

County-Wide Studies of Road Problems

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It is really a pleasant task to discuss county-wide studies of transportation. As county officials you have been elected or appointed to contribute to the present and future of your communities.

It may be presumptuous for a non-county administrator or supervisor, in your sense of the word, to address a group of professionals on the subject of county-wide studies in transportation. It might also seem unnecessary. I could say that if you weren't already convinced that there is a real necessity for county-wide studies of transportation you would neither be in your present county capacity nor would you be in attendance at the 1951 Purdue Road School. I do not consider this discussion to be presumptuous, nor do I believe it unnecessary. I think that it is important that you are informed of what others think of your problems and the reasons why you need support and assistance. Road school programs, such as the one you are attending, serve best when they bring fresh viewpoints to you, both from within your own group and from someone outside your profession.

YOUR RESPONSIBILITIES AND THEIR IMPORTANCE

Your responsibilities as county officials have many ramifications. They include matters of policy, administration, supervision, appointment, compensation, planning, finance, insurance, permits and licenses, and welfare. Because of modern traffic and the vast network of roads, streets and bridges in each county, the policy and administrative problems associated with the transportation facilities of your community are of great significance. Many of the problems are technical in character; others are social, political and economic.

Your transportation problems, in general, pertain to the highway, the street and the bridge. Many of your highway transportation problems are either directly associated with other forms of transportation or are influenced by them. Whatever you do in the field of highway transportation may be affected by, or have an effect upon, other forms of transportation. The good roads created at the county level contribute toward local, inter-community, state and national development. The truckload of corn originating at the farm in your community may progress through transportation media involving the local, secondary and primary highways, the railroads and the waterways before it reaches the final consumer. Traveling in the opposite direction, the supplies and equipment used in your communities may have traversed similar avenues.

Roads form the principal supply lines for all of us, whether we are farmers or dwellers in our cities and towns. All products of the farm, including practically all basic commodities of food, clothing and shelter, generally move initially by highway transport before reaching the consumer. Whether these products move directly to the ultimate consumer or to the factory, processing plant, grain elevator or stock yard, they are carried at least an important part of the distance, and usually at each end of the journey, by motor transport.

To be sure, your day-in and day-out interest in transportation and that of the farmer is more frequently directed toward the roads you serve and those adjacent or near to his farm. Because these county roads of Indiana are important links in the nation's supply chain, that interest should be shared by the urban dweller. Here lies a common interest that cannot be ignored. It is your duty to maintain your end of that link, as it is the duty of others to maintain the main roads of general motor use, the urban approaches and the city streets. While the city dweller's interest in streets is quite obvious, you and the farmer must share in these extensions of the local road, as they, too, form major links in the transportation system upon which he depends.

It is only natural that you and the farmer are most interested in the more than 74,000 miles of county roads in Indiana, because they include the first link in the chain of road systems essential to getting to and from markets or in promoting community activity. You recognize among others that poor roads and bridges in your counties represent limiting factors in promoting improvements of schools, in furnishing adequate postal service, in providing health needs, in marketing and purchasing of necessities and luxuries and in making possible social and political meetings of your constituents.

STUDIES SHOWING THE IMPORTANCE OF ROADS TO RURAL AREAS

The importance of transportation services rendered to rural areas by local roads was the subject of a recent cooperative study by the Bureau of Public Roads, the University of Maryland and the Maryland State Roads Commissioner. The study had many cooperating agencies—the Maryland Farm Bureau, the National and State Grange, the Maryland State Department of Education, the Extension Services of the University of Maryland, the State Agricultural Experiment Station, county agents and supervisors, superintendents of schools and other local officials, the Automotive Safety Foundation and the Bureau of Public Roads. The study of several counties was pursued for the purpose of portraying the importance of service rendered by rural roads to education, mail delivery and the movement of farm products. In addition, an inquiry was made concerning the attitudes of rural residents with respect to the improvement of rural roads (19).*

Another study of the local road problem was conducted in Logan County, Colorado. The general objective was to study the transportation needs and travel habits of people in communities as related to land use and the economic status of the rural areas. This cooperative project included the Logan County Board of County Commissioners, the Colorado Agricultural Extension Service, the Colorado State Highway Department and the Bureau of Public Roads. The study included such items as land use, highway system service, trip frequency, purpose and length, commodity and tonnage movement, class of hauls and vehicle ownership (20).

The object of an economic study of the secondary system of roads in Floyd County, Virginia, was to determine the cause of the unsatisfactory condition of the secondary roads and to ascertain what steps could be taken, with available local materials and funds, to make such improvements as would adequately meet the traffic requirements of the agricultural, educational and industrial activities of the people. The survey included studies of population, agriculture, industry, recreation, topography and geology, traffic conditions and causes of failures of secondary roads, requirements for improvements, available materials and conditions of road improvement or abandonment (2).

The main purpose of the Administrative Survey of the Road Program of Fulton County, Georgia, was that of analyzing the

* In general, numbers in parenthesis refer to references in the Bibliography.

internal organization and administration of the county's road program and its integration with the other governmental units. The study presents the need for greater city-rural cooperation in the development of fringe areas (1).

RURAL HIGHWAY PROBLEMS, 1920-1935

Prior to 1930, the improvement of the main rural highways was a primary objective. Primary highways were recognized and designated as a part of the highway system in accordance with the laws of the states. Many of these primary highways have been incorporated into the federal-aid highway system.

During the decade of the 1920's, the states expended on highways an annual average of \$457 million; the federal government expended an annual average of about \$100 million. This was for the pioneer improvement of the main rural highways (16). By 1930, some degree of improvement was extended to nearly the whole of the selected primary system, and a situation was created which called for a re-evaluation of the guiding policies.

The registration of motor vehicles increased from more than nine million in 1920 to about 26.5 million in 1930 (25). The volume and type of traffic grew at an even faster rate. Speed of travel increased and continued to mount. It was observed that much of the earlier improvement of the principal rural highways would soon become inadequate for the needs of the developed traffic and thus reconstruction and enlargement of facilities were necessary.

This recognized inadequacy of the main rural highways in the 1930's was complicated by other traffic facilities showing signs of distress. City streets, which earlier had appeared to be adequate, were suffering because of the increase in traffic. The rural secondary and feeder roads also felt the pressure from increased volumes of traffic. Thus, there was an apparent need for considering not only the primary highways, but the city streets and the secondary and feeder roads.

PLANNING SURVEYS AND ROAD STUDIES

In the early 1930's there was recognition of the need for a careful appraisal of this new and complicated situation. The Hayden-Cartwright Act of 1934 authorized expenditure of not more than one and one-half per cent of the amount of federal-aid funds apportioned for any year to any state for the making of surveys, plans

and engineering investigations of projects for future construction (36). Beginning in 1935, so-called state-wide highway planning surveys were undertaken by the states in cooperation with the Bureau of Public Roads to develop facts essential to the revision of policies. They provided an invaluable foundation for a continuing measure of road use, highway finance, road conditions, road life and related factors. Problems of policy, administration, finance, planning and others began to take new meanings.

The nation-wide basic inventory of highway conditions was made by on-the-spot checks of the location and physical condition of all rural roads. Observers drove every mile of public road. They recorded width, type and condition of all roadway surfaces; the type, dimensions and conditions of all structures—bridges, overpasses and underpasses; the location of all farms, rural dwellings, schools, churches and other cultural features which are sources of traffic and have a definite bearing on road needs; and the physical characteristics of all railroad grade crossings—sight distances, curvature and grades of railroad and highway, and type of protection. On the important routes they measured the location and degree of curvature of all sharp curves, the location and grade of all steep curves and the location and nature of all restrictions to road visibility which might present a traffic hazard.

The inventory data were summarized in numerous tables. They were also used to prepare a series of states and county base maps, drafted in accordance with standards agreed upon by the states. These maps show all public roads and their surface types in relation to land use. Many states have used these base maps to show school bus routes, mail routes, regularly scheduled truck and bus routes, and a geographical representation of the annual average 24-hour traffic volume on every mile of rural road. Periodic revision of both the tabulated inventory data and the several map series was interrupted during World War II, but it has been resumed (16).

The traffic survey on rural roads included several phases. Perhaps the two most important were a determination of traffic volumes for all rural roads and the obtaining of information concerning weights, heights, lengths and other characteristics of trucks and buses.

Traffic was counted at a relatively small number of "key" stations and at a much larger number of "coverage" stations grouped about the key stations. Electronic recorders were used to make the counts at a limited number of carefully selected points. Their cost prohibited wide use. An hourly record was obtained which has been useful in estimating hourly, daily and seasonal variations in traffic volume.

There are at present several hundred of the fixed-type photo-electric counters in use throughout the United States. They are located at strategic positions on the highway system. Many of the counters have been operated continuously at the same location since the beginning of the planning surveys.

Traffic has also been counted by human observers, making so-called manual counts. Nearly all of the traffic counts on the low-type roads were made by this method because electrical counters are expensive and mechanical counters are not accurate on gravel or crushed stone roads.

More recently, portable non-recording and recording mechanical counters have been used on improved roads. These machines are comparatively inexpensive and are used in place of the earlier manual counting, except for the purpose of vehicle type classification. Because of them, traffic counting procedures and schedules have changed significantly.

In the initial traffic survey, trucks and buses were weighed and measured at stations located on the more important state and federal highways. Several millions of vehicles were examined at more than 3,000 stations distributed throughout the nation. These weighing stations were, in general, located at the key traffic stations and operated on the same type of schedule. The information obtained included the type and manufacturers' rated capacity of the vehicles, gross vehicle weight, load on each axle, the width, height and length of the vehicle, the commodity carried, and when possible the weight of the net load, the origin and destination of the vehicle and other pertinent data.

The information for these weighing stations has provided essential data for the design of roads and motor vehicles. It has been particularly useful in the consideration of appropriate regulatory measures concerning sizes and weights of vehicles and in establishing financial responsibilities.

Road design for higher speeds, greater volumes, increased weight and other physical characteristics has resulted in thicker and better drainage and soil treatment, wider pavements, straighter alignment and opportunity for safe passing, multilane facilities, floodlighting intersections of main highways, elimination of crossings at grades, adequate separation of opposing streams of traffic, wider shoulders, super-elevation and spiraling of curves, limited-access design, intersection design, zoning and signing. These design features are obviously increasing the cost of highways (5).

The improvement in vehicle design by manufacturers has received indirect help by these studies. The use of more axles and lighter materials has made possible greater gross and net weights without exceeding legal limits (34).

Several states have used their data for more effective establishment of allocated costs to the several classes of vehicles. Among them are California, Oregon, Washington, Illinois and New York.

The purely financial phase of these studies consisted of a correct and complete determination for a single year of :

1. All forms and rates of taxation imposed by the various levels of government for highway purposes.
2. Total revenue accruing from each form and rate of tax imposed by each taxing jurisdiction and the grand total raised by all taxing means and jurisdictions.
3. The relative magnitudes of highway revenue and the revenues collected for all other purposes of government.
4. The incidence of highway tax burden upon road and other beneficiaries resident in each taxing jurisdiction.
5. The amounts, terms, and interest rates of all existing debt created for highway purposes by the several levels of government.
6. The amounts and purposes (such as construction, maintenance, engineering, administration, debt charges, and others) of all highway expenditures by the various levels of government.

The Financing of Highways by Counties and Local Rural Governments, 1931-1941, published by the Bureau of Public Roads is a typical report of these studies (13). Other BPR reports, stemming in part from these financial studies, are *Toll Roads and Free Roads* (37) and *Interregional Highways* (38).

The Board of County Engineer Consultants made a state by state inquiry in 1949 which showed 1947 improvement costs of 50,000 miles of local roads as follows (10) :

1. Improvement costs of nearly 16,000 miles involving the placement of granular surfacing on existing alignments, including incidental grading and structures, were distributed as follows :

Per cent	Range in Cost per mile
76	\$1000—\$3000
16	\$3000—\$5000
6	\$5000
2	\$1000

2. Improvement costs of nearly 22,000 miles involving the placement of granular surfacing on adequately graded and drained roads, including grading and structures, were distributed as follows:

Per cent	Range in Cost per mile
47	\$5000—\$10,000
23	\$1000—\$3000
20	\$3000—\$5000
10	\$10,000

3. Improvement costs of over 12,000 miles of local roads with surfaces of dustless type were substantially higher than the costs reported for granular roads. In 1947, more than half of these dustless roads cost more than \$10,000 per mile.

Table 1 shows the estimated construction and maintenance costs per mile for roads carrying fewer than 50 vehicles a day, built in rolling terrain to various standards (10).

It may be observed that maintenance costs (exclusive of snow removal) on the roads carrying fewer than 50 vehicles a day ranged from \$148 to \$440 a mile depending upon the standards of the road. By means of comparison these costs may be contrasted with the \$12.5 million (about \$170 a mile) available to the counties of Indiana in 1947 for the construction and maintenance of 73,600 miles of local roads (26). With additional funds from local sources and federal funds the total available in 1947 for county roads was less than \$13.2 million or approximately \$179 a mile (10).

THE FINANCIAL PROBLEM IN INDIANA

Approximately \$674 million was collected by the State of Indiana in motor vehicle taxes during the fiscal years 1920-1948. This sum excluded refunds and administrative expenses associated with the collection of these taxes. The state highways received an allocation of more than \$411.5 million; the counties and towns received \$236.5 million. Approximately \$26 million was diverted to other uses (35).

The gross receipts from motor vehicle taxes in Indiana for the 1948 fiscal year approached \$51 million. The net amount for distribution after refunds, expenses and other payments was more than \$43.7 million. The State Highway Commission received \$26.5

TABLE 1

Construction Type	Width		Construction Cost per mile*					Average Annual Maintenance Cost per mile**			
	Graded	Surfaced	Grading or Ditching	Surfacing 3-inch Gravel	Culverts	Bridges	Total	Blading, Ditching, Reshaping & Mowing	Gravel Replacement	Structures	Total
Ditched on pioneer location	8	8	\$ 110	\$ 780	\$ 200	\$1000	\$2090	\$ 59	\$ 130	\$ 10	\$ 199
	12	12	140	1170	220	1000	2530	59	195	12	266
	16	16	170	1560	450	2160	4340	70	260	16	346
	20	20	220	1950	650	2700	5520	85	335	20	440
Graded and Drained on adequate alignment	10	8	\$1400	\$ 780	\$ 280	\$1000	\$3460	\$ 40	\$ 98	\$ 10	\$ 148
	14	12	1750	1170	310	1000	4230	40	146	12	198
	20	16	3050	1560	700	2160	7470	51	195	16	262
	24	20	4200	1950	850	2700	9700	59	244	20	323

* The following unit costs were used in preparing the table:

Excavation (per cubic yard)	-----\$ 0.35
Gravel surfacing (per cubic yard, delivered)	-----\$ 2.00
Culverts (per lineal foot, in place)	-----\$ 5.00
Structures (per lineal foot, single lane)	-----\$100.00
Structures (per lineal foot, double lane)	-----\$150.00

** Costs of snow removal are not included. In colder regions these costs may be \$40 to \$100 per mile. The lower costs are usually found on roads of proper location and design.

million (60.6 per cent); counties, \$12.9 million (29.6 per cent); cities and towns, nearly \$4.3 million (9.8 per cent). The distribution to cities and towns included a portion of the county's share which was allocated to cities of certain classes (*ibid.*).

The net receipts for the fiscal year 1949-50 exceeded \$59 million. The State Highway Commission received more than \$29.7 million (53 per cent); counties, \$17.9 million (32 per cent); and cities and towns, \$8.4 million (15 per cent). The allocations in terms of percentages were in accordance with the revised allocation law of 1949 (12). The allocation to the counties was about \$240 per mile.

More than \$30 million was spent in 1949 on the 74,087 miles of county highways and about 10,000 miles of city and town streets. About 85 per cent of this expenditure came from fees and taxes collected from highway users by the state and allocated to local units as indicated previously. Local property taxes and other local sources of revenue supplied nearly 15 per cent of the local gross revenue (*ibid.*).

Income to the counties from the motor vehicle tax fund for the year 1950 was about \$19.6 million (14). This permitted an average of about \$265 a mile of county highway for construction, reconstruction and maintenance.

The records show that more money is now available than at any previous date for the construction and maintenance of county roads and urban streets. However, the shrinkage in the buying power of the dollar has caused serious problems in highway financing. This decrease in purchasing power is complicated by needs for higher standards to accommodate the increase in motor vehicle usage including number of vehicles, increased average annual mileage per vehicle and increases in vehicle size, especially of motor trucks.

The counties of Indiana reported local road deficiencies of nearly \$93 million in 1949 representing about \$1260 a mile of highway. Needs for the cities were reported to be more than \$76 million (18).

SHIFT IN FINANCIAL RESPONSIBILITY

In the face of the increasing demands for schools, roads, hospitals, public safety, public welfare and other public functions, it is not surprising that local units of government have continually sought to shift their financial burdens to the state and federal government.

By 1927 approximately 288,000 miles of local rural roads in the United States were transferred to the primary system of the states. More than 146,000 miles have been added since 1927. Although this mileage represents only about 14 per cent of the total rural mileage in the United States it does earn about 60 per cent of the road revenue (10).

In 1927 state sources supplied 18.8 per cent of the funds for local roads. Local sources supplied 81.2 per cent. In 1947 state sources supplied 56.4 per cent; local sources, 39.4 per cent. This represents a financial shift of about 42 per cent (*ibid.*).

The shift in source of funds in Indiana may be represented as follows: Local roads in Indiana received \$27.7 million in 1927, \$16.7 million in 1937, and about \$13.2 million in 1947. State contributions to local roads were \$1.8 million, \$10 million, and \$12.5 for the respective years. Local sources of revenue contributed \$25.9 million in 1927, \$6.3 million in 1937, and only \$695 thousand in 1947 (*ibid.*). Local contribution in 1927 in Indiana to local roads represented 93.3 per cent of the funds. In 1947 the local contribution was only about 5.3 per cent of the total money available for local roads.

In 1947, nation-wide contributions of local units to the support of local roads were only 64 per cent of their contributions of 1927. Price adjustments would reduce these contributions still lower. Local contribution in Indiana for 1947 dropped to less than three per cent of that for 1927.

In some instances these financial trends reflect the general policy of certain state legislatures of providing additional state support to increase the money available for local roads. In some cases local units have used state funds as a substitute for purely local revenue. This practice tends to defeat the intention of legislation designed to expedite the improvement of the local road. The failure of many local government units to sustain their share of the financial burden, when state revenues are available, raises sincere doubt as to the depth of interest in working out a solution of the financing problems (10).

ROAD USE STUDIES

The road use studies conducted in the states and counties in the late 1930's were designed to determine the relative usage of various parts of the entire highway system by owners of motor vehicles residing in various parts of the state, in rural and urban areas.

Data of these studies were obtained by personal interviews with a representative sample of registered motor-vehicle owners throughout each state, obtaining from each owner the extent in miles of his annual travel and the portions of total travel that used roads and streets of the several highway systems. It was possible in this way to determine with substantial accuracy the proportional amounts of travel, on each of the road systems, originating in the various governmental units. This information, correlated with the record of revenue contributions to the several systems by residents of the same governmental units, permitted the determination of relations between revenue contributions of the several groups of contributors to each system and the benefits derived through usage of the several systems by contributors of each group. These relations bear usefully upon the fairness of tax measures and of revenue distributions to the several classes of highways. There is considerable evidence on a national basis to the effect that local units of government have the capacity to make greater contributions than they now make toward the financing of local roads.

These original survey elements have been supplemented by origin-destination studies of the principal movements within metropolitan areas of selected cities. Typical of these studies are those conducted by the Indiana State Highway Commission for the metropolitan areas of Lake County, South Bend, Elkhart, Ft. Wayne, Evansville and Indianapolis. The Commission recently conducted surveys for the purpose of making economic evaluations of by-passes at Kokomo and Lebanon, Indiana.

A recent report of the Bureau of Public Roads concerning the use of local rural roads showed that only 10 per cent of these roads carry more than 100 vehicles a day, 21 per cent serve more than 50 vehicles a day, 17 per cent serve 25 to 50 vehicles a day, and another 22 per cent serve 10 to 25 vehicles a day. Approximately 40 per cent of the total mileage of local rural roads is traveled by 10 or fewer vehicles a day. The average traffic on the 2½ million miles of local rural roads is about 56 vehicles a day (10).

In general, financing of rural roads is on the basis of mileage of roads, population, car registration, and land area. It should be pointed out that the service performed by a county road is an important but seldom used factor in financing and planning. Certainly the service rendered by school bus routes, the milk route, and the postal service route should be included in any formula dedicated to the provision of county highways.

ROAD LIFE STUDIES

The road life studies conducted in the states were designed to determine the average service life of the several types of road surfaces and the various other elements of the highway, such as its roadbed, drainage system, shoulders and bridges. With this information, obtained by an analysis of the records of surfaces and roadway elements previously constructed and depreciated, it is possible to estimate the amount and cost of replacement that will be required in each year in the future, and on the basis of these estimates to schedule the essential construction and reconstruction program and corresponding revenue needs of a future period.

UTILIZATION OF EQUIPMENT AND PROCEDURES

Because there are wide variations in field practices in the utilization of equipment among local road units, it is quite necessary to determine the approximate extent of some of the variations. The Bureau of Public Roads has undertaken a study of the equipment performance on blading, hauling, ditching, grading and other local road operations in a limited number of counties throughout the United States. These studies in equipment usage have been supplemented by studies of local road maintenance in relation to total road maintenance problems. The purpose of these studies was to analyze within a fixed area of operating significance the maintenance problems, methods, equipment usage, work loads, deficiencies, normal and peak loads, patterns of efficient road maintenance performance and inter-highway relations.

The use of outmoded and inefficient construction, reconstruction and maintenance procedures on the various highway transportation facilities is costly to the taxpayer and highway user. Thus, it is important that proper use be made of materials, equipment and personnel through adequate and economical designs, specifications, priorities and integrating planning on a long-term basis.

PARTICIPATION BY INDIANA IN STUDIES OF THE RURAL ROAD PROBLEM

Indiana participated in the planning survey in the late 1930's. Certain data for each of the 92 counties have been recorded and are available through the State Highway Commission of Indiana. Further participation by Indiana was previously discussed under the section on road use.

PRESENT CONDITIONS AND COUNTY-WIDE NEED STUDIES

When studying county-wide transportation problems, it is desirable to obtain factual appraisals of the economic, social, engineering, financial and administrative phases of the problems. In addition, the existing status and future needs of county roads, streets and bridges should be determined.

Several basic studies conducted on a national basis, in all states or in selected areas, or in Indiana have been discussed. Among them are basic inventories of roads and bridges, traffic surveys, methods of finance, road use, road life, and utilization of equipment—methods and procedures. A knowledge of these studies is essential to a full understanding of our highway problems. These studies should be supplemented by current information at the national, state and county level. Additional studies at the county level are needed.

FINANCIAL STUDIES

Effective studies of the counties in Indiana should provide for an examination of financial procedures in an attempt to ascertain methods that may effectuate optimum economies. It seems essential that funds from the various sources be examined—federal, state and county—to determine the functional relationship applicable to budgeting, accounting and control and purchasing and distribution.

Studies should also be made to determine effective and reasonably uniform methods for the financing of bridges. Several methods of finance are in current usage—revenue from the motor vehicle fund, revenue from the general funds of the county, and revenue from bond issues. Research studies may reveal a need for more uniformity in financing, establishing a “sinking fund” and for the establishment of a long-term plan for the replacement of unsafe, outmoded and inadequate bridges. Furthermore they may reveal that the most effective use of federal-aid funds at the county level is for bridge construction.

PURCHASING AND CONTROL

The studies should also provide for a careful review of the methods of purchases or procurement (including acceptance procedures), storage and ultimate use of road supplies, materials and equipment. This is essential to insure standards, prevention of waste or loss in consumption, avoidance of theft, establishment of responsi-

bility, promotion of accurate buying, establishment of standards of consumption, prevention of overstocking, securing of accurate inventories, and the keeping of accurate cost records.

The counties are permitted by legislative act in 1943 to request the testing laboratory of the Indiana State Highway Commission to perform such tests as are necessary for the control of material specifications. The law states, "The State Highway Commission of Indiana is authorized and empowered to cooperate with counties, cities and towns by furnishing on request of such counties, cities and towns engineering service or consultation, and extending the facilities of the State Highway Commission's testing laboratory for the testing of highway construction and maintenance materials or for any other purpose. When such services are rendered by the State Highway Commission upon the request of any county, city or town, the State Highway Commission shall be reimbursed by any county, city, or town requesting and receiving such services to the extent of the actual cost of such service including salaries or personal services. When payment is made to the State Highway Commission by such counties, cities or towns, the State Highway Commission shall receipt such payments into the accounts or appropriations from which the expenditures were made by the State Highway Commission in providing the services contemplated herein (39)." It appears that the counties have not used this procedure to their best advantage. Research studies in the quality control of materials may show that more effective methods should be established to assist the counties in building and maintaining economical roads.

An examination of the specifications manual of the Indiana State Highway Commission may reveal that many practices and procedures are applicable to the county highway problem (40).

ADMINISTRATIVE AND PERSONNEL PRACTICES

The administrative and personnel practices of a business or agency often reflect its accomplishments. If success is measured in terms of per cent of surfaced local road mileage, then Indiana ranks high. The Bureau of Public Roads has reported (1949) that 85.9 per cent of the local roads in Indiana are surfaced. The national average is 50.6 per cent (10). The percentages for Indiana's neighboring states are: Wisconsin, 87.2; Ohio, 83.7; Illinois, 80.3; Michigan, 68.3; and Kentucky, 46.0. These data seem to indicate that the local roads in Indiana are in good condition. The recent spring "break-up" of the county roads in Indiana is a measure of their

quality. On this basis, even though they are improved, they are not as satisfactory as they should be to meet the standards of current or projected traffic.

Road authorities are generally agreed that the county unit plan is the most efficient method of administering local roads. Thus, local roads in Indiana appear to have efficient administration. The authorities suggest that county commissioners should confine their activities to general policy matters and programs. They further agree that county highway construction and maintenance should be under a competent engineer or otherwise technically qualified person with adequate practical experience. Such a system provides for better definition of policies and functions. It affords an opportunity to broaden the tax base, promotes uniform cost accounting and control, and provides for more efficient use of personnel, better use of materials and equipment, better cooperation between local, state and federal road authorities, and greater progress in programming, and long range planning in terms of needs. Unfortunately, only a limited number of counties in Indiana have qualified engineers or technical personnel with adequate experience. In addition, there were more than 60 changes in road supervisors during 1950.

In order to evaluate the administrative and personnel practices of the counties of Indiana it seems desirable to develop an administrative chart and handbook showing the responsibilities of certain county officials—especially those of the commissioners, council, auditor, surveyor, attorney and road supervisor.

It is essential to write job descriptions for administrative, supervisory, technical and other positions—giving job title, assignment, scope of responsibilities, educational and experience requirements, and special conditions for the purpose of wage administration. An appropriate training program may be necessary for effective on-the-job activities. Furthermore, it may be necessary to determine current personnel practices and suggest an effective program for good working conditions including working hours, wages, insurance (accident, health, hospitalization, and disability), sick leave, vacation, promotion, job security and others.

ENGINEERING SOILS—MATERIALS MAPS

Because soils constitute the ultimate foundation of a road, street or highway, it is not difficult to appreciate the value of an adequate engineering soils-materials map. Its use is essential in county highway work because it furnishes proper information concerning terrain

conditions, including the origin and type of parent-soil material, thereby enabling the qualified person to perform economical location work.

The supporting value of soils depends intimately upon the soils-textures and upon the ability of the soils to discard excess water as quickly as possible. A soils map classifies the soils-materials according to relative textures, thus aiding in the design of an adequate and economical road. Borrow pits, sand and gravel deposits, limestone and other road materials may be quickly located and evaluated through use of the soils map.

The erosion characteristics of soils may be derived from a soils map if supplemented by the knowledge of the origin, mode of formation and the texture of the soils of a given area.

Engineering soils-materials maps have been completed for about one-third of the counties in Indiana. Many more are in process. The maps are available through the Joint Highway Research Project of Purdue University.

SURFACE DRAINAGE MAPS

Surface drainage maps of counties are closely related to the engineering soils-materials maps and have many potential uses. They show the topographic irregularities and the exact location and extent of all drainage areas. This information is valuable in making preliminary surveys of flood control, highway and airport location.

These drainage maps give clues to the determination of run-off factor constants and corresponding formulas. They can be of value to county road supervisors in the planning of highway structures and road improvements. They can also serve the county engineers in their drainage ditch programs. The city planners can use the maps for location of subdivisions. Where drainage patterns on the maps are of fine density, the soil conservationists may expect to find areas of erosion.

Drainage maps for more than half of Indiana's counties have been completed. They also are available through the Joint Highway Research Project.

GENERAL SUMMARY

An attempt has been made to suggest ways and means to improve our county highways. It seems quite necessary that each county in Indiana become thoroughly familiar with current county highway problems. County-wide studies of transportation should

provide insight into the problems of providing comfortable, safe and economical transportation.

All of the activities discussed in this presentation are tools for providing adequate and economical county transportation. Purdue University, through the Joint Highway Research Project, is in a position to assist the counties and to undertake cooperative county road research in a limited number of counties in Indiana. It is the duty of the counties to make optimum use of this facility.

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