management will be required if the Feeder Road Systems are to be adequately developed and maintained. Some of the principal necessary changes are these:

1. ***While the commission form of government would be desirable in all counties, fiscal courts of the magistrate type should establish a three-member County Road Board consisting of the County Judge and two magistrates and should charge it with responsibility for maintenance and construction of the county's Feeder Road System on a countywide basis.***
2. ***Counties with less than $150 per mile of feeder roads, or under $60,000 per year for expenditure on roads, should form a Road District with one or more***

adjoining counties of similar status. The combined Feeder Road Systems of the district should be managed by a Commission made up of road commissioners, one appointed by the fiscal court of each of the respective counties and one appointed by the governor. Counties above those limits should also be encouraged to join forces for road purposes if they so desire.

3. *Each County Road Board, County Fiscal Court (commission type) and District Commission should appoint a road superintendent or engineer whose qualifications would be set by the state, which should approve each appointee. The superintendent or engineer should be given full administrative responsibility and operate on a countywide basis under general policies established by the court, board or commission.*

4. *The Fiscal Courts and Commissions should agree to centralize administration of equipment and supplies under the supervision of the county or district superintendent or engineer.*

Should the General Assembly adopt a policy of state financial aid to counties for county feeder roads in lieu of direct expenditure by the state, the General Assembly should make compliance with the above proposed changes a mandatory condition for a county to receive its allotment. Under such a policy, the counties and districts also should be obliged to comply with the following additional conditions:

5. All detailed construction plans and specifications would be initiated by the county or district and should be approved by the Department of Highways.
6. All maintenance work would be subject to an annual inspection by state maintenance engineers, who would make a written report to the fiscal court or district commission and to the Commissioner of Highways, appraising the adequacy of maintenance performance and recommending improvements in procedures consistent with the amount of state and local funds available.
7. Counties or road districts would be required to report annually to the state on the expenditure of all road revenues on forms prescribed by the Department of Highways.
8. Annual construction programs would be submitted by each county or road district to the Department for approval, prior to preparing plans and letting contracts or carrying the work out by force account.
9. An initial grace period, after passage of legislation, of not more than three years should be provided to permit the counties or road districts to properly organize themselves, after which the conditions cited above for withdrawal of state aid would take effect.
10. Compliance with the conditions required as outlined above would be subject to annual review by a state board broadly representative of the engineering, governmental and public interests involved. Membership of the board should be established by the General Assembly and put on a staggered term basis.

Should state aid be granted, it is suggested a specific sum be set aside for each county complying with above conditions, solely to pay the salary of a county engineer.

Municipal Street Management

In general, Kentucky cities are handicapped in street management by a shortage of engineering personnel and by a lack of planning for future development. Only five cities have arterial plans and only six appear to be giving serious thought to their preparation. In the absence of a plan and of a program for carrying it out, construction expenditures too often result in haphazard improvements which do not key together for the production of a street pattern fitted to community needs.

All cities of over 5,000 population should be required by law to have a full time professional engineer. A state law should require that an arterial street plan be prepared in all cities of the first four classes, the plan to be based on engineering and traffic studies. Also, a long-range program should be developed from data indicating traffic and parking requirements. This planning should be conducted in cooperation with the Department of Highways.

Should state aid be granted for arterial streets, plans and specifications for construction should be submitted to the Commissioner of Highways for approval.

CONCLUSION

The proposals and suggestions for establishing efficient management structures and methods in Kentucky's highway agencies are based on studies of conditions and needs as they exist and as they would be affected by the recommended plans for future development. ***Problems of organization must be given constant and continuing study.*** It is recognized that administrative organization is not static but that, to remain effective, it must be adjusted to changing conditions. It is believed that the changes and revisions here proposed are essential to deal with the accumulated problems confronting the Commonwealth today.

CHAPTER IV

Highway Needs and Programs

A MAJOR PART of the Kentucky highway needs study was to determine requirements of bringing the Commonwealth's road and street systems up to standards adequate for efficient transportation service.

As the end product of the study, this final chapter reports the physical deficiencies, estimates the cost of correcting them, and proposes alternative programs for doing the work.

Needs and costs were determined in five direct and logical steps, the first two of which have been described:

1. Traffic volumes and characteristics of travel were analyzed and an estimate made of the trends of traffic to 1975. (See Chapter I)
2. The whole highway and street mileage was classified and arranged in systems with like traffic functions, and each system was assigned to a specific highway agency. (See Chapters II and III)
3. Standards of design suitable for present and future traffic were selected for each system; this included an analysis of the limits of sizes and weights of vehicles to be accommodated.
4. Needs on each roadway section were determined by comparing its status with the selected standards; urgency depended on allowable tolerance below the standards.
5. Costs of meeting indicated needs on each system were computed on the basis of standards for adequate facilities, and estimates were made of average annual expenditures under alternative 10, 15 and 20-year programs.

DETAILS OF STUDY PROCESS

The basic plan for determining highway needs was relatively simple, but its practical accomplishment called for collection and processing of a large amount of information. Operations were arranged to assure that data would be thoroughly factual and representative with results sound and accurate. Particular attention was given to selection of design standards, since they describe facilities required for various conditions.

Selection of Standards

In building and operating roads for motor vehicle use, it has been found certain features and methods get best results. Out of this experience engineers have developed sets of design standards economically suited to differing volumes and kinds of travel on different classes of roadways.

Standards contribute to traffic efficiency and safety by establishing for motor vehicle operators consistent facilities and conditions on roadways of similiar service character. Standards furnish highway administrators and engineers with sound formulas for providing facilities giving maximum service with minimum hazards at reasonable cost. They constitute tested and approved criteria for measuring highway adequacy in relation to service demands.

For the purposes of this study two criteria were required and developed—design standards which establish the desirable levels of design which

Trucks dimensionally are important factors in traffic movement, as shown by this trailer combination turning at this state highway junction in Shelbyville.

should be the objective of development on each highway system, and "tolerable conditions" which set minimum levels of conditions and fitness feasible for present traffic service.

Both design standards and tolerable conditions were selected by the study engineering staff. To make sure they fitted Kentucky conditions, this work was done in consultation with technical committees representing state, county and municipal highway agencies. Details are shown in tables in the appendix of this report; only their general character and purpose are described below.

Design Standards

The design standards for rural highways and roads adopted in this study are based on those recommended by the American Association of State Highway Officials after much research by state highway departments, universities, the Highway Research Board and the U.S. Bureau of Public Roads. However, certain modifications were made in recognition of such practical factors as topography, costs, and the best features of Kentucky design practice. In the absence of officially approved standards for city streets, standards for that purpose were selected which represent modern concepts of urban planning and street design.

The separate design standards for each of the systems of roadways include ranges aimed to provide optimum operating conditions for different volumes of traffic in flat, rolling or mountainous terrain. In all cases capacity is provided to meet estimated traffic demands throughout most of the probable service life of the facilities. County arterial and feeder roads are designed for estimated 1965 traffic; state trunklines and city streets for estimated 1975 traffic.

Necessarily standards differ widely between roads with different service characteristics, but the object in every case was to prescribe facilities adequate to the service required. Application of these standards to future improvement programs would produce highways on each system generally superior in design and service to those built in the past.

It is recommended that the design standards developed in this study be adopted by Kentucky highway agencies.

Tolerable Conditions

Two practical facts required the selection and establishment of a set of "tolerable conditions." The first is that Kentucky roads and streets cannot be brought up to approved design standards all at one time; the most urgent situations must be dealt with first. The second is that many existing roadways, although falling short of the design standards for new construction, still can serve their traffic with reasonable safety and efficiency; these residual values must be utilized.

Tolerable conditions set the limits between roads that can serve for the time being and those which no longer give even minimum service. They also were used, in connection with estimates of road life and of traffic growth, to determine when roads now usable will become intolerably deficient because of physical deterioration or lack of capacity.

In general, tolerable conditions involve acceptance of narrower and lower types of surfaces, and slower driving speeds than are demanded under similar circumstances by the design standards for new construction.

Size and Weight Standards

Standards for the design and construction of highways and structures must be based on firm knowledge of the loads to be carried. Minimum specifications regarding dimensions and strength of highway facilities presuppose fixed limitations of the maximum size and weight of vehicles. Provision of highways to serve the expanding nationwide movement of commercial highway traffic requires that such limitations be generally uniform from state to state. The limits recommended by the American Association of State Highway Officials have been adopted by a majority of states.

Kentucky has three sets of regulations limiting the size and weight of vehicles. A basic set establishes limitations for general application to all highways. Two other sets establish higher maximum limits for application to state-maintained highways when specifically designated by the Commissioner of Highways. Principal maximum limits of these sets of regulations are compared in the accompanying table with the limits recommended by the American Association of State Highway Officials.

Kentucky regulations are aimed to protect deficient roads and bridges on a system which includes some routes of acceptable quality. However, weight regulations are badly chosen in that they impose some heavy stresses on structures while limiting permitted gross weights below reasonable levels and below those of adjoining states. Also, the law contains outmoded restrictions on load per inch of tire width.

Most of the highways now designated as "A" routes are capable of carrying weights permitted under the AASHO recommendations. The proposed improvement programs would progressively qualify all important carrier routes for operation under these regulations. Therefore, ***it is recommended that present legislation be repealed, and that the limitations recommended by the American Association of State Highway Officials be adopted as the basic regulations of commercial vehicle size and weight in Kentucky.***

Many eastern states do not permit the 60-foot truck-trailer combination, due principally to congested conditions in cities, sharp curvature in mountainous country and greater problems in passing such vehicles. If other features of the AASHO recommendations were adopted, authorization of the truck-trailer combination could be deferred, pending modernization of principal routes.

TRUCK SIZE AND WEIGHT LIMITATIONS

	KENTUCKY		*AASHO*
	Basic	**For State-Maintained Routes*	*Recommendations*
Height	11½ ft.	12½ ft.	12½ ft.
Width	96 in.	96 in.	96 in.
Length			
Single truck	26½ ft.	35 ft.	35 ft.
3-axle bus	.....	.....	40 ft.
Tractor and Semi-Trailer	30 ft.	45 ft.	50 ft.
Truck and Trailer	.....	.....	60 ft.
Weight—on Axles			
Single	.....	18,000 lbs.	18,000 lbs.
Tandem, under 8′ spacing		32,000 lbs.	32,000 lbs.
Gross Weight			
Single axles	18,000 lbs.	42,000 lbs.	.....
Tandem axles	18,000 lbs.	42,000 lbs.	.....
Single Trucks			**up to 50,000 lbs.
45-foot combination			**up to 60,800 lbs.
50-foot combination			**up to 64,650 lbs.
60-foot combination			**up to 73,280 lbs.

* Ruling of Commissioner of Highways for "A" Routes; other routes, 30,000 lbs. gross weight limit.

** Depending on distance between axles.

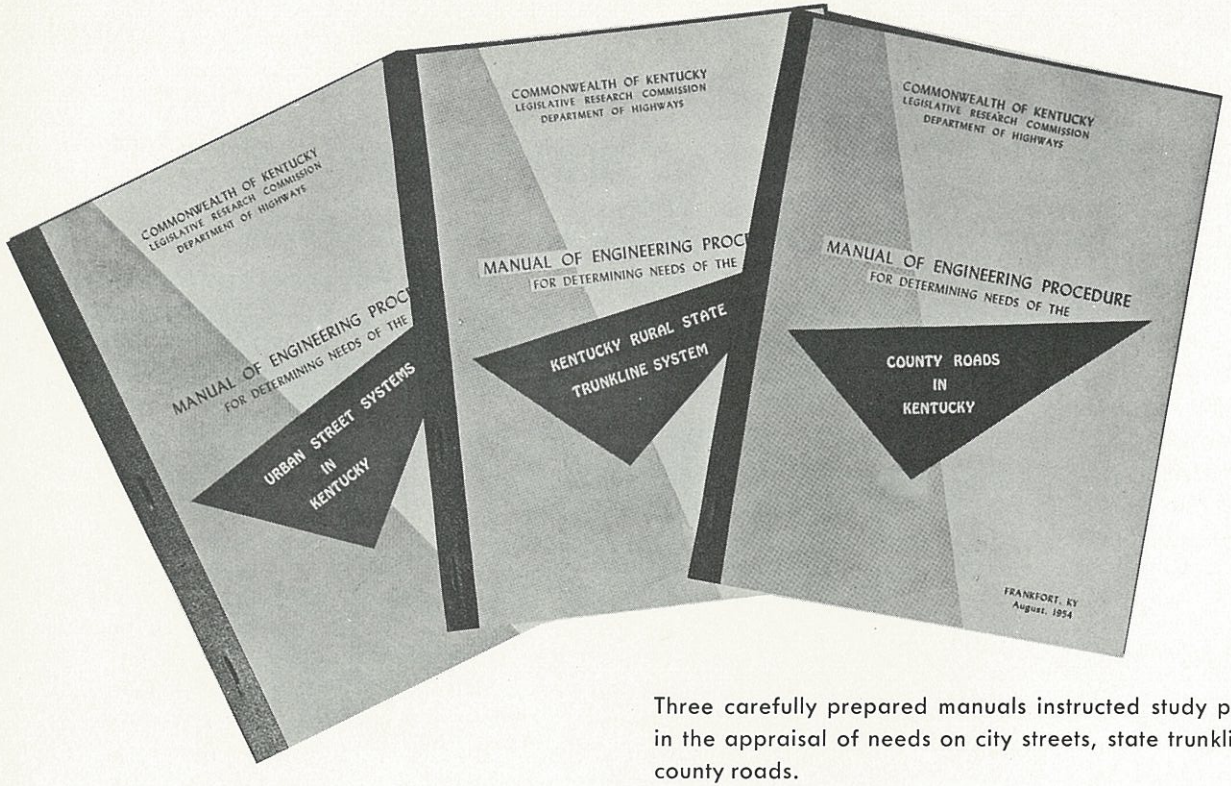
However, in Kentucky it is necessary to continue for a time some additional regulatory protection of existing facilities. Therefore, ***it is recommended further that the Commissioner of Highways be authorized to classify the routes under Department of Highways' control, according to the carrying ability of their surfaces and structures, and to specify lower weight limitations where required. The same authority should be granted county and municipal officials over systems under their management, but their authority should be limited to such systems.***

Procedures of Needs Study

Kentucky's highway needs were studied and determined for each of the rural and urban systems as selected by classification and as recommended for adoption as the Commonwealth's permanent jurisdictional systems. The process required an inventory of the roadways of each system and an appraisal of their tolerability for present service, a determination of their present and future needs, and an estimate of the cost of improving deficient roads to the proposed new design standards described above.

Detailed operations involved in this process were supervised and directed by the study's engineering staff, but the field work and initial office work were performed, as far as possible, by officials and personnel of the agencies concerned. Existing records were used whenever available and pertinent.

To assure proper and consistent appraisal of conditions and costs, three Manuals of Engineering Procedures were prepared — for rural state trunklines, for county roads, and for urban streets. These manuals gave those employed in the study detailed instructions and information regarding inventory and appraisal methods, but



Three carefully prepared manuals instructed study personnel in the appraisal of needs on city streets, state trunkline and county roads.

urged engineers to make constant use of their experience and judgment.

The step by step operations of the study were arranged to provide a continuous check and review of data, methods and results.

Determination of Needs

Records in the files of the Department of Highways furnished much of the basic inventory information regarding the types, dimensions, alignment, usage, and age of pavements and structures on most of the selected State Trunkline and County Arterial highways. Much additional information, including sight distance data, was obtained from special surveys in the field.

The staff analyzed the road data section by section. Road sections and structures whose condition was less than tolerable were listed as a backlog of needs. Those now tolerable which will become deficient within 20 years were listed as future needs. Types of improvements suitable for meeting future traffic needs were prescribed to conform with the design standards for new construction, utilizing existing facilities so far as possible.

Appraisal sheets were sent to highway districts in which the roads are located. The District Engineers checked the findings and, in cooperation with Zone Office design engineers, estimated the costs of proposed construction. The Central Office staff reviewed this work and passed it on to the engineers of the Automotive Safety Foundation for final review.

Needs on the 42,000 miles of county feeder roads were determined by a sampling process, the sample consisting of the feeder roads in nine counties having county road engineers and in 12 other counties selected as representatives. Information was collected in the one group by the county engineers and in the other by engineers from the Department's district offices. The deficiencies, needs and cost items found in the 21 sample counties were expanded to represent the entire feeder road mileage in the state.

Plans for correcting deficiencies on state trunklines in cities and arterial streets were formulated in conferences of staff engineers and munipal officials. Feeder street needs were estimated by the staff, based on inventories of all such streets.

Estimates of Cost

Expenditures required to construct the roadways and structures prescribed to correct existing and future physical deficiencies were estimated on the basis of unit prices. Much study was given selection of these factors. Not only do construction and right of way costs vary greatly in different parts of the state, but they are radically changed by shifts in basic conditions. Local variations could be and were compensated for, but year by year fluctuations of construction prices were not considered.

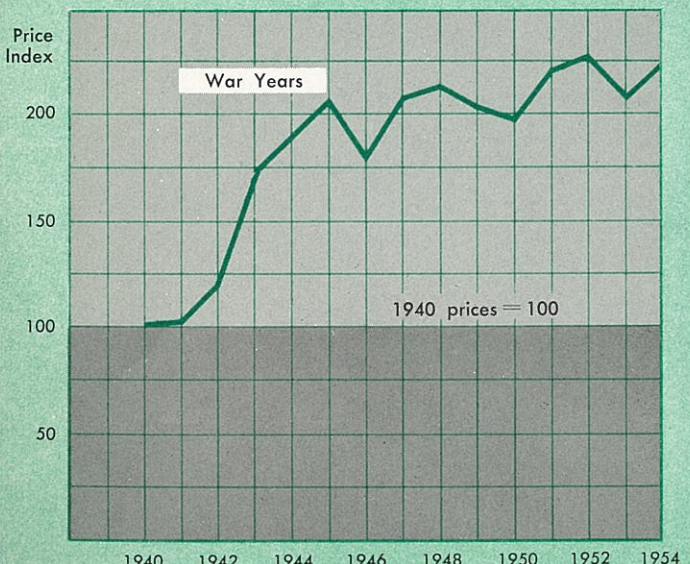
Prices of highway construction work have more than doubled in the past 25 years, mostly as a result of the inflation of prices precipitated by World War II. An analysis of contracts awarded by the Department of Highways during that period reveals the pattern of the inflationary process in Kentucky. It shows that during the five war years, 1940 to 1945, the index of highway prices rose from 100 to 208 and that, after some fluctuations, it reached a peak of 226 in 1952. The index receded to 207 in the calendar year of 1953, but in 1954, the latest year for which full data are available, it rose to 224.

The steep upward flight of construction prices, coupled with the higher costs of wider and more modern highways, has had a profound effect on highway operations in the postwar period. The direction of the price trend in the future will be a basic factor in the accomplishment of programs now proposed.

However, all cost estimates in this study were computed from contract unit prices actually paid for work in the area of each proposed project in the fiscal year 1953-54. That means, of course, that program estimates of this study would have to be revised upward or downward, depending on future divergence of construction prices from those of 1953-54.

Highways or bridges on which work was at least under contract on June 30, 1954, were appraised as if completed, but work planned to study design standards and work put under contract since that date are included in the estimates.

Highway Prices More Than Double Since 1940



NEEDS AND PROGRAMS

This appraisal of Kentucky highways found that more than half—52 percent—of all road and street mileage does not measure up to conditions tolerable for present traffic use.

The proposed rural State Trunkline System including the Federal Interstate System, is relatively most deficient of all systems with two-thirds of its 5,240 miles now inadequate.

Fifty-five percent of the 37,263 miles of road on the proposed County Feeder Systems in the 120 counties are below tolerable conditions; County Arterials, totaling 14,320 miles, are 48 percent inadequate now.

Only 20 percent of the mileage of City Trunkline and Arterial Street Systems fails to provide tolerable service for today's traffic, but 55 percent more will become deficient in the near future.

Within the next 20 years practically all mileage in all systems will require some type of improvement work to keep facilities in condition and to accommodate anticipated traffic increases.

To rehabilitate Kentucky's 60,000 miles of roads and streets would require an expenditure during that 20-year period of about $105 million annually for construction work alone. Additional costs of maintenance and administration would bring the total to an average of $144.2 million per year. That figure compares to the $118 million average annual income which, according to estimates of the fiscal study, will be available from existing revenue sources, including Federal aid, at present rates. The Commonwealth's total 20-year needs are the equivalent of 1.2 cents per vehicle mile of travel estimated over that period, compared to about 1.1 cents spent in 1954.

Attesting to the need for an acceleration of work as soon as possible is the fact that 62 percent of the 20-year construction needs is for remedying the existing backlog of intolerable conditions.

Those are over-all figures, but each system differs from the others in extent and urgency of its needs and in the means by which it is financed—the engineering results must be considered along with those of the fiscal study. For these reasons, the systems are discussed separately in succeeding sections and summarized in conclusion.

Interstate Highway System

Need for a nationwide network of major highways for the essential movements of military and civilian traffic received much consideration following the first World War. More recently, important engineering studies requested by Congress furnished scientific bases for selection and development of a National System of Interstate Highways. They include "Toll Roads and Free Roads" (1939); Inter-regional Highways" (1944); "Highways for National Defense" (1949); and "Needs of the Highway Systems, 1955-84" (1955). In addition, the President's Advisory Committe on a National Highway Program, after extensive hearings submitted a report in January, 1955, entitled "A Ten-Year National Highway Program."

The latter two reports, as well as studies by the states, crystalize the magnitude and importance of the total highway problem and suggest substantially increased Federal expenditures. Both reports emphasize the special significance of the Interstate System and urge its early development to fully modern design for economic and military reasons and for civilian defense.

On the basis of much testimony substantiating the findings of these reports, the Senate and House Public Works Committees approved bills authorizing greatly expanded Federal aid,

Interstate traffic follows the route of U.S. 60 through Olive Hill on this heavily congested business street. This is a reason why it is proposed that the entire Interstate System be relocated to bypass all cities except Louisville and Covington and that urban freeways be provided in those centers.

providing for 90 percent Federal participation in Interstate System improvement costs, instead of the present 60 percent. The Senate passed the bill approved by its committee, but the House did not take favorable action.

Interstate Standards

It has long been recognized that the Interstate System should be developed to high standards for lasting service. Freeway design is required to provide the requisite capacity, speed and safety, and to avoid early obsolescence. Experience shows that elimination of interference from the roadside and at intersections doubles the maximum traffic capacity of ordinary highways, provides for higher safe speeds, saves an average of 10 lives and many accidents annually for each 100 miles in service, and greatly increases the life of the facility.

The Automobile Manufacturers Association has estimated that modernization of the nationwide Interstate System to freeway standards would save $2.1 billion annually to drivers in operating, accident and time costs. On this basis, yearly savings on the Interstate highways in Kentucky would amount to about $26 million.

In recognition of such facts, Federal policy requires freeway or expressway design on all Interstate System projects involving Federal-aid funds. Study of present and future traffic and existing conditions on Kentucky's Interstate routes confirms the wisdom of this policy. Maps on pages 26 and 61 show the extent of the Interstate System in this state.

Interstate Needs

It is not feasible to obtain needed full freeway design on existing Interstate System routes without great damage to business and homes located on them. Moreover, nearly complete reconstruction would be required to achieve adequate standards of width, grades and curves. For these reasons, plans for the system in Kentucky should provide that the entire mileage be on new locations where modern design can be secured permanently at reasonable cost.

Proposed routes should bypass all cities except Louisville and Covington. They should be located near enough to all cities on the routes to provide traffic service while still following a reasonably direct line between major centers. This would avoid undue disruption of present facilities and assure maximum service to Kentuckians who would contribute an estimated 80 percent of all travel on the system.

Approximate locations which conform to those criteria, shown in the map on page 61, have been used for estimating purposes. Final locations are subject to detailed surveys and future policy decisions of the Federal government.

Traffic studies show need for the 439 miles of rural four-lane divided Interstate highways included in the map on page 58, and for 102 miles of two-lane highway between Winchester and Ashland, the latter to be designed for widening to four lanes after 1975. It should be noted that while the 40-mile toll road, now under construction from Louisville to Elizabethtown, is considered part of the proposed Interstate System, no costs for that section are included in this report.

Louisville Freeways

Louisville and Covington are the only Kentucky cities where full freeway design is required. Several plans prepared by or for Louisville have been carefully studied in relation to current Federal policy, to construction now planned, and to traffic, industrial, business, residential and topographical problems. The map on this page shows a 35-mile integrated freeway plan which comprises proposed Interstate System routes and necessary urban connections in Louisville.

All surface streets now carrying Interstate routes are heavily congested in peak hours. New freeway design, without traffic signals or other interference to free movement, is a current necessity.

The proposed system makes use of the Watterson Expressway and the North-South Expressway, both now under construction and both designed as full freeways meeting requirements for Interstate routes. Addition of another pair of lanes on the two-lane section of the Watterson route, and extensions to form a complete outer loop with business district connections, are recommended. The system would distribute and collect traffic for approaching rural routes of the Interstate System in both Kentucky and Indiana. Exact location of the two Ohio River bridges required for the Indiana connection should be determined by detailed studies.

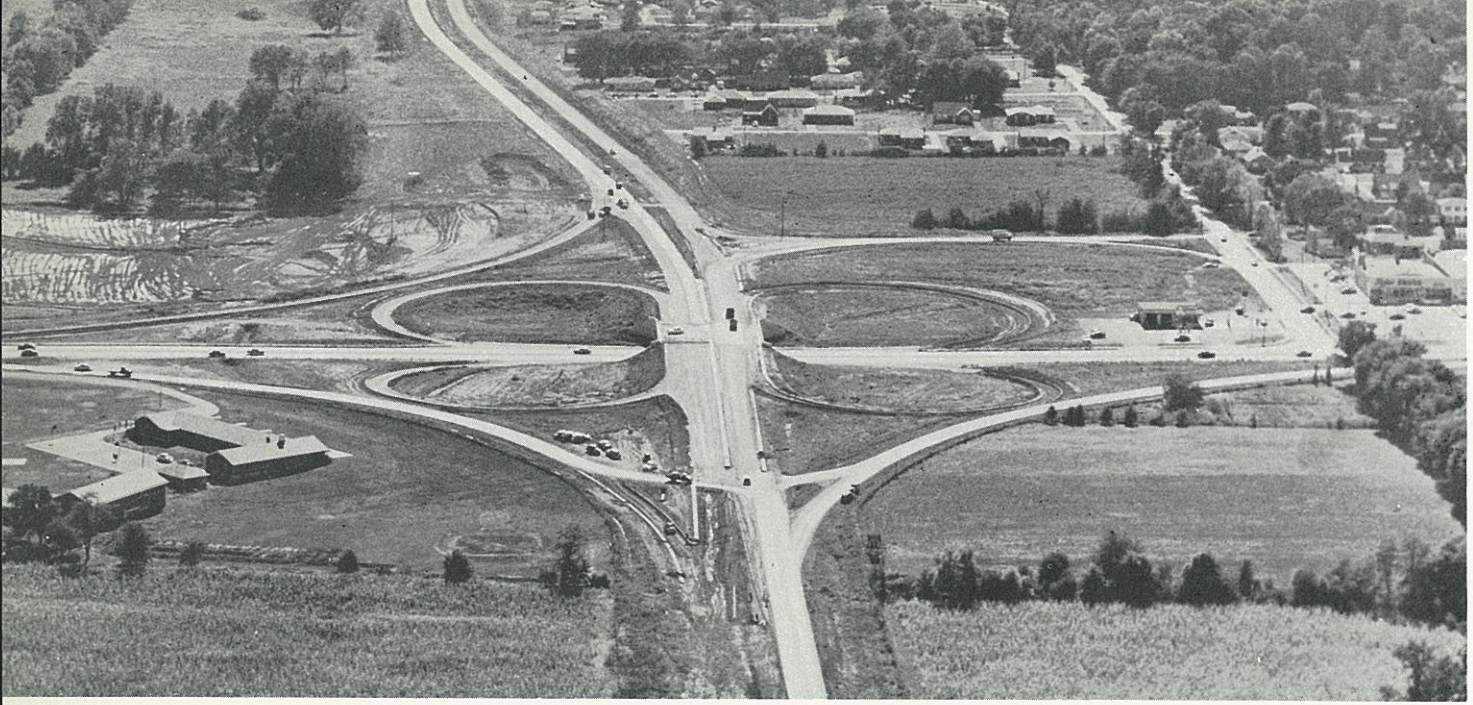
Rerouting main traffic flows on the proposed facilities would greatly relieve many now congested streets; reduced needs on the balance of Louisville's street system are founded on this freeway development. However, certain additional street work would be required to facilitate flow to and from the freeways.

Designation of the proposed urban connections as part of the Interstate System depends on state and Federal action. Under Federal law

SUGGESTED INTERSTATE FREEWAY SYSTEM AND OTHER NEEDS IN LOUISVILLE

Direct fast service to and from downtown and other important areas of the city and all connecting rural routes would be provided by the proposed 35-mile freeway system, shown in black. It is proposed as part of the Interstate System and its urban connections.

Green lines show important arterial and trunkline streets, with principal proposed street extensions and connections shown in dashed lines. Freeway design is also needed on U. S. 31W to the southwest, and along the Ohio River east of the North-South Expressway. Many other improvement projects needed which are not shown here, include new grade separations.



On 619 miles of rural and urban Interstate routes, construction like this on the Watterson Expressway near Louisville is needed to give faster movement free from stop lights, cross roads, and dangers of unlimited access.

there is only limited mileage available for such routes. However this study has allocated all estimated costs of such connections to the Interstate System. It will be noted that the study shows a reduction of original Interstate mileage in Kentucky, resulting from relocations, including bypasses.

Interstate System Costs

New construction of rural sections of the Interstate System would cost $275,843,000, including $32,246,000 for right of way and $35,426,000 for 386 bridges and grade separations needed to eliminate all cross traffic.

The cost in Louisville and Covington would amount to $92,584,000 for new facilities which would include a six-mile elevated section, three Ohio River bridges, and $19,888,000 for right of way not yet procured. Not included is the cost of a proposed 2.5 mile connection between the toll road and the North-South Expressway in Louisville.

From the viewpoint of both state and national interest, construction of the Interstate System is a top priority program, but it cannot be accomplished over night. In keeping with testimony presented to Congress, with legislation it considered, and urgent needs, this study has estimated a 10-year period for completion of the entire system in Kentucky.

Some 73 percent of the present rural mileage is currently below tolerable conditions and would require work as soon as possible, even if the need for full access control, or freeway design, were not considered. In 10 years, 12 percent more mileage will be intolerable. Moreover, it is estimated that an average of $1,658,000 per year would have to be spent to keep existing rural and urban sections in service during the 10-year program period needed for construction of the new Interstate routes.

The average annual cost of the proposed Interstate System program, including average maintenance and administration of all rural and urban new construction in place, would be $41,835,000 for 10 years—if built and paid for in that time. However, if built in 10 years, but with costs spread over 20 years the average annual cost would be $22,018,000 during the 20-year period. The latter figure includes full maintenance for the second 10 years, plus some resurfacing of pavements built early in the program.

The accompanying table shows details of alternative 10, 15 and 20-year financing plans. In each case maintenance, administration, stopgaps, replacements and new construction costs, based on actual completion of new facilities in 10 years, are shown spread over the terms indicated.

ANNUAL PROGRAM COSTS
Kentucky Interstate System
Average Per Year
(Based on completing new facilities in 10 years but spreading costs over indicated periods)

RURAL	*10-year Program*	*15-year Program*	*20-year Program*
Construction	$28,864,000	$19,290,000	$14,526,000
Maintenance and Administration	2,617,000	2,337,000	2,200,000
Sub-total	*$31,481,000*	*$21,627,000*	*$16,726,000*
URBAN			
Construction	9,678,000	6,453,000	4,857,000
Maintenance and Administration	676,000	514,000	435,000
Sub-total	*$10,354,000*	*$ 6,967,000*	*$ 5,292,000*
TOTAL RURAL AND URBAN	$41,835,000	$28,594,000	$22,018,000

It would be possible, of course, to extend construction over more than a 10-year period, but this would involve additional stopgap work. For example, if the construction period were stretched to 20 years, the cost of such additional work would amount to $907,000 per year; over 15 years, the additional cost would be $620,000 annually.

The question of the amount of future Federal aid, as well as the extent of required matching by the state, is of great importance in considering future financing plans. Interstate System construction costs are summarized along with those of the other Federal-aid systems later in this report.

Other State Trunklines

Ultimately, the rural State Trunkline System as proposed for development should comprise, in addition to the new Interstate routes, 4,621 miles of main highways outside city limits. Engineering analysis shows that 2,895 miles, 63 percent, and 1,047 bridges should be built quickly to remedy existing intolerable conditions. The map on page 61 shows all mileage in that backlog of work.

Also needed now are another 62 miles of improvements and 34 bridges on the 318 miles of State Trunkline routes other than Interstate, in the incorporated municipalities.

The backlog of construction work on rural mileage would cost $381.9 million—60 percent of all construction needed in the next 20 years. Urban sections would cost $17.6 million—31 percent of trunkline street construction required within 20 years.

Average annual cost for a 20-year program, including maintenance and administration, totals $44,066,000. Alternative programs for shorter periods would, of course require greater annual expenditures for the period to get the backlog work completed sooner, following which construction expenditures could be reduced for a time.

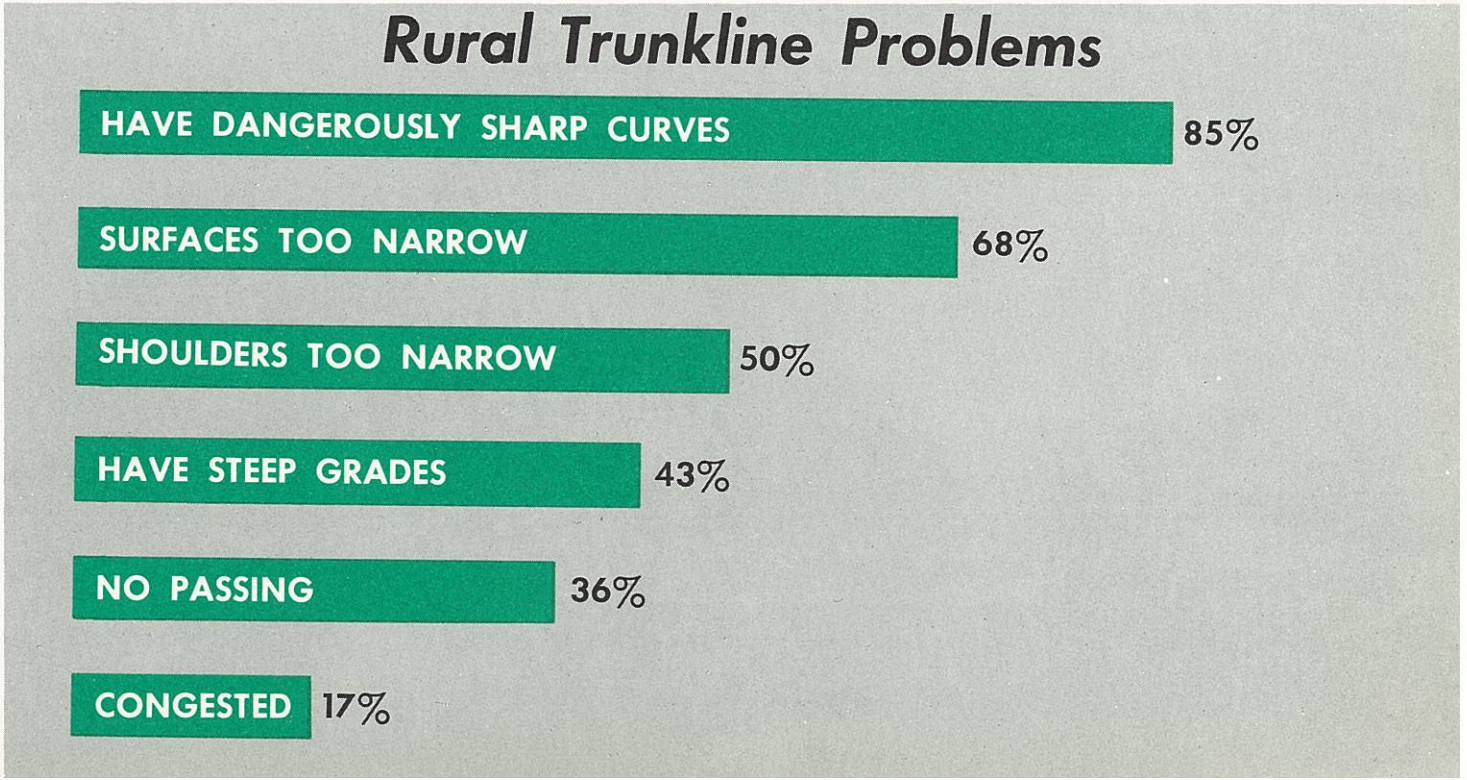
Rural State Trunklines

Narrow roadways and bridges, dangerous curves and insufficient sight distance, coupled with almost complete lack of protection for through traffic by access control are predominant faults of the present routes of the proposed rural State Trunkline System. Those factors are also basic ills of the Interstate portion of the system, as already described.

Some 4,380 miles of present rural locations were generally retained in the ultimate proposed trunkline system. Of these, 72 percent have surfaces 19 feet wide or less, half of which carry over 1,000 vehicles daily. Some 868 miles of the total have only a light bituminous surface treatment, and 151 miles are stone or gravel surfaces.

Of the total, 2,723 miles are now rated intolerable for a combination of reasons:

- 2,230 miles, 85 percent, contain so many sharp curves that reasonable speed with safety is impossible
- 1,851 miles, 68 percent, have dangerously narrow paved surfaces, many combined with narrow shoulders and sharp curves as well
- 1,363 miles, 50 percent, have shoulders narrower than the widths considered tolerable
- 1,167 miles, 43 percent, include grades too steep for modern operation of trucks and passenger cars
- 984 miles, 36 percent, lack enough sight distance to allow safe passing as often as needed to maintain a reasonable speed
- 455 miles, 17 percent, have insufficient capacity to serve their present traffic



adequately. Nearly 200 miles of these have more than 3,000 vehicles on an average day.

The accompanying table shows estimated mileages of work and total costs of construction over a period of 20 years ahead. It includes remedies for the existing backlog of needs, added work needed in the future as roads now tolerable wear out or traffic exceeds their capacity, costs for subsequent resurfacing within the period, and stopgaps to keep intolerable facilities in service until they can be properly reconstructed.

20-YEAR CONSTRUCTION NEEDS

Rural State Trunkline System
(Other than Interstate routes)

	Miles	*Cost*
Backlog in 1954	2,895	$ 381,873,000
1955 - 1965	876	106,038,000
1966 - 1975	869	148,089,000
Total, 20 years	4,640	$ 636,000,000

The total includes some mileage of four-lane divided highways which would be developed in stages—that is, first built as two lanes with two more lanes added later. All together, 13 miles of new freeway construction on U.S. 31W in Jefferson County plus 221 miles of four-lane divided highways are needed now on these routes; 80 miles more are needed within 10 years and 211 miles by 1975; the total is 525 miles, as shown on the accompanying map.

Some 366 miles of new roads, in addition to Interstate routes, are needed within the 20-year period. They include new bypasses at Lexington, Paris, Henderson, Campbellsville, Hodgenville, Lebanon, Flemingsburg, Clinton and other locations noted on the map on page 61.

Minor relocations along existing routes would, however, shorten distances by 102 miles. Major relocations of existing routes are proposed on U.S. 60 from Owensboro to Cloverport, on U.S. 41 around Madisonville, on U.S. 421 northwest of Frankfort, on U.S. 62 from Chaplin towards Bardstown, south of Hickman on KY. 94, around and to the northeast of Benton on U.S. 641, on KY. 15 near Hazard, on U.S. 23 from Prestonsburg to Paintsville, from Pikeville to Shelbiana on U.S. 23, on U.S. 119 from Jenkins to Seco, and a number of other locations.

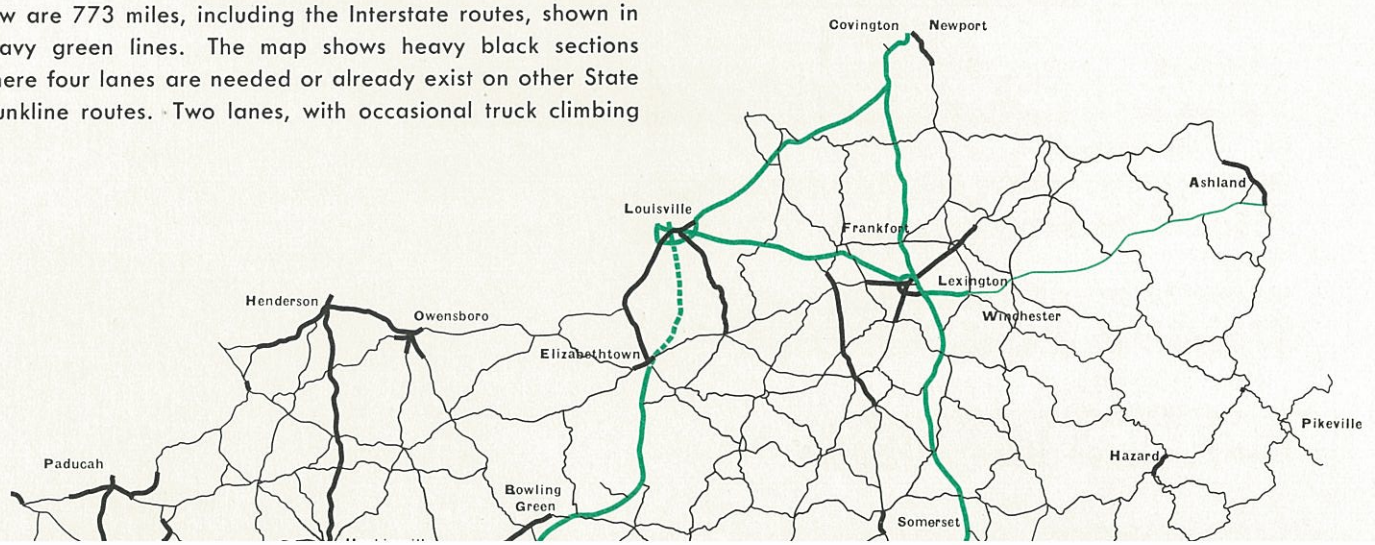
Other aids to travel would involve redesignation of routes, such as transfer of U.S. 60 west of Paducah to present routes U.S. 62 and KY. 286, and their improvement to carry the traffic. Drivers would benefit by time saving, and costs would be less than on the present U.S. 60. Simple re-signing of some routes to identify clearly the shortest and best road to follow would be of great help. ***It is recommended, therefore, that use of alternate route designations be cut to a minimum and that the basic route number always be used to designate the best route for through travel. The Division of Traffic Engineering should study the situation and develop a plan for proper and consistent route marking between, in and around cities.***

Some 20 miles of truck climbing lanes would be needed — principally in mountainous areas where lower traffic volumes do not justify four lanes or where topography will not permit reasonable reduction of grades and curves on heavy trucking routes.

Of 1,457 existing bridges and grade separations, 1,116 or 77 percent, are or will be deficient in width within the 20-year period; 689 or 47 percent, are 20 feet or less in width and should be widened or replaced as soon as possible. However, only 30 bridges on the trunkline routes are now below tolerable load carrying capacity.

NEARLY 1,000 MILES OF DIVIDED HIGHWAYS NEEDED

Traffic congestion, resulting in slow and unsafe driving conditions, requires development of 964 miles of new rural four-lane divided highways in the next 20 years. Needed now are 773 miles, including the Interstate routes, shown in heavy green lines. The map shows heavy black sections where four lanes are needed or already exist on other State Trunkline routes. Two lanes, with occasional truck climbing lanes, should be sufficient on the balance of the system, shown by thin black lines and a thin green line for the two-lane section of the Interstate System.



Urban State Trunklines

Proposed construction of the Interstate routes and local bypasses would relieve mileage

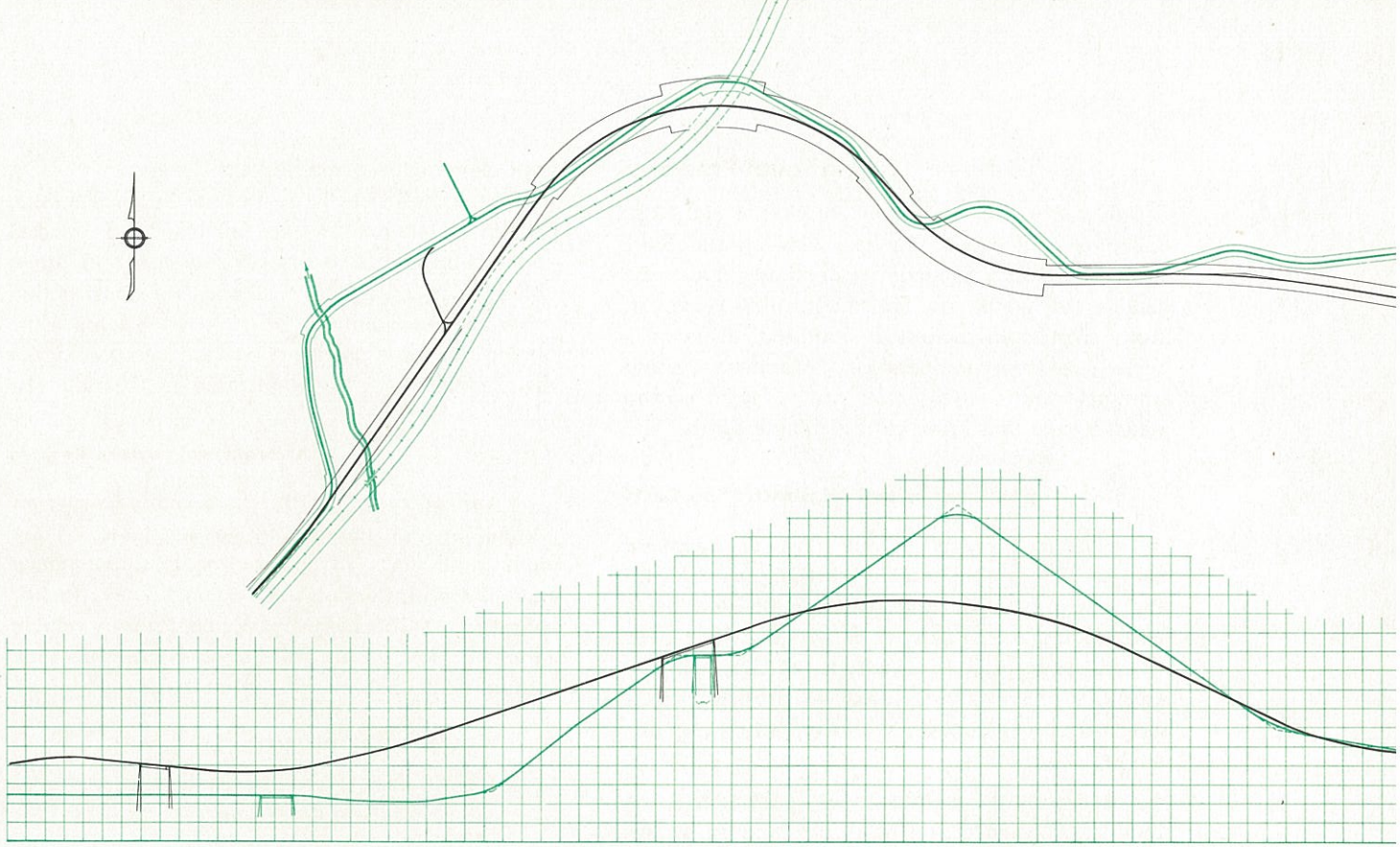
and construction needs of other state trunkline routes in municipalities, especially Louisville, Lexington and most smaller places on the Interstate routes.

Of the 318 miles of streets, other than Interstate, composing the recommended urban State Trunkline System, 62 miles, 20 percent, need work now at a cost of $17,643,000. But in the next 10 years, an additional 171 miles, costing $23,565,000, will be needed.

Total construction needs over a 20-year period include 297 miles of work at a cost of $56,839,000. Costs include right of way and 93 bridges and grade separations.

That work would remedy the most severe and costly congestion found in cities, when coupled with effective traffic engineering programs for efficient use of existing facilities and with needed off-street parking developments in the cities.

Urban work involves 81 miles of resurfacing, 161 miles of widening, 37 miles of reconstruction, and 18 miles of new street construction. Some of the more important needs are listed below. Full details for each municipality are contained in the study records on file in the Department of Highways.



How a bad situation can be remedied is shown by this example of a completed improvement on U. S. 60 at Princess. In the upper part of the drawing, green lines show the old, sharply curved, dangerous approaches to a narrow railroad overpass. Black lines show the new alignment with wider surface and variable width right of way. The lower drawing shows how the old steep grades, shown in green, were eased by cuts and fills to provide better sight distance.

Lexington—Through traffic would be diverted from congested streets by proposed Interstate System by-passes, and by addition of a new beltline to the south, all outside the incorporated area. Inside the city, sections of U. S. 25 and U. S. 27 would be widened to 40 feet. From Scott to Cedar, U. S. 27 would be increased to 48 feet in width, providing four good traffic lanes. Proposed trunkline and arterial street construction needs, combined, total $8.6 million.

Ashland—Widening Greenup Street to 68 feet and high-type pavement provide for a much improved route for U.S. 23 and U.S. 60, and should facilitate movement to and from the Ohio River bridge. A proposed railroad grade separation on 12th Street (U.S. 60) should eliminate delays and hazard. Expenditure of an estimated $9,830,000 is required for proposed trunkline and arterial street projects in the city.

Hazard—Five construction projects are aimed to improve the KY. 15 route through the city. Forty-foot pavement with curbs, gutter and sidewalks will replace the present surface which ranges from 20 to 32 feet wide. A new twin structure will supplement the present bridge with its 19-foot roadway and each will carry one-way traffic across the Kentucky River. Trunkline and arterial street projects in Hazard represent a proposed expenditure of $1,217,000.

Paducah—A proposed bypass provides for through traffic on U.S. 62 and between that route and U.S. 45. A considerable section of U.S. 62, only 23 feet wide and in poor condition, will be replaced with 44-foot pavement with curb, gutters and sidewalk. The project includes a stream crossing and a railroad grade separation. Trunkline and arterial street projects in Paducah will cost $2,388,000.

Annual Programs

Construction improvements represent from 83 to 69 percent of annual costs on the State Trunkline System depending on how rapidly the backlog of work can be caught up. However, more than construction is required to keep a highway system in operation. Maintenance and administration are essential on all systems and actually take first priority of available funds.

Maintenance and Administration Costs

Special analyses of the cost of adequate maintenance were made as part of this over-all study; results were used to estimate unit costs required for the system as it would evolve over various study periods. Amounts as shown in the appendix are not predicated on arbitrary fixed budget limits as done now, but on actual requirements.

Quality of maintenance, particularly of shoulders, drainage and roadsides, should be improved. It is estimated that the necessary quality of maintenance could be obtained on existing roads with not more than 10 percent increase in total expenditures, provided management recommendations contained in Chapter III were carried out. ***It is further recommended that annual budgets for maintenance should be based on detailed section by section studies of maintenance requirements in each district, and that cost records be improved to provide for constant rapid engineering analysis of unit maintenance costs.*** Such analysis would be a great aid both in improving the quality and efficiency of maintenance operations and of budget control, and in programming future construction improvements needed to reduce high maintenance costs.

Administrative costs, excluding direct job engineering included in construction costs, have been estimated at six percent of total construction and maintenance cost for the Interstate System and, separately, for the rest of the State Trunkline System. That provides for all overhead, general supervision, office quarters, research and allied activities necessary to a stepped-up construction program. In addition, $6,720,000 has been included for new construction and remodeling of district offices, as recommended in Chapter III.

Alternative Program Periods

Annual costs for three alternative program periods are in the accompanying table. They include all costs of improvement, maintenance and administration of the system. They do not include costs of highway police, motor vehicle administration, or tax collection. Neither do they include debt service, since none exists.

ANNUAL PROGRAM COSTS
State Trunkline System
(Excluding Interstate routes)

	Backlog Catch-up Period		
	10 years	*15 years*	*20 years*
Rural			
Construction	$48,791,000	$36,682,000	$31,800,000
Maintenance and Administration	9,664,000	8,730,000	8,347,000
Sub-total	*$58,455,000*	*$45,412,000*	*$40,147,000*
Urban			
Construction	$ 4,120,000	$ 3,464,000	$ 2,842,000
Maintenance and Administration	1,138,000	1,112,000	1,077,000
Sub-total	*$ 5,258,000*	*$ 4,576,000*	*$ 3,919,000*
Grand Total	$63,713,000	$49,988,000	$44,066,000

Each of those alternative programs would complete the work required to catch up the backlog of needs and do the new work accruing in the period. Of course, the higher annual cost programs would complete the backlog work sooner, but an appreciable time still would be necessary. In that interval, the accruing needs would themselves be deferred beyond the time when they would come due. For example, referring to rural work alone:

- In a 20-year program, 12 years would be needed to catch up backlog needs, and all widening and resurfacing and new construction becoming necessary in that period would have to be put off to the last eight years, or else some present needs would have to be tolerated even longer
- In a 15-year program, it would require 10.4 years to catch up
- In a 10-year program, it would take 7.8 years to catch up, and all new needs arising in that period would have to be deferred until the last 2.2 years of the program.

The fact that all backlog needs have already been deferred—most of them for many years—emphasizes the urgency of accelerating work to the greatest extent found feasible by the separate fiscal study. This might be done by credit financing which would spread costs over a longer period, but accelerate the availability of funds. In that case, interest charges would have to be added to costs. But speeding up new work would reduce stopgap requirements necessary to keep old roads in service, besides providing the benefits of modern highways at an earlier date.

After the catch-up work is completed in whatever time period seems most feasible, subsequent annual costs would be less for some time. However, other studies of long range capital investment needs in highways show that, except for extra stopgap needs, there is little or no difference in *total* costs over a 20 to 30-year period.

Priority of Work

Fundamental considerations in establishing priority of individual projects in annual work programs include:

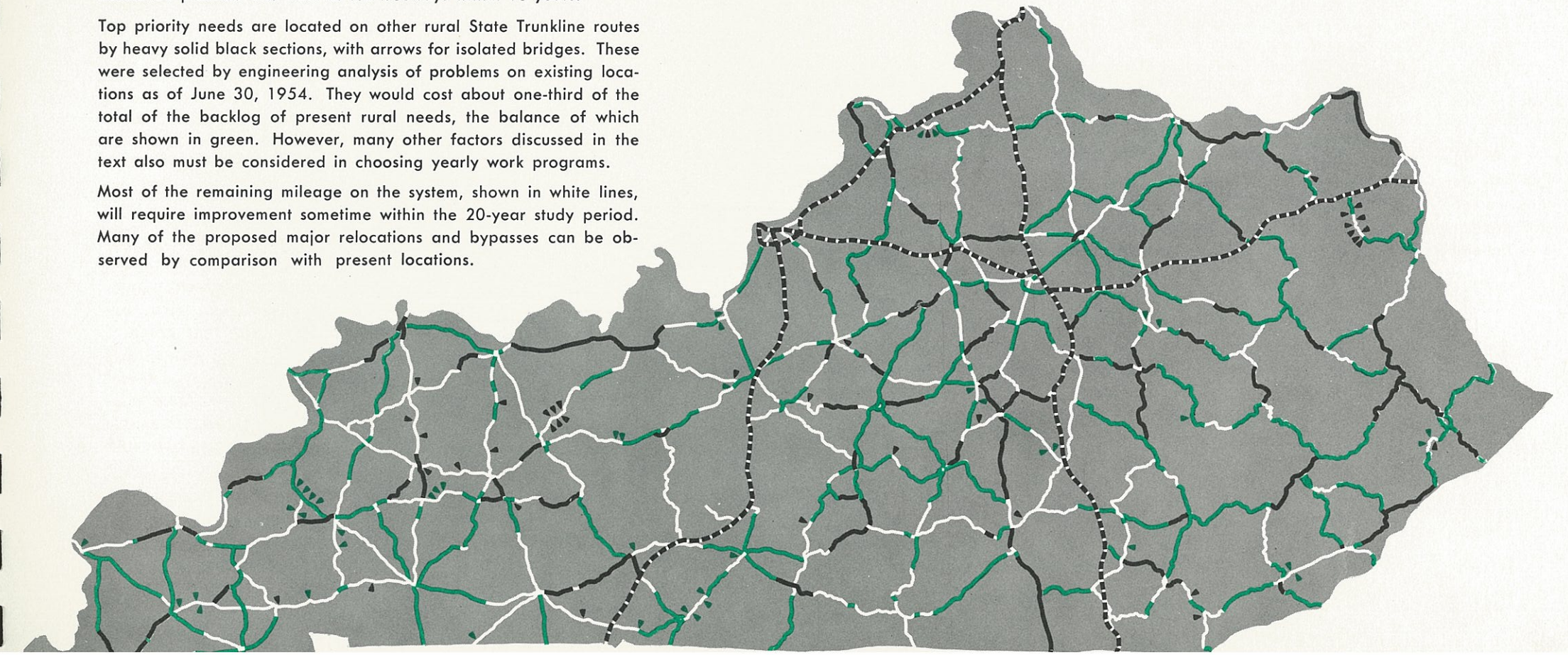
- System Importance. Within availability of total funds, should greater emphasis be given to one system or another? Should improvement of one system be advanced more rapidly than others by General Assembly adoption of a shorter term program for it?
- Division of Funds between Rural and Urban Work. Over-all, this study indicates where funds are needed, but there is no present scientific basis for establishing the relative urgency of a particular project in a city over some other project in rural areas or in another city. Also, there remain questions of the extent of possible state aid to counties and municipalities.
- Available Income. Extent of Federal aid, limitations of its use, and matching requirements will have great effect on priority of work. Amount of total state revenue available each year for each system will affect priorities. For example, a badly needed expensive river bridge might have to be deferred in favor of stopgap or

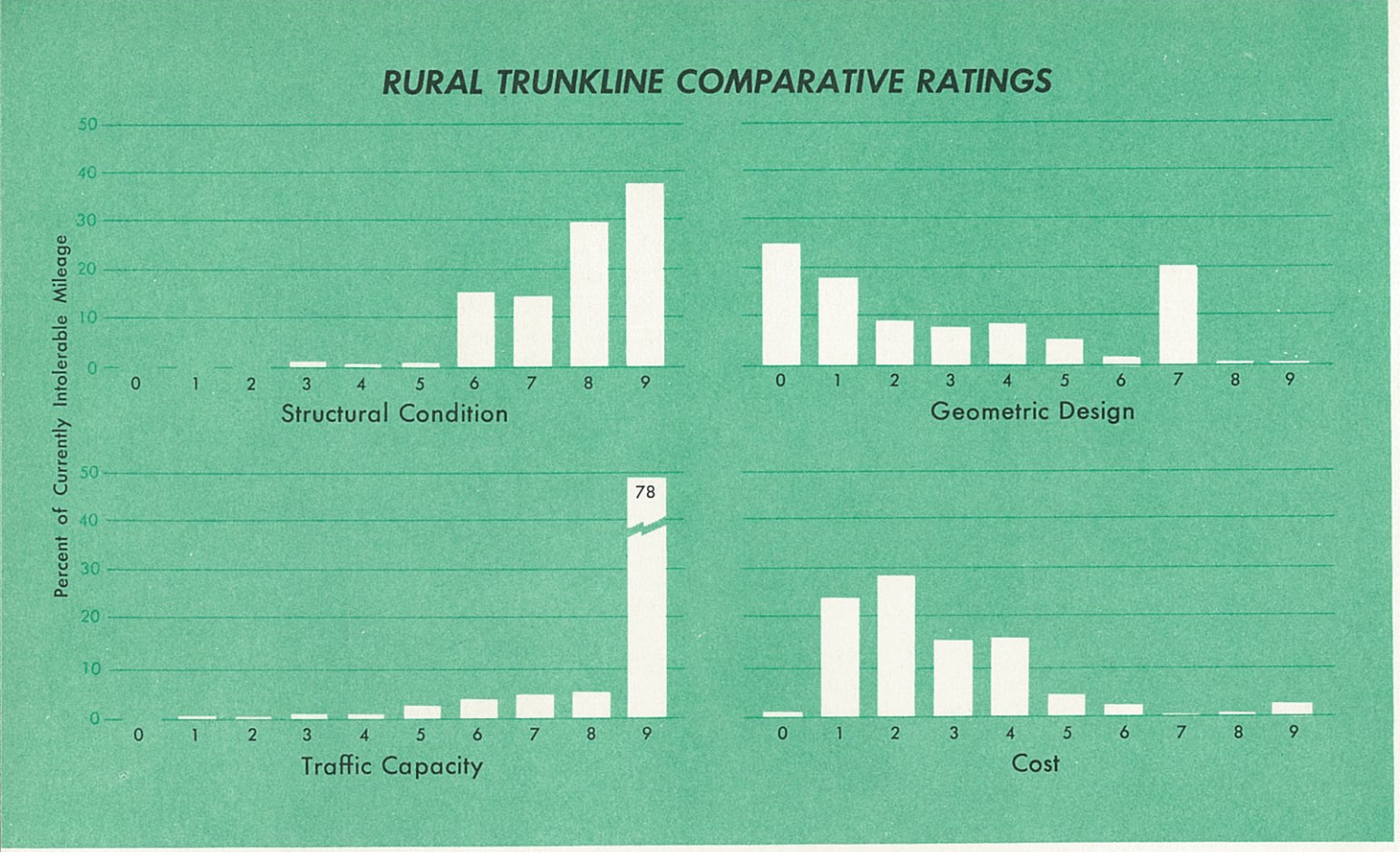
High Priority Needs On Interstate System and Other State Trunklines

Interstate routes, with general location shown in dashed black lines, should be planned and built as full freeways within 10 years.

Top priority needs are located on other rural State Trunkline routes by heavy solid black sections, with arrows for isolated bridges. These were selected by engineering analysis of problems on existing locations as of June 30, 1954. They would cost about one-third of the total of the backlog of present rural needs, the balance of which are shown in green. However, many other factors discussed in the text also must be considered in choosing yearly work programs.

Most of the remaining mileage on the system, shown in white lines, will require improvement sometime within the 20-year study period. Many of the proposed major relocations and bypasses can be observed by comparison with present locations.





Currently deficient rural trunklines were rated physically in three categories: structural condition, geometric design and traffic capacity. Worse conditions were rated near zero, and better conditions toward nine. Least cost to improve per vehicle mile of use rated near zero; greatest cost rated toward nine. Top priority projects selected generally rated toward zero in all categories, with consideration for route continuity and other factors.

maintenance work on other routes, if funds were insufficient to do both.

- Need for Continuity. Relocation of a high priority section may involve extending it to join the existing route in such a way as to also replace some lower priority sections. Consistency of design over long sections is also essential, as exemplified by the need for continuity of freeway design on the Interstate System.
- Solution of Engineering Problems. Studies, location, purchase of right of way, design and agreement by all parties concerned, sometimes require a deferment of urgent work.
- Distribution of Work. Work loads must be distributed to some extent geographically in order to utilize personnel effectively, to maintain strong, efficient contracting organizations and material supplies, and to avoid unduly concentrated disruption of traffic.

Most of those factors are the responsibility of the highway administrators. They should find in this report and in the fiscal study the framework of facts on which the necessary decisions can be made. To aid better advance planning, so vital to Kentucky's highway future, this study has developed also a systematic approach to priority analysis for a major part of the state's highway needs—the rural State Trunkline System.

Since all future construction needs, other than backlog and stopgap requirements, are scheduled by time, that furnishes a priority guide for such work. But the backlog itself, the most urgent priority work, is so large that additional breakdowns are needed for advance planning purposes.

Four basic guides were followed, and present road conditions for all backlog projects were rated by degree for each. They include (1) structural condition, (2) capacity to carry traffic safely at reasonable speeds, (3) adequacy of surface and shoulder width, curves, grades and other design features necessary for safety, and (4) cost of proposed work per vehicle mile of travel. Results of the ratings are shown in the accompanying chart. Bridge needs not otherwise included in roadway sections were rated similarly.

The system utilized in part the sufficiency ratings made by the Department of Highways, but interpreted each element separately to arrive at a grouping of the most urgent projects on a statewide basis. Thus, extremely poor structural conditions were included in the first of three groupings of the backlog work; then, roads heavily overloaded with traffic, or severely deficient in capacity, were selected. Next, roads in poor structural condition were chosen; then, those quite deficient in capacity. This process was continued until all were arrayed.

Further study was given to road sections so selected. Reasonable continuity of proposed work and its integration with existing facilities were considered, and special cases such as bypass routes and isolated bridges were given attention.

Top priority projects recommended on these bases are shown in the map on page 61.

Those road sections, totaling 891 miles, would cost approximately $134 million, including 343 bridges. They represent about one-third of the cost of backlog needs.

The balance of the backlog needs are shown also on the map. Many of these are very similar in degree of urgency to the top priority projects, and the earlier choice of some of them would not necessarily impair the principles of priority selection. Some projects shown are now under construction, awarded since the cut-off date of the study, attesting to their importance.

As previously indicated, the entire Interstate System is considered a high priority program, and its proposed development has great effect on urgency of work elsewhere on the trunkline system. Should its construction be deferred unduly, considerable revision of the Commonwealth's programs, as proposed in this report, would be essential.

The data, principles and procedures remain with the Planning Division of the Department of Highways. ***It is recommended that priority studies be further refined and put on a continuing basis — dropping projects as completed, and revising and extending the selections into remaining sections.*** This is one of the major steps needed in the advance planning process recommended strongly in Chapter III.

County Arterial Systems

The 14,320 miles of the roads classified as County Arterial Systems, and recommended as a complete state responsibility, have 48 percent, or 6,913 miles, which do not provide tolerable service for present traffic. Of the 3,538 bridges on these systems, 2,019 are not adequate now.

It would cost $232,703,000 to remedy the current defects to have the facilities fully adequate for 1965 traffic, plus added sums for maintenance, administration and additional work needed in the future. Over a 20-year period, cost would average a total of $31,795,000 per year.

County Arterial Problems

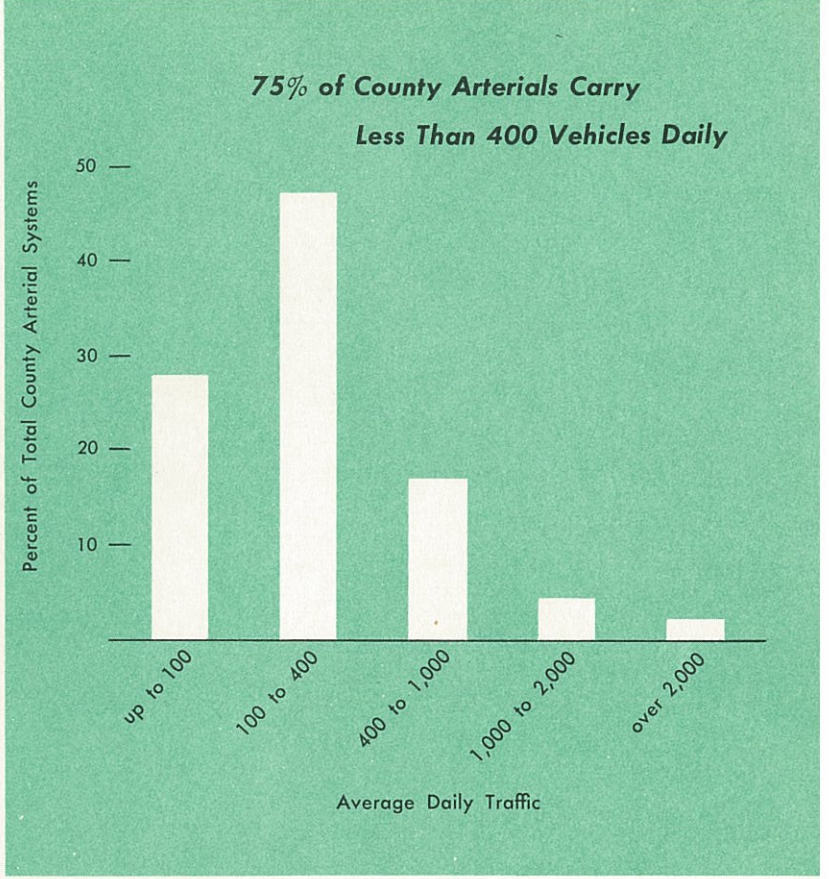
Of all 14,320 miles of ultimate proposed county arterial routes, 9,532 miles are now state maintained and 4,788 miles are now county maintained. Most major defects are in the latter group, since the Department of Highways has already improved many of these highways under the Rural Secondary program.

Arterial systems also include some existing main state route sections which would be transferred to County Arterial status upon completion of certain sections of the Interstate System and of new locations proposed along other State Trunkline System routes. Most routes so transferred would serve their reduced traffic satisfactorily for many years without further improvements.

Of the 14,320 miles of classified arterial systems, pertinent data show:

- 444 miles, 3 percent, are unimproved
- 6,450 miles, 45 percent, now are stone or gravel surfaced roads
- 4,664 miles, 33 percent, now have light bituminous surface treatments
- The balance, 19 percent, are paved with medium or heavy duty surfaces
- 7,980 miles, 56 percent, are 17 feet or less in width.

The accompanying chart shows what traffic is carried by the system. Note that 28 percent of the mileage now carries less than 100 vehicles



daily and generally needs development to no higher than minimum county arterial standards. Such routes are only required to serve lightly populated areas or to provide interconnection between sections of heavier travel. On the other hand, about seven percent of the mileage carries traffic of more than 1,000 vehicles per day; this is mostly short trip travel, but it requires standards similar to trunkline routes.

Of the 3,538 bridges on the system:

- 1,608 or 45 percent, are 18 feet or less in width
- 733, or 21 percent, cannot carry gross loads in excess of ten tons or less
- 239, or seven percent, have timber substructures subject to rapid deterioration.

County arterial traffic service is heavily penalized when loads are limited and movement is restricted to one lane as on this bridge on KY.198 in Casey County.

Of the 6,913 miles of roads which are intolerable for present traffic, nearly all lack sufficient shoulder width, 77 percent have surface widths below allowable tolerances for their traffic class, as shown in a table in the appendix, and some 84 percent have bad alignment which results in low speeds. On only 21 percent of that mileage are surface types inadequate, but 54 percent of all deficient mileage is in poor or bad structural condition.

Needs and Programs

Cost of the 6,913 miles composing the backlog of construction needs is $232,703,000—some 57 percent of total construction requirements in a 20-year period.

Included in the backlog cost is seven percent for right of way and $56,516,000, or 24 percent for 2,019 bridges and railroad protection. Details of the nature of construction requirements will be found in the appendix.

Alternative programs shown in the accompanying table have been estimated on the basis of meeting the backlog needs in 10, 15 or 20 years by a similar method and including similar classes of additional work to those described in the section pertaining to the State Trunkline System. Average total expense is less per year for longer terms; but again, backlog needs and consequent benefits are deferred.

Improvements will be needed on roads now tolerable and bridges as they wear out and as traffic increases during the several periods of the programs. These have been estimated statistically by actuarial methods based on actual road life in Kentucky and other states.

Unit maintenance costs shown in the appendix were estimated and applied to the average inventoried mileage over various program periods. Estimates were based on requirements for surface maintenance and on the ratios in other states of costs on roads of this class to those on state trunkline highways. Past Kentucky costs on the state-maintained portions are not pertinent since ***it is recommended that maintenance on the County Arterial Systems be planned for an adequate, but lower level than on the State Trunkline System.*** Further, the construction prescribed by the proposed improvement program should reduce expenses for maintenance.

Administration was estimated at four percent of the annual cost of construction and maintenance, since part of the overhead supervision would be available through State Trunkline System administration.

ANNUAL PROGRAM COSTS

County Arterial Systems

	Backlog Catch-up Period		
	10 years	*15 years*	*20 years*
Construction	$32,177,000	$23,909,000	$20,541,000
Maintenance and Administration	11,628,000	11,345,000	11,254,000
Total	$43,805,000	$35,254,000	$31,795,000

Interpretation of these data is similar to that described for the State Trunkline System. However, due to the larger share of annual construction costs for work accruing in the future, the backlog of needs could be taken care of slightly faster, provided the necessary total construction funds were made available.

Maintenance expense on the county arterials is a much heavier proportion of total annual cost than on trunkline routes, due mainly to much lower construction costs per mile, shown in the appendix.

Completion of the 20-year program would result in marked improvement of the County Arterial Systems' service to traffic. The mileage of paved surfaces would be doubled, surface treated mileage would be increased by a fourth, the miles of gravel and other traffic bound sur-

face would be cut 53 percent, and unimproved mileage eliminated. Improvements in drainage, width and other features would also be accomplished and all bridges would be developed to standard widths and strengths.

County Feeder Systems

The 120 County Feeder Systems, consisting of 37,263 miles and 8,192 bridges, recommended in this report for basic management by the counties themselves, would require $31,746,000 annually over a 20-year period to develop and maintain them properly.

Some 55 percent, 20,548 miles, of the feeder system throughout the state is now inadequate for present use, and would cost $264,285,000 to improve properly for 1965 traffic—an average of $12,800 per mile, including the 6,151 bridges needed now.

It is estimated, on the basis of inventory data available for all counties and field studies in 21 counties, that:

- 75 percent have surfaces 16 feet wide or less
- 25 percent do not have all-weather surfaces
- 58 percent have gravel or stone surfaces
- 17 percent have light bituminous surfaces
- 78 percent of all 8,192 bridges are 16 feet wide or less
- 47 percent of all bridges can safely carry loads of only 10 tons or less
- 23 percent of all bridges are built of timber, subject generally to rapid deterioration.

Of the mileage of County Feeder Systems found presently deficient when compared to the tolerable conditions established for them:

- 12 percent have inadequate surface types
- 16 percent have surfaces too narrow
- 43 percent have no shoulders, or they are too narrow
- 30 percent lack proper drainage
- 26 percent are in poor or bad structural condition.

Relatively few miles, about 11 percent, have curves or grades deemed inadequate for the local service these roads provide. Most of the deficient mileage includes defects of several types which combine to make them intolerable.

Of the 6,151 currently inadequate bridges, 56 percent are too narrow, 41 percent cannot carry tolerable minimum design loads, and 42 percent are in poor structural condition.

Needs

In studying county operations, it was noted that most past expenditures on county roads were classed as maintenance, with little for actual improvement. Field study indicates that failure to make basic improvements in roadbeds and drainage results not only in inadequate roads, but higher maintenance costs.

On the assumption that such improvements would be made as part of the proposed construction program, maintenance costs were estimated for all types of roads, as shown in the appendix. Lack of county records precluded adequate information on actual costs and therefore the estimates were based on reasonable proportions of costs on trunklines and arterial roads, as derived in part from records of other states. Care was taken to provide for necessary surface replacements, as well as sufficient roadside maintenance.

It is recommended that, in improvement of county management, uniform standards

This feeder road in Owen County is typical of a large mileage of narrow, poorly surfaced roads in counties throughout the state.

and procedures for maintenance and record keeping by types of surfaces and nature of work be developed in cooperation with the Department of Highways. Only in this way can necessary improvement in maintenance become standard practice in all counties, and costs be kept for current analysis and study of future needs.

Excluded from consideration are approximately 3,500 miles of "paper" roads which appear on inventory records but are found to have been abandoned. ***It is recommended that each county re-examine possible further abandonments in order to reduce maintenance and construction liability.***

Over a 20-year period, the proposed improvement program would increase paved and surface-treated roads by a third, to a total of 8,032 miles. Stone and gravel surfaces would be considerably improved by widening, better drainage and heavier surfacing. No unimproved roads would remain on the systems, but the limited useage of some 9,000 miles warrants only better grading and drainage with light spot surfacing where required.

All 6,151 bridges now deficient would be replaced or improved at a cost of about $93,000,000 for appropriate structures, and others would be repaired as needed.

Rate of actual future development in each county should depend heavily on individual county action. Extent of local financial support and quality of management would be controlling factors. County officials and engineers, fully understanding their own needs, are in the best position to determine work most needed in their respective areas, and how rapidly it should be done. For those reasons, program estimates for all County Feeder Systems are given for a 20-year program only. That provides a sufficient perspective and comparison, on a statewide basis, to other road and street systems.

For the 20-year period, construction improvements would require an average of $19,611,000 per year for all 120 counties. Proper maintenance and management is estimated to cost $12,135,000 annually. That includes four precent of construction and maintenance costs for administration, including salary of a county engineer or supervisor, as recommended in Chapter III. Total average needs are $31,746,000 per year.

City Streets

Of all city streets, 351 miles classified as part of the State Trunkline System which includes the Interstate routes, have already been described. About 708 miles, including proposed new extensions, are classed by this study as Arterial Streets, for which Chapter III recommends that cities have basic responsibility. The remainder, 2,390 miles, are classed as Feeder Streets—largely residential—for which it is recommended that cities have full responsibility.

Arterial Streets

Some 21 percent, 147 miles, of the important Arterial Street Systems in the incorporated cities of Kentucky are now inadequate for their service demand. It would cost $29,903,000 to improve them properly. In the coming 10 years, $50,426,000 more will be needed on an additional 144 miles of streets, including bridges and grade separations, as traffic continues to increase and as old streets become inadequate.

Within a 20-year period, $102,502,000 will be required solely for construction. Of this, one-fourth, or $25,424,000, is in Louisville alone. Another third of the total is needed in the 14 other cities of more than 10,000 population.

Work proposed in cities of 2,500 people or more over the 20-year period includes:

- 195 miles of resurfacing only
- 263 miles of resurfacing and widening
- 74 miles of reconstruction, including widening
- 9 miles of new street construction
- 82 new or reconstructed bridges and grade separations
- 78 railroad crossing gates or flashers.

Planned work is geared to the proposed Interstate and other state trunkline improvement programs. With attention to adequate traffic engineering measures, such as better signal synchronization, parking controls, development of one-way street systems, and other features, the trunkline and arterial street programs should provide for reasonable traffic movement throughout the cities. Proposed improvements are in accord with urban street appraisal principles and standards shown in the appendix.

Some new street openings are of special importance to relieve bottlenecks or to provide opportunities to extend and develop pairs of one-way streets. Some such major projects proposed in Louisville are shown as dashed lines in the map on page 55 . An example of a complete trunkline and arterial plan for a smaller city is shown in the accompanying map of Bowling Green.

Parking problems were not studied, but curb parking is a major handicap to free flowing street traffic, particularly in congested downtown areas. Restriction or elimination of curb parking will be necessary along many streets which cannot be widened economically. ***It is recommended that each city take early action to see that more off-street parking is provided.***

Annual Programs

Development of city streets depends largely on the ability of each city to plan and finance necessary improvements, as well as to maintain and reconstruct old streets. However, annual programs are calculated for all cities as a group to obtain the necessary statewide perspective in relation to other statewide costs.

While needed arterial construction programs have been determined individually for all 66 cities over 2,500 population, and as a group for smaller places, city records do not permit adequate evaluation of maintenance costs. Those shown in the appendix were computed by reference to other detailed studies, analysis relating estimates to state costs, and estimates of work involved in street maintenance. ***It is recommended that cities improve their methods of cost keeping and analysis so that they may determine their budgetary needs more adequately.*** Administrative costs were computed at five percent of construction and maintenance.

ANNUAL PROGRAM COSTS

Municipal Arterial Streets

	Backlog Catch-up Period		
	10 years	*15 years*	*20 years*
Construction	$8,033,000	$6,312,000	$5,125,000
Maintenance and Administration	1,643,000	1,563,000	1,512,000
Total	$9,676,000	$7,875,000	$6,637,000

Because of the higher proportion of work which will develop in future years as compared to the backlog of work currently required, the total construction fund called for annually would complete the backlog in about six years of a 20-year program, and in about four years for a 10-year program. Funds in the remaining years would provide for construction needs accruing in the period.

Feeder Streets

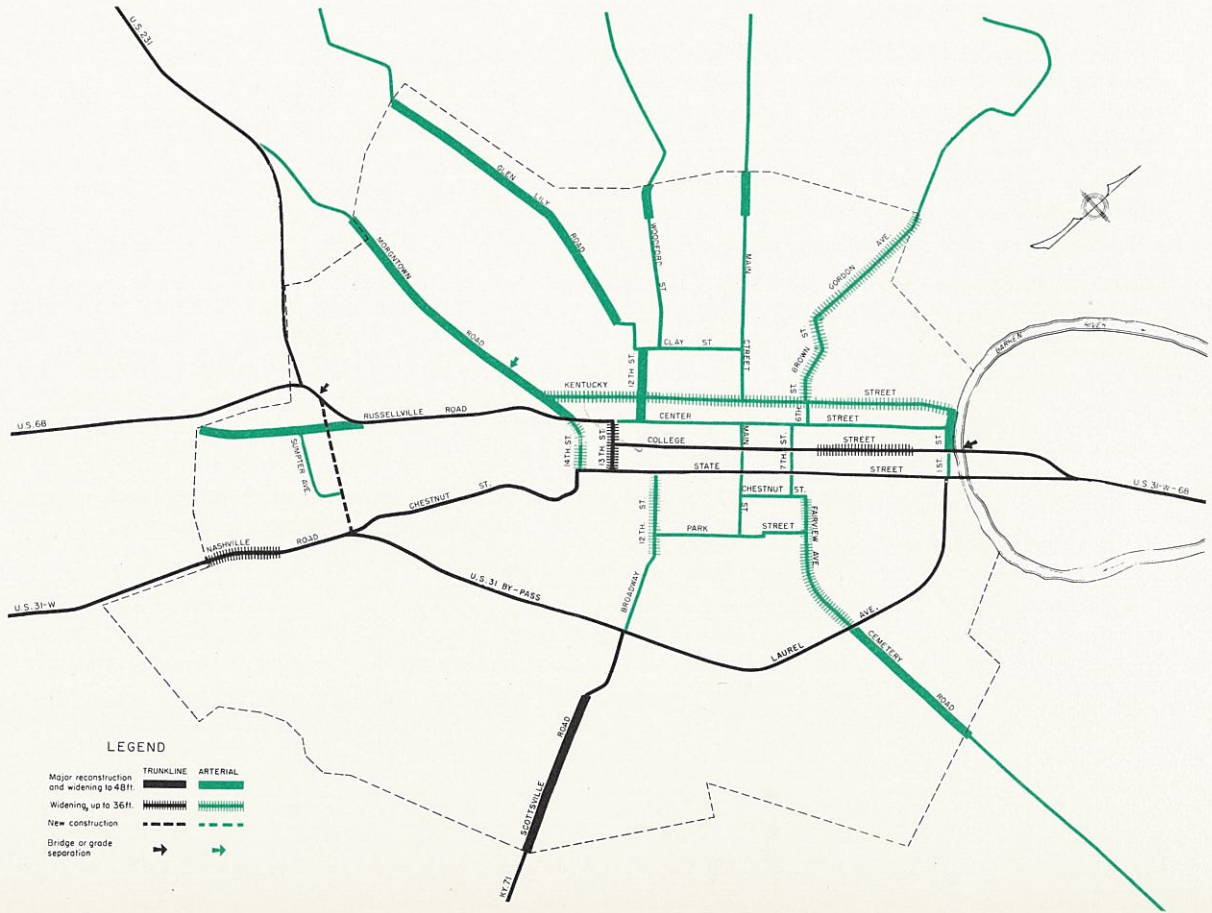
Feeder streets are historically the responsibility of the cities and their residents. Rate of development depends on individual needs and ability to finance desirable improvements in a variety of ways. However, to complete the whole picture of transportation needs, a mass analysis and estimate was made for all existing feeder streets in all municipalities.

A complete inventory of surface types and widths was obtained for all cities, and an estimate made of their adequacy. Standards, varying for different conditions, were set up; actuarial methods established the long-range costs of meeting those standards. In effect, construction costs represent the annual capital investment required to

STREET PLAN FOR BOWLING GREEN

Although much of the heavy traffic on U.S. 31W through Bowling Green would bypass the city on the proposed Interstate freeway to the east, improvements totaling about $2.1 million are needed over a 20-year period on State Trunklines and Arterial Streets in the city. One-third are needed now. The map shows most of the principal projects proposed, among them a new bridge over the Barren River to permit adequate one-way street operation in Bowling Green. Cost of the bridge is allocated to rural trunklines, and therefore is not included in the city total.

Other major jobs include a new trunkline connection between U. S. 31W and U. S. 68 in the southwest area of the city, widening of the railroad underpass on U. S. 68, widening Old Russellville Road to reach a new industrial area, and widening Sixth, Brown and Gordon Streets from Kentucky north to the city limits.



develop the streets and reconstruct them as needed.

Estimated maintenance unit prices are shown in the appendix, and were applied to the inventory of all streets. Usually such costs and administration are general city obligations.

Results of the computations show that an average of $7,953,000 annually is needed for feeder streets in all 366 cities. That includes $2,314,000 for maintenance and administration. Approximately 30 percent of the monetary needs are in Louisville alone. The funds would provide for eventual improvement of all built-up streets to paved status, with proper drainage and curb and gutter in larger cities. Outlying streets in smaller cities would be improved and maintained as traffic-bound surfaces with dust layer.

Summary—All Systems

For the first time, a complete picture of long-range construction and maintenance needs in the entire Commonwealth has been put together in the accompanying table which summarizes the preceding sections. The table shows average annual costs for the principal systems during 10 15 and 20-year periods in which the present backlog of deficiencies could be remedied, and the 20-year needs for local feeder systems.

The shorter periods would cost more per year and accordingly, the systems would be brought up to date sooner. Fiscal feasibility, under study by the Bureau of Business Research of the University of Kentucky, governs the choice of programs to be finally determined by action of the General Assembly and other governmental agencies.

It should be recognized that each program includes only the work to remedy backlog needs plus added costs, including maintenance and needs accruing in the period—but not thereafter. Other studies indicate that *total* costs over a long period will be about the same regardless of the rate in particular years, except that where a large backlog of work exists, stop-gap needs per year are greater.

Were means found to expedite completion of backlog work on a given system in, say 10 years, costs of the succeeding 10 years would be much lower; the total of the two decades would be little different than that for the 20-year pro-

Summary of Average Annual Program Costs

Kentucky Highway Systems

System	Mileage	Backlog Catch-up Period 10 years	15 years	20 years
Interstate				
Rural	581	$ 31,481,000	$ 21,627,000	$ 16,726,000
Urban	38	10,354,000	6,967,000	5,292,000
Sub-total	**619*	*$ 41,835,000*	*$ 28,594,000*	*$ 22,018,000*
Other State Trunklines				
Rural	4,621	$ 58,455,000	$ 45,412,000	$ 40,147,000
Urban	318	5,258,000	4,576,000	3,919,000
Sub-total	*4,939*	*$ 63,713,000*	*$ 49,988,000*	*$ 44,066,000*
County Arterials	14,320	43,805,000	35,254,000	31,795,000
Sub-total, Proposed State Responsibility	**19,878*	$149,353,000	$113,836,000	$ 97,879,000
Municipal Arterials	708	$ 9,676,000	$ 7,875,000	$ 6,637,000
Municipal Feeders	2,390			7,953,000
County Feeders	37,263			31,746,000
All Systems, Annual Total	60,239			$144,215,000

** Includes toll road and urban extension, for which no costs are shown.*

gram period less extra stopgap work. Costs would rise later, as need for replacement of facilities begin to appear.

The table shows that if principal systems for which complete state responsibility is proposed were to be developed and maintained properly, giving due consideration to reasonable tolerances below design standards for the time being, it would cost:

- $97,879,000 per year for a 20-year program
- $113,836,000 per year for a 15-year program
- $149,353,000 per year for a 10-year program.

The 20-year figure of $144,215,000 for all systems provides a picture of financing requirements over a sufficiently long period to indicate the relative needs of the systems during the period. That figure compares to the $118,000,000 of average annual income available for highway purposes anticipated over a 20-year period from all present sources at present tax rates in all governmental units. No increase in present income levels is included except that from the anticipated increase of motor vehicles and gasoline consumption.

Federal-aid Systems Construction Costs

The hearings and debates in the national Congress during recent months indicate the probability of a greatly expanded Federal-aid highway program in the near future. When this comes, it will materially affect the requirements at state and local levels to finance any of the alternative programs presented in this report, except those for feeder roads and streets.

To bring the Kentucky picture into focus and permit an evaluation of the possible effect of an expanded Federal-aid program, construction requirements are summarized in the following table for each of the several Federal-aid highway systems described in Chapter II. *Since the Federal-aid systems are administrative in nature and coincide with portions of proposed state managed rural and urban systems of roads and streets, Federal-aid system needs shown are a duplication of, and not in addition to, the needs previously discussed.*

COST OF IDENTIFIED CONSTRUCTION NEEDS

Federal-aid Systems
20-year Period

Interstate	
Rural	$ 290,525,000
Urban	97,144,000
Sub-total	*$ 387,669,000*
Other Federal-aid Primary	
Rural	$ 363,230,000
Urban	50,176,000
Sub-total	*$ 413,406,000**
Federal-aid Secondary	239,135,000**
Total	$1,040,210,000

*Does not include needed replacements and stopgaps.

**Backlog needs only. Does not include reconstruction for currently tolerable roads, future replacements or stopgaps.

Federal-aid apportionments to Kentucky total $15,757,032 for the current fiscal year, divided as follows:

Interstate	$ 3,232,347
Federal-aid Primary	5,861,614
Federal-aid Primary in Urban areas	1,801,096
Federal-aid Secondary	4,861,975

Federal funds generally must be matched equally by the state, except that the Interstate system is on a 60 percent Federal basis. All funds are limited to construction work and some of the right of way cost. Interstate and Federal-aid Primary funds may be used in both rural and municipal areas; the amount designated for urban areas must be spent inside specially defined urban limits of areas containing 5,000 people or more; secondary funds are used on rural roads and connecting streets in places of less than 5,000.

In relation to the proposed state systems, most funds except Federal-aid Secondary apportionments would be confined to the Interstate and other parts of the State Trunkline System. About half of Federal-aid Secondary costs are on the County Arterial Systems and the balance on trunkline routes which cannot qualify for Federal-aid Primary designation, because of Federal restrictions on total mileage.

Review and Comparisons

On a 20-year average basis, expenditures proposed on the systems recommended for full responsibility of the Department of Highways total $97,879,000 annually—68 percent of all road and street costs.

For all systems, costs of construction alone for the 20-year period total $2,098,821,000. Average annual cost for construction would amount to about $105,000,000 with maintenance and administration totaling another $39,000,000. The ratios of construction to total annual program costs vary by systems—from 88 percent for construction on Interstate routes, to 62 percent on County Feeder Systems.

Municipal needs for all systems inside incorporated areas total 17 percent of the 20-year requirements for all systems.

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Municipal needs for all systems inside incorporated areas total 17 percent of the 20-year requirements for all systems.

Urgency of construction work among principal systems also varies, as the following table indicates:

System	*Construction Backlog*	
	Cost	*Percent of 20-year Construction Cost*
Interstate		
Rural	$275,843,000	95
Urban	92,584,000	95
Other State Trunklines		
Rural	381,873,000	60
Urban	17,643,000	31
County Arterials	232,703,000	57
Municipal Arterials	29,903,000	29

With the volume of this backlog work already deferred beyond tolerable limits, it would be desirable to find means to expedite its completion within financial feasibility.

Today, Kentucky is spending on highways, roads and streets the equivalent of about 1.1 cent per vehicle mile of travel, about 12 percent of the total average cost of owning and operating the average motor vehicle. With the expected increase of about 72 percent in travel by 1975, average traffic during the next 20 years would be 36 percent above the 1954 level and costs to develop and maintain all systems properly would amount to about 1.2 cents per vehicle mile. That value compares favorably with other states:

Kentucky	1.2 cents
Michigan	0.97 cents
Minnesota	1.02 cents
Mississippi	1.18 cents
Ohio	1.04 cents
*West Virginia	1.46 cents

* Less feeder streets

Annual average total cost per capita, estimated for the period, is another guide to consideration of program feasibility. Such costs for a 20-year program show:

	Annual Cost Per Capita
Kentucky	$ 45
Michigan	44
Minnesota	46
Mississippi	28
Ohio	33
*West Virginia	46

Only Kentucky and Michigan data include the high standards of Interstate System improvement described in this report. Other studies were completed prior to determination of need for full freeway design on that system. The $45 estimated for Kentucky is the equivalent of about 12 cents per day per person.

CONCLUSION

Kentucky's economic future and the welfare of its citizens depend in large measure on the adequacy of its highway transportation network. For many years, investment in improved highways has lagged behind needs of mounting traffic, with the result that there are large mileages of roads and streets which now fail to give tolerable service.

This report gives a reasonable and conservative statement of what is required to catch up and then keep up with highway needs. The program requires a long range continuing effort on the part of all highway agencies. Highway systems are never "completed," but investments can be made to last longer and therefore cost less per year through better advance planning and adequate basic designs.

Total financial requirements must be considered in the light of the separate fiscal study. The features and recommendations of both studies are geared together:—the long-range financing possibilities are based on the costs estimated in this study; the costs are based on the proposed classification of systems; improvement needs are keyed to proposed developments on other systems, such as construction of the Interstate system; all phases presume efficient management developed in general along the lines recommended herein.

Should one element be adopted without the others, careful analysis should be made of the effect upon the whole structure. One of the basic difficulties now existing is an unbalanced operation, proceeding without full realization of its far-reaching effects. For example, the report emphasizes the importance of county and city government in road and street operations and financing; if their role is diminished, rather than enhanced, a greater burden is thrown upon the state.

Continued change is characteristic of a dynamic economy, and highway affairs must keep pace. Continued planning and restudy of all pertinent matters by all highway agencies is essential to properly advise legislators and the public on needed changes of the future. For the time being, this report furnishes a sound basis for appropriate action which should lead to beneficial results.

APPENDIX

COUNTY ROAD MILEAGES AND EXPENDITURES

Mileages as of January 1, 1955

Expenditures in year ending June 30, 1953

*Less than $60,000 per county, or less than $150 per mile

County	Mileage	Rural Highways Fund Allotment Spent by State	Direct County Expenditures from Truck Licenses and Local Taxes	Total Spent on County Roads	Expenditures Per Mile
Adair	651	$ 41,805	$ 16,400	$ 58,205*	$ 89*
Allen	451	37,767	20,750	58,517*	130*
Anderson	214	27,970	38,020	65,990	308
Ballard	282	29,676	26,970	56,646*	201
Barren	673	48,355	44,898	93,253	139*
Bath	198	32,189	58,663	90,852	459
Bell	235	52,718	17,993	70,711	300
Boone	208	32,805	11,761	44,566*	695
Bourbon	250	33,024	60,772	93,796	375
Boyd	178	33,590	220,860	254,450	1,430
Boyle	175	29,142	78,375	107,517	615
Bracken	219	27,514	26,076	53,590*	244
Breathitt	305	47,235	17,040	64,275	211
Breckinridge	563	46,983	27,533	74,516	132*
Bullitt	334	33,412	34,816	68,228	204
Butler	472	38,967	14,628	53,595*	114*
Caldwell	317	32,945	21,647	54,592*	172*
Calloway	733	39,694	54,031	93,725	128*
Campbell	204	31,334	131,280	162,614	797
Carlisle	243	25,435	19,651	45,086*	186
Carroll	109	24,655	20,014	44,669*	410
Carter	468	45,929	21,047	66,976	143*
Casey	643	43,326	17,031	60,357	94*
Christian	522	64,121	80,184	144,305	277
Clark	233	30,534	57,633	88,167	378
Clay	583	49,204	13,427	62,631	107*
Clinton	173	29,174	9,064	38,238*	221
Crittenden	322	35,547	17,096	52,643*	163
Cumberland	279	32,367	11,821	44,188*	158
Daviess	612	49,217	199,512	248,729	406
Edmondson	215	32,066	11,961	44,027*	205
Elliott	266	27,823	24,639	52,462*	197
Estill	347	34,461	21,050	55,511*	160
Fayette	259	48,164	19,946	68,110	263
Fleming	303	35,831	32,448	68,279	226
Floyd	313	69,417	68,197	137,614	439
Franklin	231	31,966	123,889	155,855	665
Fulton	213	31,466	25,233	56,699*	266
Gallatin	84	19,982	15,868	35,850*	427
Garrard	262	30,590	48,898	79,488	303
Grant	308	30,287	57,270	87,557	284
Graves	819	51,960	91,158	143,118	175
Grayson	586	46,120	25,362	71,482	122*
Green	439	32,642	27,553	60,195	137*
Greenup	371	45,670	79,486	125,156	337
Hancock	219	24,933	28,662	53,595*	245
Hardin	587	70,993	96,490	167,483	285
Harlan	173	79,937	57,732	137,669	795
Harrison	373	35,541	81,331	116,872	314
Hart	435	41,314	51,250	92,564	213
Henderson	407	40,805	160,422	201,227	494
Henry	261	33,016	49,526	82,542	316
Hickman	282	28,663	25,822	54,485*	193
Hopkins	535	55,805	80,972	136,777	256
Jackson	559	36,191	15,074	51,265*	92*
Jefferson	702	115,609	643,132	758,741	1,081
Jessamine	167	29,452	38,200	67,652	405
Johnson	284	41,518	18,120	59,638*	210
Kenton	232	44,984	215,118	260,102	1,120
Knott	330	42,428	20,548	62,976	191
Knox	332	49,551	26,388	75,939	229
Larue	303	30,789	21,291	52,080*	172
Laurel	851	50,190	29,024	79,214	93*
Lawrence	408	40,630	56,157	96,787	237
Lee	383	27,910	23,877	51,787*	135*
Leslie	309	40,974	6,696	47,670*	154
Letcher	174	51,112	19,779	70,891	406
Lewis	437	42,291	36,715	79,006	181
Lincoln	404	40,545	69,169	109,714	272
Livingston	225	30,945	11,817	42,762*	190
Logan	430	52,047	31,680	83,727	195
Lyon	202	28,505	16,914	45,419*	225
McCracken	252	35,273	152,733	188,006	748
McCreary	337	42,181	15,842	58,023*	172
McLean	317	30,721	29,762	60,483	191
Madison	492	46,393	69,968	116,361	216
Magoffin	367	35,424	12,500	47,921*	131*
Marion	276	39,554	70,095	109,649	397
Marshall	395	36,369	13,856	50,225*	127*
Martin	185	30,966	8,374	39,340*	212
Mason	216	29,891	93,792	123,683	574
Meade	356	32,258	29,418	61,676	173
Menifee	229	24,910	15,349	40,259*	176
Mercer	304	30,195	77,903	108,098	355
Metcalfe	419	32,115	13,584	45,699*	109*
Monroe	414	36,583	15,532	52,115*	126*
Montgomery	116	26,908	48,977	75,885	654
Morgan	428	37,839	11,132	48,971*	114*
Muhlenberg	571	56,621	57,506	114,127	200
Nelson	459	45,023	153,787	198,810	433
Nicholas	177	26,757	68,429	95,186	532
Ohio	914	52,198	95,883	148,081	162
Oldham	164	28,629	40,786	69,415	424
Owen	309	34,191	28,816	63,007	204
Owsley	251	26,325	11,903	38,228*	153
Pendleton	343	31,268	36,947	68,215	199
Perry	250	56,581	44,441	101,022	404
Pike	651	101,607	90,053	191,660	294
Powell	143	24,998	13,485	38,483*	269
Pulaski	1,152	63,327	52,955	116,282	101*
Robertson	86	19,193	9,030	28,223*	330
Rockcastle	481	35,841	19,826	55,667*	118*
Rowan	194	34,056	23,494	57,550*	297
Russell	310	34,511	27,500	62,011	200
Scott	301	31,475	61,902	93,377	311
Shelby	318	41,684	82,724	124,408	392
Simpson	289	31,280	31,038	62,318	216
Spencer	154	25,280	19,665	44,945*	292
Taylor	344	35,112	33,897	69,009	201
Todd	234	37,592	30,715	68,307	292
Trigg	332	38,628	14,283	52,911*	160
Trimble	173	22,676	16,534	39,210*	227
Union	229	37,789	104,326	142,115	620
Warren	474	52,963	110,805	163,768	345
Washington	440	34,772	31,161	65,933	149*
Wayne	421	44,540	20,990	65,530	156
Webster	387	38,137	54,372	92,509	239
Whitley	601	50,661	11,534	62,195	104*
Wolfe	270	27,718	13,337	41,055*	152
Woodford	183	29,128	105,659	134,787	739
Totals	42,557	$4,699,895	$6,190,457	$10,890,352	
Average					256

NEW CONSTRUCTION STANDARDS FOR RURAL COUNTY FEEDER ROADS

TRAFFIC ADT (1965)	SURFACE TYPE	SURFACE WIDTH	GRADE WIDTH	CURVES GRADES AND NON-PASSING SIGHT DISTANCE	MIN. R/W WIDTH	BRIDGES			R.R. GRADE CROSSING PROTECTION
						DESIGN LOAD	CLEAR WIDTH FT.	VERT. CLEAR FT.	
OVER 700	USE CONSTRUCTION STANDARDS FOR COUNTY ARTERIAL ROADS								
STANDARD NO.1 400 - 700	SURFACE TREATED	20	28 /4	SAFE FOR 40 MPH.	50	H-15	24	14	/2
STANDARD NO.2 100 - 400 /1	SURFACE TREATED	18	24 /4	SAFE FOR 35 MPH	50	H-15	22	14	/2
STANDARD NO.3 50 - 100	TRAFFIC BOUND	16	22	SAFE FOR 30 MPH	40	H-10	18	14	/2
STANDARD NO.4 UNDER 50 /3	GRADED AND DRAINED	—	20	SAFE FOR 25 MPH	40	10-T	18	14	WARNING SIGNS

/1 Includes built-up subdivision streets.

/2 Flashing Lights Signals when highway trafic (ADT) times number of trains per day exceeds 3500. Warning signs at all crossings.

/3 On Roads in this class which are Mail or Bus Routes use standard No.3.

/4 Grade width may be reduced 2' in heavy mountainous terrain.

TABLE OF TOLERABLE CONDITIONS FOR RURAL COUNTY FEEDER ROADS

TRAFFIC ADT (1952)	SURFACE TYPE	GRADE WIDTH	CURVATURE, GRADE & NON-PASSING S. DIST.	BRIDGES		
				LOAD RATING	CLEAR WIDTH	VERT. CLEAR.
TOLERANCE NO 1 OVER-700	USE CHART OF TOLERABLE CONDITIONS FOR COUNTY ARTERIAL ROADS					
TOLERANCE NO 2 200-700 /4	SURFACE TREATED 2 LANES	22 /3	SAFE FOR 30 MPH	H-10	18'	12
TOLERANCE NO 3 100-200	T. B. /1 MEDIUM	20	SAFE FOR 30 MPH	H-10	16'	REASON-ABLE
TOLERANCE NO 4 50-100	T. B. LIGHT	18	SAFE FOR 25 MPH	SAFE FOR 10-TONS	1 LANE	TO SERVE
TOLERANCE NO 5 UNDER-50 /2	PASSABLE G & D EARTH	14	SAFE FOR 20 MPH	SAFE FOR 6-TONS	1 LANE	PRESENT USEAGE

/1 T. B. Medium 900-1100 Tons Per mile
Light 500-700 Tons Per mile

/2 On Roads in this class which are Bus routes use Tolerance No. 3; For mail routes only use Tolerance No. 4. Roads not required to provide daily service (used for only a few trips a year) are tolerable in present condition.

/3 Grade widths in Heavy Mountainous Terrain to be reduced 2 feet.

/4 Includes built-up subdivision streets.

NEW CONSTRUCTION STANDARDS FOR COUNTY ARTERIAL RURAL ROADS, STRUCTURES & R.R. GRADE X-ING PROTECTION

FUTURE ANNUAL AVG. 24 HR. TRAFFIC IN V.P.D. (1965)	SURFACE TYPE	SURFACE WIDTH (FT.)	GRADE WIDTH (FT.) /3	MAX. CURVATURE (DEGREES) TERRAIN			STOPPING SIGHT DISTANCE (FT.) TERRAIN			MAX. GRADE (PER CENT) TERRAIN			MIN. R/W WIDTH (FT.)	BRIDGES			R.R. GRADE CROSSING PROTECTION
				FLAT	ROLLING	MT.	FLAT	ROLLING	MT.	FLAT	ROLLING	MT.		DESIGN LOADING	CLEAR WIDTH (FT.)	VERT CLEAR (F.T.)	
OVER 2000	USE SAME STANDARDS AS FOR RURAL TRUNKLINE SYSTEM																
1000-2000 (STD. NOS. 1,2,3)	MEDIUM TYPE (2" TO 3" THICK)	22	34	5	8	12	525	375	300	5	6	8	70	H-20	26	14	/2
400-1000 (STD. NOS. 4, 5, 6)	MEDIUM TYPE (1" TO 2" THICK)	20	32	7	9	14	350	350	275	5	7	9	60	H-15 /1	24	14	/2
100-400 /4 (STD. NOS. 7, 8, 9)	SURFACE TREATED	18	28	9	14	20	300	275	225	5	8	10	50	H-15	22	14	/2
LESS THAN 100 (STD. NOS. 10, 11, 12)	LOW TYPE (T.B.)	18	24	14	20	25	275	225	200	5	10	12	50	H-15	20	14	WARNING SIGNS

STANDARD NUMBERS (EXCEPTING TRAFFIC OVER 2000):-

TERRAIN	TRAFFIC (ADT) 1965			
	1000-2000	400-1000	100-400	LESS THAN 100
FLAT	1	4	7	10
ROLLING	2	5	8	11
MOUNTAINOUS	3	6	9	12

/1 Use higher Values for roads carrying heavy Truck Traffic
/2 Flashing Light Signals when highway traffic (ADT) times No. of trains daily exceed 3500. Warning signs at all crossings.
/3 Grade Widths may be reduced 3' to 4' in Heavy Mountainous Terrain. (Except that no grade width will be less than 22 feet.)
/4 Use this class for built-up subdivision streets.

TABLE OF TOLERABLE CONDITIONS FOR COUNTY ARTERIAL ROADS & STRUCTURES

Annual Average 24 Hour Traffic In V.P.D. (1952 Volume)	Surface Type	Surface Width (ft.)	Grade Width (ft)	Maximum Curvature and Stopping Sight Distance Measured By Safe Speed (M.P.H.)			Maximum Grade Per Cent			Bridges		
				Flat	Rolling	Mountainous	Flat	Rolling	Mountainous	Load Rating	Clear Width (ft)	Vertical Clearance (ft.)
Above 1000	Apply Table of Tolerable Conditions For State Rural Trunk Line System.											
400-1000	Surface Treated	18	26 /5	Safe for 45 M.P.H.	Safe for 40 M.P.H.	Safe for 35 M.P.H.	6	8	10	/3 H-10	/4 18	12
200-400	Surface Treated	16	24 /5	Safe for 40 M.P.H.	Safe for 35 M.P.H.	Safe for 30 M.P.H.	6	9	12	/3 H-10	/4 18	12
100-200	Low Type (Medium)	2 Lane	22	Safe for 35 M.P.H.	Safe for 30 M.P.H.	Safe for 25 M.P.H.	8	12	15	/3 H-10	18	12
Under 100 /2	Low Type (Light) /1	2 Lane	20	Safe for 35 M.P.H.	Safe for 25 M.P.H.	Safe for 20 M.P.H.	8	12	15	/3 10 Tons	1 Lane	12

TOLERANCE NUMBERS (EXCEPTING TRAFFIC OVER 1000):

TERRAIN:	TRAFFIC (A.D.T.)-1952			
	400-1000	200-400	100-200	Under 100
FLAT	1	4	7	10
ROLLING	2	5	8	11
MOUNTAINOUS	3	6	9	12

/1 Minimum Quantity of Surfacing Material necessary for reasonable year around Service.
/2 On roads in this class which are school bus routes, use Conditions for A.D.T. of 100-200 classification.
/3 Bridge rating should be higher where subject to heavy loads.
/4 Bridge width must equal existing approach pavement width if greater than width indicated.
/5 May be reduced 2 feet in heavy mountainous terrain.

COMMONWEALTH OF KENTUCKY
LEGISLATIVE RESEARCH COMMISSION
STATE DEPARTMENT OF HIGHWAYS
CONSULTANTS: AUTOMOTIVE SAFETY FOUNDATION
MARCH 1954

DESIGN STANDARDS FOR RURAL STATE TRUNKLINES

SYSTEM		SELECTED STATE TRUNKLINE OTHER THAN INTERSTATE SYSTEM												NATIONAL SYSTEM OF INTERSTATE HIGHWAYS					
DESIGN	1975 ADT	LESS THAN 1000			1000—2000			2000-3000			3000-5000			LESS THAN 2500			2500 OR MORE		
CONTROL	TERRAIN ①	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
ITEM	STANDARD NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DESIGN SPEED (MPH) ③		60	50	40	70	60	50	70	60	50	70	70	60	70	60	50	70	70	60
OPERATING SPEED (MPH) ③		45-50	40-45	35-40	45-50	45-50	40-45	45-50	45-50	40-45	50-55	45-50	45-50	45-50	45-50	40-45	50-55	50	45-50
CURVATURE (MAXIMUM DEGREE) ③		6	9	14	4	6	9	3	5	7	3	4	5	3	5	7	3	3	5
STOPPING SIGHT DISTANCE (FT) ③		475	350	275	600	475	350	700	525	400	700	700	525	700	525	400	700	700	525
GRADIENT (MAXIMUM PERCENT) ④		4 ADD 1% FOR GRADES UNDER 750'	6	8	4 LESS 1% FOR GRADES OVER 1000' ADD 1% FOR GRADES UNDER 500'	5	7	3% MAXIMUM STANDARD CAPACITY 3% TO 7% GRADES REQUIRE SPECIAL CAPACITY ANALYSIS FOR CLIMBING LANE 7% MAXIMUM ANY LOCATION						3	4	SAME REQUIREMENTS AS FOR STANDARDS NO 7-12				
PASSING SIGHT DISTANCE MINIMUM % AVAILABLE PER MILE ⑤	1500'	WHERE FEASIBLE			10	5		10	10		10	10		10	10		10	10	
	800'			WHERE FEASIBLE			10			10			10			10			10
LANE WIDTH (FT.)		10	10	10	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12
SHOULDER WIDTH ⑥ (FT.)	IN CUTS	7	6	3	7	6	4	8	7	4	8	8	7	8	7	5	8	8	7
	ON FILLS	7	7	5	8	8	7	9	8	7	10	10	8	10	10	8	10	10	8
RIGHT OF WAY MINIMUM WIDTH (FT.) ⑥		70	70	70	80	80	80	100	100	100	120	120	120	120	120	120	150	150	150
SURFACE TYPE		MEDIUM			MEDIUM			HIGH			HIGH			HIGH			HIGH		
BRIDGES ALL 14' MINIMUM VERTICAL CLEARANCE	DESIGN LOAD	H-15			H-20			H-20, S-16											
	CLEAR WIDTH 80' OR LESS IN LENGTH	24'			26'			ROADWAY WIDTH						ROADWAY WIDTH					
	OVER 80' LENGTH	24'			26'			30'						30'					
GRADE SEPARATIONS BASIC DESIGN AS FOR BRIDGES		NONE REQUIRED						SPECIAL STUDY FOR WARRANTS											

① TERRAIN ABBREVIATIONS: F – Flat to and including light rolling, R – Medium through heavy rolling, M – Mountainous. (See Text)
② For volumes in this range, or greater, capacity studies may indicate need for four lanes. Standards are same as for nos. 10, 11, 12, and note ① with these exceptions: Passing sight distance is not a factor; Median strip is required, width at least 20 feet except in special cases, minimum in any case 4 feet; Right of way requires minimum of 200 feet, plus access control on new locations.
③ In urban-like congested areas outside incorporated limits, or in rural-like sections inside incorporated places, design and operating speeds may be reduced 10 M.P.H., with appropriate curvatures and sight distance.
④ Gradient and passing sight distance standards for volumes of 2000 or more ADT shall be the best obtainable with reasonable economy. On that basis, capacity analysis will determine possible need for truck climbing lanes, or four lanes.
⑤ For standards nos. 7 to 18, use stabilized shoulders up to 8 feet wide.
⑥ Right of way should include control of access on all new locations on the interstate system and on other highways carrying over 3000 ADT. (See Text)

COMMONWEALTH OF KENTUCKY
LEGISLATIVE RESEARCH COMMISSION
STATE DEPARTMENT OF HIGHWAYS
CONSULTANTS: AUTOMOTIVE SAFETY FOUNDATION
MARCH 1954

TOLERABLE CONDITIONS FOR RURAL STATE TRUNKLINES

SYSTEM		CLASSIFIED STATE TRUNKLINES OTHER THAN INTERSTATE SYSTEM												NATIONAL SYSTEM OF INTERSTATE HIGHWAYS					
DESIGN	1952 ADT	LESS THAN 1000			1000 - 2000			2000 - 3000			3000 - 5000			LESS THAN 2500			2500 OR MORE		
CONTROL	TERRAIN ①	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
ITEM	REFERENCE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DESIGN SPEED (MPH) ②		50	40	35	50	45	40	60	50	40	60	50	45	60	50	40	60	60	50
OPERATING SPEED (MPH.) ②		NO CAPACITY PROBLEM			40-45	35-40	35	40-45	40-45	35	45-50	40-45	40	40-45	40-45	35	45-50	45-50	40-45
CURVATURE (MAXIMUM DEGREE) ②		9	14	20	9	12	14	6	9	14	5	7	9	6	9	14	5	5	7
STOPPING SIGHT DISTANCE (FT.) ②		350	275	225	350	300	275	475	350	275	475	350	300	475	350	275	475	475	350
GRADIENT (MAXIMUM PERCENT) ③		5 ADD 1% FOR GRADES UNDER 1000'	7	8	5	7	8	4	5	7 SUBTRACT 1% FOR GRADES OVER 1000'	4	5	7	4	5	7	4	5	7
PASSING SIGHT DISTANCE MIN. % AVAILABLE BY 2 MILE SECTIONS ②	1500'	NOT APPLICABLE			10	5		10	10		10	10		10	10		10	10	
	800'						10			10			10			10			10
LANE WIDTH (FT.)		9	9	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
AVERAGE NORMAL SHOULDER WIDTH (FT.) ④		3	3	3	4	4	3	6	6	4	7	6	4	6	6	4	7	6	4
SURFACE TYPE		SURFACE TREATED GOOD CONDITION			MEDIUM GOOD CONDITION														
BRIDGES ALL 12' MINIMUM VERT. CLEARANCE	DESIGN LOAD	H-10			H-15														
	CLEAR WIDTH	19	19	19	22	22	22	24' WITH MINIMUM OF 2' WIDER THAN APPROACH PAVEMENT											
GRADE SEPARATIONS BASIC DESIGN AS FOR BRIDGES		NONE REQUIRED			SPECIAL STUDY FOR WARRANTS														

① TERRAIN ABBREVIATIONS: F - Flat to and including light rolling, R - Medium through heavy rolling, M - Mountainous. (See Text)
② In urban like congested areas outside incorporated limits, or in rural like sections inside incorporated places, tolerable design and operating speeds are 10 MPH. less than shown with curvature and sight distance accordingly.
③ For 1952 ADT. of 2000 or more, existing grades and passing sight distances will be used for calculating traffic capacities at the tolerable operating speeds.
④ If the existing lane width is less than tolerable, the tolerable average normal shoulder width must be increased by a dimension equal to the lane width deficiency. Four lane sections are tolerable if condition stated in reference nos. 10, 11, 12, and note 2 are met.

BASIC PRINCIPLES FOR STUDY OF MUNICIPAL STATE AND ARTERIAL ROUTE PROBLEMS AND NEEDS

The first objective in the municipal street needs appraisal is to provide a plan for an integrated arterial street system, including State Trunklines, County Arterial roads and major streets, adequate to serve the estimated 1975 traffic requirements.

The second objective is to determine how best to fit present streets into the desirable future plan at least cost, what new facilities are needed to complete the plan and what the total cost would be.

The third objective is to divide the 20-year plan into stages of work according to degree of urgency and practicability.

1. Reasonable freedom from delay should be provided, varying in amount in each community, depending on time losses. Special attention should be given to delays at major intersections.

2. The solution should anticipate the probable direction and extent of population, industry, business and traffic growth. Statewide, traffic is estimated to increase by 80 percent by 1975. The rate of traffic growth will vary between areas of a municipality, as well as between municipalities, depending on present and future land use, economic conditions and other factors.

3. Traffic control measures are required to the maximum extent to keep the existing street system at top efficiency but, in most cases, they cannot be expected to solve the basic, long-range physical problem.

4. Generally, there are several streets available to serve a directional traffic flow, and alternative solutions to traffic problems are possible.

5. State and local traffic must be considered jointly—not independently. Since main arteries are usually State Trunklines, development plans should be keyed heavily to trunklines.

6. Trunkline re-routing or rural by-passes should be considered when large volumes of through traffic are encountered and where other internal improvements within the municipality would be minimized thereby.

7. Central business districts are established and in many cases little physical improvement within such areas is possible to aid traffic circulation. Adequate by-passes of these districts are justified wherever there is heavy through traffic.

8. The best modern engineering practices should be followed in new designs. Widening of existing streets where feasible, should produce at least one added full traffic lane, or at least the 1975 capacity requirement.

9. On the other hand, terrain and existing urban development may severely restrict location and type of facility which can be provided with reasonable economy.

10. Resurfacing or reconstruction of pavements will be needed in accordance with estimated pavement life expectancy.

11. Removal of parking at peak periods, or at all times, may gain sufficient capacity to satisfy the demand. No construction project will be considered where diagonal parking is maintained. Neither will a construction project be considered where provisions for parallel parking will require additional right-of-way involving extensive property damage.

NEW CONSTRUCTION STANDARDS FOR STATE TRUNKLINES AND ARTERIAL STREETS IN MUNICIPALITIES Δ

DESIGN FEATURES	ALL CITIES			CITIES OF OVER 5,000 POPULATION			CITIES OF UNDER 5,000 POPULATION		
	CONTROLLED ACCESS Δ			ARTERIALS			ARTERIALS		
				BUSINESS AREA	DENSE RESIDENTIAL	OUTLYING AREA	BUSINESS AREA	DENSE RESIDENTIAL	OUTLYING AREA
1975 AVERAGE DAILY TRAFFIC VOLUME TOTAL FOR NO. OF LANES SHOWN	40,000 TO 60,000	UP TO 40,000	STATE TRUNKLINE BY-PASSES ONLY UNDER 6,000 Δ	SEE BELOW					
SURFACE TYPE	A			A	A OR B Δ		A	A,B OR C Δ	
NUMBER OF LANES	6 Δ	4 Δ	2 Δ	CONTROLLED BY ANTICIPATED 1975 TRAFFIC VOLUMES AND OPERATING CONDITIONS (SEE MANUAL)					
SURFACE WIDTH	72'	48'	24'	DETERMINE REQUIRED STREET WIDTH BY CONSULTING CAPACITY TABLES Δ					
CURBS AND SIDEWALKS	NOT REQUIRED PEDESTRIANS NOT PERMITTED PEDESTRIAN CROSSING TO BE PROVIDED WHERE NEEDED			YES	YES	ONLY AS REQUIRED	YES	YES	ONLY AS REQUIRED
SHOULDER WIDTH	12'	12'	10'	—	—	8'	—	—	8'
MEDIAN WIDTH	MINIMUM 4' IF NOT MOUNTABLE, OTHERWISE 20'		—	4' MEDIAN WHERE AVERAGE DAILY TRAFFIC VOLUME EXCEEDS 10,000, IF FEASIBLE					
PARKING	NOT PERMITTED EXCEPT ON FRONTAGE ROADS			FOR STREETS HAVING AVERAGE DAILY TRAFFIC VOLUME EXCEEDING 7500, PARKING GENERALLY TO BE DISCOURAGED, WITH PARALLEL PARKING PERMITTED ONLY DURING OFF-PEAK HOURS. PARALLEL PARKING PERMITTED FOR LESSER TRAFFIC VOLUMES					
ILLUMINATION	CONTINUOUS	AT INTERSECTIONS		CONTINUOUS	AT INTERSECTIONS		CONTINUOUS	AT INTERSECTIONS	
INTERSECTION TREATMENT 10% OR MORE OF TRAFFIC ON INTERSECTING STREET	GRADE SEPARATED		CHANNELIZED AND SIGNALIZED	PROGRESSIVE TRAFFIC SIGNAL SYSTEM OR FIXED TIME SIGNAL WHERE WARRANTED					
				STOP SIGN CONTROL FOR LOWER TRAFFIC VOLUMES					
LESS THAN 10% OF TRAFFIC ON INTERSECTING STREET	INTERCHANGES	INTERSECTION AT GRADE		TRAFFIC OR PEDESTRIAN ACTUATED SIGNALS WHERE WARRANTED, OR STOP SIGN CONTROL					
STRUCTURES WIDTH	UNDER 100 LONG-FULL ROADWAY WIDTH Δ OVER 100' LONG-PAVEMENT WIDTH PLUS 6' PLUS MEDIAN			PAVEMENT WIDTH PLUS SIDEWALKS					
VERTICAL CLEARANCE	14'			14'					
LOADING	H-20-S-16			FOR HEAVY COMMERCIAL TRAFFIC H-20-S-16 MODERATE H-20, LIGHT H-15 Δ					
RAILROAD CROSSING SEPARATION	AT ALL RAILROAD CROSSINGS			MAIN LINE CROSSINGS ON STREETS CARRYING HEAVY TRAFFIC VOLUME WHERE PRACTICAL AND ECONOMICALLY FEASIBLE					
R.R. GRADE CROSSING PROTECTION	—			FLASHING LIGHT SIGNALS AT ALL CROSSINGS WITHOUT WATCHMAN OR FLAGMAN AND WHERE AVERAGE DAILY TRAFFIC X NUMBER OF TRAINS = 3500 OR MORE					

Δ STANDARDS FOR CONTROLLED ACCESS ARTERIALS BASED ON 40 M.P.H. OPERATING SPEED. ACCESS PERMITTED ONLY AT INTERCHANGES AND INTERSECTIONS WITH OTHER ARTERIALS. ACCESS FROM ABUTTING PROPERTY BY FRONTAGE STREETS WHERE REQUIRED.
Δ APPLIES SPECIFICALLY TO NEW LOCATIONS OF 2-LANE STATE TRUNKLINE ROUTES BY-PASSING BUSINESS AREAS OF MUNICIPALITIES.
Δ CHARACTER AND AMOUNT OF TRAFFIC SHOULD DETERMINE THE TYPE OF SURFACE REQUIRED.

COST OF ROADWAY WORK IN CONSTRUCTION BACKLOG

(thousand of dollars)

System	Total	Type of Work: Resurface Only	Resurface & Widen	Reconstruction	New Construction
Interstate					
Rural	240,417	—	—	2,238*	238,179
Urban	31,423	—	398	2,302	28,723
Other State Trunklines					
Rural	275,534	1,642	51,924	87,446*	134,522
Urban	10,111	31	4,000	3,409	2,671
County Arterials	176,187	117	336	130,034	45,700
County Feeders	171,570	—	337	149,931	21,302
Municipal Arterials	19,054	476	8,856	6,758	2,964

Note: All Costs include right of way

* Includes costs for added lanes

NUMBER AND COST OF STRUCTURES IN CONSTRUCTION BACKLOG

System	Structures: Number	Structures: Cost ($1,000)	Railroad Crossing Gates or Flashers: Number	Railroad Crossing Gates or Flashers: Cost ($1,000)
Interstate				
Rural	386	35,426	—	—
Urban	58	61,161*	—	—
Other State Trunklines				
Rural	1,047	105,815	60	524
Urban	34	7,188	34	344
County Arterials	2,019	56,064	53	452
County Feeders	6,151	92,586	19	129
Municipal Arterials	19	8,205	78	825

* Includes cost of six miles of elevated structure

MILES OF WORK NEEDED IN CONSTRUCTION BACKLOG

System	Total	Type of Work: Resurface Only	Resurface & Widen	Reconstruction	New Construction
Interstate					
Rural	439	—	—	4	435
Urban	29*	—	3	7	19
Other State Trunklines					
Rural	2,895	50	773	821**	1,251
Urban	62	2	30	21	9
County Arterials	6,913	10	6	5,352	1,545
County Feeders	20,548	—	24	17,656	2,868
Municipal Arterials	147	16	59	62	10

* Does not include six miles of elevated structure

** Includes 184 miles of added lanes

STATEWIDE AVERAGE COSTS PER MILE FOR BACKLOG ROADWAY CONSTRUCTION

(excludes right of way)

System	Type of Work: Resurface Only	Resurface and Widen	Reconstruction	New Construction
Interstate				
Rural	—	—	$413,000	$476,000
Urban	—	$133,000	318,000	470,000
Other State Trunklines				
Rural	$33,000	59,200	91,500	95,000
Urban	15,500	96,800	117,500	190,200
County Arterials	11,700	44,000	22,000	26,700
County Feeders	—	13,600	7,700	6,700
Arterial Streets	28,000	110,000	77,000	164,700

ESTIMATED COSTS PER MILE PER YEAR FOR ADEQUATE MAINTENANCE

Covers routine and periodic work on roads and bridges, including surface sealing, traffic services and snow and ice control. Does not include betterments or resurfacing, except replacement stone or gravel.

System	Surface Type: High 4 Lanes	High 2 Lanes	Medium	Treated	Stone or Gravel	Earth
Interstate						
Rural [1]	$3,000	$2,200	—	—	—	—
Urban [1]	4,000	—	—	—	—	—
State Trunkline						
Rural	1,850	1,200	$1,085	$ 956 [2]	$ 987 [2]	—
Urban	3,200	2,200	1,700	1,300	—	—
County Arterial	1,200	800	800	750	600	$200
County Feeder	—	800	550	450	300	130
Arterial Street	2,300	1,700	1,300	1,000	800	—
Feeder Street	—	1,000	850	800	600	—

Notes: [1] For freeways. Same value used for 13 miles of rural trunkline freeways.
[2] On existing roads.

COST OF ROADWAY WORK IN CONSTRUCTION BACKLOG

(in thousands of dollars)

System	Right of Way	Grade and Drain	Base and Surface	Total
Interstate				
Rural	32,246	77,382	130,789	240,417
Urban	19,888	5,097	6,438	31,423
Other State Trunklines				
Rural	34,921	117,194	123,419	275,534
Urban	3,009	3,035	4,067	10,111
County Arterials	16,777	83,864	75,546	176,187
County Feeders	16,114	107,524	47,932	171,570
Arterial Streets	5,684	4,706	8,664	19,054

COST OF ROADWAY WORK IDENTIFIED IN 20-YEAR PERIOD

System	Right of Way	Grade and Drain	Base and Surface	Total
Interstate				
Rural	32,246	77,382	130,789	240,417
Urban	19,888	5,097	6,438	31,423
Other State Trunklines				
Rural	47,870	160,050	180,695	388,615
Urban	8,414	9,287	17,837	35,538
Arterial Streets in Cities over 2,500 pop.	14,713	12,889	32,677	60,279

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