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# Highway Transportation in MINNESOTA



AN ENGINEERING ANALYSIS

# HIGHWAY TRANSPORTATION IN MINNESOTA

## an engineering analysis



A Report To The

## MINNESOTA HIGHWAY STUDY COMMISSION

(Established by Laws 1953, Chapter 692)

prepared by the

## AUTOMOTIVE SAFETY FOUNDATION

with the cooperation of the

## MINNESOTA DEPARTMENT OF HIGHWAYS

and the

## U. S. DEPARTMENT OF COMMERCE
## Bureau of Public Roads

This study was financed jointly by the U. S. Bureau of Public Roads and the Minnesota Department of Highways as Highway Planning Survey Project 1 (18).

Saint Paul, Minnesota
September, 1954

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DEDICATED TO EDUCATION AND RESEARCH FOR SAFE, EFFICIENT HIGHWAY TRANSPORTATION

200 RING BUILDING
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September 15, 1954

Honorable A. O. Sletvold
Chairman
Minnesota Highway Study Commission
202-3 State Capitol
St. Paul 1, Minnesota

Dear Senator Sletvold:

It is a privilege to transmit to you and members of the Highway Study Commission this engineering analysis, "Highway Transportation in Minnesota."

This analysis was made in accordance with the agreement between the Highway Study Commission, acting through M. J. Hoffmann, Commissioner of Highways, as agent for the State of Minnesota, and the Automotive Safety Foundation.

The study covered engineering and administrative phases of Minnesota's highway and street problems, not including however, fiscal aspects for which the Commission had a concurrent separate study made. It is recommended that the findings and recommendations contained herein be related to the fiscal study.

Staff members and I are extremely gratified for the opportunity to participate in the fact finding work which is essential to sound highway development.

Grateful acknowledgement is made for the ready cooperation extended by your Commission, the Department of Highways, and many other public and private agencies.

Respectfully yours,

C. E. Fritts
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Vice President in
Charge of Engineering

**Registered Highway Engineer**
**Certificate No. 4750**

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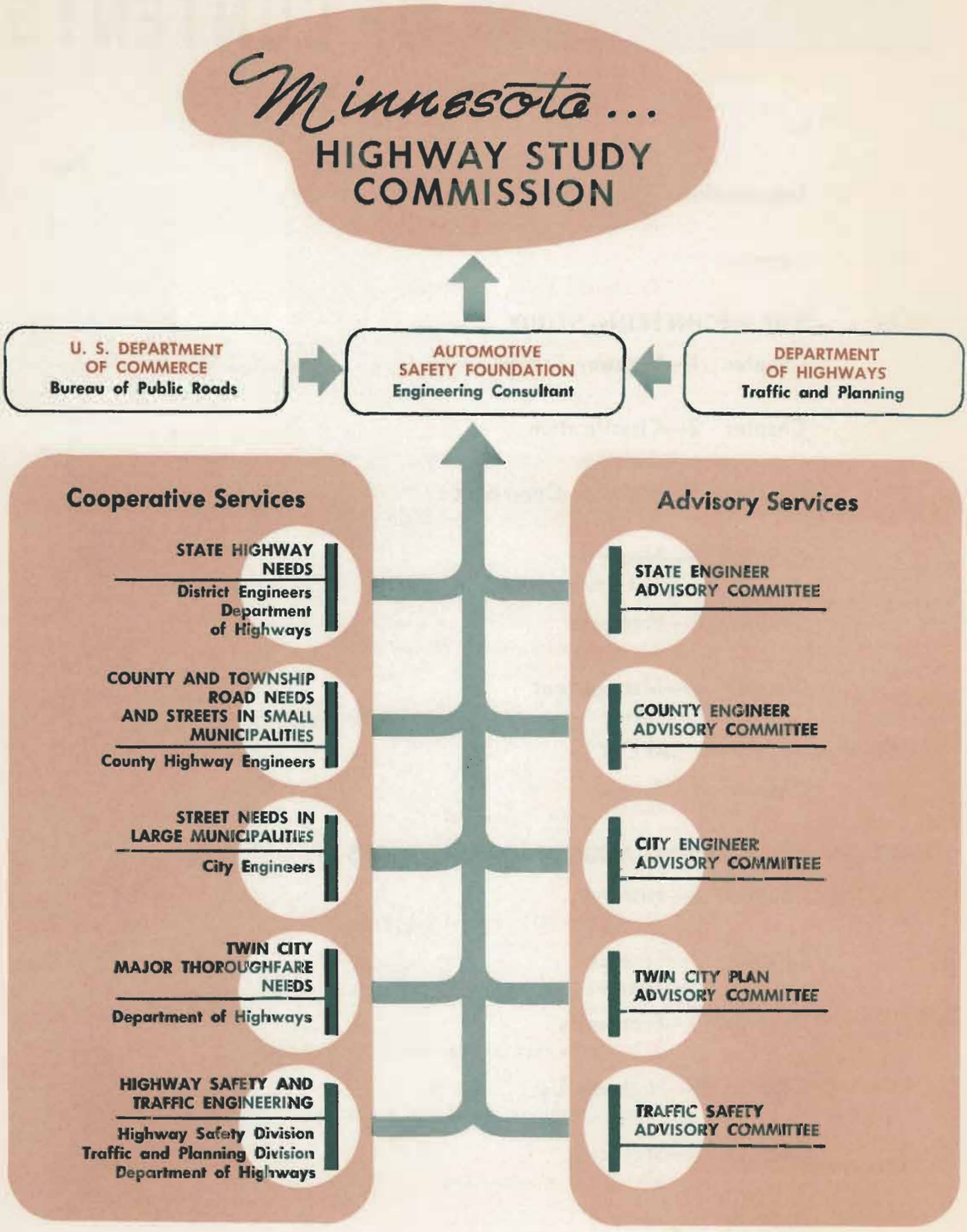
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# The Problem

MINNESOTA'S GROWING HIGHWAY NEEDS

Minnesota's highway problem is the product of several things. The depression brought a drop in highway construction, and then during World War II construction almost vanished, and maintenance fell far behind. The post-war period found the highways ill-prepared for the avalanche of traffic borne of high production and high income. While revenues for highways increased during this period, the increases were partly off-set by rising prices.

Motor vehicle travel today is more than 12 times the total travel in 1921 when the original State Trunk Highway System was created. Vehicle registration in 1953 exceeded 1.25 million or approximately one vehicle for each 2.5 persons in the State.

Minnesota's huge highway plant consists of 121,000 miles of roads and streets as shown on the map on page eight. There is about 200 feet of road or street for each man, woman and child in the State. The roads and streets are administered by 2,721 separate and independent highway agencies, yet all are a part of a single transportation network.

The large mileages involved and the many agencies with jurisdiction over them, pose major problems of intergovernmental relationships and planning, and of reasonable and balanced programming. A stumbling block to highway officials, legislators and citizens in meeting the growing problem has been the lack of knowledge as to actual and relative needs on each of the several systems.

Several other factors affecting Minnesota add further to the complexities of the highway problem. Extremes in climatic conditions and widely varying topographic and geographic conditions increase highway construction costs. Reduced load limits during the spring breakup hamper the movement of commodities by truck and add to the cost of transportation. Increasing public dependency on highway transportation requires that more and more miles of road be kept open for travel the year around. The costs of snow plowing and ice control add substantially to the maintenance expenditure.

## The Highway Study

Those factors led the 1953 Legislature to create the Highway Study Commission to investigate all matters related to highways--their adequacy, needs and financing--for the purpose of determining the sound and reasonable requirements for all highway and street systems within the State.

The Commission, acting through the Minnesota Department of Highways, entered into two agreements for technical services in carrying out the directive of the Legislature.

One agreement was with the Automotive Safety Foundation of Washington, D. C., to direct and supervise this engineering analysis of the physical condition and needs of the highway and street systems of the State and to review highway management at each level of government. The Foundation is a non-profit organization devoted to the development of safety and efficiency in highway transportation.

The second agreement was with the Public Administration Service, Chicago, Illinois, which is dedicated to improvement of governmental functions, to conduct a finance study of highway taxation and revenue distribution.

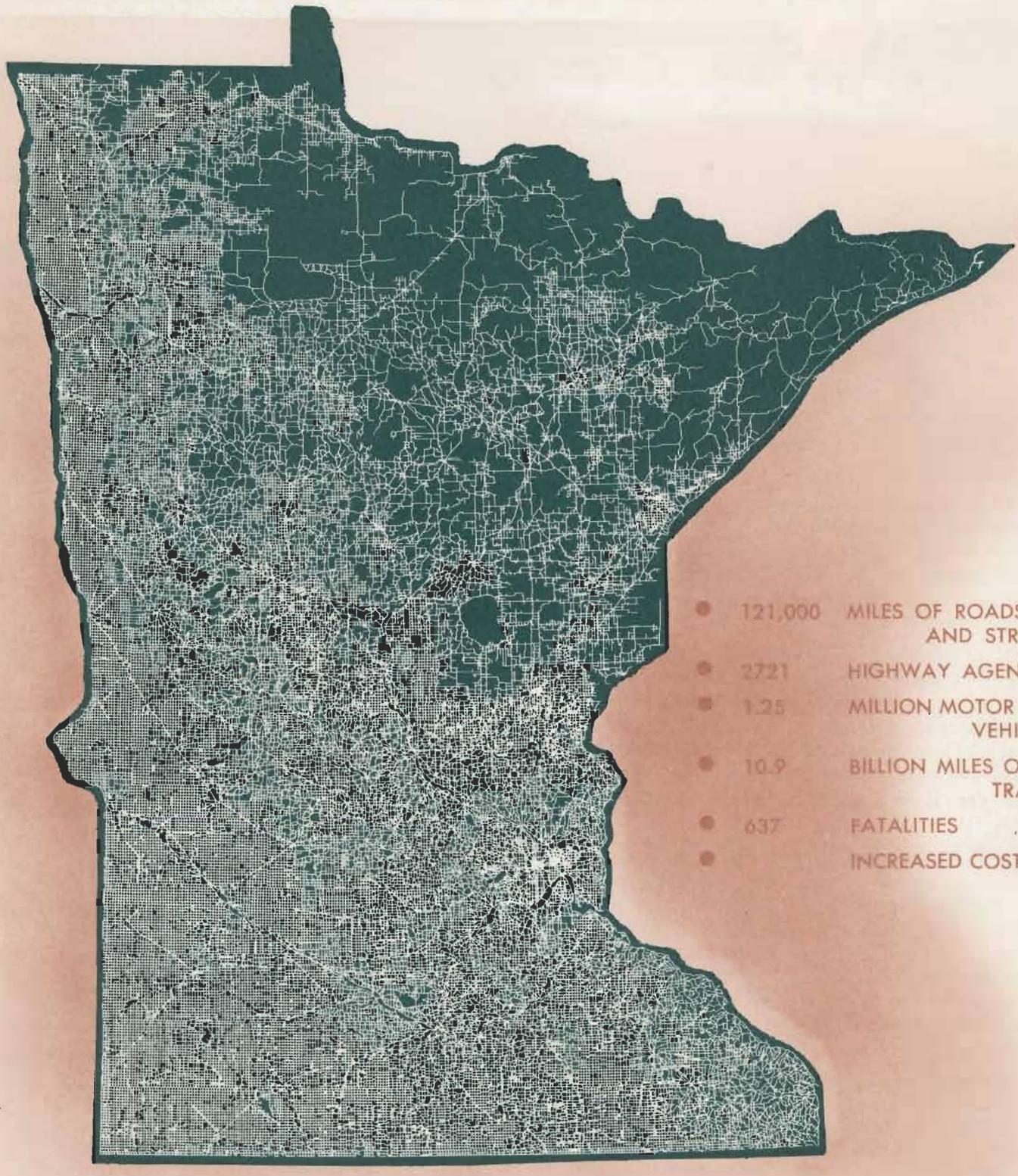
Although the two technical staffs have coordinated their work, each has conducted an independent study, and the results are published in separate reports. In arriving at a sound solution to the highway problems of the State, it will be necessary to consider the results of both the engineering and the fiscal studies.

## Scope of the Engineering Study

The engineering process involved:

1. Analysis of the fundamental economic factors affecting highway transportation in Minnesota and of the service performed by highways for agriculture, industry and commerce within the State.
2. Review of the historical development of roads and streets within the State, including an examination of highway legislation and administrative policies.

# Minnesota's Road Network




3. Historical review of highway finance, but not including recommendations on highway fiscal policy.
4. Analysis of the past and probable future use of Minnesota roadways in terms of traffic volume, travel habits, traffic patterns, the composition of the traffic stream and other factors.
5. Examination of the existing classification of roads and streets.
6. Survey of traffic engineering practices.
7. Analysis of highway safety problems.
8. Determination of tolerable physical standards for existing roads and streets and of appropriate standards for future construction.

9. Measurement of accumulated deficiencies in the existing highway plant, on the basis of a complete physical inventory and preparation of cost estimates for required improvements on the basis of the appropriate construction standards established for each class of road or street.
10. Determination of annual replacements required as presently tolerable roads and streets wear out during the years while the accumulated deficiencies are being overcome.
11. Determination of annual maintenance requirements.
12. Formulation of alternate long range programs for road and street construction, replacement and maintenance.
13. An analysis of highway administration.

The results of the study of each of these phases of the highway problem are presented in this report. Much of the basic data for the historical review of highway development, finance and road use was obtained from the Highway Planning Survey, a fact-finding agency sponsored jointly by the Department of Highways and the U. S. Bureau of Public Roads. Other special studies and research investigations also were carried out by the Highway Planning Survey, the Department of Highways and other State agencies.

## The Engineering Organization

To take full advantage of the knowledge of engineers experienced in Minnesota highway and street problems, the engineering process was based on extensive use of the engineering forces of the highway agencies of the State and local governments. The Foundation engineering staff served as a directing and co-ordinating group by establishing procedures and controls designed to secure a balanced appraisal of the entire highway and street network within the State.

Early in the study three advisory committees of State, county and city engineers were organized, with members selected for their training, knowledge and experience in their particular fields of work. Through the Commission's executive committee the State Department of Highways, the Minnesota County Highway Engineers Association and the League of Minnesota Municipalities were asked to confirm the appointment of the selected engineers and arrange for their active participation in the study. With the advice and counsel of these advisory committees the engineering staff prepared procedural manuals outlining specific criteria and techniques for measuring deficiencies and determining needed improvements for each class of roads and streets.

Four manuals were prepared, one for appraisal of rural State highways, one for rural county and township roads, one for streets in municipalities of over 5,000 population and one for streets in municipalities of under 5,000 population. While the same pattern was followed in each manual, the detailed procedure used in appraising the needs of each class of roads and streets was somewhat different in order to meet the particular characteristics of service performance.

More than 400 State, county and municipal engineers cooperated in the field appraisal. Approximately 75,000 individual report forms were prepared by the field engineers and submitted to the engineering staff.

In addition to the three advisory committees of State, county and city engineers, two other committees were formed, one to assist in development of a major thoroughfare plan for the Twin City area, and the other to review the Annual Inventory of Traffic Safety Activities prepared by various State and local agencies for the National Safety Council and advise in shaping up a program for strengthening traffic safety activities in Minnesota.

The engineering staff relied heavily on the results of highway research by the U. S. Bureau of Public Roads, the American Association of State Highway Officials, the Highway Research Board and many other state and national agencies. In addition, specialized assistance was provided by engineers of the Bureau.

## Acknowledgement

The engineering staff acknowledges its sincere appreciation to all the many engineers and State and local highway agencies who participated in the study, and to the members of the five advisory committees who gave generously of their time and valuable assistance in carrying out the objectives of the engineering study. Without the help and cooperation rendered by all participants, the work could not have been accomplished.

Further appreciation is expressed to the following agencies for their contributions:

Minnesota Department of Business Development
Minnesota Department of State
Minnesota Department of Employment Security
Minnesota Historical Society
Minnesota Legislative Research Committee
Minnesota Safety Council
U. S. Bureau of Census
University of Minnesota.


A POLICY
on
GEOMETRIC
HIGHWAY DESIGN
Public Control
of HIGHWAY ACCESS and
ROADSIDE DEVELOPMENT
A Policy
on
Grade Separations
for
Intersecting Highways
A POLICY
on
HIGHWAY CLASSIFICATION
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Rating
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on
INTERSECTIONS

# Summary

CONDENSED FACTS AND RECOMMENDATIONS

Meeting Minnesota's highway transportation needs is a big business. Most of Minnesota's 3 million people are daily highway users. They travel on 121,000 miles of roads and streets. In just one day, they burn up 2.5 million gallons of gasoline in traveling 30 million miles.

Most of that travel is for business and other essential purposes. Only a small part is for social and recreational reasons.

The daily transportation needs of the people impose, dollarwise, one of the largest responsibilities faced by the State and local governments.

And the responsibility is growing. Population is increasing, so is the ownership of motor vehicles. Today's roads are inadequate; today's attack on the problem cannot meet the needs of even the near future. Traffic is estimated to increase 50 per cent in the next 20 years.

Recognition of the need for positive action led the legislature to establish the Highway Study Commission to investigate all phases of the highway problem. Hence this engineering study of highway and street needs. Fiscal aspects of the highway problem are covered separately by another agency for the Commission.

Analysis has revealed that no single action can solve the problem; a variety of things must be done. Essential steps are presented in this summary.

## Reorganizing Highway Systems

Most of the laws governing Minnesota's highway systems were adopted many years ago when the highway needs and management problems of the State and local governments were far less complex than they are today. The population and motor vehicle increases, and the sharpened economic needs make it timely to examine existing statutes and constitutional provisions to determine their fitness for modern requirements.

Roads and streets should be developed in keeping with the service each route should provide. By grouping into systems highways which give similar service, it is possible to assign responsibility to the unit of government principally concerned, and to establish a financing plan suited to each system's needs.

### Rural State Trunk System

Back in 1921 most of the State Trunk Highway System, 6,877 miles, was set up by constitutional amendment. Later, actions of the legislature, however, increased the mileage so that now the system consists of 11,850 miles, of which 1,460 are urban extensions.

According to criteria established for the study, discussed in the Classification chapter, there are 38,000 miles of rural roads which are of community interest. Of these, 7,500 miles were found to be of state-wide character, carrying 64 per cent of all rural traffic. These heavier traffic volume roads, only seven per cent of the total rural mileage, form a completely integrated network which gives excellent circulation from rural areas to the industrial, commercial and marketing centers. They connect cities of the first, second and third class population groups and substantially all communities of 1,000 or more. They are recommended as the Proposed Rural State Trunk Highway System, created wholly by constitutional amendment or by legislation depending on where basic fiscal policies are established.

### Primary County Roads

Next in rural importance to highways of state-wide character are other roads of county-wide community interest—those that connect smaller communities and in general serve major farming, mining and lumbering areas. The study determined that there are 30,500 miles of such roads. They are recommended as the Proposed Primary County Road System, replacing the present State-aid and County-aid Systems. Composing 30 per cent of the rural mileage, they carry 28 per cent of all rural travel, averaging 145 vehicles per day. These, together with the Proposed State Trunk System, connect every incorporated place in the State, serve all rural areas, and carry 92 per cent of all rural travel.

Included in the Proposed Primary County Road System are approximately 3,000 miles of present but lesser used rural State Trunk Highways. Were those roads to continue as trunk highways, they would logically receive lowest priority in construction and maintenance. As county roads, they would hold high priority.

## Local Rural Roads

The balance of rural roads, totaling 68,681 miles, are primarily of local interest. Included are about 10,000 miles of trails and infrequently traveled roads. County engineers report some 4,500 miles are not needed to serve farms or other establishments. Also classed as local roads are about 14,000 miles of presently designated State-aid and county-aid roads which have a daily traffic of only about 25 vehicles.

## City Streets

City streets, while relatively low in mileage, carry 44 per cent of all traffic. Because of the concentrated traffic, often resulting in delay and congestion, and because of the high costs of urban construction and right of way, proper grouping of streets is extremely important.

The State has properly assumed principal responsibility for the development of the many streets which are continuations of trunk highways. As shown in the table below, urban extensions of the Proposed Rural State Trunk System total about 1,250 miles. This brings the Proposed State Trunk System to a total of 8,750 miles.

Based on criteria established for the study, city streets including trunk highway extensions, were classified into the groups shown below:

| | Streets in Cities Over 5,000 Population (Miles) | Streets in Cities Under 5,000 Population (Miles) |
|---|---|---|
| Extensions of Proposed State Trunk Highways | 444 | 808 |
| Extensions of Proposed Primary County Roads and other arterial streets | 844 | 1,835 |
| Business access streets | 176 | 269 |
| Residential access streets | 3,697 | 3,692 |
| Total | 5,161 | 6,604 |

# Making Best Use of Facilities

In the determination of highway and street needs, consideration was given to methods and devices which would facilitate traffic movement on both old and new arteries, particularly in cities. Projects were modified or eliminated wherever traffic engineering measures could help or meet the problem.

Measures include parking control, signal timing and coordination, truck routing, one-way street systems, intersection channelization and other proven methods.

# Physical Needs

Deficiencies are scattered over the entire highway and street network. Sections of highways and streets totaling 39,592 miles are below tolerable or acceptable standards and 2,800 bridges are inadequate. Since many facilities are on the verge of needing replacement and since new needs will arise in the future, separate estimates were made of present needs and future needs within 5, 10, 15 and 20 year periods.

The estimated total cost of improvements needed now on all roads and streets is $681 million, two-thirds in rural areas and one-third in cities.

## Trunk System Needs

### Rural Needs

Present needs on the 10,390 miles of rural trunk highways are for 994 miles of high type pavement and 1,752 miles of intermediate and low type pavement. In addition to roadway deficiencies, construction or reconstruction of 309 bridges and separation structures and installation of 54 railroad grade crossing protection devices is needed. Estimated cost, including right of way, grading, structures and engineering is $181,431,000.

**Present Needs, State Rural Trunk Highways**

| | |
|---|---|
| Roadway | $154,478,000 |
| Structures | 26,953,000 |
| Total | $181,431,000 |

Total construction requirements for a 10-year period are estimated to be $339,199,000 for work on 7,428 miles.

### Urban Extension Needs

Of the 1,460 miles of present urban extensions, 24 per cent or 345 miles are in need of immediate improvement. Some of these needs constitute the highest priority of needs of all systems. An additional 40 miles not now existing are required for adequate service. Work required ranges from resurfacing to construction of expressways and construction or reconstruction of bridges and highway separation structures.

**Cost of Urban Extension Needs**

| | |
|---|---|
| New Construction | $ 86,530,000 |
| Reconstruction | 1,215,000 |
| Resurfacing and Other | 22,428,000 |
| New Structures | 23,130,000 |
| Recondition Present Structures | 5,528,000 |
| Railroad Protection and Traffic Control | 556,000 |
| Total | $139,387,000 |

Total construction requirements for a 10-year period are estimated to be $284,810,000 for work on 1,066 miles.

## County and Township Roads

Of the 15,489 miles of State-aid rural roads, about half need improvement now. In addition to roadway deficiencies, construction or reconstruction of 531 bridges and separation structures and installation of protection devices at 16 railroad grade crossings should be done.

Forty-four per cent of the 26,158 miles of county-aid and county roads need improvement now. This includes the construction or reconstruction of 792 bridges and separation structures and installation of 10 protection devices at railroad grade crossings.

There are 14,037 miles of existing township roads deficient now and in need of improvement. In addition to roadway deficiencies, construction or reconstruction of 970 bridges including a few railroad separation structures should be done.

**Cost of Present Needs**

| | State-aid | County-aid and County | Township |
|---|---|---|---|
| Roadway | $82,686,000 | $82,576,000 | $54,091,000 |
| Structures | 15,501,000 | 14,813,000 | 11,484,000 |
| Total | $98,369,000 | $97,389,000 | $65,575,000 |

Grand Total ..... $261,333,000

Total construction requirements for a 10-year period are estimated to be $142,026,000 for State-aid roads, $129,464,000 for county-aid and county roads and $72,402,000 for township roads.

## Other City Streets

Streets outside the Trunk Highway System total 10,305 miles, of which 3,013 miles or 29 per cent are deficient.

Principal deficiencies on streets are surface type and condition. A limited mileage of arterials and business access streets are deficient in capacity and in need of widening. Current needs on many residential access streets are for curb and gutter. Included in municipal deficiencies is the need for construction or reconstruction of 115 bridges and railroad grade separation structures and protection devices.

**Construction Needs, Other Streets**

| | |
|---|---|
| New Construction | $20,936,000 |
| Reconstruction | 4,368,000 |
| Resurfacing and Other | 57,882,000 |
| Structures, Railroad Protection and Traffic Control | 16,045,000 |
| Total | $99,231,000 |

Total construction requirements for a 10-year period are estimated to be $208,702,000 for work on 6,338 miles.

# Alternative Plans

The capital investment needed to bring all roads and streets up to standards adequate for today's traffic is $681 million. To carry out this program with present revenues would require many years. Even if funds could be made available, it would be physically impossible to do this work within a few years.

In planning any long-range program, other needs beside present deficiencies must be considered. Many roads and streets that are adequate today will become deficient as time passes. In addition to normal wear, traffic increases will make many facilities obsolete.

Allowance must also be made for maintenance costs. Expenditures for upkeep of trunk high-

*Among the many highway jobs is that of removing snow—which on the average costs about a third of all money spent for maintenance on the State Trunk System.*

ways amount to almost $12 million a year, for State-aid and county-aid roads $17 million, for township roads $6 million and for city streets $14 million. Total maintenance expenditure is almost $50 million a year, or about 35 per cent of the total annual expenditure.

Alternate program periods of 5, 10, 15 and 20 years are presented in the full report. The estimated amounts include costs of construction needed now, future needs and replacements, maintenance and operations. The higher annual costs make the feasibility of a five-year program questionable. On the other hand, needed improvements cannot wait 20 years. The choice lies somewhere between the two extremes and depends largely on the ability and willingness of the people to pay the costs.

As an example, for the existing Trunk Highway System the cost for a 10-year program covering present and future needs, maintenance and operation, would entail an expenditure of $80,036,000 annually.

On the same basis, the annual cost for the present State-aid System would be $22,368,000 for a 10-year program. For the County-aid System, the annual cost would be $22,562,000 for a 10-year program. For present township roads, the cost would be $13,734,000 on a 10-year basis.

Adoption of the recommended reclassification of roads and streets would cut the Proposed Trunk Highway System cost to $70,297,000 for a 10-year program. For the Proposed County Primary System, the added cost due to transfer of trunk highway mileage would about offset the reduction due to transfer of State-aid and county-aid mileage to the local system. Annual costs based on a 10-year program period for the proposed local rural roads would be about $8 million more than the estimates for the present township system.

For municipal streets other than trunk extensions, total annual costs are estimated at $37,161,000 for a 10-year program. These costs are divided approximately 35 per cent for arterials, five per cent for business access streets and 60 per cent for residential access streets.

Except for the State Trunk System, actual programs will, of course, vary widely from county to county, from city to city, and from township to township, depending upon the ability and desire of local people to finance needed work.

## Management

Effectiveness of the attack on the highway problem rests in the hands of management. But management must follow basic policies established by law making bodies, and in the case of Minnesota, also by constitutional provisions. Laws, however, do not and should not cover details of operation. Legally established policies must be broad so that administrative decisions may be made to meet the prerequisites of growth and changing conditions.

In Minnesota legal directives and policies, both constitutionally and legislatively, should be modified to enable the State, counties and cities to better meet and adjust to present and future demands of highway transportation.

A basic recommendation of the engineering study is that the proposed reclassification of highways and streets be adopted as a means of getting more for the highway dollar through better management and orderly highway development. At present, the major part of the Trunk Highway System is established by constitutional amendment, the balance by legislation. Also, fiscal policies are written into the Constitution which prevent legislative and administrative adjustment to current needs. From the standpoint of good management, it would be preferable to establish the revised systems and their jurisdictions by legislative action.

As an essential step in the engineering study, laws were reviewed sufficiently to determine that it would be desirable to examine all State law pertaining to highways as to their adequacy. Action should then be taken to assure a better division of responsibility between legislative and administrative bodies.

## Department of Highways

Directing a state highway department is a huge responsibility. Unless working under sound and sufficiently broad legislative provisions, the job is

*Good maintenance is essential in the battle against the ravages of weather and the wear and tear of traffic.*

even more difficult than managing a large corporation. In Minnesota, about 3,500 year 'round employees are necessary to carry on the far-flung operations which include not only a variety of complex engineering functions, but all of the accounting, purchasing and other routine work encountered in private business.

### Personnel

The Minnesota Department of Highways has the acute problem of insufficient trained personnel. Other types of engineering and private business are competitors. Young engineers are sorely needed. Out of 238 engineers of Civil Engineer Grade II or higher only 13 are under 40 years old. The average age of the 238 is about 53 years.

To correct this alarming situation, it is recommended that incentives be improved by increasing the number of responsible jobs, that Civil Service regulations be changed to permit personnel advances in a manner better serving department needs, and that work with educational institutions include a continuing program of rerearch to stimulate student interest.

### Advance Planning

While steps have been taken in Minnesota to initiate advance planning, this most important operation should be promptly placed in effect. Adoption of major elements of the study recommendations would provide a solid base for advance program planning for five-year periods. Doing that has decided advantages—full coordination of such functions as location, right of way, procurement and design; the saving of time and money; and elimination of confusion.

### Right of Way Acquisition

Minnesota acquires needed right of way, to a limited extent, by advance purchase. Because this method can save large sums of money, it is recommended that a special revolving fund be established for the purpose. That fund, reimbursed at the time of construction, could be used when the department can develop detailed plans well in advance of construction.

The department should also be given authority to acquire property for exchange purposes. This would be helpful in urban areas where new projects may require removal of buildings to other locations.

Although the department is able to acquire control of access under certain conditions through court decisions, the law should be broadened to permit more extensive use of the authority on new or existing major highways; provide authority to apply control, protection and regulation of facilities beyond that obtained by mere acquisition of property; and give authority to close existing facilities when necessary. Similar access control authority should be extended local governments.

## Intergovernmental Cooperation

The Department of Highways has expedited planning and construction of projects of mutual concern through its County Division. The basic controls now required on the State-aid System should be extended to all county roads receiving State financial assistance. A division of similar scope should be established to work cooperatively with cities in the development of arterial projects fitting into the master plans of cities.

Since county road management in Minnesota is of high quality, and because of possible substantial savings, it is urged that townships take utmost advantage of county management facilities. Townships can extend the present practice of cooperative agreements with counties to provide maintenance operations, and they can expand the cooperative work to include construction.

Because by and large, streets are the points of worst congestion and delay, cities are urged to step up development of comprehensive plans and street department organization. Smaller cities should be encouraged to obtain the services of county engineers on a reimbursable basis.

Because of the several municipalities and counties involved, as well as the State, it is recommended that a metropolitan expressway authority be established for the Minneapolis-St. Paul area. Investments by the State and local governments could be best used, and quicker results obtained, through such a cooperative agency.

## Highways Up To Now

Minnesota has long been a "good roads" State. Since 1905 through 1952, identifiable revenues collected for highway and street purposes totaled approximately $2 billion.

Of that amount, $916 million was spent on the trunk highways and was obtained from motor vehicle and fuel taxes, Federal aid and bonds.

Of the $587 million funds available for county roads, $401 million was obtained from property taxes. The greater portion of $245 million for township roads was obtained from property tax.

Municipalities received $179 million from property taxes. The remaining $93 million came from bonds and other miscellaneous sources, with some Federal aid.

Highway expenditures in 1952 for all purposes, including maintenance, right of way, bond payments, etc., were as follows:

| | |
|---|---|
| Department of Highways | $ 68,684,000 |
| Counties | 35,741,000 |
| Cities | 26,151,000 |
| Townships | 11,789,000 |
| Total | $142,365,000 |

Over the years, despite many replacements of worn out or obsolete roads and streets, the State and local governments have accumulated a total of 20,000 miles of hard surfaced pavement and 8,750 bridges of all sizes.

The status of the rural roads and city streets is shown in the following tables:

**Present Status of Rural Road Improvement (In Miles)**

| | State Trunk Highways | State-aid Roads | County-aid and County Roads | Township Roads | Total |
|---|---|---|---|---|---|
| Hard Surfaced | 8,801 | 2,663 | 891 | 279 | 12,634 |
| Gravel | 1,588 | 12,530 | 23,608 | 35,026 | 72,752 |
| Graded–Not Surfaced | 1 | 257 | 1,359 | 11,882 | 13,499 |
| Unimproved | – | 39 | 300 | 7,349 | 7,688 |
| Total | 10,390 | 15,489 | 26,158 | 54,536 | 106,573 |

**Present Status of City Street Development (In Miles)**

| | State Trunk Highways | State-aid and County-aid roads | Other City Streets | Total |
|---|---|---|---|---|
| Hard Surfaced | 1,409 | 811 | 5,205 | 7,425 |
| Gravel | 51 | 656 | 2,699 | 3,406 |
| Graded–Not Surfaced | – | 22 | 912 | 934 |
| Total | 1,460 | 1,489 | 8,816 | 11,765 |

## Safer Highway Travel

Annually Minnesota suffers huge economic losses from traffic accidents. The 1953 total bill was $70 million, an amount about equal to that spent for all highway construction in the same year.

To reduce this needless waste, it is urged that the State and local governments step up all activities recommended in the Action Program of the President's Highway Safety Conference, and that private citizens cooperate through both safety groups and civic organizations. A major need is for increased activity by State agencies in giving technical assistance to communities and in working closely with the Minnesota Safety Council.

## State Economy and Highways

The economy and security of the nation and of all states and communities rests on highway transportation–which serves all people and all activities. The well-being of every individual is affected by the adequacy of highways and streets.

• • •

One of every seven people employed in Minnesota has a highway transportation job.

• • •

Practically everything produced or consumed in the State travels all or part of the way over the highways.

• • •

Four-fifths of the livestock moves from farms to primary markets by truck.

• • •

Almost all timber for paper mills is moved by truck.

Dispersal of light industry plants is increasing. Highways play an important role in employee transportation and in integrating operations of dispersed plants

• • •

Minnesota has more than a dozen regional wholesale centers–most of the distribution is over the highways.

• • •

Growth is expected in the highway-borne tourist business which produces in excess of $150 million each summer.

• • •

Minnesota highways link together:
3 million people
175,000 farms
About 1,000 hamlets and villages
200 county trade centers
64 large trade centers
Several hundred lumber camps
Hundreds of mining operations.

# PART I

# THE ENGINEERING STUDY

Chapter 1

# Highway Travel

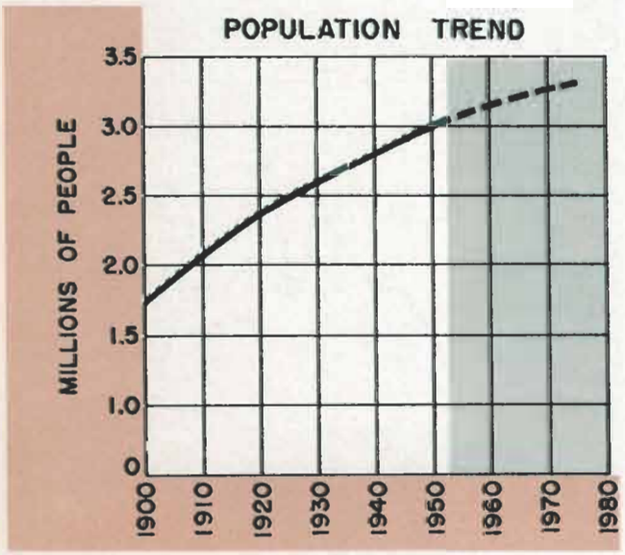
TODAY AND TOMORROW

A vital step in determining highway needs and developing practical long-range programs is the study of travel trends. Since funds for highway improvement are a capital investment for many years of service, the needs of the present must be related to future demands. Facilities designed for just today would be obsolete all too soon, as experience over the years has demonstrated.

This chapter looks to the future by projection of trends in population growth, motor vehicle registration, the ratio of vehicles to population, and gasoline use. By studying those variables it is possible to make a reasonably accurate projection of future travel. Much of the background material for this chapter is contained in Chapters 10 and 11.

## Population

Records of the U. S. Bureau of Census show a continual growth of population in Minnesota. From 172,023 in 1860 the population approximately doubled each succeeding 10-year period to reach 1,310,283 by 1890. The increase in population during the 20th century has been at a slower rate. From 1,751,394 in 1900, the population increased to 2,892,483 by 1950, or approximately 60 per cent. The rate of growth during the 1930's and 1940's was the lowest for any 20-year period in the State's history.

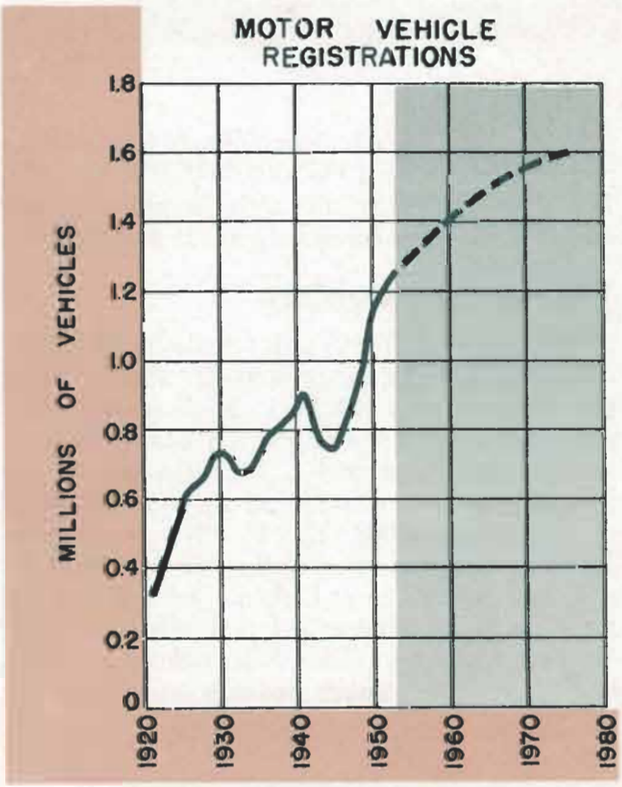



Minnesota's rural population has remained practically constant since 1920. The gradual growth in total population during the last 20 years occurred in urban areas. For the first time, the 1950 census showed a larger urban population than rural.

On the basis of national population studies by the Bureau of the Census and on the assumption that the recent trends in birth rate and migration will continue substantially unchanged, the State population is expected to increase about 10 per cent by 1975. From the 1953 midyear total of 3,052,000, the population should reach 3,220,000 by 1965 and 3,310,000 by 1975.

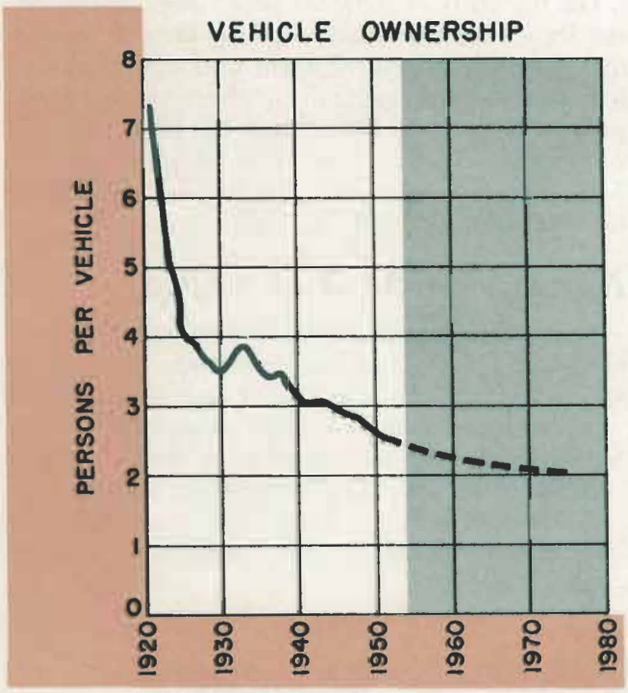
## Motor Vehicle Ownership

Since 1909 registration has been required for all motor vehicles. At that time there were 7,065 vehicles registered. The rate of increase was slow until 1921 when motor vehicle ownership in Minnesota began to grow rapidly as shown on the accompanying chart. The temporary setback during World War II has been more than overcome by the tremendous growth during the post-war years.



In 1921 there were 7.34 persons in the State for each motor vehicle registered. By 1930 this ratio had dropped to 3.51 and in 1940 reached 3.20. The rapid growth in registrations during the late 40's brought the ratio of persons per vehicle down to 2.48 in 1953, substantially below the United States average of 2.86.

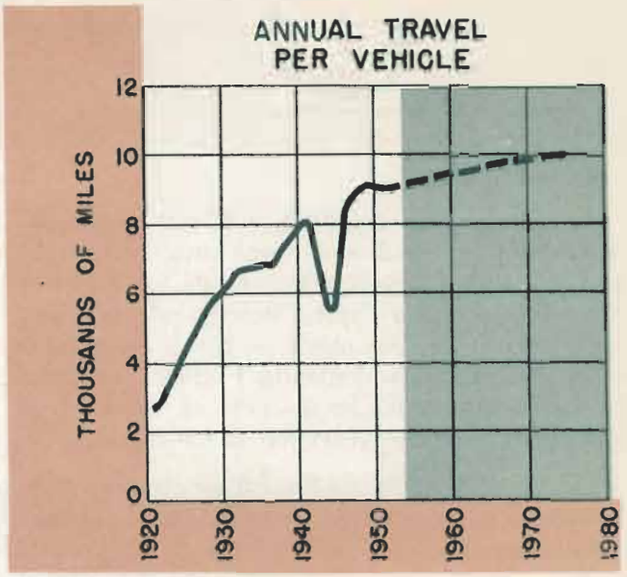
On the basis of continuing economic growth, the trend in registrations is expected to continue upward in the future but at a slower rate than prevailed in the immediate post-war period.




The number of motor vehicles is estimated to reach 1,500,000 by 1965 and 1,600,000 by 1975. The ratio of persons per vehicle probably will continue downward, reaching about 2.05 by 1975.

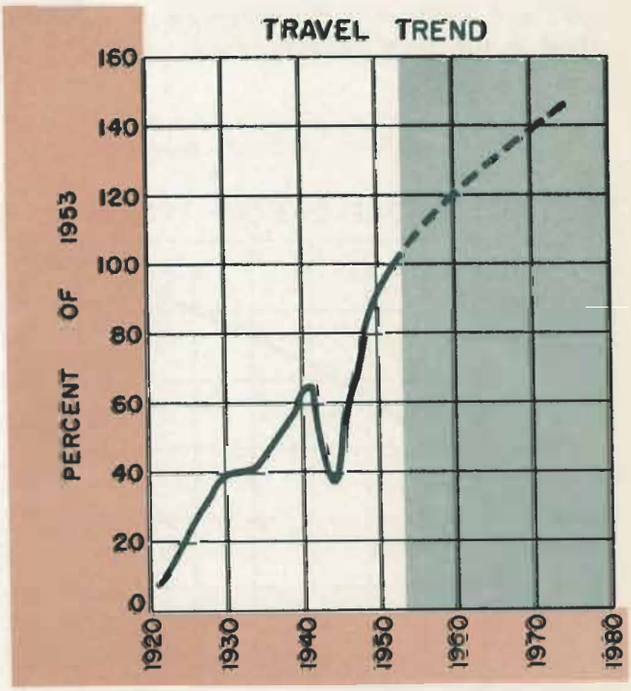
## Travel Per Vehicle

Data obtained from studies made by the Highway Planning Survey of average annual travel per vehicle from 1921 to 1953 is portrayed graphically in the accompanying chart. From an average of approximately 2,700 miles per vehicle in 1921, the amount of travel per year increased to slightly over 8,000 miles by 1941. It is noticeable that the depression of the 30's had no major influence on the upward trend. The war time restrictions on gasoline and tires resulted in a drop in average travel to about 5,500 miles per vehicle in 1945, but the setback was only temporary.




By 1953 average travel per vehicle had increased to slightly over 9,100 miles per year. Contributing factors in the leveling off in the period from 1948 through 1953 are the increase in number of two-car families and the increase in farm trucks, congestion and highway conditions.

It is to be expected, therefore, that travel per vehicle will increase at a more moderate rate in the future. Assuming a continuance of present economic levels, and improved highways, annual travel per vehicle in Minnesota should reach about 9,700 miles in 1965 and 10,000 miles in 1975.



## Total Travel

The historical trends in population, motor vehicle ownership and travel per vehicle and the expected continuance of the trends, forecast a sizeable increase in total travel during the foreseeable future. Total travel in 1953 in Minnesota was approximately 10.9 billion miles. It is expected that total travel will reach 14.2 billion miles by 1965 and 16.0 billion miles by 1975. These are increases of 30 and 47 per cent respectively, over the 1953 State travel.

*New facilities must be designed to accommodate the traffic of the future as well as the present. Otherwise, traffic increases will render them obsolete all too soon, as experience over the years has demonstrated.*

Chapter 2

# Classification

ASSIGNING HIGHWAY AND STREET RESPONSIBILITIES

The aim of long range highway plans is to develop roads and streets in keeping with the amount of service demanded of each route.

To do that it is necessary to group into systems highways performing similar service, to assign responsibility for their improvement to the unit of government most concerned, and to arrange an over-all financing plan fitted to the needs of each system.

When state, county and city highway administrators are responsible for construction and maintenance of excessive mileages or highways illogically assigned them, utmost efficiency in management and in expending funds becomes difficult. Desired results may be impossible to attain. Therefore, in developing a long range plan for Minnesota it was necessary, in addition to determining the physical needs of the various systems, to find out whether responsibilities should be reassigned to enable the State to determine a fair and stable fiscal plan.

Examination of all the elements affecting a long range plan for Minnesota brought forth fundamental questions such as:

*Should part of the trunk highway system be fixed in the Constitution with the remainder subject to legislative action?*

*Should revenues be distributed by constitutional act with limited opportunity to adjust allocations according to changing conditions?*

*Is it practical to transfer mileages from one system to another in attempts to relieve or adjust financial responsibilities?*

*Is it necessary and advisable to have two systems of county roads with different controls for each?*

*Is the State's interest in arterial city streets comparable to that in rural roads?*

Decisions reached with respect to such questions must be firmly related to a finance plan which will permit administrative bodies to develop the several systems in a progressive and orderly manner over a period of years. This chapter develops facts which lead to a recommended revised long range plan.

## Present Classification

Minnesota's roads and streets are classified as State trunk highways, both rural and urban, State-aid roads, county-aid roads, township roads and city streets. There are some minor variations in these basic systems. A few county roads are not eligible for county aid; some city streets have been recognized as extensions of county roads; some urban trunk highways are only temporarily designated; and a limited mileage are special interest roads, such as forest roads, institutional roads and Indian service roads.

### State Trunk Highway System

The initial Trunk Highway System designated by constitutional amendment in 1921 consisted of 6,877 miles. Minnesota is the only state to designate trunk highways in the Constitution. It was the intention at that time to limit the system to routes of state-wide importance to assure its early improvement. In 1933 the Legislature added 4,574 miles to the system on the premise that the constitutional roads were substantially improved. Further minor additions have been made resulting in the present system of 11,850 miles, of which 1,460 are urban extensions.

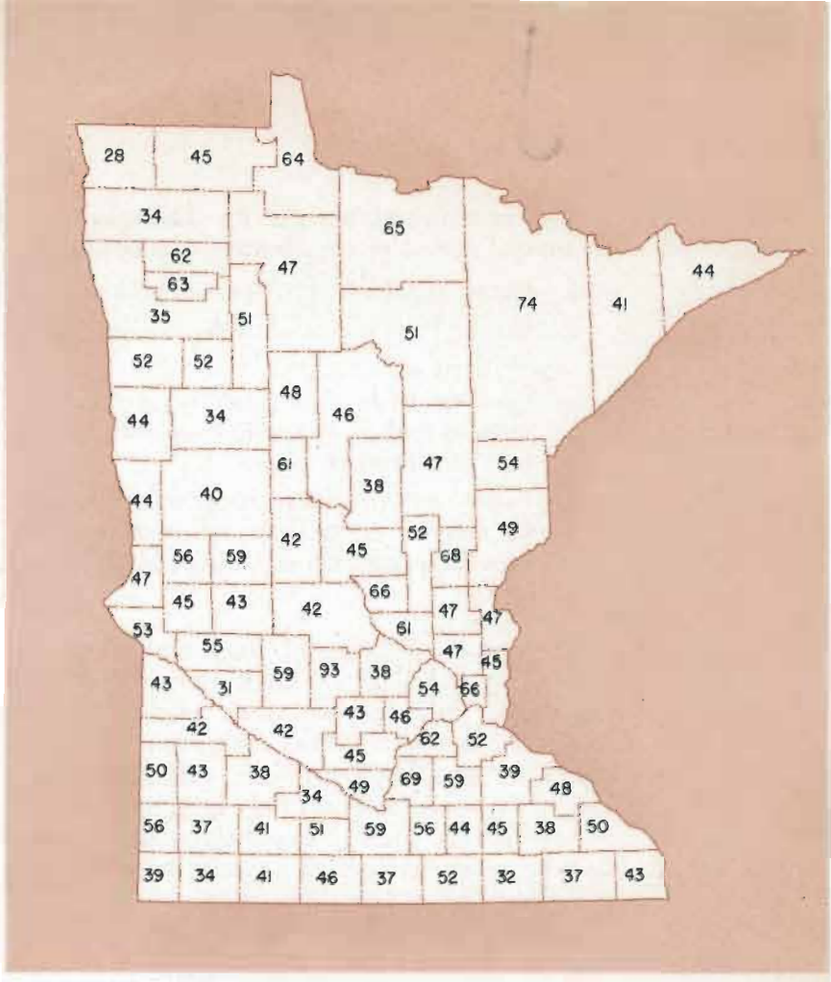
### Present County Systems

There are 15,489 miles of State-aid roads and 26,158 miles of county-aid and county roads under the jurisdiction of the Boards of County Commissioners. Designation of State-aid roads is subject to the approval of the Commissioner of Highways. The law which authorizes the county-aid system sets forth no criteria or limitations which control the selection of routes by the Boards of County Commissioners. That routes included in the county systems are not well or uniformly selected is borne out by the accompanying map.

While some variance throughout the State is to be expected because of topographical, geographical, and population density differences, these factors alone are not responsible for the great variations shown. Proof of this is evident from examination of the areas having common characteristics.

Some differences can be explained by permissive legislation which allows counties to share

*The numbers show the percentage of all rural roads in each county which are State trunk highways, State-aid roads or county-aid and county roads. There are 17 counties with less than 40 per cent, 36 counties with 40 to 49 per cent, 21 counties with 50 to 59 per cent, 11 counties with 60 to 69 per cent, and two counties with 70 per cent or more. The average for the State as a whole is 48 per cent.*




gasoline tax revenues with townships. There is a tendency in those counties which share with the townships to have relatively small county road systems. Conversely, there is a tendency in those counties which do not share with the townships to accept larger mileages on the county systems.

## Present Township Roads

There are 54,536 miles of rural roads under the jurisdiction of 1,836 townships.

## Present Urban Systems

At present there is no legal uniform classification of the 11,765 miles of streets in Minnesota municipalities. Some trunk highway extensions were permanently designated at the time they were improved. About half of the signed routes of State extensions, still short of their final development, are designated only as temporary routes.

Recent legislation authorized the designation of State-aid and county-aid streets in municipalities. However, no criteria were given for the selection of these streets and progress in their designation is far from complete.

In the larger municipalities the volume of traffic on certain streets has resulted in their designation as "through" streets. This is a form of classification based on usage, but principally for traffic control purposes.

## Net Effect of Past Development

In other portions of this report the historical development and financing of the systems are described in detail. The effect of these revenue adjustments together with the changes in system mileages has been:

To unbalance the development of the systems in relation to traffic needs.

To shift responsibility for road improvement and maintenance while holding to a fixed policy for the distribution of revenues.

To broaden the State's interest in local rural road support without a comparable consideration of urban problems.

# Study Classification Plan

That present legal systems of roads and streets fail to meet the principles of a proper highway classification plan is shown by a thorough analysis developed as a part of this engineering study.

The first step in the development of the study was to select roads and streets of community interest as distinguished from those whose principal purpose is to provide access to farms, residences or establishments alongside them. This was accomplished by determining the criteria for community interest roads and streets and comparing each existing road or street against these criteria.

## Criteria Used to Describe Community Interest

Criteria established for identification of rural roads of community interest are:

1. Carry relatively heavier traffic volumes
2. Connect towns, communities, shipping points and markets within a county or in adjacent counties
3. Provide access to rural churches, schools and community meeting halls
4. Serve as principal arteries of rural mail routes and school bus routes
5. Act as collectors of traffic from several roads of individual interest
6. Occur at reasonable intervals consistent with the density of populations.

The criteria established for identification of municipal streets of community interest are:

1. Carry relatively heavier traffic volumes
2. Connect the points of traffic interest within a city
3. Connect with rural roads of community interest and carry traffic from rural areas into and through cities
4. Form a system of streets upon which traffic can be controlled and protected to provide maximum movement within the city.

The initial selection of these routes was reviewed in the field by State, county and city engineers. Adjustments were made wherever necessary so that the final designations follow as closely as possible the criteria and principles of the study, insuring completely integrated systems of community interest roads and streets within and between the various political subdivisions.

## Rural Classification Plan

Rural routes of community interest included in the study classification plan total 38,000 miles. The location of these roads is shown by the map on page 25 superimposed on a population map of the State. The system connects every incorporated place in the State and serves all of the rural areas. The community interest roads are closely spaced in the southern part where the rural population density is highest. The roads are farther apart in the sparsely populated northern and northeastern portions. This network, while comprising only 35 per cent of the total rural roads of the State, carries 92 per cent of all rural travel. The remaining 68,681 miles of existing rural roads carry only eight per cent of the total rural travel.

The map on page 26 shows the per cent of the rural road mileage in each county which is classified as of community interest. The consistency in size of the network between counties with similar geographic and economic conditions is readily apparent.

The selected routes of community interest provide a high degree of service to rural areas. Detailed examination of a group of counties representative of the State's major economic and geographic areas indicates that approximately a third of all rural dwellings and farms are located on and served directly by the study network. Approximately 80 per cent of all farms and dwellings are within one mile and 97 per cent within two miles. Less than one per cent are located more than three miles from a route of community interest. The average distance for all rural farms and dwellings is approximately a half mile.

### Proposed State Trunk Highway System

Not all of the routes in the 38,000-mile network described above provide the same degree of community service. Travel over some is confined solely within one county or at the most between adjacent counties. Others carry travel which is statewide in character. As a part of the rural classification plan, a primary system containing roads of state-wide significance has been selected from the 38,000-mile network. This system, shown on the map on page 27 is approximately 7,500 miles in length and carries 64 per cent of all rural travel. The urban extensions of this system total about an additional 1,250 miles as described in the later section, "Street Classification Plan."

Average traffic volume on rural sections of these routes is about 1,500 vehicles per day. They connect all principal trade centers and county seats.

The Proposed Trunk System serves directly over 95 per cent of the communities with a population of 1,000 or more, including all cities in the first, second and third class population groups. It reaches all rural areas at reasonable intervals. The routes form a completely integrated network that gives the major traffic movements adequate circulation from rural areas and communities to the industrial, commercial and marketing centers within and outside the State.

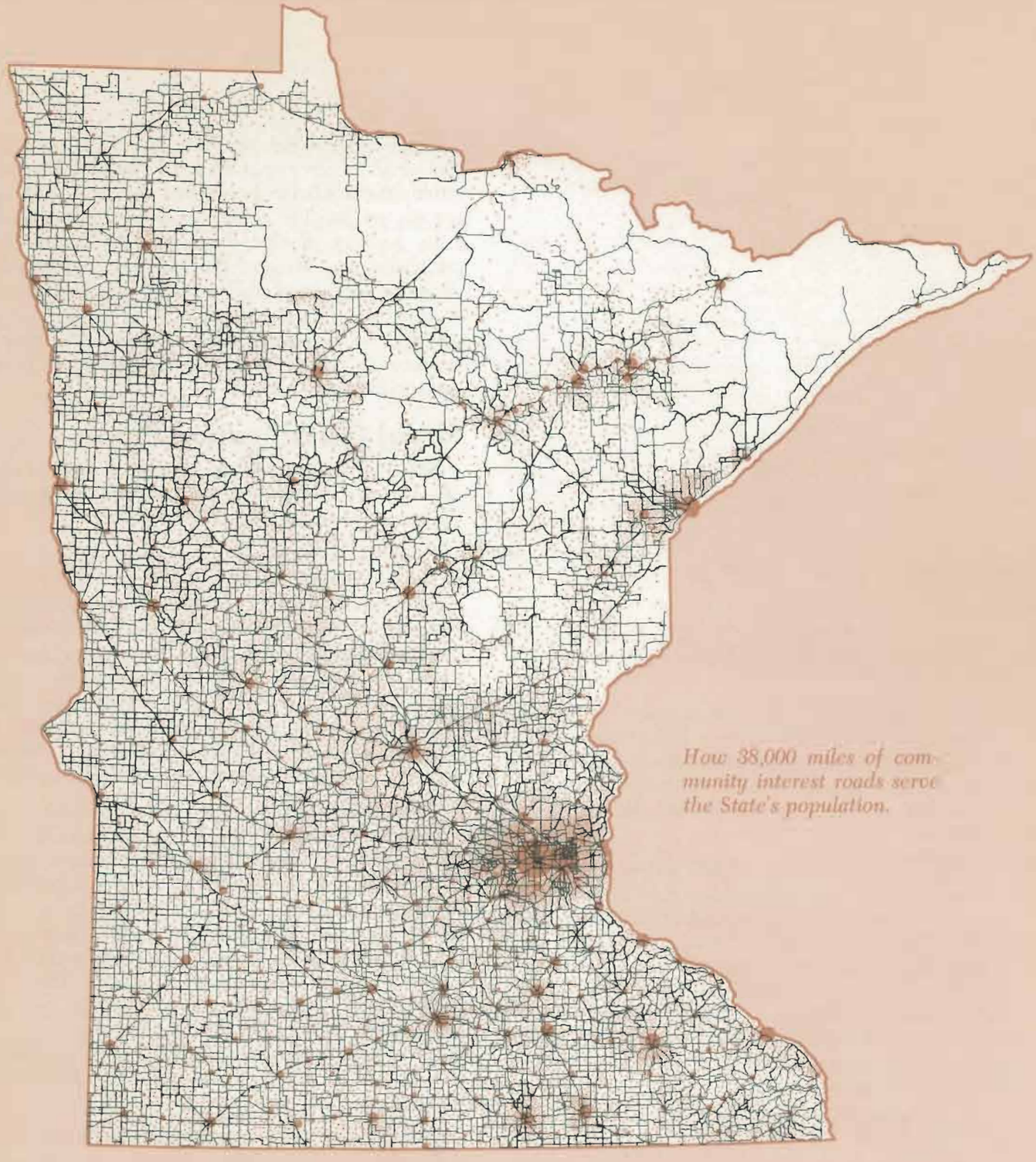
These are the roads which logically should be the Rural State Trunk Highway System.

### Proposed Primary County Roads

The remainder of the 38,000-mile network (approximately 30,500 miles) are roads of county-wide interest and include 3,000 miles of existing lesser-used rural State Trunk Highways. The average daily traffic on this system is 145 vehicles per day. It includes 30 percent of the rural mileage and serves 28 per cent of all rural traffic. It is recommended that these roads comprise a Primary County Road System.

The remaining local roads, while large in mileage and important to the economy of the State, serve only eight per cent of all rural traffic.

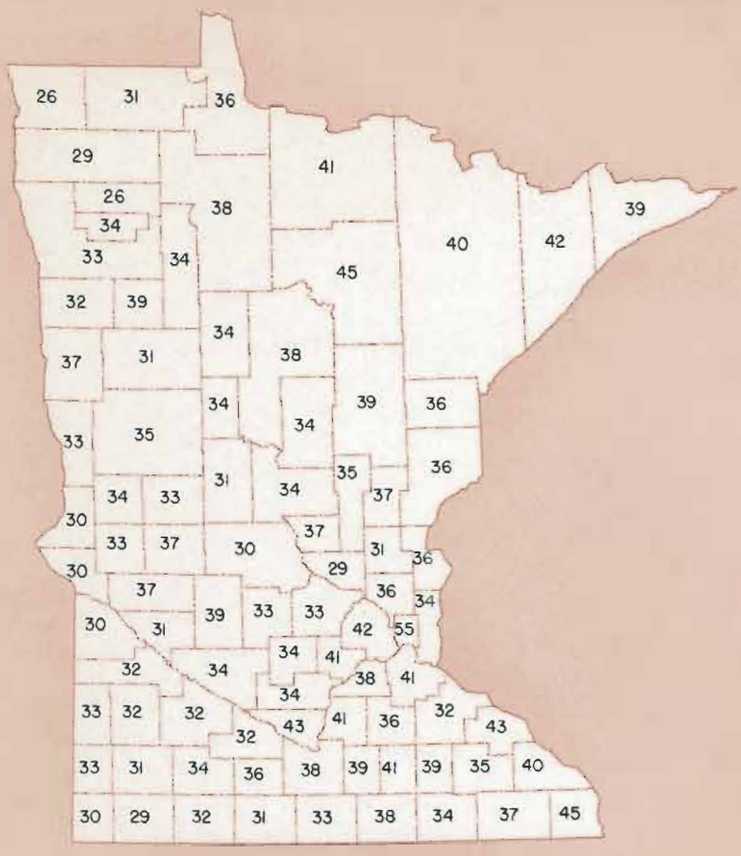
Of the 3,000 miles of present rural trunk highways recommended for transfer to the Primary County Road System, 250 are now designated as trunk highways in the Constitution and 2,750 in subsequent legislative acts. The average traffic on this transferred mileage is 300 vehicles per day.



*How 38,000 miles of community interest roads serve the State's population.*

Some of the excess mileage on the existing Trunk Highway System undoubtedly resulted from a lack of precise knowledge of travel at the time the Constitution was amended. Some have resulted from changes in land use and developments through the years. However, the major portion of this excess mileage came about through desire to relieve the counties of part of their highway burden during the depression years.

The suggestion that those roads be transferred from the present Trunk Highway System to the Primary County Road System is made with full recognition of their importance as main arteries of travel, but they are of primary local interest rather than that of the State. Should they remain on the Trunk Highway System, they should logically receive lowest priority in both construction and maintenance. But under local jurisdic-




*The numbers show the percentage of roads of community interest to the total rural roads in each county. Five counties show less than 30 per cent, 68 counties 30 to 39 per cent, and 14 counties over 40 per cent. The average for the State as a whole is 35 per cent.*

tion, they would hold high priority among the roads of county-wide interest. For example, they would be the last roads cleared of snow as part of the Trunk Highway System, but would be among the first of the Primary County Roads to be plowed.

Not included in the 30,500 miles of Primary County Roads are 14,000 miles of presently designated State-aid and county-aid roads which have an average daily traffic of about 25 vehicles per day. These roads serve primarily to give access to farms and establishments adjacent to them as distinguished from roads of general traffic use. These roads provide service similar to existing township roads and were for the most part at one time classed as township roads.

### Local Rural Roads

Exclusive of the Proposed Trunk Highway System and Primary County Roads, there are 68,681 miles of roads which are of purely local interest. Among them are about 10,000 miles of trails and other little used roads which carry five vehicles per day or less. The county engineers report 4,500 miles are not needed to serve rural farms and establishments. Most of the remainder serve only to give duplicate access to farms. In the interest of economy, this unneeded mileage could be ignored as far as improvement and continued maintenance is concerned without penalizing farm transportation or access.

## Street Classification Plan

Based upon the criteria defined earlier in the chapter, city streets were classified into the groups shown in the table below.

City streets in Minnesota generate 44 per cent of the total travel on all highway facilities. Within the cities are found the greatest bottlenecks and inefficiencies in movement. Likewise, the measurement of highway needs shows large capital investments are required if the deficiencies are to be overcome. It is extremely important, therefore, that serious consideration be given to adoption of classification and fiscal plans which will permit the greatest possible development of urban facilities.

State-wide traffic service cannot be limited to the rural portions of the Proposed State Trunk System. The service given by that system must extend into and through the larger municipalities. Even though such city routes may carry a considerable portion of purely local traffic, the State's interest in through traffic is predominant. To achieve needed coordination of efforts, the Department of Highways is and should remain principally responsible for the development of these routes. Such responsibility should be keyed to a firm financial policy established by the legislature.

Systems of arterial streets should be integrated with urban extensions of the State trunks. Because such supplementary facilities are primarily of local

| | Streets in Cities Over 5,000 population Miles | Streets in Cities Under 5,000 population Miles |
|---|---|---|
| Extensions of Proposed State Trunk Highways | 444 | 808 |
| Extensions of Proposed Primary County Roads and other arterial streets | 844 | 1,835 |
| Business access streets | 176 | 269 |
| Residential access streets | 3,697 | 3,692 |
| Total | 5,161 | 6,604 |

*This trail is used only in farming operations and is not of interest to the general public; yet it is now a part of the county-aid system.*

interest, they should be a local responsibility. Whether or not the State determines to give financial aid in developing urban arterials, it still is important that each municipality develop a comprehensive master street plan.

How the urban classification principles apply is illustrated by the accompanying map of Rochester on page 29.

## Placing the Plan in Effect

Since today part of the present Trunk Highway System is established in the Constitution, any changes in classification would require constitutional amendment or repeal.

There are two ways of establishing the Proposed State Trunk System. One way is to repeal present provisions of the Constitution, which set up part of the present system, replacing those with provisions establishing the proposed system. The second and preferable way is to repeal the present system provisions of the Constitution and establish the revised systems and their jurisdictions by action of the Legislature.

If the systems are to be established by constitutional provisions, then a suitable financial policy and allocations should also be written into the Constitution. If the legislative enactment is preferred, financial allocations likewise should be made by the Legislature.

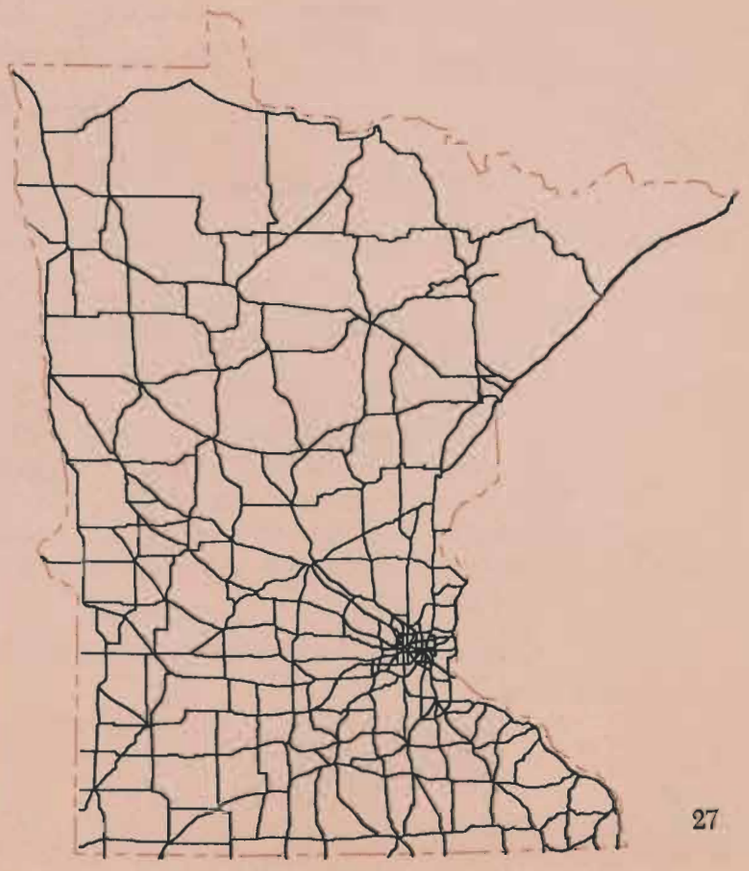
Freezing highway systems in the Constitution is inconsistent with the flexible nature of highway transportation. Population of communities changes, as do the number of vehicles, demands for highway service, and available highway funds. All other states establish highway systems and financing by legislative enactment.

To carry out a long range plan with consistency, system jurisdiction must be firmly coupled with a suitable financial policy. There is no assurance of consistency when one or more elements of the total plan are fixed in the Constitution and other elements, such as management responsibility or finance, are subject to legislative enactment and change. This is evidenced by the current unbalanced development as between rural and urban segments of the total road and street network.

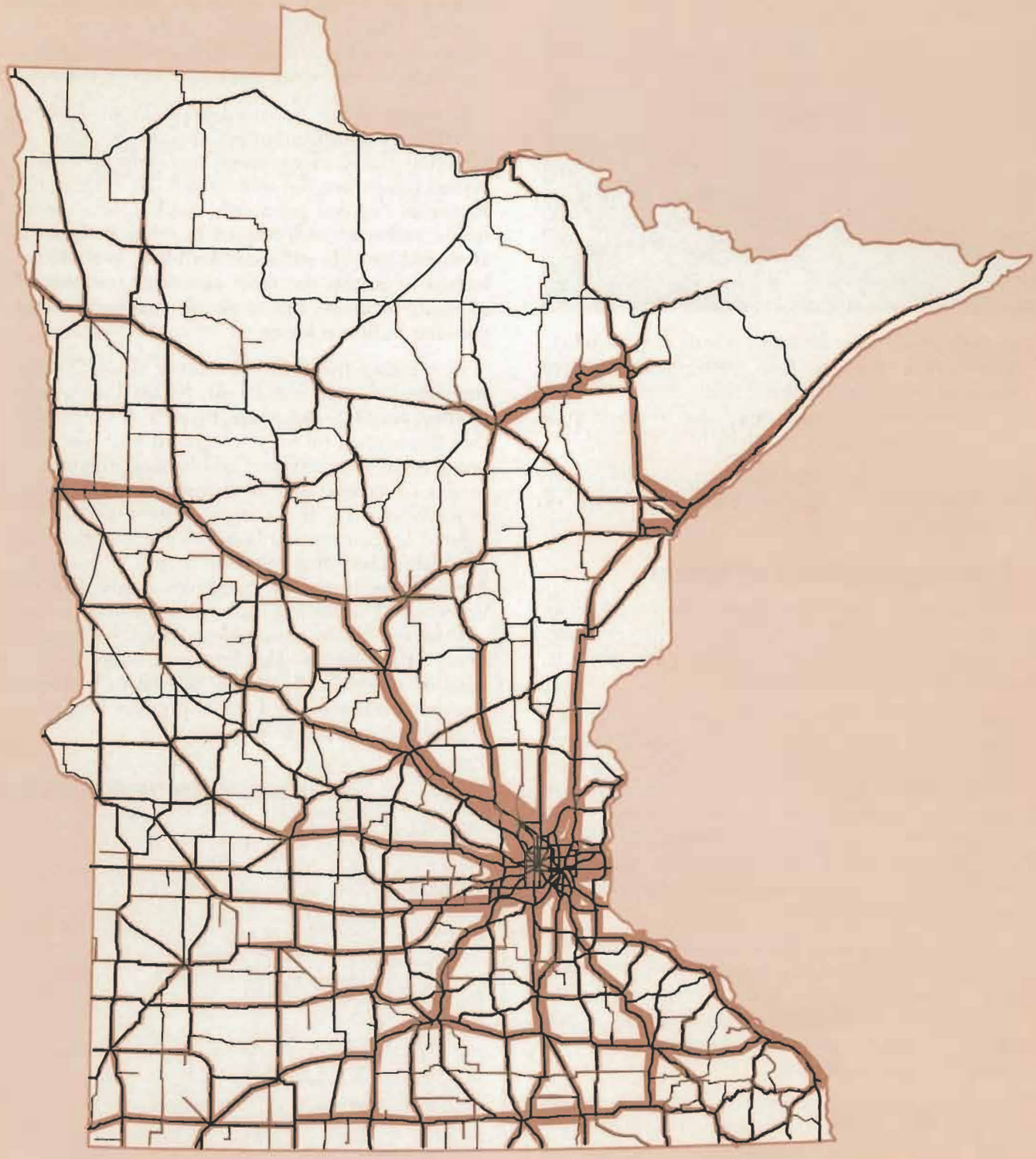
Creation of the Proposed State Trunk System, whether by Constitution or law, can be done by directing the Commissioner to establish such a system comprising not to exceed 8,750 miles of the routes, as detailed previously. Such action should define authority with respect to urban extensions. It should provide sufficient flexibility in route selection to permit the most economic selection of alternate locations and to permit changes to meet growing traffic problems.

In creating the Primary County Road System, the same basic procedure can be used as is now in effect for State-aid roads. Because it is essential that this system be fully integrated with the Proposed State Trunk System and because there must exist a reasonable degree of uniformity of service in each county, the county system should be created by cooperation between the counties and the State. The initial selection should be made by the counties using the principles established by this study. The county systems then should be reviewed and accepted or revised by the Commissioner of Highways. The Primary County System creation must also be clearly related to whatever finance plan is evolved if it is to produce maximum results and orderly development.

**PROPOSED STATE TRUNK SYSTEM**



*This map shows the present Trunk Highway System superimposed on a traffic flow map. The heavy green lines are the routes selected by the engineering staff as the Proposed Trunk Highway System. The light green lines show routes which should be included in the Proposed Primary County Road System.*



Township roads and local county roads do not need specific definition as a system. The problem of their development and maintenance, other than finance, becomes one of management. Management as related to these classes of roads is discussed in Chapter 6.

Each municipality of 5,000 or more population should be required to develop in cooperation with the Commissioner of Highways a master plan using the principles evolved for this study. It is urgent that plans of the State and the cities coincide with respect to major arterial development. To insure that such plans are carried forward, are uniform in serving traffic needs, and properly integrate the urban extension of the Proposed State

Trunk System, they should be subject to final approval of the Commissioner.

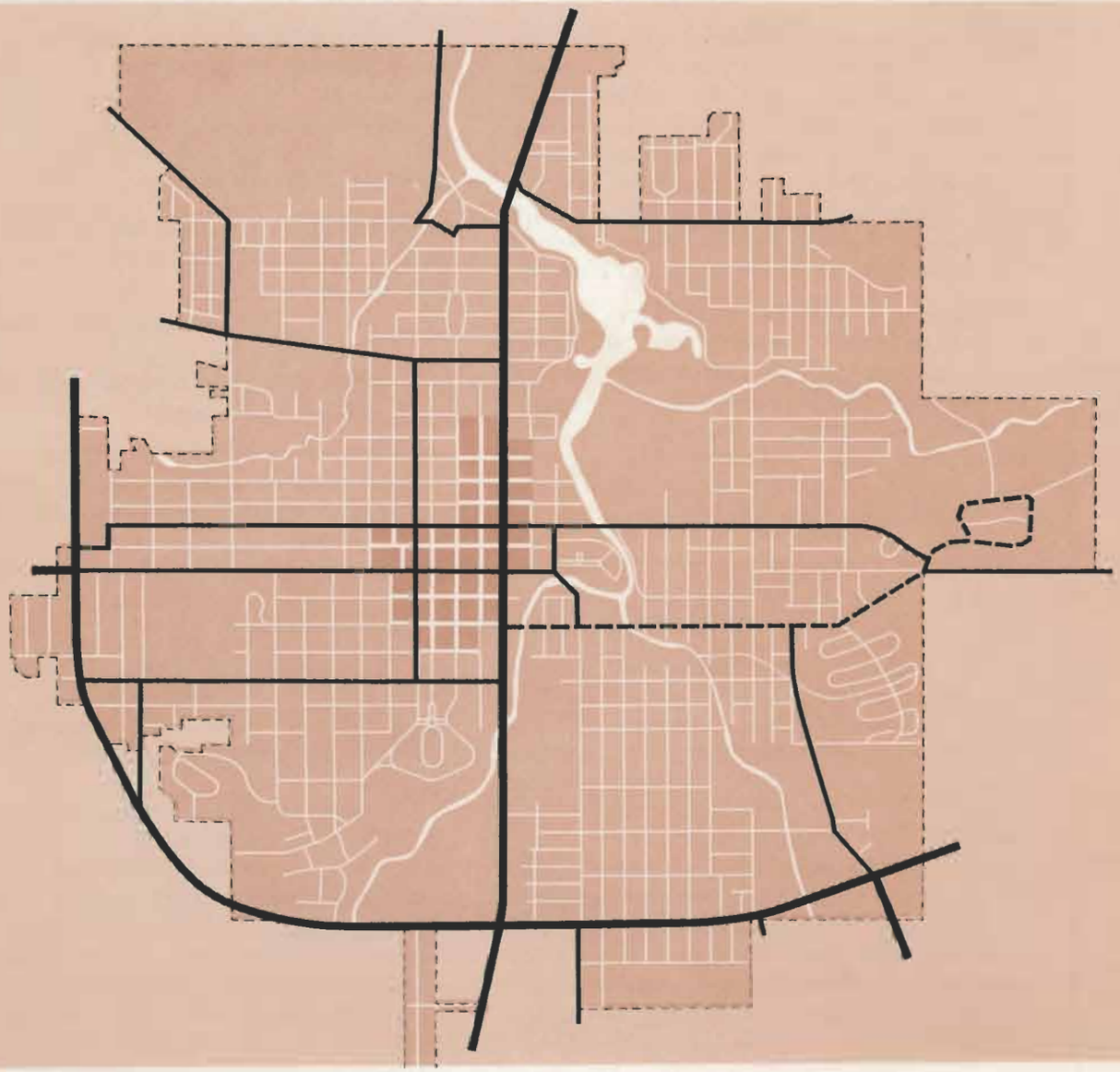
## Recommendations

The classification plan recommended by this study provides a simple, comprehensive readjustment of responsibility. It lends itself to establishing equity in financial support. The plan permits well-defined and coordinated management. It will be effective only when coupled with an equitable finance plan.

The recommended plan is as follows:

1. *Establish the proposed State Trunk System, limiting it to 8,750 miles, including extensions through the cities. The system should substantially conform to that shown on the map on page 27.*
2. *Create a Primary County Road System totalling approximately 30,500 miles. This system, serving all counties, would eliminate and replace the presently designated State-aid and county-aid systems.*
3. *Require by legislation the creation of a master plan of arterial streets, in each municipality of 5,000 or more population, which would integrate State trunk extensions and other major traffic arteries. These arterials should total approximately 850 miles, exclusive of State routes.*

## The Study Classification Plan For Rochester



*State trunk highways are shown by heavy green lines, other city arterials by light green lines. The wide white lines are business access streets. The remainder of the street network provides residential access. The dashed green line is an example of an existing trunk highway which should be reclassified as a city arterial street.*

Chapter 3

# Highway Operations

BETTER USE THROUGH TRAFFIC ENGINEERING

A state highway department has many functions involving planning, programming, location, design, construction, maintenance, and traffic movement. The driving public is concerned principally with the finished product, the highways themselves, and the ease or difficulties of driving over them. The function of controlling and guiding traffic movement, although only one of the number of important functions, is treated specially in this study because when fully performed, old and new facilities can be made to give road users immediate benefits through saving of time, vehicle operating costs, and safer travel.

Traffic engineering is concerned with the highway, vehicle and driver as they bear upon operating requirements and need for traffic control methods and devices which produce greater efficiency, safety and economy in highway travel. Operational characteristics of a highway are determined by its design, physical condition, use of abutting land and access control, traffic volumes, and the use of traffic control devices and methods.

The myriads of vehicle destinations make it necessary to determine the nature of traffic movements in order to properly design new facilities and correct present deficiencies. Failure to properly use traffic engineering techniques and control devices creates costly congestion. Planning and design of highways and their safe and efficient use must be based upon thorough studies.

## State Trunk System

Traffic engineering work on rural highways differs from that in urban areas. Although traffic volumes may not be as high on the rural system, travel speeds are naturally higher. Rural driving involves problems of safe passing and stopping sight distance, control of access, roadside development, type and placement of traffic control devices and treatment of a variety of hazardous conditions, such as at curves and intersections.

### Functions and Responsibilities

Traffic operations require engineering treatment in the planning and geometric design of highways, use and establishment of traffic control devices, control of access and roadside use, and application of engineering techniques for greater safety, efficiency and convenience of travel.

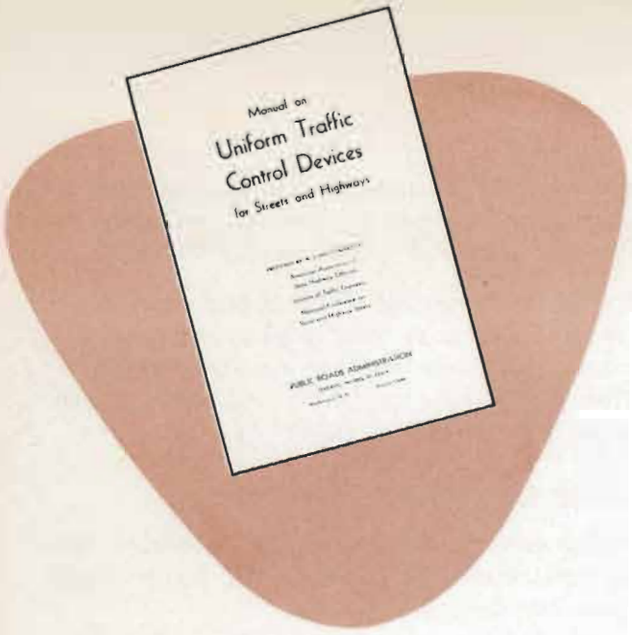
Following are functions carried on in full or in part by the Traffic Operations Section of the Department of Highways.

1. Design and use of all traffic control devices, including signs, signals, marking and highway lighting, on both the rural State trunks and urban extensions
2. Review of construction plans (as they are developed) to determine the need for traffic control devices or other measures.

### Traffic Operations and Physical Needs

The procedural manuals for the engineering appraisal of city streets required consideration of various traffic engineering techniques as possible solutions to congestion problems. The techniques included parking prohibitions, signal timing and coordinating, restriction of turning movements, truck routes, pairs of one-way streets, intersection channelization, and other accepted measures as related to street capacity, congestion and accident relief. Consideration was given to the proven methods which can facilitate traffic movement before submitting new construction projects to relieve congestion. During the engineering review of the work sheets, city projects were modified or eliminated wherever traffic engineering measures could solve or help meet the problem.

It is sound business to expect maximum use to be made of all street facilities. Unless State and local officials, with the full support of their citizens, are willing to apply proven methods of traffic operation to their accident and congestion problems, costs of providing adequate street facilities will be much higher than those indicated in Chapter 4.




3. Development and publication of standards for traffic control devices
4. Surveys for speed control, including establishment of maximum safe speed limits on all streets and highways on the State Trunk System in accordance with procedures set by law
5. Surveys and studies of traffic problems and high accident locations
6. Analysis of accident reports to determine operational corrections
7. Recommendations for changes in traffic regulations
8. Parking surveys and regulations
9. Assistance to counties and municipalities in solution of local traffic problems.

While this study was in progress, a reorganization of Divisions of the Minnesota Department of Highways was made to increase the effectiveness of traffic safety. Traffic operations were transferred from the Traffic and Safety Division to a new Traffic and Planning Division, and a separate Highway Safety Division was established.

The Traffic and Planning Division is composed of three sections, Traffic Operations, Planning, and Economic and Special Studies. Because of the importance of traffic engineering, it might well be necessary at some time in the future to consider creation of a separate Traffic Engineering Division.

The Traffic Operations Section, as in previous years, is responsible for design and location of all traffic control devices on State highways and makes necessary surveys and studies for all traffic control needs. Also, the section approves use of control devices on urban extensions of State highways and assists counties and cities in the solution of local traffic problems. Installation of control devices is handled by the Maintenance Division, except for traffic signals which are installed by the Construction Division, usually under contract.

## Deficiencies

Responsibilities of the Traffic Operations Section do not include, in most instances, review of plans and designs for new facilities or improvements of existing highways. This may prevent advance determination of the need for traffic control devices and the best use of the specialized knowledge of the Traffic Operations Section.

The new division arrangement, however, gives opportunity to overcome such functional problems, and to step-up traffic operations in general.

Traffic operations work has been of high calibre. Location and maintenance of devices are generally good. Traffic control devices generally conform to standards of the Manual on Uniform Traffic Control Devices. However, deficiencies do exist, but are mostly those requiring additional installations.

On the State system some 2,000 miles of paved highways have not been surveyed and marked for no-passing zones. About 3,000 miles surveyed have not been so marked. More extensive centerline marking also is needed beyond the progress currently being made in expanding the marked mileage.

Highway lighting, although provided at 151 hazardous locations, would add materially to safety were it installed at additional locations.


*The design and placement of route signs requires careful study of each location so that motorists may quickly read and understand the messages.*

Traffic signals have been placed at 15 locations on State highways. With only three intersections signalized in 1953, the signalizing program warrants material increase.

Many dangerous rail-highway crossings are not properly protected. For increased safety 61 urban and 54 rural intersections on the State system should be signalized or protected with gates.

Posting of safe maximum speeds on curves would further add to safe travel were it done on an additional 2,800 miles.

### Organization Requirements

To conduct an expanded traffic operations program to meet needs covered above would require additional personnel and capital outlays for materials and equipment.

Approximately 78 full-time employees in the Traffic Operations Section and the Maintenance Division are engaged in traffic operations work. This force should be increased to a total of 120 men or more, with a headquarters staff of 32 and some 90 employees in the districts, ultimately including eight District Traffic Engineers. There is a particular need for District Traffic Engineers in the districts containing the larger metropolitan areas.

The District Traffic Engineers, serving in each of the present construction districts, would be the basis of an efficient field organization. They should operate in accordance with headquarter's policies under the District Engineers and in close cooperation with the District Maintenance Engineers in performing all field traffic engineering functions.

## Urban Streets

Traffic operation problems in urban areas usually are more complex and difficult to solve than in rural areas. Although speeds are lower in urban areas, traffic volumes are usually heavier. Traffic is subjected to many interferences. Commercial signs and lights make it difficult to see route markers and traffic signals. Through traffic is impeded by parking maneuvers and often must be stopped at intersections to allow cross traffic to move. Intersections are close together and much more complicated than in rural areas. Usually, extensive lane markings, signing, signalization, and at times, channelization, are required.

Lack of street capacity is a general condition. Because of the development of abutting land, additional street space is difficult and costly to obtain. Operational changes often can increase capacity--such as control of turning movements and parking, one-way movements, establishment of turning lanes and special routing of traffic.

To obtain the utmost efficiency and convenience of travel on street systems requires adequate traffic data, competent engineering analysis and effective application of traffic engineering techniques and operational improvements.

### Traffic Operations Functions

Three cities in Minnesota are of sufficient size and have traffic problems which justify traffic engineering departments.

Functions which should be carried on by Minnesota's large cities are:

Conduct of traffic surveys and engineering investigations of traffic conditions to determine regulations or improvements for existing streets and to determine future needs for street and highway facilities.

Determine the need for and establish turning controls, parking regulations, location of parking meters, speed controls, through and one-way streets, stop intersections, signal timing, pavement markings, loading zones, transit and taxi stops, and any other operational procedure required for safe and efficient use of the street system.

Prepare plans and specifications for intersection channelization, driveways, traffic routings, off-street parking facilities, and other remedial measures.

Review and approve geometric design of streets and street pattern in subdivision plans, including parking needs and facilities.

Review and approve requests for curb cuts, routings, parking lots, and any other request affecting the operation of the street system.

Determine need for and the location, type and specifications of traffic control devices and parking meters.

Install, place, operate and maintain all traffic control devices and parking meters.

Prepare rules and regulations and amendments to existing ordinances for city council action.

Present traffic operations work, deficiencies and needs are discussed separately for each city.

*More off-street parking facilities are needed in downtown areas of the larger cities. Lack of adequate off-street parking adds to congestion because drivers circulate looking for parking space.*

## Minneapolis

In Minneapolis, the Traffic and Transportation Division, directed by a traffic engineer, is logically located under the City Engineer in the City Engineering Department, and has equal status with the Division of Construction and Maintenance.

All essential functions of traffic operations are under the Traffic and Transportation Division. This recognition of the need for sound traffic engineering has greatly improved traffic conditions.

Minneapolis has done an outstanding job in maintaining signs and signals. Signs are replaced every four years with new or rehabilitated signs. Signal lenses are regularly cleaned and control mechanisms adequately maintained.

### Deficiencies

A joint program to coordinate traffic signals on some of the State trunk extensions has been initiated by Minneapolis and the State Department of Highways. This program should be completed as rapidly as possible and extended to other arterials.

Of the 135 railroad grade crossings in the city, about half are protected by signals or gates.

Several two-way streets in the downtown area have reached capacity. More one-way streets would aid the flow of traffic.

More use should be made of lane lines to organize traffic movements at intersections. Crosswalks should be marked at several important intersections.

More use should be made of two-lens school signals to provide safer crossings for children and to reduce traffic delays.

Functions previously listed are performed by the Traffic and Transportation Division. However, additional personnel is needed to conduct surveys and to conduct an expanded improvement program. Personnel required to bring the Division to adequate strength are: a Senior Engineer, two Junior Engineers, seven Junior Engineering Aides, and an Assistant Foreman. Additional funds are also needed for control equipment and materials.

## St. Paul

In St. Paul, traffic operations work is handled by a traffic engineering division of the Department of Public Works. Responsibilities, however, are dispersed among other departments.

The Commissioner of Public Safety has authority to designate one-way streets, through streets and stop intersections; also to erect stop signs and establish parking time limits without final Council action. Some of these functions, however, have been informally transferred to the traffic engineering division.

Although the division is responsible for the design, location and installation of signs, signals and markings, the maintenance of signs and markings and the timing of signals are handled by the Police Department.

### Deficiencies

Considering the magnitude of the traffic problem and the improvements which good traffic operations can bring, progress has been slow since the traffic engineering office was established. However, commendable work has been done by the traffic engineering division in view of limited staff and inadequate budget.

Traffic control devices are standard in most cases, and good progress has been made in coordinating traffic signals on principal streets. There is need, however, for placing lane lines and centerlines on arterials. Many major intersections should have crosswalk marking. There is need for con-


*Increased efficiency results from proper signing and marking of complicated urban intersections.*

siderable improvement in maintenance of signs, marking and traffic control devices.

Consolidation of all traffic operations functions under the traffic engineering division would centralize responsibility and increase efficiency. All funds budgeted for traffic operations should be transferred to the division.

Personnel of the traffic engineering department should be increased. Added funds should be provided as traffic operations work is stepped up.

## Duluth

Traffic operations functions in Duluth are assigned to the Commissioner of Public Safety and delegated by him to the Police Department. At present they are handled by the sergeant in charge of the traffic section.

### Deficiencies

Accomplishments have been limited in Duluth. Signs and markings are poorly maintained. Few arterial streets have centerlines, lane lines or crosswalk markings. Because of the limitations of the street pattern, there is considerable congestion on the few major through streets. Little has been done to increase street capacity; studies have not been made to determine the need for one-way streets, parking restrictions, turning controls or other operational measures.

Police enforcement of traffic laws and regulations is an important function in the control of traffic movements requiring the full attention of personnel specifically trained for this work.

On the other hand, functions relating to traffic operations are engineering in character and require special technical training for successful use.

The volume of traffic work to be done is such that a traffic engineering division under the City Engineer could well be established, with that division assigned all traffic operations functions. Personnel, including a qualified traffic engineer, should be employed, with sufficient budget to conduct a comprehensive improvement program.

# Recommendations

## Department of Highways

Inadequacies in traffic operations work on roads and streets under Department of Highways jurisdiction are such that they can be overcome only by increasing personnel and budget of the Traffic Operations Section.

Plans and designs for new or improved highway facilities should be reviewed by the Traffic Operations Section to permit advance determination of traffic control needs and to make best use of specialized knowledge of traffic conditions.

Further assistance and encouragement should be given smaller cities in the solution of traffic problems.

The Department should take necessary steps to encourage specialized traffic engineering training of a limited number of engineering personnel.

## Urban

To best meet the complex and constantly changing needs of traffic, Minneapolis, St. Paul and Duluth should adopt or enlarge traffic operations programs which include the activities listed in this chapter under the title, "Traffic Operations Functions."

Minneapolis should increase personnel and budget of the Traffic and Transportation Division.

All traffic operations duties in St. Paul should be assigned to a traffic engineering division under the Department of Public Works, with adequate personnel and budget provided.

In Duluth, a traffic engineering division, directed by a qualified traffic engineer, should be established under the Department of Public Works. The division should handle all traffic operations work, and an adequate budget should be provided.

Chapter 4

# Needs

## DEFICIENCIES ON ROADS AND STREETS

This chapter presents in summary form the more significant findings of the appraisal of highway and street needs. The field reports, maps, work sheets and other supporting information on which the summaries are based are available in the offices of the Highway Planning Survey. The procedures used in the needs appraisal and for estimating costs of present and future construction requirements are described in Chapter 12.

All costs are based on 1953 contract prices. Construction requirements reflect conditions as of November 1, 1953. Some of the needed improvements are being accomplished by means of the current construction programs of the State, counties and municipalities. The total 1954 programs for highway and street construction in the State will approximate $75 million.

The estimated total construction cost to meet the existing road and street needs of the State is $681 million, one-third of which is needed in cities and two-thirds in rural areas. This is a conservative estimate because the appraisal was accomplished by comparing the physical status of each road and street to "minimum conditions" considered tolerable for traffic. Measurement of deficiencies on the basis of modern construction standards would have resulted in far greater costs.

## Rural State Trunk Highways

Of the 10,390 miles of rural State trunk highways, 2,669 miles need improvement now. An additional 77 miles of routes not yet built are required to provide adequate traffic service.

The backlog of needed construction by pavement type is as follows:

| Needed Pavement Type | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| High type pavement | 994 | $ 98,915,000 | 64 |
| Intermediate type pavement | 1,579 | 52,316,000 | 34 |
| Low type pavement | 156 | 3,071,000 | 2 |
| Gravel | 17 | 176,000 | — |
| Totals | 2,746 | $154,478,000 | 100 |

The accompanying map shows the location and character of work necessary to correct the present deficiencies on rural State trunk highways. Two-thirds of the deficient mileage can be modernized through construction or reconstruction of existing facilities.

| Character of Work | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| New construction | 949 | $ 92,914,000 | 60 |
| Reconstruction | 980 | 38,266,000 | 25 |
| Resurfacing and other | 817 | 23,298,000 | 15 |
| Total | 2,746 | $154,478,000 | 100 |

In the study analysis, the currently deficient portions of the system were summarized as being inadequate in capacity, structural condition, a combination of capacity and structural condition, or for safety and other reasons.

Capacity reflects the ability of a road to carry traffic at reasonable speeds without undue congestion. It is measured by elements of surface width, curvature, gradients, passing opportunity, and amount and character of traffic.

The structural condition of a road reflects its ability to carry the traffic loads imposed upon it. It is measured by elements of surface type and condition and base and subgrade condition. It is also influenced by factors of inadequate drainage, low grade lines and excessive maintenance costs.

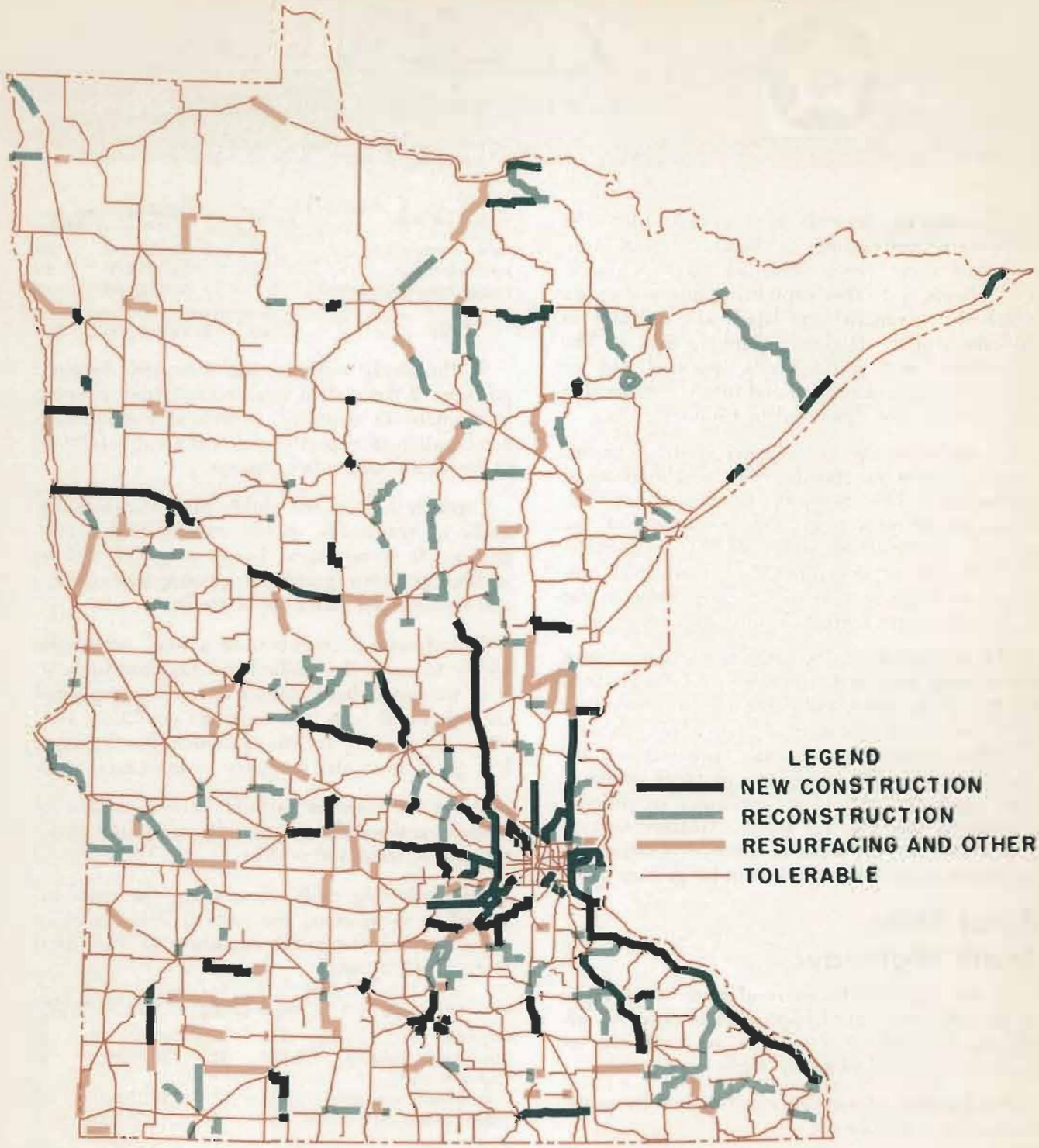
Safety deficiencies include narrow widths of surfaces and shoulders, poor alignment and structures with restricted widths.

The following table summarizes the costs involved in overcoming the present deficiencies in capacity and structural condition of the rural State Trunk System.

| Nature of Deficiency | Miles | Per Cent of Miles | Cost | Per Cent of Cost |
|---|---|---|---|---|
| Capacity | 518 | 19 | $ 46,423,000 | 30 |
| Structural condition | 1,700 | 62 | 58,820,000 | 38 |
| Capacity and structural condition | 472 | 17 | 48,229,000 | 31 |
| Safety and other reasons | 56 | 2 | 1,006,000 | 1 |
| Totals | 2,746 | 100 | $154,478,000 | 100 |

While structural condition alone accounts for 62 per cent of all existing deficient mileage of State trunk highways, the costs of needed improvements on this mileage amount to only 38 per cent of the total. This relationship exists because correction of structural deficiencies can generally be accomplished by resurfacing or reconstruction on existing alignment. Correcting of capacity deficiencies, on the other hand, involves provision for additional roadbed and surface width and frequently construction on new location to

# Present Needs on the Rural State Trunk System




*Some 2,700 miles of the Rural State Trunk System are in need of improvement now. Three-fourths of the system is tolerable for today's traffic.*

correct inadequate alignment, as reflected by lack of passing opportunity on heavily traveled roads.

### Structures

In addition to the roadway deficiencies, the construction, or reconstruction of 309 bridges and separation structures and installation of protection devices at 54 railroad grade crossings is currently needed.

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $24,085,000 | 89 |
| Recondition present structures | 2,589,000 | 10 |
| Railroad grade crossing protection | 279,000 | 1 |
| Totals | $26,953,000 | 100 |

| Type of Service | Cost | Per Cent of Cost |
|---|---|---|
| Stream crossings | $18,979,000 | 71 |
| Highway separations | 1,463,000 | 5 |
| Railroad separations | 6,232,000 | 23 |
| Railroad grade crossing protection | 279,000 | 1 |
| Totals | $26,953,000 | 100 |

## Future Needs

In addition to the 2,669 miles of rural State trunk highways needing improvement now, 2,341 miles will become deficient for structural or capacity reasons within five years, an additional 2,418 miles in the period 5 to 10 years, another 1,449 miles in the period 10 to 15 years hence, and 507 miles in the period 15 to 20 years hence. The mileage which will become deficient in a 20-year period totals 6,715 miles, including 47 miles of routes not now existing but required for future traffic service.

By pavement types, the needed future construction is:

| Pavement Type | Time Period: 5 Years (Miles) | 5-10 Years (Miles) | 10-15 Years (Miles) | 15-20 Years (Miles) |
|---|---|---|---|---|
| High type pavement | 279 | 432 | 580 | 396 |
| Intermediate type pavement | 1,851 | 1,958 | 844 | 111 |
| Low type pavement | 203 | 28 | 4 | — |
| Gravel | 8 | — | 21 | — |
| Totals | 2,341 | 2,418 | 1,449 | 507 |

By character of work, the future construction needs are:

| Character of Work | Time Period: 5 Years (Miles) | 5-10 Years (Miles) | 10-15 Years (Miles) | 15-20 Years (Miles) |
|---|---|---|---|---|
| New construction | 304 | 161 | 68 | 26 |
| Reconstruction | 922 | 446 | 261 | 153 |
| Resurfacing and other | 1,115 | 1,811 | 1,120 | 328 |
| Totals | 2,341 | 2,418 | 1,449 | 507 |

Total costs of construction needs, both present and future, are summarized in Table I. This table also shows the capital investment requirements to overcome present and future construction needs on the Proposed State Trunk System and existing State trunk highways of local importance recommended for transfer to the Primary County Road System.

The 20-year construction costs on the State Trunk System include 930 miles of four-lane divided highways, all of which are a part of the Proposed State Trunk System. The map on this page shows the location of existing four-lane divided highways and those required over a 20-year period.

*Traffic growth will require construction of an additional 930 miles of four-lane divided highways in rural areas during the next 20 years, including 380 miles needed now. This will bring the total mileage of such facilities in the State to 1,031 miles.*

## Examples

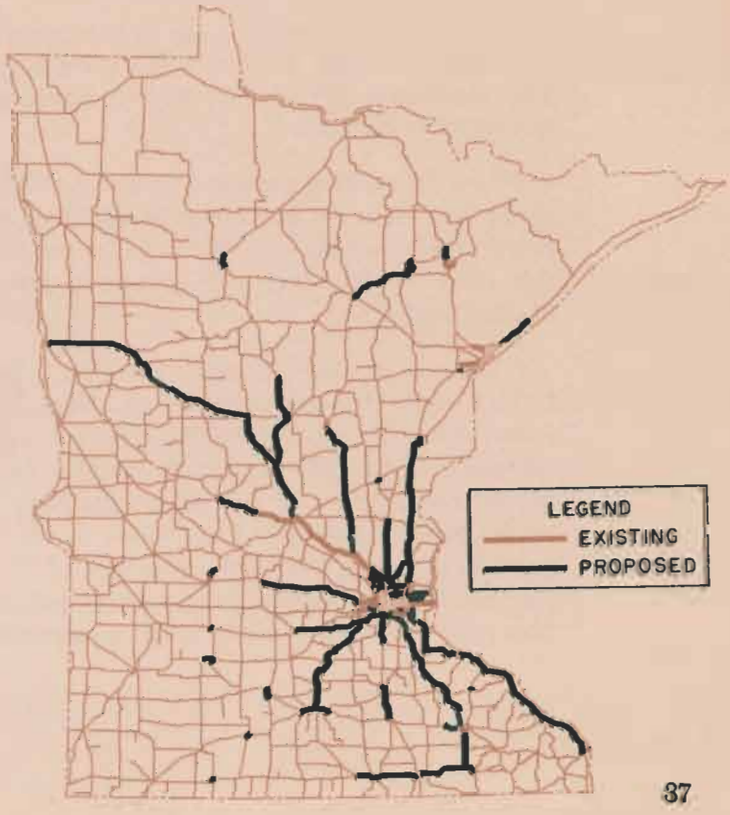
To illustrate the manner in which rural State trunk highways were appraised, typical examples of present and future construction needs are presented here.

### U. S. Route 10—Becker County Control Section 0301, Segments 2 and 3

This section of U. S. Route 10 extends westerly from Detroit Lakes to Lake Park and is 11 miles in length. This route is important to interstate travel as well as recreational and commercial traffic.

The existing surface is portland cement concrete 20 feet in width. Maximum gradient is four per cent. Passing sight distance is restricted for

**EXISTING AND PROPOSED FOUR-LANE DIVIDED HIGHWAYS**



# TABLE I

## Construction Needs
## Rural State Trunk Highways

| | Total Existing System | Proposed State Trunk System | Existing State Routes of Local Importance |
|---|---|---|---|
| Existing Miles | 10,390 | 7,388 | 3,002 |
| Miles Tolerable Now | 7,721 | 5,583 | 2,138 |
| Per Cent | 74 | 76 | 71 |
| Miles Deficient Now | 2,669 | 1,805 | 864 |
| Per Cent | 26 | 24 | 29 |
| Cost of Present Needs | | | |
| Roadway | $154,478,000 | $133,187,000 | $21,291,000 |
| Structures | 26,953,000 | 22,679,000 | 4,274,000 |
| Total | $181,431,000 | $155,866,000 | $25,565,000 |
| Total Construction Requirements | | | |
| 5-Year Period | | | |
| Roadway | $230,196,000 | $185,634,000 | $44,562,000 |
| Structures | 32,198,000 | 26,876,000 | 5,322,000 |
| Total | $262,394,000 | $212,510,000 | $49,884,000 |
| 10-Year Period | | | |
| Roadway | $303,865,000 | $248,467,000 | $55,398,000 |
| Structures | 35,334,000 | 29,899,000 | 5,435,000 |
| Total | $339,199,000 | $278,366,000 | $60,833,000 |
| 15-Year Period | | | |
| Roadway | $360,958,000 | $302,889,000 | $58,069,000 |
| Structures | 39,047,000 | 33,537,000 | 5,510,000 |
| Total | $400,005,000 | $336,426,000 | $63,579,000 |
| 20-Year Period | | | |
| Roadway | $397,402,000 | $338,218,000 | $59,184,000 |
| Structures | 40,190,000 | 34,604,000 | 5,586,000 |
| Total | $437,592,000 | $372,822,000 | $64,770,000 |

about one-half the distance. Traffic averages 3,000 vehicles per day, of which one-fourth is commercial. Peak traffic hours of 470 vehicles exceeds the practical capacity of 410 vehicles per hour by about 15 per cent. This section is below average in capacity due to poor vertical and horizontal alignment which restricts passing over half the length.

Stopping sight distances are below acceptable standards for roads in this traffic volume group. The remaining life of the present pavement is estimated at 10 years.

While the existing pavement is structurally adequate now, it is deficient in capacity. The anticipated traffic increase of 2,000 vehicles per day on this route in 20 years will require a four-lane divided highway.

Provision of the needed four-lane divided facility could be accomplished in stages by reconstructing the existing two-lane road to modern standards to provide increased capacity and deferring construction of the second roadway until traffic growth requires four travel lanes. That procedure would not take advantage of the remaining 10 years of life in the existing pavement. The plan used in this study is for construction of the second roadway now, deferring the modernization of the existing two-lane road until a period 10 to 15 years hence. The total cost will be about the same in either case, but under the study plan, a maximum return is secured from the investment in the present road, better service is provided, and there will be a minimum interference to traffic.

The total improvement cost is estimated to be $1,274,000 or $116,000 per mile. The amount required for reconstruction of the existing road in the 10 to 15 year period is $472,000.

### State Route 23—Stearns County
### Control Section 7305, Segments 3, 4 and 5

This portion of State Route 23 extending easterly from Roscoe to Cold Spring is nine miles in length. It is a part of the original constitutional system and is included in the Proposed State Trunk System recommended in Chapter 2.

The present roadway has a bituminous surface 24 feet in width. Shoulders are eight feet wide. There are no curves sharper than three degrees. The maximum gradient is about four per cent. Safe passing opportunity is restricted for one-third the length of the section. The annual maintenance cost is approximately $800 per mile.

# TABLE II

## Construction Needs
## All City Streets

| | Present Systems | | Proposed Systems | | | |
|---|---|---|---|---|---|---|
| | State Trunk Highways | Other City Streets | State Trunk Highways | Arterial Streets | Business Access | Residential Access |
| Existing Miles ..... | 1,460 | 10,305 | 1,252 | 2,679 | 445 | 7,389 |
| Miles Tolerable Now.. | 1,115 | 7,292 | 943 | 2,069 | 260 | 5,135 |
| Per Cent ..... | 76 | 71 | 75 | 77 | 58 | 70 |
| Miles Deficient Now.. | 345 | 3,013 | 309 | 610 | 185 | 2,254 |
| Per Cent ..... | 24 | 29 | 25 | 23 | 42 | 30 |
| Cost of Present Needs | | | | | | |
| Roadway .....$110,173,000 | $ 83,186,000 | $107,921,000 | $ 22,763,000 | $ 8,684,000 | $ 53,991,000 | |
| Structures ..... 29,214,000 | 16,045,000 | 28,507,000 | 12,690,000 | 1,935,000 | 2,127,000 | |
| Total .....$139,387,000 | $ 99,231,000 | $136,428,000 | $ 35,453,000 | $ 10,619,000 | $ 56,118,000 | |
| Total Construction Requirements | | | | | | |
| 5-Year Period | | | | | | |
| Roadway .....$182,861,000 | $126,771,000 | $175,808,000 | $ 46,542,000 | $ 11,443,000 | $ 75,839,000 | |
| Structures ..... 38,114,000 | 23,997,000 | 37,106,000 | 19,697,000 | 2,460,000 | 2,848,000 | |
| Total .....$220,975,000 | $150,768,000 | $212,914,000 | $ 66,239,000 | $ 13,903,000 | $ 78,687,000 | |
| 10-Year Period | | | | | | |
| Roadway .....$242,070,000 | $169,336,000 | $232,829,000 | $ 60,707,000 | $ 14,994,000 | $102,876,000 | |
| Structures ..... 42,740,000 | 39,366,000 | 41,664,000 | 33,879,000 | 2,989,000 | 3,574,000 | |
| Total .....$284,810,000 | $208,702,000 | $274,493,000 | $ 94,586,000 | $ 17,983,000 | $106,450,000 | |
| 15-Year Period | | | | | | |
| Roadway .....$291,796,000 | $213,335,000 | $282,092,000 | $ 70,694,000 | $ 19,266,000 | $133,079,000 | |
| Structures ..... 54,564,000 | 44,473,000 | 53,477,000 | 37,733,000 | 3,522,000 | 4,305,000 | |
| Total .....$346,360,000 | $257,808,000 | $335,569,000 | $108,427,000 | $ 22,788,000 | $137,384,000 | |
| 20-Year Period | | | | | | |
| Roadway .....$337,186,000 | $260,168,000 | $327,307,000 | $ 80,488,000 | $ 23,854,000 | $165,705,000 | |
| Structures ..... 61,946,000 | 47,637,000 | 60,842,000 | 39,637,000 | 4,062,000 | 5,042,000 | |
| Total .....$399,132,000 | $307,805,000 | $388,149,000 | $120,125,000 | $ 27,916,000 | $170,747,000 | |

Traffic averages 1,500 vehicles per day, of which 12 per cent is commercial. The peak traffic during the summer months is 210 vehicles per hour—less than 50 per cent of the practical capacity of 540 vehicles per hour.

The alignment, gradients, and width of the existing facility are adequate from a capacity standpoint for traffic requirements of the next 20 years. The remaining life of the existing surface is estimated to be about three years because of deficiencies in surface and base conditions. It has been classified as structurally deficient in the one to five year period.

There is a bridge 26 feet long within this section with a roadway width of 36 feet. This bridge is structurally adequate for at least 20 years.

The proposed improvement consists of base strengthening and plant mix bituminous surfacing on existing alignment over the entire section. The estimated cost is $253,000, or $28,000 per mile.

### U. S. Route 12—Kandiyohi County
### Control Section 3404, Segments 3 and 4

U. S. Route 12, east from Kandiyohi for 3.5 miles is paved with portland cement concrete.

Traffic averages 2,600 vehicles per day, of which 17 per cent is commercial.

Safe passing opportunity is restricted on two-thirds of the length. The maximum gradient is five per cent and the sharpest curve nine degrees. This curvature is below the minimum condition considered tolerable for roads in this traffic volume group.

The existing pavement is in poor structural condition and is only 18 feet wide. The road is now critically deficient for structural reasons.

The proposed improvement consists of building a 24-foot high type pavement on new location

to provide adequate sight distance and desirable operating conditions. The estimated cost is $285,000, or $82,000 per mile.

## Municipal Street Needs

Costs of improvements required to correct present and future needs on the 11,765 miles of city streets are summarized in Table II by present classification and for each of the proposed systems recommended in Chapter 2. A breakdown of immediate needs is presented in the Appendix for each of the three first class cities and for all other municipalities by population groups.

City streets while consisting of but 10 per cent of the total road and street mileage in the State carry 44 per cent of all travel. The cost of immediate street needs in all of the 807 municipalities in the State amounts to 35 per cent of the total cost of all immediate road and street needs. Requirements in the three first class cities, where congestion is the greatest and 31 per cent of the State's population is concentrated, represent 20 per cent of the total cost of existing needs.

### Urban State Trunk Highways

Urban State trunk highways constitute only slightly over one per cent of all the road and street mileage of the State, but carry one-fifth of all travel. Twenty-four per cent of this mileage is deficient for present traffic and in need of immediate improvement. In the three first class cities, 43 per cent of the Trunk system mileage does not meet tolerable standards. Work ranging from resurfacing of existing pavements to construction of expressways is needed.

Of the 1,480 miles of urban State trunk routes, 345 miles need improvement now. In addition, 40 miles of routes not now existing are required to provide adequate traffic service, making a total of 385 miles on which a backlog of needed construction exists. By character of work the present construction needs, exclusive of structures and traffic control devices, are as follows:

| Character of Work | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| New construction | 165 | $ 86,530,000 | 79 |
| Reconstruction | 11 | 1,215,000 | 1 |
| Resurfacing and other | 209 | 22,428,000 | 20 |
| Totals | 385 | $110,173,000 | 100 |

In addition to the street deficiencies, the construction or reconstruction of 133 bridges and separation structures, installation of protection devices at 61 railroad grade crossings and other miscellaneous work for control of traffic is currently needed.

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $23,130,000 | 71 |
| Recondition present structures | 5,528,000 | 26 |
| Railroad protection and traffic control | 556,000 | 3 |
| Totals | $29,214,000 | 100 |

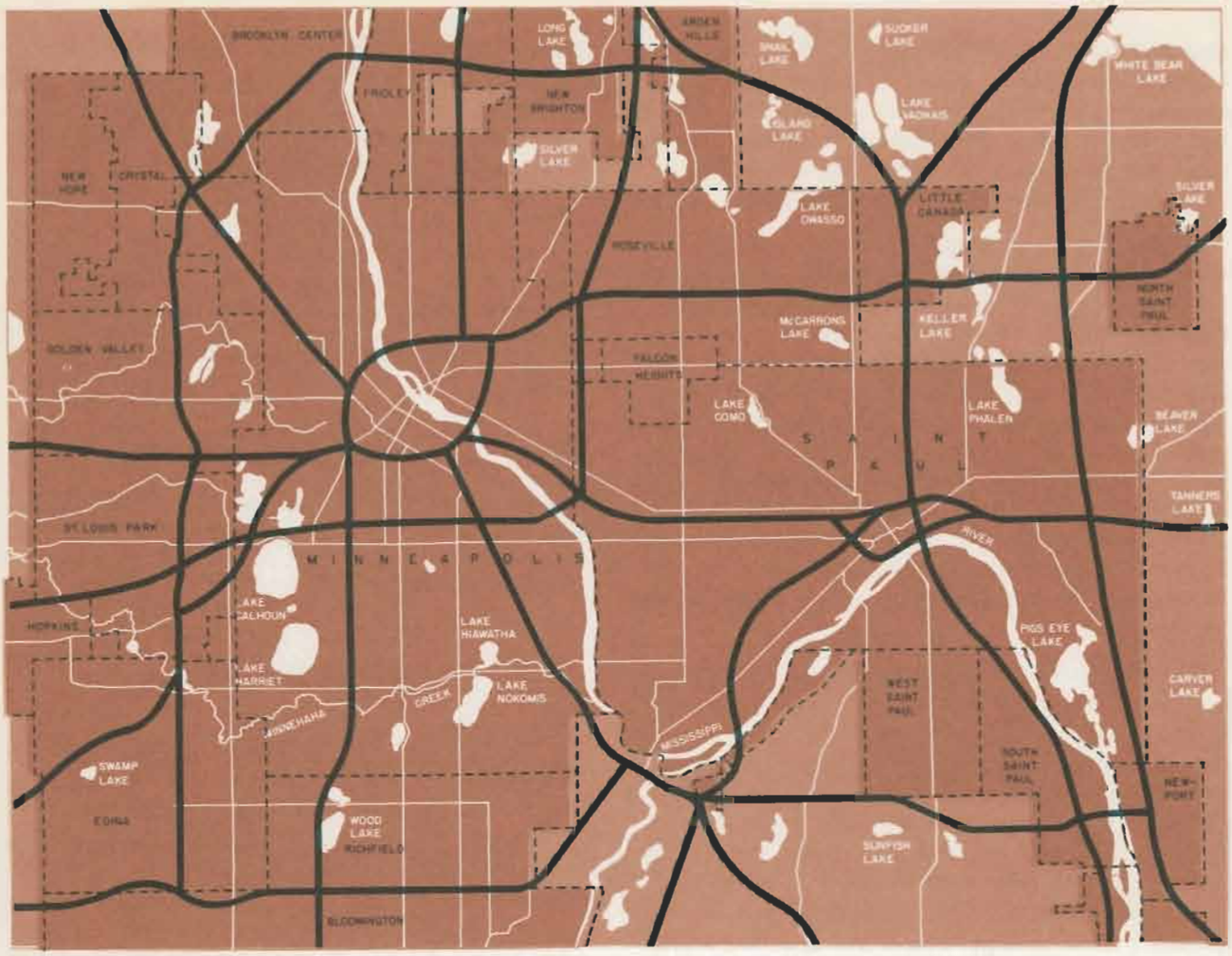
Besides the 345 miles of urban State trunk routes needing improvement now, an additional 1,017 miles will become deficient within 20 years for structural or capacity reasons. The future deficiencies include 113 miles not now existing but required for future traffic service. By character of work, the future construction needs are as follows:

| Character of Work | Time Period | | | |
|---|---|---|---|---|
| | 5 years | 5-10 years | 10-15 years | 15-20 years |
| | (Miles) | (Miles) | (Miles) | (Miles) |
| New construction | 148 | 84 | 51 | 35 |
| Reconstruction | 26 | 20 | 7 | 20 |
| Resurfacing and other | 171 | 232 | 185 | 38 |
| Totals | 345 | 336 | 243 | 93 |

In the smaller cities, the principal deficiencies are surface type and condition. Capacity is seldom a problem. Where capacity problems do exist, they generally can be corrected by widening of the existing facilities or by traffic engineering techniques, such as pairs of one-way streets, channelization of intersections, or installation of progressive traffic control signal systems.

In some cases where the volume of through traffic warrants, construction of rural by-pass routes around or through relatively undeveloped areas of the city will provide the needed additional capacity at less cost than widening or modernization of the existing route. The total length of new State trunk highway locations proposed in smaller cities is 79 miles.

# Twin City Major Thoroughfare Plan




*Construction of the expressway facilities portrayed on this map offers the most practical means of providing the additional capacity to relieve the heavy traffic congestion in the Twin City area.*

In the three first class cities, lack of capacity on State trunk routes is the principal deficiency from the standpoint of cost. Particularly this is the case in Minneapolis and St. Paul. Narrow congested streets, many with rough, worn-out pavements, present daily problems to thousands of through travelers as well as the 33 per cent of the State's population living within the Twin City metropolitan area.

Expressway type construction offers the most practical means of providing the additional capacity to relieve the heavy traffic congestion on some of the State trunk routes in the Twin Cities. It would be impossible to provide for anything approaching the same degree of traffic service by widening and reconstruction of present facilities.

## Minneapolis-St. Paul Major Thoroughfare Plan

Because of the magnitude of the traffic problem in the Twin City area and the need for regional planning to arrive at an effective and reasonable solution, an advisory committee was formed to aid the engineering staff in the development of a long-range plan of major thoroughfares. This committee was composed of the city engineers of Minneapolis and St. Paul, the county engineers of Hennepin and Ramsey counties, and the Chief Engineer of the Department of Highways.

To aid in the deliberations and serve as a basis for determining both present and future requirements, the staff and committee were fortunate to have available the results of a comprehensive origin and destination traffic survey of the Twin City area. This survey, made in 1950 by the Department of Highways with the cooperation of the U. S. Bureau of Public Roads and the cities of Minneapolis and St. Paul, provided basic data on traffic volumes and desired lines of travel. Forecasts of future travel, 20 years hence, were based on this study modified to reflect anticipated future changes in land use during the forecast period.

The accompanying map shows the major

thoroughfare plan developed for the Twin City Metropolitan Area for a 20-year period. The routes shown are general locations required to serve major traffic flows. Determination of exact locations for each route must be based on detailed engineering and economic investigations.

The routes shown total 191 miles in length, including the necessary connections in rural areas. Of this mileage, 61 miles exist now and with modifications will fit into the major thoroughfare system. The remaining 130 miles are new facilities. The estimated cost, including structures, is $274,151,000, an average cost of about $1,435,000 per mile. Of this amount, $18,473,000 is for improvements in rural areas and the remainder is for portions of the plan in the incorporated areas of St. Paul, Minneapolis and adjacent suburban communities. These costs are included in the summaries of cost for rural and urban State trunk highways.

On 22 miles of the system where traffic now ranges up to 40,000 vehicles per day and future traffic in 20 years will exceed 70,000 vehicles per day, the need for construction is urgent. The estimated construction cost of this 22 miles is $81,076,000. It is inevitable that the highest costs occur in the built up areas of greatest congestion where right of way and building removal costs are a major factor. The estimated cost of the presently needed expressways averages $3,685,000 a mile, including railroad and highway separation structures, bridges, interchange facilities, rights-of-access and rights of way.

All of the routes included in the thoroughfare plan are now, or should be, a part of the State Trunk System. The primary responsibility for their construction should rest with the Department of Highways. However, because of the regional character of the plan and the interests of the many political subdivisions which it would serve, there is need for cooperative effort in planning and in establishment of a long-range financing policy. Only through such cooperative enterprise will it be possible to resolve the many questions of location, construction and financing. The problem is urgent. Congestion in the Twin City area is the number one traffic problem in the State today.

## Other Municipal Streets

Municipal streets other than urban extensions of trunk highways constitute 10,305 miles or about 87 per cent of the total street mileage in Minnesota municipalities. Of this mileage, 2,471 miles are arterial streets, 445 miles are business access streets, and the remaining 7,389 miles provide residential access. Twenty-nine per cent, or 3,013 of the 10,305 miles of other municipal streets are presently in need of improvement. The present construction needs are as follows:

### Selected Arterial Streets

| Character of Work | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| New construction | 96 | $ 7,116,000 | 35 |
| Reconstruction | 9 | 718,000 | 4 |
| Resurfacing and other | 469 | 12,677,000 | 61 |
| Totals | 574 | $20,511,000 | 100 |

### Business Access Streets

| Character of Work | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| New construction | 31 | $2,037,000 | 23 |
| Reconstruction | 10 | 1,279,000 | 15 |
| Resurfacing and other | 144 | 5,368,000 | 62 |
| Totals | 185 | $8,684,000 | 100 |

### Residential Access Streets

| Character of Work | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| New construction | 322 | $11,783,000 | 22 |
| Reconstruction | 69 | 2,371,000 | 4 |
| Resurfacing and other | 1,863 | 39,837,000 | 74 |
| Totals | 2,254 | $53,991,000 | 100 |

The principal deficiencies on municipal streets are inadequate surface type and condition. A limited mileage of arterials and business access streets are deficient in capacity and in need of widening. Capacity is a very minor problem on residential access streets. Of the 2,254 miles of residential access streets in need of improvement now, 1,631 miles are gravel or dirt surfaces in areas well occupied by homes. Provision of dustless surfaces and in some cases curb and gutter on this mileage accounts for 51 per cent of the current needs on residential access streets.

### Structures

In addition to the street deficiencies, the construction or reconstruction of 115 bridges and railroad separation structures and installation of protection devices at railroad grade crossings and other miscellaneous work for control of traffic is currently needed.

### Selected Arterial Streets

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $10,857,000 | 91 |
| Recondition present structures | 412,000 | 3 |
| Railroad protection and traffic control | 714,000 | 6 |
| Totals | $11,983,000 | 100 |

# TABLE III

## Construction Needs
## Rural Roads Other Than State Trunk Highways

| | Present Systems | | | Proposed Systems | |
|---|---|---|---|---|---|
| | State-aid | County-aid and County | Township | Primary County | Local Rural Roads |
| Existing Miles | 15,489 | 26,158 | 54,536 | 30,504 | 68,681 |
| Miles Tolerable Now | 7,547 | 14,572 | 40,499 | 15,122 | 49,634 |
| Per Cent | 49 | 56 | 74 | 50 | 72 |
| Miles Deficient Now | 7,942 | 11,586 | 14,037 | 15,382 | 19,047 |
| Per Cent | 51 | 44 | 26 | 50 | 28 |
| Cost of Present Needs | | | | | |
| Roadway | $ 82,868,000 | $ 82,576,000 | $ 54,091,000 | $156,618,000 | $ 84,208,000 |
| Structures | 15,501,000 | 14,813,000 | 11,484,000 | 30,416,000 | 15,656,000 |
| Total | $ 98,369,000 | $ 97,389,000 | $ 65,575,000 | $187,034,000 | $ 99,864,000 |
| Total Construction Requirements | | | | | |
| 5-Year Period | | | | | |
| Roadway | $100,197,000 | $ 97,373,000 | $ 56,413,000 | $211,787,000 | $ 86,758,000 |
| Structures | 18,480,000 | 17,187,000 | 13,272,000 | 35,919,000 | 18,342,000 |
| Total | $118,677,000 | $114,560,000 | $ 69,685,000 | $247,706,000 | $105,100,000 |
| 10-Year Period | | | | | |
| Roadway | $120,515,000 | $109,856,000 | $ 57,305,000 | $254,971,000 | $ 88,103,000 |
| Structures | 21,511,000 | 19,608,000 | 15,097,000 | 40,575,000 | 21,076,000 |
| Total | $142,026,000 | $129,464,000 | $ 72,402,000 | $295,546,000 | $109,179,000 |
| 15-Year Period | | | | | |
| Roadway | $144,939,000 | $124,956,000 | $ 58,362,000 | $296,523,000 | $ 89,803,000 |
| Structures | 24,620,000 | 22,105,000 | 16,979,000 | 45,325,000 | 23,889,000 |
| Total | $169,559,000 | $147,061,000 | $ 75,341,000 | $341,848,000 | $113,692,000 |
| 20-Year Period | | | | | |
| Roadway | $172,754,000 | $142,505,000 | $ 59,556,000 | $342,214,000 | $ 91,785,000 |
| Structures | 27,825,000 | 24,693,000 | 18,930,000 | 50,238,000 | 26,796,000 |
| Total | $200,579,000 | $167,198,000 | $ 78,486,000 | $392,452,000 | $118,581,000 |

### Business Access Streets

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $1,082,000 | 56 |
| Recondition present structures | 578,000 | 30 |
| Railroad protection and traffic control | 275,000 | 14 |
| Totals | $1,935,000 | 100 |

### Residential Access Streets

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $1,701,000 | 80 |
| Recondition present structures | 314,000 | 15 |
| Railroad protection and traffic control | 112,000 | 5 |
| Totals | $2,127,000 | 100 |

Besides the 3,013 miles of other municipal streets needing improvement now, an additional 5,300 miles will become deficient within 20 years, for the most part because of structural reasons. The table below shows the estimated mileage of future deficiencies by time period.

| System | Time Period | | | |
|---|---|---|---|---|
| | 5 Years | 5-10 Years | 10-15 Years | 15-20 Years |
| | (Miles) | (Miles) | (Miles) | (Miles) |
| Arterials | 316 | 238 | 174 | 108 |
| Business access | 60 | 60 | 70 | 50 |
| Residential access | 1,410 | 1,310 | 1,230 | 300 |

## County and Township Road Needs

Costs of improvements required to correct present and future deficiencies on the 96,183 miles of county and township roads are summarized in Table III for each of the present legal systems. Table III also shows the estimated costs of construction needs for the Proposed Primary County Road System and Local Road System recommended in Chapter 2. The costs for the Primary County Road System include the 3,000 miles of existing State trunk highways of local importance.

The costs of improvements to correct present deficiencies on the existing systems in each county is shown in the Appendix.

### State-aid Roads

Of the 15,489 miles of rural State-aid roads, 7,942 need improvement now. An additional eight miles of road, not now existing, are required, making a total of 7,950 miles on which a backlog of needed construction exists.

Classified by pavement types, the backlog of needed construction is as follows:

| Needed Pavement Type | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| High type pavement | 14 | $ 872,000 | 1 |
| Intermediate type pavement | 1,954 | 24,617,000 | 30 |
| Low type pavement | 3,107 | 37,908,000 | 46 |
| Gravel | 2,875 | 19,471,000 | 23 |
| Totals | 7,950 | $82,868,000 | 100 |

In addition to the roadway deficiencies, construction or reconstruction of 531 bridges and railroad separation structures and installation of protection devices at 16 railroad grade crossings is currently needed.

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $13,967,000 | 90 |
| Recondition present structures | 1,400,000 | 9 |
| Railroad grade crossing protection | 134,000 | 1 |
| Totals | $15,501,000 | 100 |

## County-aid and County Roads

Of the 26,158 miles classified as county-aid and county roads, 11,586 or 44 per cent are deficient now and in need of improvements. An additional 22 miles of road are required for traffic, making a total of 11,608 miles.

The backlog of needed construction classified by pavement types is as follows:

| Needed Pavement Type | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| Intermediate type pavement | 355 | $ 4,265,000 | 5 |
| Low type pavement | 1,502 | 18,799,000 | 23 |
| Gravel | 9,751 | 59,512,000 | 72 |
| Totals | 11,608 | $82,576,000 | 100 |

Construction or reconstruction of 792 bridges and railroad separation structures and installation of protection devices at 10 railroad grade crossings is currently needed on county-aid roads.

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $13,331,000 | 90 |
| Recondition present structures | 1,397,000 | 9 |
| Railroad grade crossing protection | 85,000 | 1 |
| Totals | $14,813,000 | 100 |

## Township Roads

There are 14,037 miles of existing township roads deficient now and in need of improvement. This mileage represents 26 per cent of the total 54,536 miles of township roads. In addition, another 31 miles of road are required making a total of 14,068 miles requiring improvement.

| Needed Pavement Type | Miles | Estimated Cost | Per Cent of Cost |
|---|---|---|---|
| Intermediate type pavement | 17 | $ 233,000 | – |
| Low type pavement | 112 | 1,243,000 | 2 |
| Gravel | 13,939 | 52,615,000 | 98 |
| Totals | 14,068 | $54,091,000 | 100 |

In addition to the roadway needs, reconstruction of 970 deficient bridges, including a few existing railroad separation structures and installation of protection devices at four railroad grade crossings are currently needed.

| Type of Work | Cost | Per Cent of Cost |
|---|---|---|
| New structures | $10,718,000 | 93 |
| Recondition present structures | 753,000 | 7 |
| Railroad grade crossing protection | 13,000 | – |
| Totals | $11,484,000 | 100 |

## Character of Present Deficiencies County and Township Roads

Construction needs on county and township roads consist chiefly of raising grade lines and flattening backslopes to facilitate snow removal, installation of drainage structures and resurfacing. Because of higher traffic volumes, 68 per cent of the mileage needing improvement on State-aid roads requires construction of dustless surfaces. In contrast, the mileage of dustless surface construction required on county-aid and county roads is only 21 per cent of the total mileage in need of improvement and on township roads is only two per cent.

## Future Problems— County and Township Roads

The table below shows the mileage of county and township roads which can be expected to become deficient for various reasons in the future:

| System | Time Period | | | |
|---|---|---|---|---|
| | 5 Years | 5-10 Years | 10-15 Years | 15-20 Years |
| | (Miles) | (Miles) | (Miles) | (Miles) |
| State-aid | 1,850 | 1,650 | 1,640 | 1,140 |
| County-aid | 1,790 | 1,050 | 1,070 | 930 |
| Township | 500 | 120 | 130 | 50 |

These future deficiencies principally involve replacements of bituminous surfaces now adequate, as they wear out and become obsolete, and reconstruction of a limited mileage of gravel roads to dustless surfaces to meet demands of future traffic increases. Reconstruction of gravel roads now deficient has been included under present needs. Future needs on gravel roads covers reshaping and regraveling as a part of maintenance activities.

Costs of this work are included as a part of the program costs presented in Chapter 5.

The ultimate extent and type of surfaces at the end of 20 years on county and township roads compared with existing surface types are shown in the table below.

The 14,000 miles of unsurfaced roads in the ultimate township road inventory consists of little used roads and trails.

## Examples of County and Township Road Deficiencies

The following are typical examples of needed improvements found in the appraisal of county and township roads.

### State-aid Road 4—Ottertail County Road Section 2034

This section of road extends from Vergas southwesterly six miles to Lake Lida. Traffic averages 245 vehicles per day. The road serves as a school bus, mail and milk route. It is used by recreational traffic during the summer months. The present surfacing is gravel.

In comparison with tolerable standards, the road is deficient in surface type, alignment, gradients and drainage. The grade line is low and steep backslopes increase the snow removal problem.

The proposed improvement consists of raising the grade line, minor regrading to correct alignment deficiencies and constructing a bituminous surface 24 feet in width. The estimated cost is $133,000 or $22,000 per mile.

### County-aid Road 56—Meeker County Road Section 246

County-aid road 56 in Meeker County extends from State-aid Road 23 northerly five miles to Grove City. It carries an average daily traffic of 75 vehicles. It is surfaced with gravel on a 22 foot roadbed. The grade line is low and, as evidenced by the accompanying picture, the lack of drainage results in poor subgrade conditions.

It is proposed to reconstruct the road to a modern cross section 24 feet in width and resurface with gravel. The estimated cost for the five mile section is $26,000 or $5,200 per mile.

### Township Road—Pine County Road Section 35

This section of township road has a traffic of 20 vehicles per day. It terminates one mile beyond the point at which the accompanying picture was taken and is the only outlet for four farms.

The road has a low grade line, poor drainage and narrow width. Because of these conditions, maintenance is difficult in wet weather and during the winter months.

| Pavement Type | State-aid | | County-aid and County | | Township | |
|---|---|---|---|---|---|---|
| | Existing (Miles) | Ultimate (Miles) | Existing (Miles) | Ultimate (Miles) | Existing (Miles) | Ultimate (Miles) |
| High type pavement | 69 | 68 | 20 | 18 | 9 | 9 |
| Intermediate type pavement | 1,912 | 5,197 | 550 | 2,082 | 61 | 65 |
| Low type pavement | 682 | 5,611 | 322 | 3,806 | 209 | 461 |
| Gravel | 12,472 | 4,574 | 23,212 | 19,550 | 35,025 | 40,013 |
| Unsurfaced | 354 | 47 | 2,054 | 724 | 19,232 | 14,019 |
| Totals | 15,489 | 15,497 | 26,158 | 26,180 | 54,536 | 54,567 |

It is proposed to reconstruct the road to a grade width of 20 feet, raising the grade line above the natural ground line to provide drainage and resurfacing with gravel. The estimated cost is $3,500.

## The Federal-aid System

Present construction needs on the Federal-aid Systems total $388,340,000, or about 57 per cent of the total backlog needs on all roads and streets. Since these systems are administrative in nature and consist of portions of the legal systems of roads and streets, the Federal-aid System needs are a duplication of and not in addition to the needs previously discussed.

### The National System of Interstate Highways

Immediate needs on routes included in the National System of Interstate Highways total $89,745,000 of which $10,307,000 is for structures. All of these needs are included in the State Trunk System needs. Seventy-one per cent of these needs are in urban areas; the balance in rural areas.

### The Federal-aid Primary System

Exclusive of the needs on Interstate routes, which are a part of the Federal-aid Primary System, needs on this system total $181,477,000, of which $39,257,000 is for structures. All of the Federal-aid Primary System mileage is located on State trunk highways. Of the existing needs, 75 per cent are in rural areas and 25 per cent in urban areas.

### The Federal-aid Secondary System

The total cost of existing needs on the Federal-aid Secondary System is $117,118,000, of which $20,534,000 is for structures. Of the total $38,209,000 are costs for needed improvements on Federal-aid Secondary routes on the State Trunk System, and the balance is for Federal-aid secondary routes on other roads and streets.

## Average Costs

The average cost of presently needed improvements on rural State trunk highways is $57,900 per mile exclusive of structures. The average cost of State-aid roads is $10,400 per mile, for county-aid and county roads $7,100 per mile and for township roads, $3,900 per mile.

By character of work, the average costs on each system are as follows:

**Cost Per Mile—Rural**

| Character of Work | State Trunk System | State-aid | County-aid and County | Township |
|---|---|---|---|---|
| New 2-lane construction | $95,000 | $12,100 | $9,000 | $5,600 |
| Reconstruction ..... | 39,000 | 10,900 | 7,300 | 4,400 |
| Resurfacing and other .. | 28,500 | 7,700 | 3,700 | 1,500 |

The cost of converting two-lane State trunk highways to four-lane divided facilities averages $106,000 per mile. Cost of a limited mileage of new four-lane divided highways averages $376,000 per mile.

The average cost of presently needed improvements on existing urban State trunk highways is $125,700 per mile. In the three first class cities the average cost is $205,500 per mile, in cities of 5,000 to 30,000 population, $125,000 per mile, and in cities under 5,000, $96,000 per mile. For the proposed Twin City expressway system costs average $1,150,000 per mile for 153 miles of four-lane construction and $3,750,000 per mile, for 19 miles of six-lane construction.

Costs for improvements of other city streets range from an average of $143,500 per mile for improvement of arterial streets in first class cities to $12,000 per mile for residential street construction in cities of under 5,000 population.

## Summary

Of the total of 121,022 miles of roads and streets in the State today, 39,592 miles are below tolerable standards and in need of immediate improvement. In addition, there are 2,800 inadequate bridges.

It will require considerable time to overcome this backlog of needed construction. During that time the future needs discussed in this chapter will accumulate and continued costs of maintenance and administration must be provided for. Chapter 5 will cover these items and present alternate long-range programs for each of the several systems, present and proposed.

Chapter 5

# Programs

LONG-RANGE ALTERNATIVE PLANS

It has been shown in Chapter 4 that the capital investment required to overcome the backlog of needed construction on all roads and streets is $681 million. This is the amount required to bring the State's road and street network up to standards adequate for today's traffic. Total expenditures for all roads and streets for all purposes in 1952 were $142 million. Even were funds available, it would be impossible to accomplish a construction program of this magnitude within a few years. Time needed for preparation of plans and getting rights of way would make it physically impossible.

Obviously the work must be spread over a period of years. During this period, the total highway plant must be maintained and the needs of the future met as they arise.

The selection of a proper program period depends on fiscal and economic factors which are decisions to be made by the Legislature and related to fiscal policies.

Alternate program periods of 5, 10, 15, and 20 years are presented in this chapter. Most people would not consider a five year program feasible, yet it is impractical to delay major needed improvements for 20 years. The choice lies between the two extremes and depends largely on the ability and willingness of the people to pay the costs.

Since total needs, service provided and fiscal policies vary for each system, separate consideration must be given each system.

Annual costs for each program period, in addition to the amount required to overcome present deficiencies, provide for (1) future needs, including replacements and stop-gaps, (2) maintenance and (3) administration. The annual costs are averages for the program periods and comparisons to income should be made to average anticipated income during a program period rather than to current income.

## Future Needs and Replacements

Many roads and streets adequate today, and not included in the backlog of needs, are going to become deficient in five years, an additional number in 10 years, and still more in 15 years. Traffic increases will make some obsolete. Pavements will wear out and require reconstruction.

Nearly all road and street construction today involves replacement of existing facilities. The replacement rate on the State Trunk System is shown in the chart on page 48. Since establishment of the system in 1921, it has grown in size from 6,877 miles to 11,850 miles. The total miles of construction, by the State, since 1921 has accumulated to 36,238. On the average, each mile has been improved about three times or approximately once every 10 years. Not all of the mileage involved complete reconstruction. Some resulted from improvement of a road in "stages", that is, grading one year, base and initial surfacing a second year, and a finished wearing surface later. Other mileage involved only light resurfacing.

In any case, no road improvement is permanent. With the passage of time, roads become obsolete or deteriorate to a point where reconstruction in some degree becomes an economic necessity.

In any long-range program, some of the improvements which are constructed in early years of the program will wear out and require resurfacing again before the end of the program period. Provisions for these "second generation" replacements are also included in the annual program costs.

As the length of the program period increases, the longer some of the presently needed construction will have to be postponed. Many immediately needed improvements cannot be deferred for several years without disruption to travel. Some stop-gap measures of a temporary nature will be required to keep such facilities in service until the required construction can be undertaken. Also, the longer the program is extended, the greater will be the total amount of funds required. Annual program costs include up to a maximum of three-fourths of one per cent for stop-gap improvements.

Future needs on the State Trunk System and city arterials were determined project for project during the field appraisal as explained in Chapter 12. Future replacement needs on all other roads and streets were estimated by the engineering staff. These estimates were based on analysis of the rates at which different types of pavements wear out or become obsolete, and are being replaced. Costs of future needs are indicated in Chapter 4 for each class of roads and streets.

## Maintenance

The annual costs for various program periods include allowance for maintenance based on past experience and the extent and nature of improvements required on each of the several systems.

Road and street maintenance is of utmost importance in preserving the large capital investment in the highway plant. The higher the standard of highway facility, the greater the investment and, consequently, the greater is the need to protect it.

Maintenance costs, as have most other costs, have increased considerably during the last several years, partly because of increased costs of labor, equipment and materials and partly to increased travel and to the constantly higher standards of traffic service, convenience and safety demanded by the public.

Maintenance costs as normally recorded by the State and local governments include betterments to highway and street facilities accomplished by maintenance forces. Betterments are actually minor capital additions and for this study have been charged to construction as stop-gap improvements.

State expenditures for maintenance, exclusive of overhead charges and betterments, currently amount to almost $12 million a year. Maintenance expenditures by counties on State-aid and county-aid roads are approximately $17 million a year. Similar expenditures for township roads exceed $6 million a year and for city streets total $14 million a year. The total maintenance expenditure is almost $50 million a year and represents about 35 per cent of the annual expenditure for all highway purposes.

Present standards of maintenance have been used as a basis for estimating future maintenance requirements. Average costs for maintenance of each of the various surface types, as reported by the State, counties and cities, were applied to the average number of miles of each type of surface in each program period. The increase in mileages of higher type surfaces, the wider widths of right of way, road bed and surfaces resulting from new construction will increase future maintenance costs. Replacement of older pavements, which have deteriorated structurally and require above average maintenance to keep in service, will tend to offset the increases resulting from higher construction standards. For example, it is estimated the combined effect of the compensating factors will increase present maintenance expenditures on the State Trunk System eight per cent on the average in the next five years, 12 per cent in 10 years, and 15 percent in 15 years.

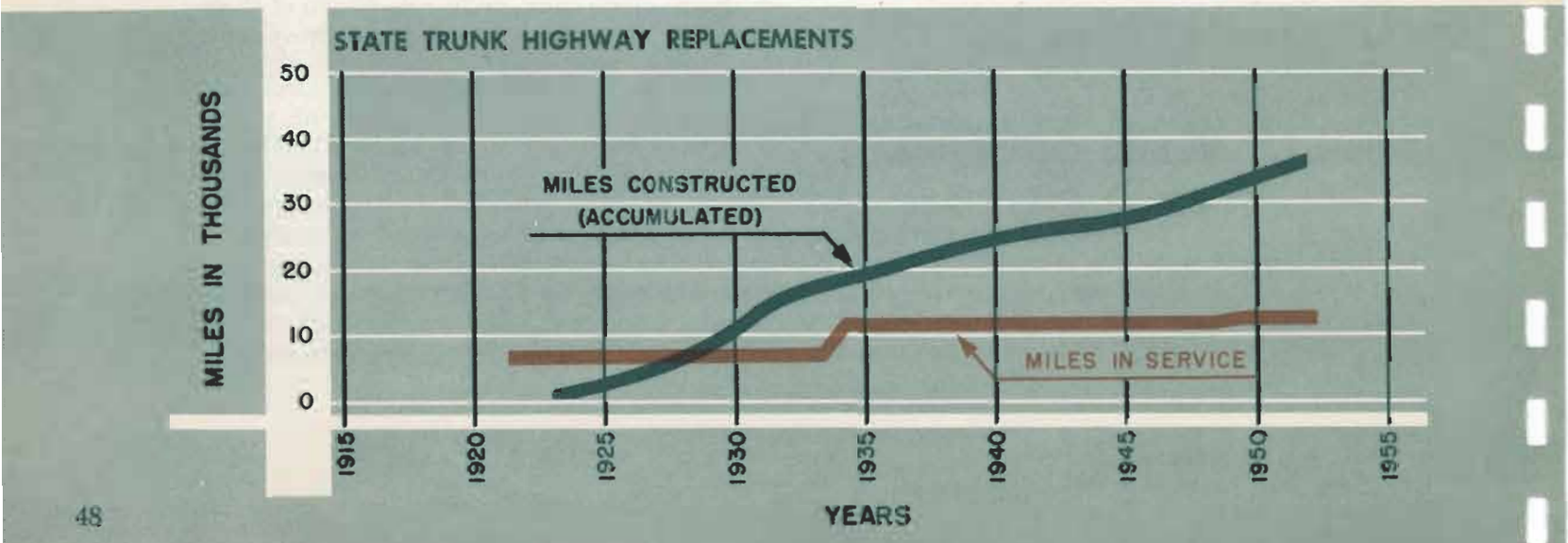
## Administration Costs

The annual program costs for construction and maintenance include direct engineering and supervision. They do not include the costs of general management, personnel, materials and research, legal, services and stores, buildings, and the like. Those costs are included separately in the annual program cost calculations as administrative expenses.

Estimated amounts for administration have been calculated on a percentage basis of the total construction and maintenance costs for each system. The percentage allowance varies by systems based on experience.

The percentages ranged from a maximum of six per cent on the State Trunk System to one per cent in cities of less than 5,000 population.

*On the average, each mile of the State Trunk System has been improved three times since 1921, or approximately once every 10 years.*



# TABLE I

## Program Costs
## State Trunk Highways

| System | Annual Costs for 5-Year Program | 10-Year Program | 15-Year Program | 20-Year Program |
|---|---|---|---|---|
| **Existing State Trunk** | | | | |
| Rural | | | | |
| Present Needs | $ 36,286,000 | $18,143,000 | $12,095,000 | $ 9,072,000 |
| Future Needs & Replacements | 16,193,000 | 15,777,000 | 14,572,000 | 12,808,000 |
| Maintenance & Operations | 13,594,000 | 12,574,000 | 12,223,000 | 11,958,000 |
| Total Rural | $ 66,073,000 | $46,494,000 | $38,890,000 | $33,838,000 |
| Urban | | | | |
| Present Needs | $ 27,878,000 | $13,939,000 | $ 9,293,000 | $ 6,970,000 |
| Future Needs & Replacements | 16,317,000 | 14,542,000 | 13,798,000 | 12,987,000 |
| Maintenance & Operations | 5,882,000 | 5,061,000 | 4,861,000 | 4,793,000 |
| Total Urban | $ 50,077,000 | $33,542,000 | $27,952,000 | $24,750,000 |
| Total | | | | |
| Present Needs | $ 64,164,000 | $32,082,000 | $21,388,000 | $16,042,000 |
| Future Needs & Replacements | 32,510,000 | 30,319,000 | 28,370,000 | 25,795,000 |
| Maintenance & Operations | 19,476,000 | 17,635,000 | 17,084,000 | 16,751,000 |
| Total Rural and Urban | $116,150,000 | $80,036,000 | $66,842,000 | $58,588,000 |
| **Proposed State Trunk** | | | | |
| Rural | | | | |
| Present Needs | $ 31,173,000 | $15,587,000 | $10,391,000 | $ 7,793,000 |
| Future Needs & Replacements | 11,329,000 | 12,250,000 | 12,037,000 | 10,848,000 |
| Maintenance & Operations | 11,146,000 | 10,357,000 | 10,117,000 | 9,912,000 |
| Total Rural | $ 53,648,000 | $38,194,000 | $32,545,000 | $28,553,000 |
| Urban | | | | |
| Present Needs | $ 27,286,000 | $13,643,000 | $ 9,095,000 | $ 6,822,000 |
| Future Needs & Replacements | 15,297,000 | 13,807,000 | 13,276,000 | 12,585,000 |
| Maintenance & Operations | 5,438,000 | 4,653,000 | 4,471,000 | 4,414,000 |
| Total Urban | $ 48,021,000 | $32,103,000 | $26,842,000 | $23,821,000 |
| Total | | | | |
| Present Needs | $ 58,459,000 | $29,230,000 | $19,486,000 | $14,615,000 |
| Future Needs & Replacements | 26,626,000 | 26,057,000 | 25,313,000 | 23,433,000 |
| Maintenance & Operations | 16,584,000 | 15,010,000 | 14,588,000 | 14,326,000 |
| Total Rural and Urban | $101,669,000 | $70,297,000 | $59,387,000 | $52,374,000 |

The allowance for administration costs for the State Trunk System, present and proposed, does not include costs for the Safety Division of the Highway Department which handles the highway patrol and driver examination and licensing, or of the Motor Vehicle Department. Costs for these activities, now carried in the Department of Highways' budget are approximately $2,250,000 annually.

## Effect of Prices

Program costs are based on 1953 prices. No attempt has been made to adjust to future price levels. Any increase or decrease in highway construction and maintenance costs will require a corresponding adjustment in program costs and financing if the recommended program is to be accomplished within a set time period. An increase in costs without a proportionate increase in revenues, for instance, would extend the time period required to accomplish the construction needs included in a given program period.

Periodic review of the programs may be necessary to make adjustments to conform with changes in price levels.

## Program Selection

Annual program costs for each system are presented in such a manner as to provide several alternatives for consideration. Selection of the proper program period for each system must be dependent upon the recommendations of the separate highway finance study, the relative urgency of needs, and the benefits to be received.

A long program period will postpone some of the improvements needed today for many years. A short program period, while accelerating the accomplishment of backlog needs, will increase the annual financial requirements. The Highway Study Commission may find it desirable to recommend different program periods for different classes of roads and streets.

# TABLE II

## Program Costs
## County and Township Roads

| System | Annual Costs For | | | |
|---|---|---|---|---|
| | 5-Year Program | 10-Year Program | 15-Year Program | 20-Year Program |
| State-aid Roads | | | | |
| Present Needs | $19,674,000 | $ 9,837,000 | $ 6,558,000 | $ 4,918,000 |
| Future Needs & Replacements | 4,061,000 | 4,366,000 | 4,746,000 | 5,111,000 |
| Maintenance & Operations | 8,261,000 | 8,165,000 | 8,146,000 | 8,149,000 |
| Total | $31,996,000 | $22,368,000 | $19,450,000 | $18,178,000 |
| County-aid and County Roads | | | | |
| Present Needs | $19,478,000 | $ 9,739,000 | $ 6,493,000 | $ 4,869,000 |
| Future Needs & Replacements | 3,434,000 | 3,208,000 | 3,311,000 | 3,491,000 |
| Maintenance & Operations | 9,731,000 | 9,615,000 | 9,595,000 | 9,600,000 |
| Total | $32,643,000 | $22,562,000 | $19,399,000 | $17,960,000 |
| Township Roads | | | | |
| Present Needs | $13,115,000 | $ 6,558,000 | $ 4,372,000 | $ 3,279,000 |
| Future Needs & Replacements | 822,000 | 682,000 | 651,000 | 645,000 |
| Maintenance & Operations | 6,558,000 | 6,494,000 | 6,477,000 | 6,470,000 |
| Total | $20,495,000 | $13,734,000 | $11,500,000 | $10,394,000 |
| Proposed Primary County Roads | | | | |
| Present Needs | $37,407,000 | $18,703,000 | $12,469,000 | $ 9,352,000 |
| Future Needs & Replacements | 12,134,000 | 10,852,000 | 10,321,000 | 10,271,000 |
| Maintenance & Operations | 15,840,000 | 15,415,000 | 15,277,000 | 15,227,000 |
| Total | $65,381,000 | $44,970,000 | $38,067,000 | $34,850,000 |
| Proposed Local Rural Roads | | | | |
| Present Needs | $19,973,000 | $ 9,986,000 | $ 6,658,000 | $ 4,993,000 |
| Future Needs & Replacements | 1,047,000 | 932,000 | 922,000 | 936,000 |
| Maintenance & Operations | 11,158,000 | 11,076,000 | 11,047,000 | 11,038,000 |
| Total | $32,178,000 | $21,994,000 | $18,627,000 | $16,967,000 |

### Programs for State Trunk Highways

Annual program costs for 5, 10, 15 and 20 year periods are summarized in Table I for the existing State Trunk System and the Proposed State Trunk System. The estimated amounts are broken down to show requirements to meet present needs, future needs and replacements and for maintenance and operations. The total annual cost for a 15-year period is $66,842,000 for the present system and $59,387,000 for the proposed system which has less mileage.

To overcome the existing backlog of needs in 10 years and meet requirements for future needs, maintenance and operation would require an increase of 19 per cent over 15-year annual costs on the present State Trunk System and 18 per cent on the proposed system, or an annual average cost of $80,036,000 and $70,297,000 respectively.

### Programs for County and Township Roads

Table II shows annual program costs for existing State-aid, county-aid and county and township roads and for the Proposed Primary County System and local rural roads.

The program costs for township roads and local rural roads are presented primarily as a guide to over-all fiscal considerations. These roads are now largely financed from local funds. The rate of future improvement, as it has been in the past, will be dependent on the desires of local people for road improvement and the extent of financing by those directly concerned. This is true to a lesser extent for county roads which are now partly financed from gasoline tax funds and Federal aid. The amount of funds raised locally will materially affect the length of the program period which will vary county by county.

Were the proposed reclassification plan placed in effect, the annual program costs for the Proposed Primary County Road System, although smaller in total mileage, would be about the same as the combined total for the existing State-aid and county-aid systems. This is because of the inclusion of 3,000 miles of present State trunk highways at relatively higher costs per mile.

The annual 15-year program costs for the Proposed Local Rural Roads would be approximately $7 million higher than those for the existing township road system by reason of the larger mileages involved.

# TABLE III

## Program Costs Municipal Streets

| System | Annual Costs For | | | |
|---|---|---|---|---|
| | 5-Year Program | 10-Year Program | 15-Year Program | 20-Year Program |
| All Municipal Streets (Except Existing State Trunk Highways) | | | | |
| Present Needs | $19,846,000 | $ 9,923,000 | $ 6,614,000 | $ 4,961,000 |
| Future Needs & Replacements | 10,308,000 | 10,947,000 | 10,574,000 | 10,429,000 |
| Maintenance & Operations | 16,413,000 | 16,291,000 | 16,231,000 | 16,205,000 |
| Total | $46,567,000 | $37,161,000 | $33,419,000 | $31,595,000 |
| Proposed City Arterials | | | | |
| Present Needs | $ 7,091,000 | $ 3,545,000 | $ 2,364,000 | $ 1,773,000 |
| Future Needs & Replacements | 6,157,000 | 5,913,000 | 4,865,000 | 4,234,000 |
| Maintenance & Operations | 5,072,000 | 4,977,000 | 4,914,000 | 4,897,000 |
| Total | $18,320,000 | $14,435,000 | $12,143,000 | $10,904,000 |
| Proposed Business Access Streets | | | | |
| Present Needs | $ 2,124,000 | $ 1,061,000 | $ 707,000 | $ 532,000 |
| Future Needs & Replacements | 657,000 | 737,000 | 813,000 | 863,000 |
| Maintenance & Operations | 809,000 | 789,000 | 783,000 | 780,000 |
| Total | $ 3,590,000 | $ 2,587,000 | $ 2,303,000 | $ 2,175,000 |
| Proposed Residential Access Streets | | | | |
| Present Needs | $11,223,000 | $ 5,613,000 | $ 3,741,000 | $ 2,805,000 |
| Future Needs & Replacements | 4,514,000 | 5,032,000 | 5,418,000 | 5,733,000 |
| Maintenance & Operations | 10,976,000 | 10,933,000 | 10,924,000 | 10,907,000 |
| Total | $26,713,000 | $21,578,000 | $20,083,000 | $19,445,000 |

As discussed in Chapter 2, decisions with respect to reclassification and long-range programs for development must be firmly coupled with an equitable finance plan.

## Programs for Municipal Streets

In a similar manner to the table for the rural road systems, Table III summarizes program costs for municipal streets other than urban extensions of State trunk highways. Those streets are now largely the responsibility of cities and villages. A limited amount of Federal and county funds are used for capital improvements under special agreements. Counties have a legal responsibility for maintenance of designated State-aid and county-aid extensions.

As in the case of township roads, the program costs for access streets are presented primarily to provide a total picture of the highway and street problem. Actual programs for access street improvement will vary widely from city to city, depending largely on the ability and desire of the local people to finance needed work.

Arterial street programs also will vary from city to city depending on the local finance structure, extent of needs, and use of borrowings.

## Comparative Costs

For comparison, the annual cost per mile for improving, maintaining and operating each class of road and street over a 15-year period is shown in the following table. Also shown are the average costs per vehicle mile of total travel estimated to occur in the 15-year period.

### Comparative Costs by Systems 15 Year Period

| System State Trunk Highways | Average Cost Per Mile Per Year | Cost Per Vehicle Mile of Travel (Cents Per Vehicle Mile) |
|---|---|---|
| Rural | $ 3,750 | 0.75 |
| Urban | 19,150 | 1.01 |
| All Trunk Highways | 5,650 | 0.84 |
| State-aid Roads | 1,250 | 1.95 |
| County-aid and County Roads | 750 | 2.98 |
| Township Roads | 200 | 3.01 |
| Municipal Streets (Other than State Trunks) | 2,350 | 1.18 |
| All Roads and Streets | 1,300 | 1.18 |

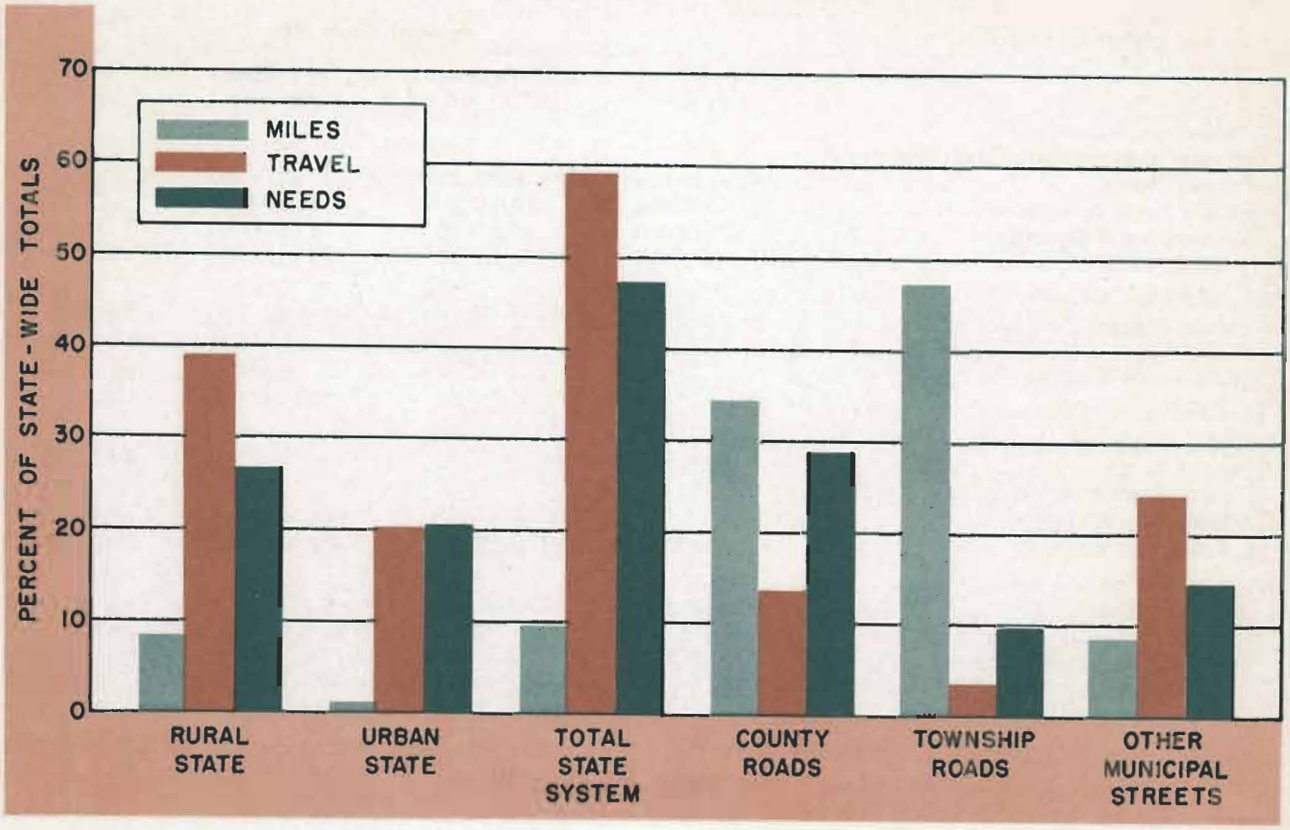
While annual costs per mile are highest on the State Trunk System, rural and urban, the cost per vehicle mile of travel is the least. It is on that system the greatest benefit per dollar of expenditure will occur.

## Priorities of Improvement

Establishing proper priorities for control of long-range programs is necessary so that the more urgent work can be accomplished as promptly as possible with the revenues available.

Adequate maintenance must have first priority on available funds from the standpoint of protect-

## COMPARISON OF MILES, TRAVEL AND PRESENT NEEDS ON THE VARIOUS CLASSES OF ROADS AND STREETS




ing and preserving the large investment in the highway plant. Construction programs can only take up remaining balances.

Factors influencing the establishment of priorities for construction programs may be classified in two categories; (1) those involving the relative importance between systems and (2) those involving the relative importance of individual projects and the order in which their needs should be accomplished.

The first category is one for consideration by the Highway Study Commission and the legislature. The second category is the responsibility of the highway administrators. Selection of specific improvement projects within each system's annual construction budget involves variables which cannot be expressed realistically through legislation.

To permit scheduling of surveys, plan preparation and right of way acquisition well in advance of construction, tentative construction programs should be developed three to five years ahead and reviewed annually.

### System Priorities

While all roads and streets are important to an integrated highway transportation network, the several classes of roads and streets vary in importance with the amount and type of service they give. In addition, the relative size and character of the backlog needs—that is, the extent of present deficiencies—must be considered in establishing priorities between systems.

The accompanying chart shows a comparison of miles, travel and cost of present construction needs by existing systems. While comprising only 10 per cent of the total road and street mileage, the State Trunk System serves 60 per cent of all travel. Almost one-half of the $681 million cost for present needs is for correction of existing deficiencies on this system.

While greatest benefits would come from accelerating improvement of State trunks, it must be recognized that a balanced transportation network also requires that deficiencies on other classes of roads and streets be overcome—possibly at a slower rate—but as rapidly as possible consistent with total revenues available.

### Priorities Within Systems

In Chapter 4, the backlog of present construction needs was presented for each system of roads and streets. Projects comprising this backlog on each system should be given first priority in program development. They represent the most critical needs now existing.

Since the $681 million backlog is far greater than can be overcome in a few years, the establishment of project priorities for each system is essential to insure accomplishment of the more urgent needs first.

Selection of specific projects to comprise the annual improvement program should, as previously stated, be the responsibility of the various highway administrators.

A number of factors influence establishment of project priorities. These include:

- Present condition of the facility
- Volume and character of traffic service
- Necessity for area distribution of work
- Availability of material, equipment, labor and contractors
- Emergency needs caused by floods or other disasters
- National defense requirements
- Technical difficulties in the preparation of plans, the procurement of rights of way, and the award of contracts
- Climatic conditions.

Other lesser factors such as maintenance costs, accident frequency and new developments call for new or improved highway facilities.

The importance of each of the above factors varies from project to project. Those applicable to a specific case must be carefully considered in annual program formulation to insure the most progress in highway development.

### State Trunk Highways

Annual program costs for urban portions of the existing State Trunk System are approximately 42 per cent of the total annual costs. On the Proposed State Trunk System, the portion of the total cost for urban extensions is 45 per cent. Current expenditures on State trunk highways in cities are only 20 per cent of the total annual expenditures on the entire system.

In the selection of program periods for overcoming present and future needs on the trunk system, existing or proposed, consideration should be given to accelerating the rate of progress on overcoming the backlog of urban needs in order to bring the entire system into better balance from a traffic service standpoint.

Of particular importance is the need for an early start on the proposed Twin City Major Thoroughfare Plan. Considerable time will be required for the engineering investigations to establish specific locations, make surveys, prepare plans and acquire rights of way. Until the essential preliminary phases are well under way and more detailed information is ready, decisions on specific priorities for improvement are not practical.

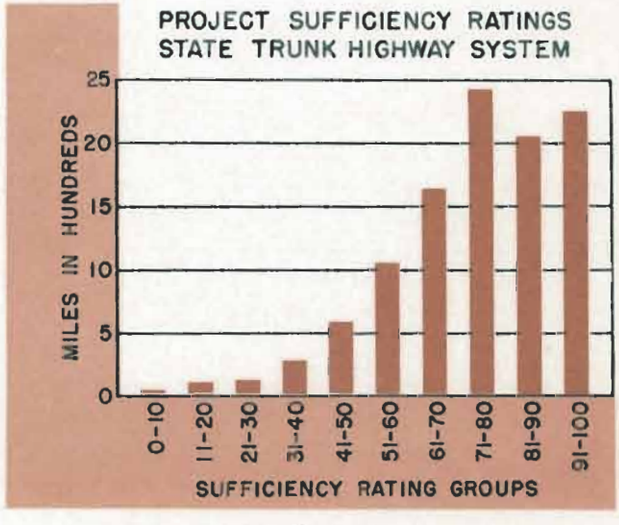
### Sufficiency Ratings

A useful tool to the highway administrator in the development of annual construction programs is the sufficiency rating procedure. This is a device for comparing sections of highway against standard rating elements by assigning numerical values representative of actual conditions as measured by the standards.

The Department of Highways has developed a sufficiency rating procedure for use on rural portions of the State Trunk System. This sufficiency rating is composed of four elements with par values as follows:

| | Par Value |
|---|---|
| Structural Factor as measured by spring load restrictions | 30 points |
| Traffic Capacity Factor | 30 points |
| Maintenance Cost Factor | 30 points |
| Accident Frequency Factor | 10 points |
| | 100 points |

Each section of trunk highway is rated against each of the four basic elements. The combined result is a numerical index of the adequacy or sufficiency of the road to serve traffic. Thus, any given section may be rated from 0 to 100 depending on its degree of adequacy. The lower the rating, the poorer the condition and the more urgent the need for improvement.




The accompanying chart shows the miles of rural State trunk highways by various sufficiency rating groups. These 1952 ratings do not necessarily reflect the actual condition of any section

of the Trunk System, as of the time of appraisal because of construction changes and progressive deterioration. The average sufficiency rating for all rural trunk highways in 1952 was 75.

The 2,669 miles of rural trunk highways found to be intolerable in the appraisal have been analyzed in relation to the 1952 sufficiency ratings. It was found the average rating on the intolerable sections, representing present construction needs, was 65.

Use of the established sufficiency rating procedure to assist in the selection of road sections most urgently in need of improvement will aid in the development of well-planned, orderly annual programs. Periodic recomputation of sufficiency ratings will be necessary to reflect current conditions and for the purpose of measuring progress on the long-range needs.

Program development is not a mechanical procedure, however, and sufficiency ratings, while a valuable tool, represent only one of several factors previously outlined which must be considered in establishing priorities.

### County Roads

In the development of annual construction programs in each county, priority should be given to projects involving dustless surface construction. Over two-thirds of the presently needed improvements on the State-aid system are for work of this character.

Currently, neither sufficiency ratings nor any other priority tool is being used uniformly by the counties in the development of annual construction programs. Experience elsewhere has indicated that sufficiency rating techniques can be adapted to the determination of project priorities within a county. The results would be as valuable to local officials as they are to the State.

## Conclusions

The alternative programs set up in this chapter afford the Highway Study Commission and the State and local law making agencies opportunity to readjust their fiscal policies to the needs of highways and streets logically under their jurisdictions. Doing this will assure steady progress in the improvement of the several systems in accordance with their importance and in keeping with the financial ability of the State, cities, counties and townships. The integrated program for the entire network of highways and streets will work to the mutual advantage not only of the several governments but of all citizens of the State.

The vast amount of data assembled and analyzed in this study is available for the use of the highway agencies. This data should be utilized in establishing priority programs for each class of highway so that critical deficiencies can be eliminated in proper turn and the greatest benefits from the highway dollar achieved.

Chapter 6

# Management

ADMINISTRATION AND COORDINATION OF HIGHWAY AGENCIES

Management of the highway and street systems is controlled by the basic policies fixed by the lawmaking bodies of State, local and Federal governments. Even the best administrative agency can be severely handicapped by inadequate or inconsistent legislative provisions. Conversely, good laws cannot overcome all deficiencies when there is understaffed or poorly organized administration. The public's greatest values from highway investment come when legislative provisions are sound, and when intent is clear and broad management responsibilities are well defined.

Minnesota legislative bodies early recognized that the highway management function requires engineering direction. The result has been a generally high level of engineering and administrative leadership in State, county and city highway management.

However, analysis of all phases of the problem of meeting needs adequately and efficiently shows serious consideration should be given to revision of some policies and practices. Some of the desirable basic policy revisions have been discussed under the subjects of Classification and Programs. This chapter discusses further needs affecting management.

## Legislative—Administrative Relations

This study has been concerned with major elements of the highway problem. Laws have been reviewed sufficiently to determine that it would be highly profitable to examine each item of the statutes to determine its adequacy or necessity and to ultimately undertake a complete recodification of all laws affecting highway development based on such a study.

A few examples illustrate how laws can become outmoded or conflicting.

One section of the law (Subd. 4, Section 161.02) fixes salaries of bookkeepers, stenographers and draftsmen at rates which are inconsistent with current provisions and authority of the Civil Service Act. A salary is also fixed for an Assistant Commissioner of Highways.

An example of an outmoded section is found in Section 160.63 which prohibits blowing of a traction engine whistle within 500 feet of a team passing on the highway.

Another section (Section 160.03) sets a minimum width of bridges on trunk highways and State-aid roads. While such a limitation may be desirable, in practice all design features should be determined on the basis of their necessity to serve traffic efficiently and safely. Decisions on all design features more properly belong in the standards and regulations imposed by administrative authority rather than by law.

Those and many other questionable provisions point to the need for a review of all provisions by a properly authorized agency in cooperation with responsible public officials leading to recommendations to the legislature for necessary and desirable changes in highway laws.

The most effective working relationship is one wherein the legislature defines its policy with respect to system responsibilities, establishes firm fiscal policy, coordinates both with provisions of the Constitution, gives broad latitude and authority to the administrative bodies and requires an accurate reporting and accounting of progress made in achievement of the goals established by legislation.

## State Highway Management

For nearly four decades, management of the State Trunk System has been under the direction of the Commissioner of Highways. Under assignment of responsibility and broad policy set by legislative enactments, he has been responsible for the formation of detailed policies affecting the organization of the highway department and the functions performed. His authorities extend beyond the Trunk System to certain controls over present State-aid systems. Also, he has authority over urban portions of the Trunk System, so that to a major degree urban highway development is effected by programs carried out under his direction.

This single executive type of management, used in 14 states, is recognized as being effective when

competent men are selected. This method affords opportunity for expeditious action unhampered by sometimes unwieldly or slow moving commissions.

On the premise that Minnesota will continue its traditional policy of having capable executives in office without pressure to unbalance programs and policies, it is recommended that the present management form be retained.

All functions shown separately are being performed by the highway department. It is the intent here to discuss only revisions in engineering organization or functions which need greater emphasis. It is always possible to organize in a variety of ways and still achieve effective results. Therefore, specific internal organizational plans are secondary in importance to certain basic management requirements.

A first essential is to have a soundly conceived plan of organization, with well-defined responsibilities, to have proper balance and coordination in all functions. In an organization as large as a highway department, this requires detailed study and analysis and periodic revision to meet changing conditions.

Another essential is procurement and assignment of sufficient trained personnel to carry out the assigned functions.

## Personnel Problem

The highway program in Minnesota is at its highest level in history and if present and future needs are to be met it will get larger. Even to meet today's requirements efficiently, there is a shortage of trained personnel. Of immediate concern is the serious shortage of engineers in the younger age groups. Many engineers of senior grade will soon reach retirement age.

Steps should be taken promptly to redefine all engineering position duties and responsibilities, delegating as much responsibility as possible to the lower grades. This has the decided advantage of relieving men in the highest positions of detail which takes valuable time away from determination of broad policies and major decisions.

Another step needed is increasing the number of positions which are secondary to principal division or department heads. The men should be given incentives and responsibilities which permit them to competently take over top positions as normal retirements occur. A successful organization must be more than one man deep.

### Functions
### Minnesota Department of Highways

- General Administration
  - Accounting Procedures and Controls
  - Purchasing
  - Administrative Services—
    - Office Management
    - Communications
    - Building Services, etc.
- Construction
  - Advance Planning and Programming
  - Location and Design
  - Right of Way Acquisition
  - Control of Materials
  - Construction Engineering and Inspection
- Operations
  - Control and Guidance of Traffic
- Maintenance
  - Preservation of All Facilities

Civil Service regulations should be reviewed in light of the great urgency of immediately increasing the availability of qualified personnel and in permitting personnel advances in a manner best serving department requirements. Today when there are so many engineers being attracted to private industry, the only hope to meet the large public requirements is to adjust Civil Service provisions in a manner which will meet competition.

The table on this page of registered engineers by age groups shows the necessity for a well developed plan of personnel recruitment and ad-

### Civil Service Classification By Age
### Department of Highways

| Age | C. E. II | C. E. III | C. E. IV | C. E. V | C. E. VI | C. E. VII |
|---|---|---|---|---|---|---|
| 28-35 | 6 | — | — | — | — | — |
| 35-39 | 7 | — | — | — | — | — |
| 40-45 | 26 | 8 | — | — | — | — |
| 46-50 | 42 | 5 | 3 | — | — | — |
| 51-55 | 25 | 13 | 6 | 5 | 1 | — |
| 56-60 | 28 | 9 | 7 | 3 | — | — |
| 61-65 | 10 | 1 | 7 | 7 | 1 | — |
| 66-70 | 5 | — | 4 | 2 | 4 | 1 |
| 71-75 | 2 | — | — | — | — | — |
| Total | 151 | 36 | 27 | 17 | 6 | 1 |
| Graduates | 37 | 18 | 12 | 9 | 4 | 1 |

vancement. Note that out of 238 engineers of Civil Engineer II grade or higher, there are only 13 under 40 years old. Also note that 15 of the 24 men in the three top grades (Civil Engineer V to Civil Engineer VII) are over 60 years old. The average age of engineers Civil Engineer II grade or higher is about 53. Retirement age is 70 years.

In 1948 when the annual construction program totaled $19 million the number of engineers of Civil Engineer II grade or higher was 182. In 1954 with a construction program of $44 million, more than twice as great, the number of engineers had increased to 238, or only 30 per cent, indicating that personnel had not been assigned in proportion to the program size. No change at all took place in the number of engineers in Civil Engineer V to Civil Engineer VII grades.

Engineers can be attracted when they understand a construction program of stable quality is to be carried out, when salaries and fringe benefits are comparable to those of private industry, and when they realize that sound promotional policies will be effected.

Every effort should be made to work cooperatively with the universities and colleges in developing interest and competence in highway engineering training and research.

Work with educational institutions should include a continuing program of research which will create interest of undergraduate and graduate students, and will encourage instructors to carry forward research in the whole field of highway administration and construction. It would be desirable to authorize the department to permit qualified employees to attend specialized schools, granting leaves of absence and special aids to encourage advanced engineering.

## Advance Planning

An important operation that should be emphasized in Minnesota is advance program planning. A firm fiscal policy should be adopted which will permit revenue forecasting to guide future work.

The study of needs in this report, plus firm decisions by the legislature on major elements, will provide a solid base for development by the highway department of a program planned in detail for several years in advance for which there are decided advantages. Advance planning permits full coordination of all functions, and saves time, money and confusion. Location, design, and right of way procurement can be scheduled and concluded well in advance of the construction program. Engineering personnel requirements can be predetermined and most efficiently assigned. Finally, the process serves as a continual means of evaluating progress in relation to needs. Programs can be readily enlarged to meet any expansion of highway income.

Initial steps are already being taken to establish long range planning. It can be most effectively carried out by making maximum use of the basic traffic, inventory and economic data available in the Traffic and Planning Division. The development of the plan also must make full use of the detailed engineering knowledge of District Engineers and affected headquarters divisions. The staff responsibility has been assigned to a special unit in Traffic and Planning. Final adoption of a five-year plan by the Commissioner should follow a review and concurrence by principal staff heads, as well as by the Chief Engineer. The plan should fully utilize all facts which give logical priority to the sequence of projects. The plan should be developed for five years and revised annually to keep a program for that period constantly ahead.

Having adopted such a plan, responsibilities for carrying out the many phases can be clearly defined both in the headquarters and in the districts. The organization plan should be such as to relieve the Chief Engineer and department heads of a great amount of detail so they may devote attention to study and direction of major elements of responsibility.

## Location and Design

As the program is carried out and personnel is available, the design functions should be properly allocated between districts and headquarters. Design standards and policies should be firmly decided by headquarters when projects are authorized in accordance with the advance planning schedule to eliminate unnecessary changes as field and office work progresses. A preliminary location report should be developed and reviewed by headquarters prior to final location and plan development.

## Maintenance and Equipment

The maintenance function is the largest direct operation of the department in terms of personnel, equipment and materials. The level of maintenance in Minnesota is comparatively high; however, refinement of organization and continued study of efficient methods must be made.

At present the State is divided into 16 mainte-

nance districts—two in each of the eight construction districts. According to the organization chart, district engineers have supervisory powers over maintenance. It has been observed that in practice headquarters works directly with the maintenance districts. This practice can breed confusion.

Under management plans generally subscribed to in all large organizations, it has been found that strict lines of authority and responsibility are most effective. Consideration should be given to channelizing maintenance policies, controls and operation directly through the district engineers. Within the districts, the authority may then be delegated to the two maintenance engineers by the district engineer to whom they report.

As an alternative the position of assistant district engineer in charge of maintenance could be created with corresponding changes made in the title and responsibilities of present maintenance engineers.

Observations and comparisons indicate that Minnesota utilizes mechanization in maintenance to a relatively large extent. This is commendable because in so doing costs are lowered. Equipment selection and operation must be carefully studied to achieve maximum economy.

On the basis of comparative records, it would appear that some reduction in the amount of maintenance of gravel surfaces might be warranted when related to the volume of traffic served. Comparative cost studies also show that more extensive expenditures for traffic services of signing and striping would be warranted. This is shown in the traffic engineering analysis.

One need is for cost records which show outlays by surface type and width for the various classes of highways.

## Right of Way Acquisition

Present practice in right of way acquisition in Minnesota results in obtaining nearly all needed right of way by processes of condemnation and utilizing the authority granted for the right of immediate possession. This results from the lack of an advance schedule which will permit prior acquisition by normal processes of negotiation.

Most studies of relative costs in other states show that settlement of right of way damages in court costs more in total outlay than by orderly processes of negotiation. The negotiation method usually is more satisfactory to property owners.

As the urban problem is more boldly attacked, situations will arise where it is desirable to move buildings to new locations to make room for major facilities. That this may be done most economically and with the least dissatisfaction, the department should be given authority to acquire property for exchange purposes.

An advantageous device to save large sums of money, used to a limited extent in Minnesota, is advance acquisition of right of way on future locations before expensive developments take place on planned routes. A special revolving fund should be established to accelerate advance right of way acquisition. The fund would be reimbursed from normal funds at the time of construction. It could only be used when the department is able to get its detailed plans developed well in advance of construction. The practice is saving large sums in California.

The department is now able to acquire control of access under certain conditions by reason of court decisions based on existing laws. Serious consideration should be given to broadening the law to obtain full benefits of the authority.

Additional benefits resulting would include: more extensive use of the authority on major highways for both new construction and reconstruction; authority to apply control, protection and regulation of facilities beyond that obtained by mere acquisition of property; extension of the principle to local governments; and authorization for closing existing facilities when necessary.

## Housing

Housing should be in keeping with the functions and organization required for economy and efficiency of operations. The department is now seriously handicapped through its location in several buildings. Every step should be taken to expedite early completion of the proposed central headquarters. A few of the district offices are housed in inadequate quarters.

## Public Information

A highway administrative function of growing importance is the dissemination of facts to the public. Because of the technical nature and complexity of activities of the Department of Highways, the task is more difficult than in some other State agencies.

Yet the magnitude of the department's work, and its major social and economic impact on the welfare of the State, make it essential Minnesota

people receive as much information as possible about it. Public understanding of basic issues underlying highway affairs is necessary to good administration and vital to sound and progressive legislative decisions, both state and local.

A good program logically is divided into two parts. The first is internal; to a major degree, the department's policies and program are interpreted to the public by the department's own employees, professional and non-professional alike.

The internal phase deserves more attention than is ordinarily given it by highway administrators. In their own personal contacts, all employees are in a real sense emissaries of the department, conveying to the citizens of the State in a first-hand manner the attitudes, aims and philosophy of the department. If well-informed, they become primary sources of information. Public confidence in the highway department, on which so much of its success depends, is reduced or increased by what is done and said by each individual employee.

The second part of the public information program is external; distribution of facts to the public through all available channels of communications. A minimum program should take into consideration not only periodic printed reports, but also television, radio, the press, motion pictures and slide films, exhibits, and an organized schedule of departmental speakers.

For many years the Minnesota Department of Highways has recognized necessity for this activity. The work now is performed by a director of public information and two assistants who are writers. Relations with the press, preparation of public statements by key departmental officials and a limited amount of activity in the radio and television field claim the full time of this staff. Routine information requests and complaints leave little opportunity to carry on a planned program of informing the public on basic road issues.

Competent personnel should be added to the staff to work with television and radio, and to produce occasional motion pictures, slide films, and exhibits, and reasonable budgets should be provided for such activities. This would enable the department to meet better its obligations in this neglected area of highway administration.

## Size and Weight Control

As shown in Chapter 12, it is essential to establish as a base for design, standards for the size and weight of vehicles. The adopted standards should closely relate and produce maximum utilization of highway design and vehicle use. The control of vehicles in relation to their size and weight should be strictly enforced.

It is recommended that Minnesota laws governing sizes and weights of vehicles be amended to bring limitations on gross loads, tandem axle loads and lengths of tractor-semi-trailer and truck combinations into conformity with the nationally recognized standards of the American Association of State Highway Officials. Research studies under way may point up in the future the desirability of some changes in loading limitations and commercial vehicle lengths. Minnesota size and weight laws should be amended as necessary in the future to reflect revisions in the size and weight policy adopted by the American Association of State Highway Officials.

*The control of size and weight of vehicles is essential to the protection of the highway investment. One means of control is the roadside weighing station.*

Present provisions for reduction in vehicle loads during spring months when subgrades are in a saturated condition from frost thawing should be continued for protection of the highway investment.

## Intergovernmental Cooperation

The commonly accepted highway policy throughout the nation is that each governmental agency must accept a proper degree of responsibility for development of highway transportation in keeping with the predominant interest of the agencies involved. The Federal Government traditionally has evidenced interest by means of Federal aid to be used on systems conceived to be in the national interest. The states have assumed the primary role not only in actual direct utilization of Federal aid to support state systems but secondary and urban systems as well. The states are assisting counties in support of their systems and in varying amount are supporting urban highway development. Counties are assisting townships in varying degrees.

Excellent working relationships are well established in Minnesota between the State and the county highway agencies. This came about with adoption of the State-aid law in 1906. Further benefits were produced when the Department of Highways established its County Division in 1945 to expedite planning and construction of projects of mutual concern. However, there is need for extending application of the principle of the State serving as the primary coordinating agency.

To improve the coordinated effort, basic controls now required on the State-aid System should be extended to all county roads receiving State financial assistance. Also, the same principles should be made applicable to the urban arterial systems.

Major elements of such a plan which should be made applicable to counties and municipalities are:

1. Counties and cities should be required to designate systems as described in the Classification chapter. These selected systems should have final approval of the Commissioner of Highways.
2. There should be developed standard guides by counties and cities in cooperation with the Commissioner which will govern future capital improvements of county and city systems.
3. Annual capital improvement programs should be developed by counties and cities where State aid is to be utilized. These programs should have approval of the Commissioner prior to final adoption.
4. Counties and cities should submit annual reports of all expenditures showing the purpose and location of such expenditures on a uniform basis. These reports should be analyzed and published by the Commissioner on a biennial basis for legislative and public use.
5. Urban extensions invariably are the most important links in trunk systems. Because they are the most costly and time consuming sections to construct and require cooperative relationships and plans, a major division of the highway department should be created to stimulate needed programs in urban areas. This division would have as its primary task the development of projects fitted into an integrated master plan for each of the areas.
6. In the Needs chapter it was pointed out that in the Minneapolis-St. Paul area an expressway plan must be fully developed on a cooperative basis so that investments by both State and local governments can be best used to get adequate facilities. The State should take leadership in bringing together units concerned to complete the plan. It is recommended that legal status be given to a metropolitan expressway authority empowered to act for the several governmental units. The department's urban division should represent the Commissioner of Highways in bringing a plan into final form and adoption.

## County and Township Management

In management of county roads Minnesota is among the leading states. This is attributable to recognizing early that management is essentially an engineering function. Since 1921 Minnesota law has required counties to have engineers. Policy formation and over-all controls are exercised by county commissioners.

As a result of sound management the counties are developing road systems of good standards, have established capable maintenance organizations, and have used new procedures and techniques in design and construction.

The 1,846 townships have some degree of responsibility over 56,000 miles of road. The average mileage in their jurisdiction is 33. Management of township roads is done in two ways. In 68 of the 87 counties, all of the townships function to some degree in road matters. In the other 19 counties, county highway departments have taken over local road management in unorganized townships.

The trend is for townships to rely more and more on counties to perform maintenance. In 1952, 48 counties maintained 14,500 miles of township roads. In that year, 58 counties removed snow on 25,000 miles. Only 16 per cent of the townships own motorized equipment, and so, many townships must arrange with counties and private owners for equipment.

Townships should take utmost advantage of county management facilities. This would improve their local road functions and at the same time preserve local initiative and support. The townships can utilize county management by:

1. Accelerating the present growing practice of cooperative agreements with counties to provide maintenance operations.
2. Expand the cooperative efforts to include construction activities.

Were townships to contract with the counties for all construction and maintenance, benefits would be:

1. Construction and maintenance to desirable standards would be performed cheaper.
2. Work throughout the county would be more uniform and in keeping with traffic needs.
3. Such operation would help support needed equipment for expanded services of the counties.
4. Lower prices for increased volume of materials and equipment.
5. Planned yearly programs.

## Municipal Management

Metropolitan area bottlenecks constitute the most critical of all deficiencies in the highway plant. Solution involves costly readjustments of a bold nature, yet potential returns from such investments are extremely high. Urban highway engineering problems are a major engineering challenge.

Every major city should reassess management requirements in terms of plans, personnel and finances. The State should help and supply initiative, particularly because of its responsibility for urban extensions. Each city, however, must step up to its own responsibilities in development of comprehensive plans and organization to carry out its program.

*Here is an excellent example of access control along a heavily traveled divided highway, Trunk Highway 7. Minnesota law governing access control, however, should be broadened to provide further benefits to property owners and motor vehicle users.*

It is generally recognized that street management has been handicapped by diffusion of functions. Several cities in other states have recognized the necessity of reappraising city transportation management and have consolidated all engineering functions relating to highways under one department or section. Cities in Minnesota should take similar action.

Basic functions described for a state highway department also are required in city management. In addition, city management must consider integration of the highway plant with mass transit operation, parking and practical plans for comprehensive urban development and redevelopment. Depending upon the degree of Federal, State and the individual city support, each engineering department must organize and staff itself to plan the program and execute it. To follow recommendations of this study, each major city should materially expand its management staff. When personnel needs cannot be met locally, it may be necessary to employ competent consulting service for special problems.

## Smaller Cities

Management of streets in smaller cities is somewhat similar to the problem of management of townships. Needs of the mileage of streets and the amount of funds necessary to be expended are relatively small and preclude requirement for continuous engineering service. Yet, when capital improvements are required and in the conduct of maintenance programs, engineering direction will result in much more return from the funds available. To provide this service, it is recommended that smaller cities be authorized to obtain the services of county engineers on a reimbursable basis. Further, it is urged that the State extend its advisory services to give aid to cities through the recommended urban division.

# Conclusion

This study of management aims to assist the legislature and the public officials of the State, counties and cities to better meet the many responsibilities and problems posed by highway transportation.

The provision of highway service today is big business, involving totals running high into the millions of dollars. Good management is essential to economical spending, but to have good management there must be good laws and capable personnel.

Because of their mutual interests, there must be close cooperation between the State and local bodies -- for after all, the goal is good transportation for all the people of the State.

To achieve the highest level of performance, to make the road dollar produce the greatest value, will require some changes in Minnesota law. The foundation for major elements of such revision are contained in the several recommendations of this report. Others will arise following adoption of an equitable and stable fiscal policy.

# PART II

# HIGHWAY SAFETY

By
Norman Damon
and
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Chapter 7

# Safety

## TRAFFIC ACCIDENT APPRAISAL

Since a goal of the engineering appraisal is to find means for increasing efficiency and economy in highway transportation, it is necessarily concerned with the problem of accidents.

Accidents mean losses in human life, limb and property, which are a large part of the total transportation cost.

The State highway department is concerned with the physical development of the street and highway systems. Also, the Department has specific responsibilities for safety. Many responsibilities are not set forth by statute; therefore, they require administrative action.

A principal element is safety of design as it involves roadway curvatures, grades, widths and surfaces and the use of signs, signals and markings.

Other safety activities, usually carried on by other State departments, including keeping of accurate accident records and their analysis, traffic law enforcement, driver licensing, driver control and improvement programs, vehicle inspection, high school driver training, an adequate system of traffic court administration, public education and safety organization.

In Minnesota many of these activities are lodged in the Department of Highways and have recently been put under the newly created Highway Safety Division. All of them, whether in the highway department or other State departments, are discussed in this chapter. Recommendations in this chapter are based on the facts reported in the Annual Inventory of Traffic Safety Activities (discussed later in this section), additional data made available by State Officials, and the advice of a citizens' advisory group designated by the Minnesota Safety Council.

## The Minnesota Accident Picture

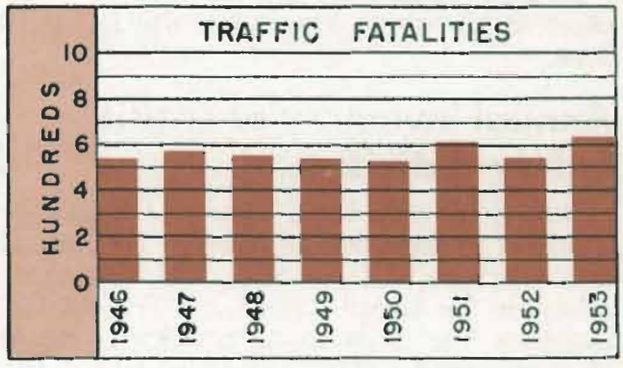
Economic losses for 1953 from traffic accidents exceeded $70 million according to National Safety Council estimates.

In the eight years since World War II, the loss exceeded $438 million, a greater amount than construction expenditures on the State Trunk System in the same period.

In 1953, 637 persons were killed in Minnesota traffic accidents. Twenty thousand others were injured.

This is a marked increase over 1952 both in number and fatality rate per 100 million vehicle miles. One hundred more persons lost their lives and the fatality rate rose from 5.2 to 5.9 in 1953.

While the Minnesota rate is below the national average of 7.0, one state has reduced its rate to




2.8 and several others are below 5.0. The average rate of the nine states in the group with Minnesota was 6.4 and the lowest state rate in the group was 5.7.

## Action Program

Safety activities in Minnesota are based on the Action Program of the President's Highway Safety Conference. The Program was formulated in 1946 at a national conference on highway safety called by the President of the United States and attended by representatives of state and local governments, highway and safety bureaus, safety organizations and individuals throughout the country. The Program makes specific recommendations and suggests means for carrying them out in all fields relating to safety and more efficient highway transportation.

The Program, based on proven methods, was reaffirmed by a similar Conference in 1949 when the group found that the cities and states which applied most of the elements of the Program since 1946 had the lowest accident rates. The 1954 Conference re-endorsed the Action Program and agreed upon further means for developing public action in support of the Program.

*Huge economic losses, deaths, injuries, inconvenience and frequently delay in movement of valuable cargo are the prices paid for accidents.*

Much of the Action Program has been put into effect in Minnesota. More work remains to be done.

## Annual Inventory of Traffic Safety Activities

Needed activities based on several factors are appraised in the following sections. The original data was provided by State and community officials in the Annual Inventory of Traffic Safety Activities. The Inventory is an objective means of measurement and evaluation of traffic safety activities. The detailed report is made annually by Minnesota public officials. An analysis of the reported activities is made by the National Safety Council.

The report covers the following activities:

| | |
|---|---|
| Uniform Laws | Driver Licensing |
| Accident Records | Periodic Motor Vehicle Inspection |
| Education | Public Information |
| Enforcement | Safety Organization |
| Traffic Engineering | |

Each activity is evaluated in accordance with recognized criteria and the performance of states and municipalities which have well developed, effective programs.

Inventory report forms and evaluation schedules are prepared by committees of technicians selected by the organizations having a particular interest in the several fields. They include the National Education Association, the International Association of Chiefs of Police, the American Association of Motor Vehicle Administrators, the American Association of State Highway Officials and the American Bar Association.

Minnesota Inventory analysis was further screened by a citizens' advisory group. The group, invited by the Minnesota Safety Council to advise the Automotive Safety Foundation, included key business and industry leaders, and leaders in civic, fraternal, religious, women's, agricultural, media and other groups. Two meetings were held—one prior to completion of the Inventory report and another to discuss the analysis. Each session proved most valuable to the staff.

Known deficiencies in Minnesota's traffic accident prevention program should be corrected as quickly as possible. The State program should be reviewed annually in the light of the analysis of the Annual Inventory of Traffic Safety Activities to insure continuing improvement.

## Uniform Laws

Good laws in harmony with national models provide a main basis for safer and more efficient transportation.

While it is recognized that continuing studies are undertaken to keep the laws up-to-date, there are differences between present Minnesota laws and the Uniform Vehicle Code.

For example, chauffeurs' licenses are issued by the Secretary of State's office. Operators' licenses are issued by the Department of Highways. The Action Program recommends, as stated in the Code, that all licensing functions be conducted within one centralized state agency.

Applicants for chauffeurs' licenses are not given a driving examination, nor an eye test. A chauffeur's license does not permit operating a private passenger car.

The Uniform Code provides for the use of a quadruplicate traffic ticket and specifies the means of accounting for the copies to eliminate the ticket "fix". The American Bar Association has

developed a Uniform Traffic Ticket to meet these needs. Use of the ticket will do much to improve enforcement.

Current law does not provide legal authority for the administration of chemical tests for intoxication. Eighteen states have this legislation and six others are seeking it. Provision for chemical tests in Minnesota would materially assist law enforcement agencies.

### Recommendations

Bring Minnesota laws up to the standards of the Uniform Vehicle Code.

Consolidate driver license administration in one department.

Require chauffeurs to take an eye examination and a driving test.

Adopt, for state-wide use, the Uniform Traffic Ticket.

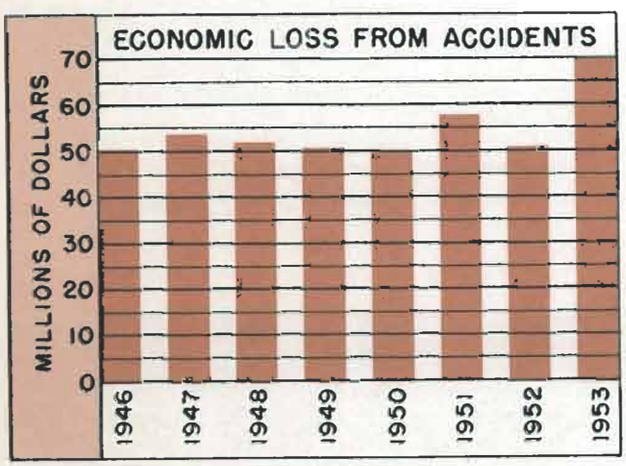
Provide authority for chemical tests for intoxication.

## Accident Records

Accident reporting should be stepped up at least 50 per cent in rural areas. While urban reporting is comparatively better, further effort must be expanded to get more complete reporting.

Accident records provide the basis for developing a sound traffic safety program. Without them, officials approach many problems blindfolded; the better the accident records, the more effective become engineering, enforcement and education programs.

Rural reporting ratios in 1953 were 12 non-fatal injury and 19 property damage accidents for each fatal accident reported. States with better accident reporting have a minimum on 20 non-fatal injury and 35 property damage accidents for each fatal accident.




Urban reporting ratios were 43 non-fatal injury and 159 property damage accidents per fatal accident reported. (The State urban average is increased materially by the Twin City reports which are in excess of 300 property damage accidents for each fatality.) This compares to a minimum standard measure of 55 non-fatal and 200 property damage accidents for each fatal accident.

In 1953, 53,005 accident reports were received by the Highway Department and processed at a cost of $108,000 in relation to the estimated economic loss of $70 million. The cost of processing reports in order to have necessary information to guide the accident prevention program represented less than a fraction of a cent per accident in relation to the total monetary loss.

In both non-fatal and property damage accidents the ratio of reporting was lower than in 1952.

Insufficient personnel and authority for the Highway Patrol are major factors in the low ratio of rural reporting. Should the current patrol force be increased 65 per cent (recommended in the Enforcement section) it is reasonable to expect that with concerted effort, a marked increase in the reporting and investigation of rural accidents will result.

Should increased enforcement and other accident records activities result in a 50 per cent increase in rural accident reports, it will be necessary to analyze and process an additional 5,500 rural reports.

### Recommendations

Increase rural accident reporting through increased investigations by the Highway Patrol and through public education and information.

Adopt a plan for processing an additional 5,500 accidents annually (10 per cent increase at an approximate cost of $11,000).

Develop an accident spot map to obtain a more clear picture of where accidents are happening by types.

## Safety Education

Some 70 per cent of the students enrolled in secondary schools in Minnesota are receiving classroom instruction in traffic safety. Only 25 per cent are enrolled in practice driving and classroom instruction.

Education in schools—both classroom and behind the wheel training—has proved a most effective measure in traffic safety programs.

High school students receiving a safety education course and practice driving are reported to have 50 per cent fewer accidents than those who have not had the advantage of training under the direction of qualified instructors. Investment in driver training for all students as they become of driving age pays immediate and long range dividends in highway safety.

This year, 44,275 high school students will reach the age of 15, the legal driving age. Minnesota officials estimate the cost of training a high school student to drive is $30. The annual cost for all eligibles would be approximately $1.3 million annually, an increase of about $1 million over the present program.

### Recommendations

Give every high school student classroom instruction and behind the wheel driver training by a qualified instructor prior to reaching driver age.

Provide a full-time staff member in the Department of Education to supervise the local traffic safety education program.

## Traffic Law Enforcement

Manpower shortage is the real roadblock to obviously needed improvement in rural traffic law enforcement and accident investigation.

Enforcement needs should be given prompt attention. Good selective enforcement is the most immediate means of reducing accidents by placing police manpower where and when they can do the most good.

Highway Patrol jurisdiction is confined to trunk highways. The Patrol is further handicapped by limited power of arrest. Unless a violation or accident is witnessed by the State Patrolman, under existing practices, it is necessary to consult the county attorney who may or may not issue an arrest warrant. Warrants are then served by the County Sheriff. As a result, enforcement activities are considerably below standards of the International Association of Chiefs of Police and the performance of leading states, with the exception of the apprehension of hit-run drivers and activity on vehicle equipment defects.

*Good driver examination and driver improvement and control programs are the best means of developing better driver behavior.*

Traffic arrests and warnings for hazardous traffic violations must be at least doubled to reach performance levels of top ranking states. Enforcement volume declined from 12,884 hazardous traffic violations arrests in 1952 to 12,227 in 1953.

Convictions per "drinking accident driver" were only one-eighth of that of ranking states. Chemical tests were used in 31 per cent of driver arrests involving intoxication.

Pedestrian enforcement activities in 1953 decreased 88 per cent under 1952 and rural pedestrian deaths in Minnesota increased 30 per cent.

Traffic training for recruits and in-service personnel was below minimum standards of the International Association of Chiefs of Police.

Some below standard activities are being remedied with present forces but major improvement requires additional personnel.

Operating cost of the Patrol in 1953 was $1,386,615, an average of $6,450 per man for the 215 uniformed force. These costs, paid out of Department of Highway funds, were partially defrayed ($766,616) by fines assessed and receipts from motor vehicle license violations. Fines suspended amounted to $23,188 and an additional $3,366 from arrests made by the Patrol reverted to counties and cities.

### Recommendations

Add at least 140 more men, including increased supervisory personnel to the Highway Patrol. The approximate increased annual cost would be about $900,000.

Base traffic enforcement activities on selective enforcement.

Give Patrol broader arrest authority, particularly in relation to accident investigations.


Use chemical tests in all arrest cases involving intoxication.

## Traffic Engineering

Traffic engineering, a part of the Annual Inventory of Traffic Safety Activities on which much of this chapter is based, is discussed in Chapter 3.

## Driver Licensing

A well administered driver licensing program, along with good enforcement, is one of the most effective means of realizing safe and efficient highway transportation.

Anything short of meeting the minimum requirements for sound driver licensing administration destroys the public's confidence in the basic driver license principle:

> "To operate a motor vehicle is a conditional privilege, to be earned through qualifying examination, and in turn, retained through satisfactory driving performance."

The Minnesota driver licensing program ranks high in most respects. The driver improvement and control program has increased in the past year.

The number of special examinations, hearings and interviews for drivers with bad performance records, however, still does not meet minimum standards. One Chief Hearing Officer and four assistants should be added to the staff to overcome this deficiency. This would cost a minimum of $50,000 annually.

At present passenger car driving licenses are issued for four years at $1.00–25 cents per year. Of the 1.5 million licenses some 80 per cent are issued through district clerks of court. They receive 20 and the State 80 cents of the $1.00 fee.

Driver license administration costs (private car drivers only) half a million dollars a year. Deficits averaging $200,000 a year, are made up out of Department of Highways funds.

### Recommendations

Consolidate driver license administration, as recommended in the section on Uniform Laws.

Give chauffeurs driving examinations.

Make provision for placing drivers with bad performance records on a "probationary basis" following hearings and interviews in the driver improvement program when records do not warrant suspension or revocation.


*Patrolmen should be on duty in areas where the most accidents and violations occur and during the hours of greatest frequency. Two-way radios aid in making maximum use of manpower.*

Since driver licensing fees are a service charge, no part of driver license costs should be financed from Department of Highway funds.

## Periodic Motor Vehicle Inspection

States requiring periodic inspection of vehicles have increased to 13 with the recent adoption of a semi-annual inspection law in New York State. Delaware and New Jersey utilize state-owned and operated inspection stations. The remaining states designate privately operated garages and stations for inspection. The average over-all rejection rate is 30 per cent. Inspection fees range from 50 cents per inspection in eight states to a maximum of $1.50 in one state.

Periodic vehicle inspection is accepted today as an integral part of an overall safety program. The Uniform Vehicle Code provides for periodic inspection and the Action Program recommends that it be carried on where an over-all accident prevention program is provided.

### Recommendations

Adopt periodic motor vehicle inspection as a means of augmenting the state-wide safety program, as soon as other deficiencies are corrected.

## Public Information

All media are giving extensive support to traffic safety. Unfortunately, they do not receive the amount of factual material that could be provided

by officials, an effective Governor's Coordinating Committee, and the Minnesota Safety Council.

To keep the public aware of the traffic safety problem, news bulletins, radio shorts, magazine articles and other means should be used regularly. New promotional ideas, to fit the State's needs, should be developed to stimulate public interest.

### Recommendations

Efforts of the Governor's Coordinating Committee, the newly created Highway Safety Division and the Traffic and Planning Division of the Highway Department, and the Minnesota Safety Council, collectively, can produce, as a matter of routine, more information, at no additional cost to the State.

## Safety Organization

An effective state-wide safety program exists only when there is sound organization.

First, there must be an official program developed by public officials in accordance with State needs based on the Action Program.

Second, there must be a well organized public action group comprising the top leaders in business and industry and in civic, farm, women's publishing, fraternal and religious groups.

The Action Program recommends that the official State traffic safety program be developed and coordinated by an official committee headed by the Governor and comprised of the State officials concerned with highway safety. The official program would then be administered through regular meetings (quarterly or more frequently when necessary) of the officials to discuss their departmental interests, responsibilities and problems and effect concerted action.

The Governor's Official Coordinating Committee, through State departments concerned with highway safety, should provide technical assistance to communities, and cooperate closely with the constituted public support organization. Through these two organizations the over-all traffic safety program can be carried forward more effectively.

The Minnesota Safety Council, over a period of many years, has been most effective in developing public action through the active support of key business and civic leaders on a state-wide basis.

However, public action groups in local communities are below standard. The 51 municipalities that should have action groups, according to the city Inventory reports, on the average, do not meet 60 per cent of minimum standards. Several municipal reports show no public support organization exists.

### Recommendations

A Governor's Traffic Safety Coordinating Committee should be activated with the Governor as ex-officio Chairman, and under existing State Organization the Commissioner of Highways as Chairman, and the Director of the Highway Safety Division as Secretary to:

1. Make an annual realistic survey of traffic safety conditions and problems for the Annual Inventory; consider analysis of the Inventory; study legal authority, current budgets, available manpower, and facilities of official agencies conducting traffic safety activities, in comparison with recommended standards.

2. Periodically review progress made on official highway safety programs to better plan future work.

3. Establish and maintain close liaison between the Governor's official coordinating committee and the Minnesota Safety Council.

Present community official and public action programs must be increased, or created where needed. The Governor's Coordinating Committee and the Minnesota Safety Council should extend assistance to the cities in improving their traffic safety programs.

## Summary

As the State and local governments develop public programs to increase safety and efficiency for the people of Minnesota, they must give serious consideration to advancing traffic safety programs for drivers of publicly owned vehicles. Government employees should set an example for all others in safe driving.

In the driver license, accident records, education and enforcement fields, the State is spending approximately $2,270,000 annually, according to information received.

The annual budget for a minimum program, adequate for today's needs in these fields is nearly $4,250,000. Reduction of the total annual accident loss of $70 million by only seven per cent would be more than equal to the cost of the total stepped-up program.

# PART III

# BACKGROUND AND SUPPORTING FACTS

Chapter 8

# History

HOW TODAY'S HIGHWAYS DEVELOPED

The network of highways now reaching to all parts of Minnesota would have been confounding to the early pioneers of the Minnesota area who had to be content with stumpy and muddy trails shoved through forest and swamp. People had to make the best use they could of Red River carts of wood and rawhide, stages, and river boats.

In the middle of the 19th century, the Territorial Legislature and the Federal Congress gave road construction a boost--Congress with funds for military and Indian Agency roads, the Legislature with laws that enabled counties to construct roads with taxes paid largely in labor, and by use of voluntary labor and contributions.

The first railroad came in 1862, and so Minnesota entered into a half a century of dependence on steam and rail for long distance travel. Roads became a matter of strictly local concern. Hauling grain could wait until roads were dry or the ground frozen, or until snow permitted use of sleds. Cattle were driven to market, often with considerable loss of weight.

But in the 1890's, interest again turned to highways. The growth of dairy farming in Minnesota created a demand for roads that would permit frequent and regular trips to local creameries. Farmers needed better access to markets and sources of supply. Good roads interest was also generated by the rural mail delivery plan and the general use of bicycles. Moreover, merchants were anxious to extend their trade areas.

The first state-wide good roads convention was held in St. Paul in 1893 and, in the following year, the State Fair had its first "good roads day" and exhibit. In 1895 the Good Roads Association of Minnesota was formed.

From early Statehood until the turn of the century, responsibility for roads rested with local governments and officials although various Legislatures prescribed the selection of State and county roads and the methods by which their improvement and repair could be financed.

*The Trunk Highway System, established in 1921 by constitutional amendment, totaled 6,877 miles in length.*

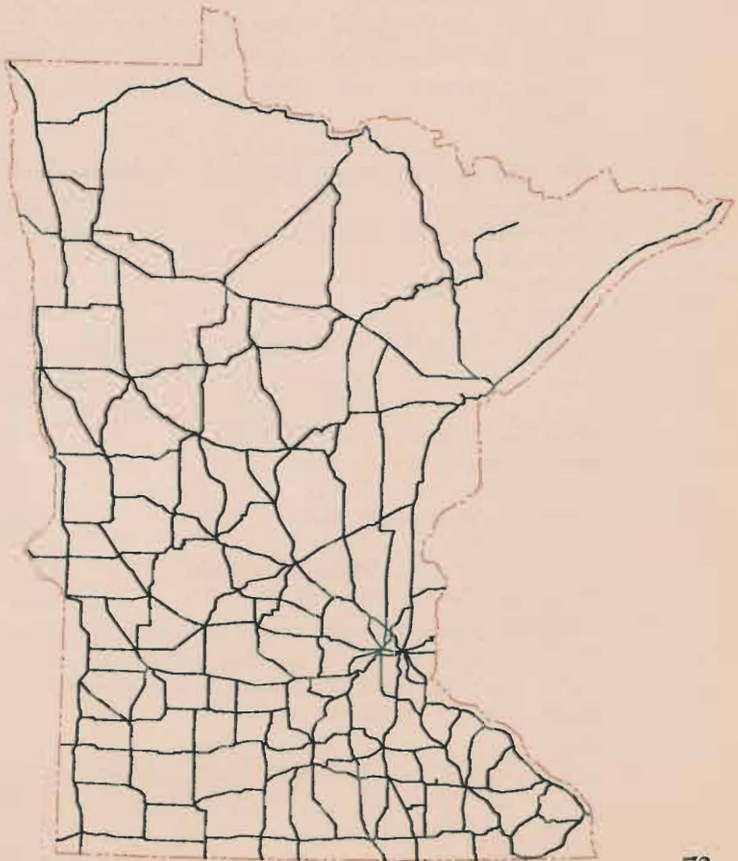
## Advent of the Automobile

Not every one had a high regard for the automobile when it came in with the new century. In 1907 a bill was proposed to the Minnesota Legislature which would allow town boards to prohibit travel by car. But opposition faded as more and more cars appeared--by 1917 Minnesota had 200,000 motor vehicles, twice as many as were in the entire nation a decade earlier.

Attention was turned to the problem of getting better roads faster. The three-member highway commission set up in 1906, to administer State aid to the counties, was abandoned and the office of Commissioner of Highways was created in 1917. Two years later the Legislature approved for constitutional amendment the first integrated system of important rural roads and a plan for road improvement.

The amendment was approved in 1920. By 1921 the Trunk Highway System was under maintenance by the Department of Highways. The

**ORIGINAL STATE TRUNK SYSTEM**



*This road was typical of the main traveled roads in the central lake country of Minnesota before establishment of the Trunk Highway System.*

amendment authorized the issuance of bonds for the improvements needed on the trunk highways and for reimbursement to the counties for debts incurred for past improvements. Revenues from motor vehicle taxes were made available for the retirement of bonds and for further construction and maintenance of the Trunk Highway System.

In addition to the trunk highways, the same plan created and assigned responsibilities for State-aid and county roads and required the appointment of county highway engineers.

Demands for additional trunk highways arose almost immediately after the initial 6,877 miles were selected. However, because of restrictions in the constitutional amendment it was not possible to materially increase the Trunk Highway System until 1933. By this time 75 per cent of the original system was considered to be satisfactorily improved and the Legislature added an additional 4,574 miles to the system. Subsequent Legislatures have added a limited additional mileage.

## Present Status of Road Development

The townships, the counties and the State have in turn been the major rural road building units. The townships still lead in the number of miles of road, the counties come second and the State third, but State roads come first in rural traffic volume, county roads second and township roads third.

**Mileage of Minnesota Roads and Streets Today**

| System | Miles |
|---|---|
| Rural State Trunk Highways | 10,390 |
| State-aid Roads | 15,489 |
| County-aid Roads | 26,158 |
| Township | 54,536 |
| *Minor State and Federal Systems | 2,684 |
| **Total Rural** | **109,257** |
| State Trunk Highways within Cities | 1,460 |
| State-aid Roads within Cities | 960 |
| County Roads within Cities | 529 |
| Other City and Village Streets | 8,816 |
| **Total Municipal** | **11,765** |
| **Total all Roads and Streets** | **121,022** |

**Minor State and Federal systems include 1,256 miles of State Forest, Parks, Refuge and Institution roads and 1,427 miles of National Forest, Forest Development, Indian Service and Refuge roads.*

### Township Roads

Town Boards had almost complete responsibility for all roads from 1858 until around 1900—they retained partial responsibility for all the roads until 1913, and they are still responsible for one-half of the rural road mileage. In 1953 the total rural mileage in the State was slightly more than 109,000 miles of which 54,500 miles were township roads.

### County Roads

Counties had a minor part in road improvement until around 1900 when they began acquiring more responsibility. "State" roads eligible for State-aid had increased to 13,653 miles by 1921, when most of the trunk highway mileage (6,877 miles) came out of this system. The residue of the "State" roads were renamed "State-aid" by the 1921 session, and became the main secondary system. By 1933 the State-aid System had been increased to 16,782 miles. In this year about 4,574 miles were added to trunk highways by the legislature, a large portion thereof coming from the State-aid System. Subsequent additions to the trunk highway system normally came from the State-aid System also. Despite periodic reductions, the mileage of this system totalled 15,489 miles in 1953. Improvements to State-aid roads are made by the counties, but supervised by the Commissioner of Highways.

The "county-aid" system roads are authorized by the 1929 Legislature, to consist of county and town roads designated by the county boards. Construction and maintenance of these roads is done by each county, without State supervision. Establishment of this system followed adoption of the "gas tax" amendment, providing that one-third of this fund should be apportioned to the counties. The mileage of county-aid roads has increased steadily, with additions normally coming from town roads and deductions going to the State-aid system. The rural county-aid system totalled 26,158 miles in 1953.

## Trunk Highways

State participation in road improvement from 1858 to 1906 was confined to distribution of proceeds of Federal grants. From 1906 to 1920 it was confined to distribution of state aid and supervising its expenditure. The State entered road building directly in 1921 with establishment of a Trunk Highway System totalling 6,877 miles. Subsequent additions have increased the Trunk Highway System to a total of 11,850 miles in 1953 of which 10,390 miles are in rural areas and 1,460 miles are in cities.

## Rural Road Improvements

The status of improvement of rural roads varies widely between the various systems.

**Present Status of Rural Road Improvement**

| Type of Surface | State Trunk Highways (Miles) | State-aid Roads (Miles) | County-aid and County roads (Miles) | Township Roads (Miles) | Total (Miles) |
|---|---|---|---|---|---|
| Hard Surfaced | 8,801 | 2,663 | 891 | 279 | 12,634 |
| Gravel | 1,588 | 12,530 | 23,608 | 35,026 | 72,752 |
| Graded–Not Surfaced | 1 | 257 | 1,359 | 11,882 | 13,499 |
| Unimproved | 0 | 39 | 300 | 7,349 | 7,688 |
| Total | 10,390 | 15,489 | 26,158 | 54,536 | 106,573 |

Eighty-five per cent of the mileage of the present rural trunk highways is hard surfaced and 15 per cent is surfaced with gravel.

The mileage of hard surfaces is about 17 per cent of the State-aid System and three per cent of the county-aid and county systems. Gravel surfaces occur on 81 per cent of the State-aid system and 90 per cent of the county-aid and county system. The remaining roads are not surfaced.

Less than one per cent of the township roads have hard surfaces, 65 per cent are gravelled and the remaining 34 per cent are unsurfaced or unimproved and impassable for many months of the year.

## Development of City Streets

The status of improvement of city streets also varies widely between the various systems.

**Present Status of City Street Development**

| Type of Surface | State Trunk Highways (Miles) | State-aid and County-aid roads (Miles) | Other City Streets (Miles) | Total (Miles) |
|---|---|---|---|---|
| Hard Surfaced | 1409 | 811 | 5,205 | 7,425 |
| Gravel | 51 | 656 | 2,699 | 3,406 |
| Graded–Not Surfaced | — | 22 | 912 | 934 |
| Total | 1,460 | 1,489 | 8,816 | 11,765 |

Ninety-seven per cent of the trunk highway mileage in municipalities has a dustless surface, and three per cent is surfaced with gravel.

Of the State-aid and county-aid roads in municipalities, 54 per cent have dustless surfaces, 44 per cent are surfaced with gravel, and the remainder are not surfaced.

Fifty-nine per cent of the remaining city streets have dustless surfaces, 31 per cent are surfaced with gravel, and the remainder are not surfaced.

The State has the primary responsibility for construction and maintenance of trunk highways within municipalities. The authority for construction is subject to approval of plans and specifications by the governing body of the municipality before work is started. Municipalities may enter into agreements with the Commissioner for the construction of trunk highways of greater width or capacity than necessary to accommodate the normal trunk highway traffic.

Counties have the primary responsibility to maintain and to remove snow from designated State-aid and county-aid roads within municipalities. Construction of these streets is a matter of individual agreement with the municipality concerned, except that for construction of a higher type or greater width than necessary to accommodate the normal rural traffic, the added cost is a responsibility of the municipality.

*Construction methods in use at the time the Trunk Highway System was designated in 1921.*

Chapter 9

# Finance

## HIGHWAY REVENUES AND EXPENDITURES

A comprehensive statement of the highway tax structure is contained in the report "A Compilation of Material Pertaining to the Financing of Highways in Minnesota" prepared by Public Administration Service dated February 15, 1954. To avoid unnecessary duplication, the discussion in this chapter is confined to a brief historical review and summary of the principal sources and amounts of highway revenues and purposes of expenditure for each class of roads and streets.

During the first half century of Statehood all roads and streets in Minnesota were supported entirely by the counties, townships and municipalities. The framers of the State constitution in 1857 included a provision barring the State from incurring debts for works of internal improvement, or being a party in carrying out such works except in cases where grants of land or other property had been made to the State especially dedicated to a specific purpose. While this provision of the constitution was apparently intended to curb State aid in railroad building it also effectively barred State participation in road building until the constitution was amended.

The first State legislature created township organizations and boards with general supervision over the roads and bridges in the townships. Separate county and township boards were created in 1860. Property taxes were the principal source of revenue for both county and township roads but most road work was done by "working out taxes" and this practice was not entirely stopped until 1911 when a new law required that all road taxes be paid in cash.

State aid in the development of local roads was made possible with the adoption of a constitutional amendment in 1898, creating a State road and bridge fund to consist of income from the internal improvement land fund and a State tax on property not to exceed one-twentieth of a mill. No action was taken by the legislature under this authorization, however, until 1905. The State-tax levy on property for State-aid roads was increased in 1911 to one-fourth of one mill and to one mill in 1913. The one-mill rate remained in effect until 1941 when the State property tax was abolished.

Due to incomplete data prior to 1937 it is not possible to determine the total investment in the highway and street network of the State. The Highway Planning Survey has complete finance data on county and township roads beginning with 1937 and for city streets since 1940. Finance data for State trunk highways are available since the establishment of the Trunk Highway System in 1921.

Identifiable revenues for highway purposes since 1905 total slightly over 2 billion dollars.

## Sources of Highway Revenue

Revenues for highway purposes have come from four principal sources: property taxes and special assessments, road user taxes, bond issues and Federal aid. Revenues from each source have varied considerably throughout the years.

### Property Taxes

Property taxes, levied specifically for highways and streets from 1905 to 1952 and special assessments from 1940 to 1952 have provided $798 million in road and street revenues. Special assessments for street purposes prior to 1940 are not available in summary statements nor is the

**Source of Revenues**
**All Roads & Streets**
**1905-1952**

| SOURCE | 1905-1920 | 1921-1932 | 1933-1942 | 1943-1952 | TOTAL |
|---|---|---|---|---|---|
| Property Taxes | $119,291,926 | $218,159,301 | $147,148,426 | $313,210,029 | $797,809,682 |
| Road User Taxes | | 168,741,686 | 241,135,659 | 410,037,376 | 819,914,721 |
| Bond Issues | | 63,730,748 | 17,403,649 | 46,809,469 | 127,943,866 |
| Federal Aid | | 31,318,004 | 60,725,695 | 76,160,518 | 168,204,217 |
| Miscellaneous | | 5,368,450 | 15,881,918 | 78,617,618 | 99,867,986 |
| TOTALS | $119,291,926 | $487,318,189 | $482,295,347 | $924,835,010 | $2,013,740,472 |

amount of general funds used for road or street purposes by local governmental units.

All levels of government, except the State, now levy property taxes for road or street purposes. Proceeds from the State property tax for State-aid roads totalled $58 million from 1905 to 1941, all of which was returned to the counties. No other state-imposed property tax has ever been used for road purposes.

Counties levy a property tax for road purposes which currently provides about 48 per cent of the total revenue for county roads. Property tax levies provide 75 per cent of the total road revenue for township roads and property taxes and special assessments provide 52 per cent of municipal street revenue.

Revenue from property taxes has increased substantially during the post-war period and in 1952 was approximately 32 per cent of the total road and street revenue available at all levels of government.

## Road User Taxes

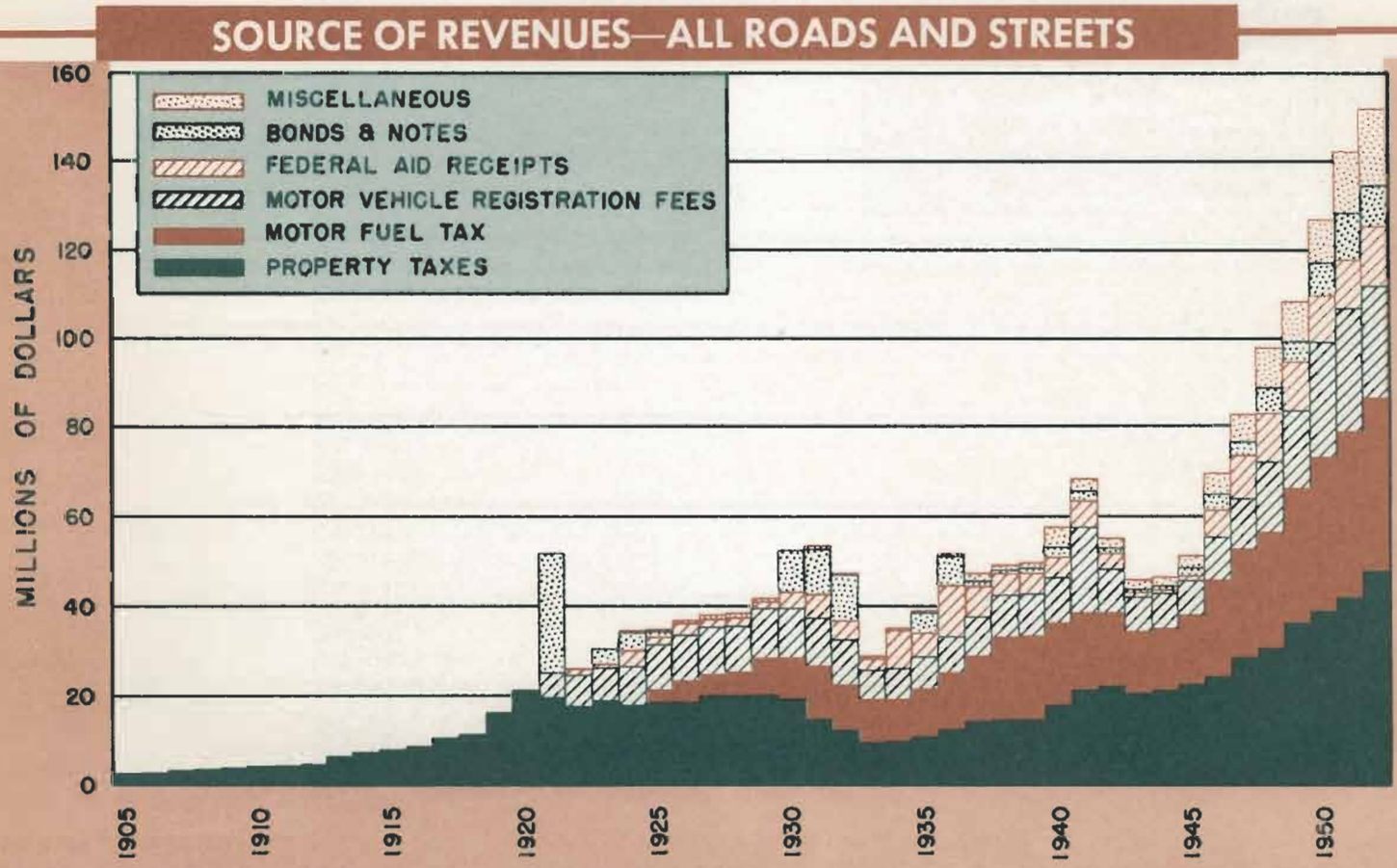
Road user taxes are registration fees and motor fuel taxes. Motor vehicles were first registered in Minnesota in 1909, initially on an annual flat rate basis and, starting in 1911, at a flat rate for three-year periods. Registration on a basis comparable to the present method began in 1921. Proceeds from registration fees, exclusive of the costs of collection, are used for State trunk highways. Total proceeds from 1921 to 1952 amounted to $359 million. Currently, registration fees provide 42 per cent of total revenue for State trunk highways.

The motor fuel tax was first collected in 1925 at a rate of two cents per gallon. The rate was increased to three cents in 1929, to four cents in 1937; it was returned to three cents per gallon in 1940 and again increased to four cents in 1941. The current rate of five cents per gallon was established in 1949. From 1925 to 1929 all proceeds from the motor fuel tax were used for State trunk highways. Since 1929, the constitution has allotted one-third of the net motor fuel tax collections to counties and two-thirds to State trunk highways.

Total proceeds from the motor fuel tax from 1925 to 1952 amounted to $461 million. Motor fuel taxes now provide 42 per cent of total revenue for State trunk highways and about 34 per cent of total revenue for county roads.

## Bond Issues

Proceeds from bond and note issues for highway and street purposes from 1921 to 1952 have provided $128 million. Of this, $75 million represents state highway bonds and the so-called Trunk Highway Reimbursement Bonds, which were state-assumed county bonds, the proceeds of which were used to finance improvement of county roads taken into the original Trunk Highway System. There is no outstanding bonded indebtedness for State trunk highways. Outstanding



highway and street bond and note issues at the close of 1952 for all local levels of government totalled $36.7 million. Currently bond and short term note issues provide about three per cent of the total revenues for county roads, about seven per cent of the total revenues for township roads and about 18 per cent of the total revenues for municipal streets.

## Federal Aid

The present pattern for Federal aid for highway improvement was established in the Federal-aid Road Act of 1916, which provided an appropriation of $75 million to be expended over a period of five years for improvement, in cooperation with the states, of roads "over which the United States mail is now, or may hereafter, be transported." The act prescribed a formula for distributing funds among the States according to their relative areas, populations, and post road mileages. An important provision of this Act made Federal aid available only to states with adequately constituted state highway departments. Minnesota was allotted $2,131,879 under the 1916 Act.

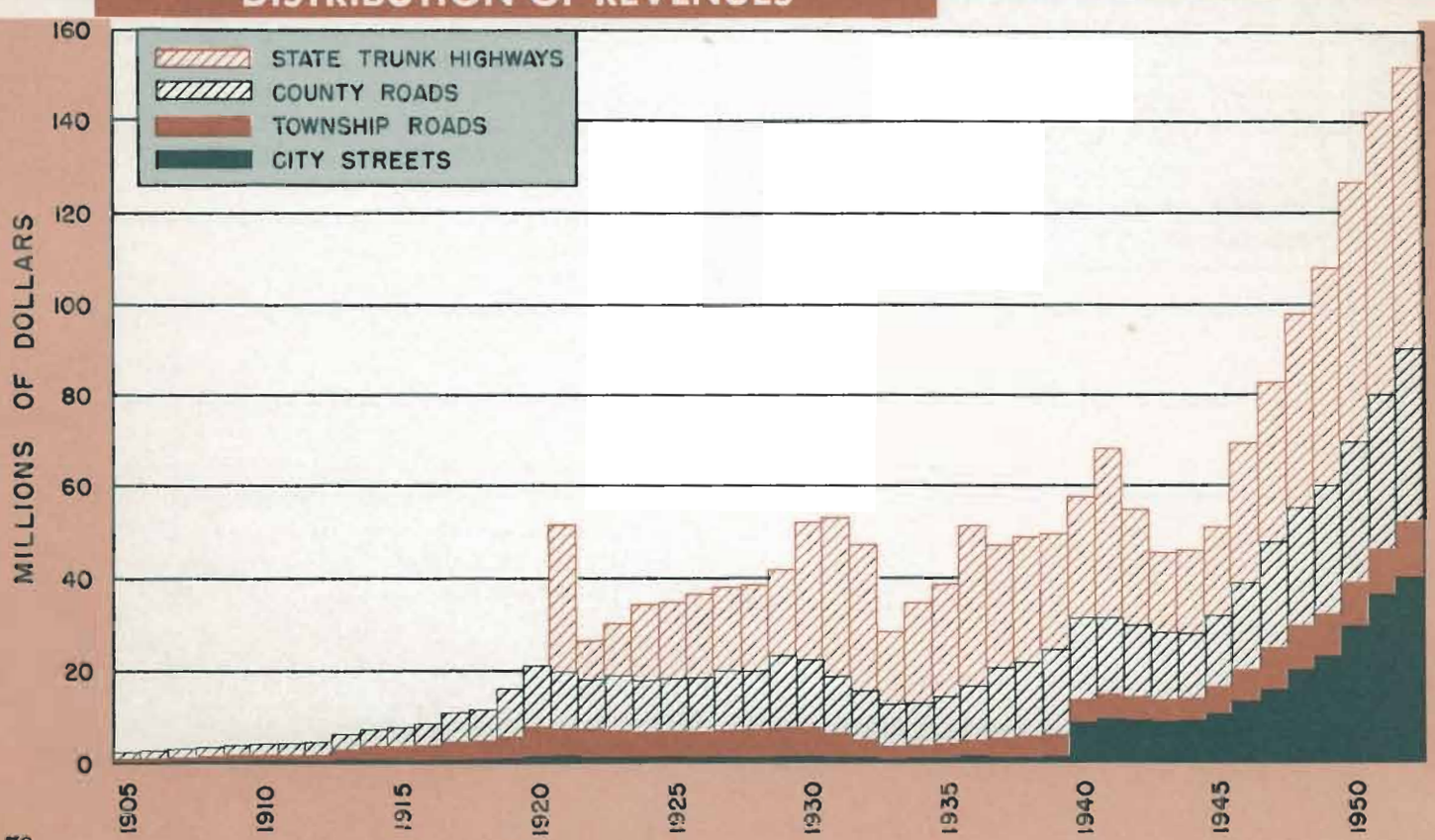
The Federal Highway Act of 1921 extended and enlarged the Federal-aid highway program. It provided for the designation of a Federal-aid Highway System, which was not to exceed seven per cent of the total rural mileage of the state. All Federal-aid funds were to be expended on this system, thus encouraging the development of an integrated network of principal roads.

Subsequent legislation continued regular Federal aid. In 1931 an emergency appropriation was passed to relieve unemployment. In 1933 and 1934 regular Federal aid was suspended and aid to highway construction allotted from funds appropriated under the National Industrial Recovery Act. In 1934 an act for the biennium beginning July 1, 1935, re-established the regular Federal-aid program authorized by the 1921 Act. The 1934 Act also provided separate funds for aid to secondary roads and for railroad grade crossing elimination. To provide for administration of Federal-aid secondary funds, the 1935 Legislature authorized the Commissioner of Highways to cooperate and act as agent for the Federal Government in supervising construction and maintenance of roads receiving secondary Federal aid.

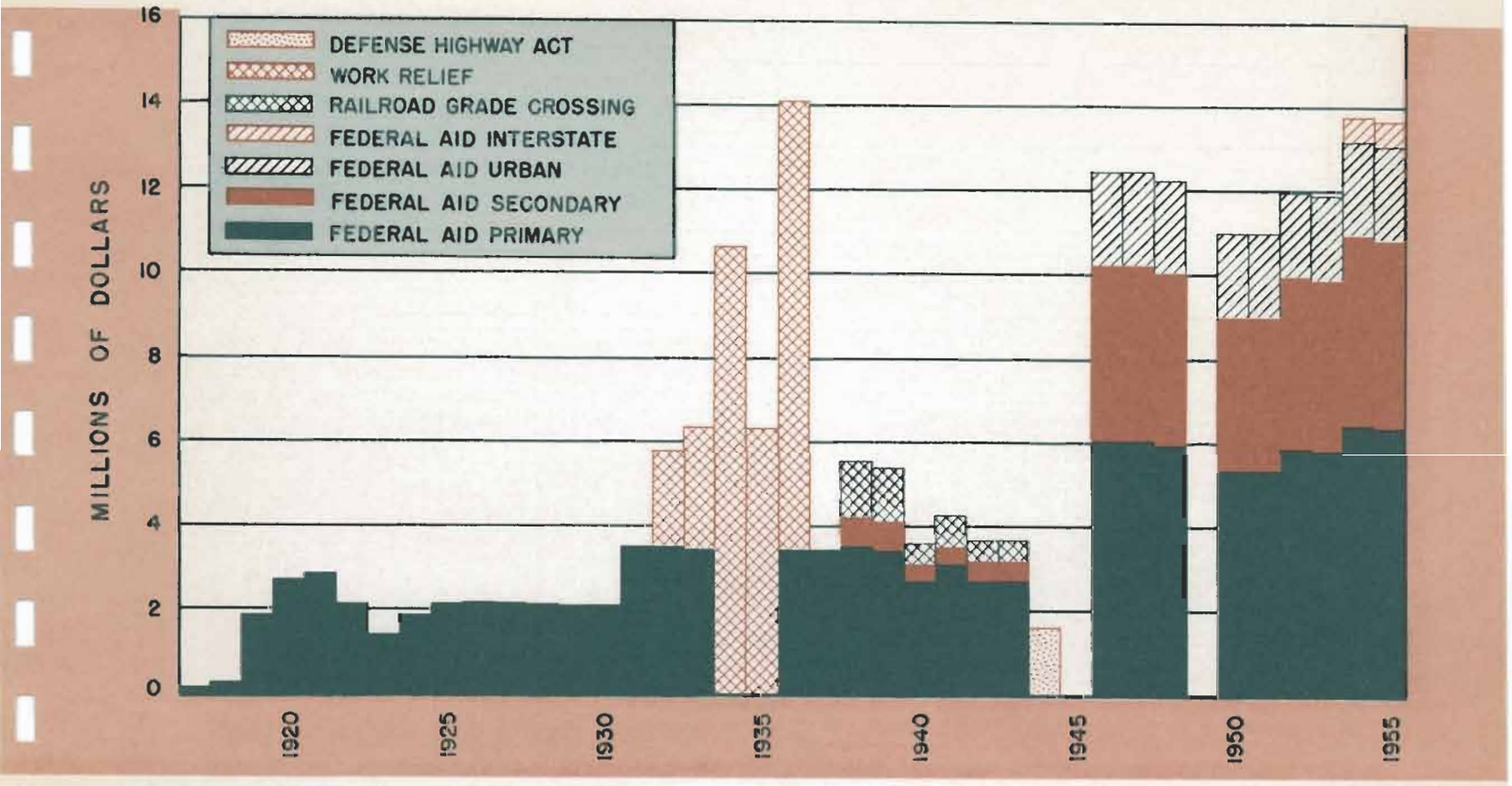
With the entry of the United States into World War II use of Federal-aid funds for highway construction was suspended except for projects already under contract, emergency projects and those needed for national defense.

As the close of the war drew near, Congress enacted the Federal-aid Highway Act of 1944 and authorized appropriation of $500 million for each of the first three post-war years. Three important new features of the 1944 Act were the authorization of special funds for projects on Federal-aid highways in urban areas, the establish-

## DISTRIBUTION OF REVENUES



# FEDERAL-AID ALLOTMENTS




ment of a National System of Interstate Highways and the provision for creation of a Federal-aid Secondary System.

Following the passage of the Federal-aid Highway Act of 1944, the Minnesota Department of Highways, in cooperation with the various county boards began selection of a Federal-aid Secondary System. This system, on December 1, 1953 totalled 16,156 miles of which 4,391 miles were State trunk highways.

The National System of Interstate Highways authorized by the 1944 Act is composed of about 40,000 miles of the most important routes in the United States and was selected to "connect the principal metropolitan areas, cities and industrial centers, to serve the national defense and to connect at suitable border points with routes of continental importance in the Dominion of Canada and Republic of Mexico." The portion of the Interstate System within Minnesota is approximately 850 miles in length.

Subsequent legislation in 1948, 1950, and 1952 provided for continuation of the Federal-aid program, the 1952 Act carrying authorizations of $575 million per year for the entire country starting July 1, 1953 and July 1, 1954.

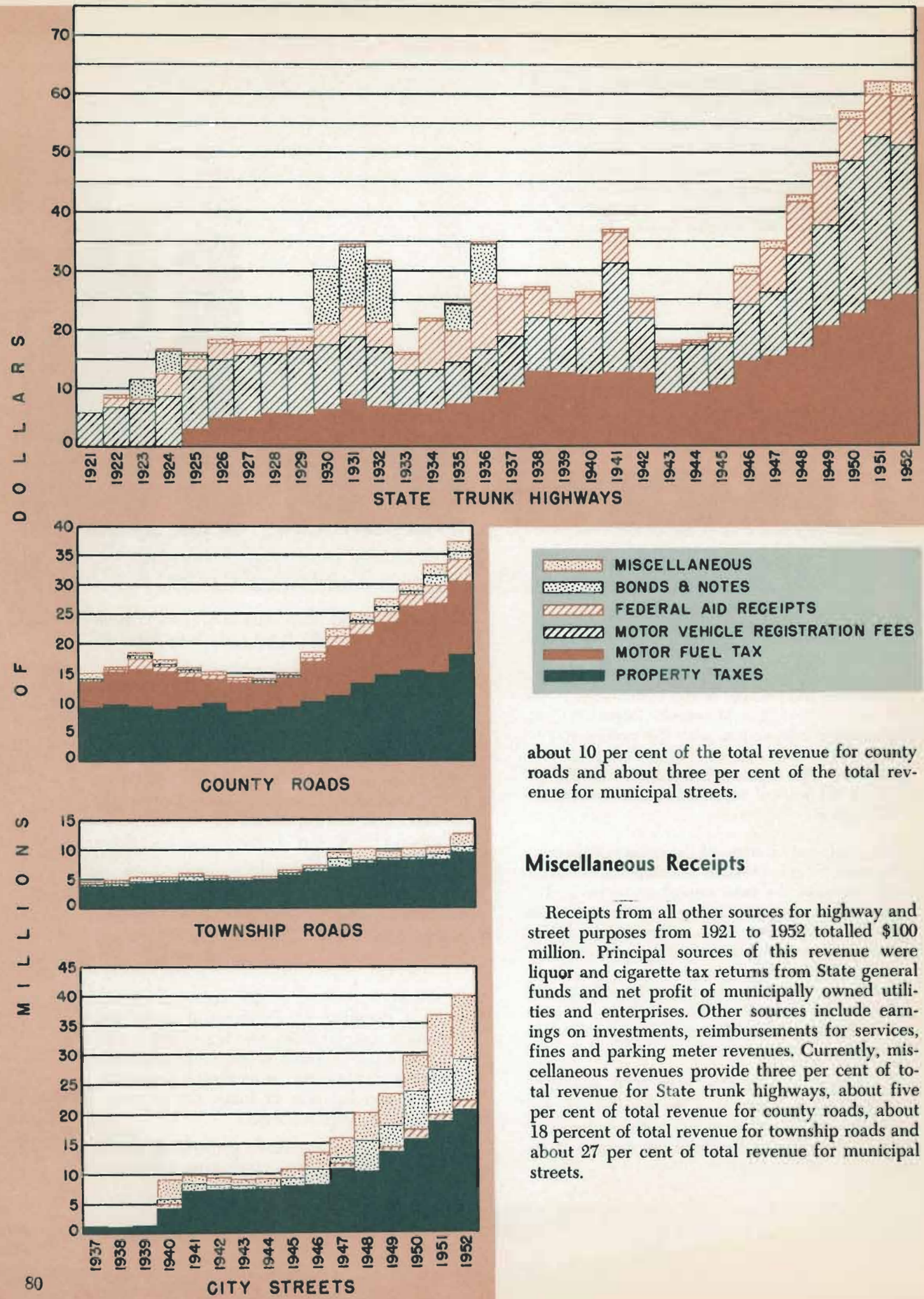
Total Federal aid allotments to Minnesota from 1916 through the 1955 fiscal year have been almost $215 million:

**Federal-aid Allotments**
**1917-1955 Fiscal Years**

| | |
|---|---|
| Federal-aid Primary | $114,635,523 |
| Federal-aid Secondary | 40,251,686 |
| Federal-aid Urban | 18,850,063 |
| Federal-aid Interstate | 1,307,889 |
| Federal-aid Grade Crossing Elimination | 5,020,981 |
| Emergency Work Relief (1932-1933) | 5,168,553 |
| National Industrial Recovery Act (1934-1935) | 16,982,120 |
| Works Progress Administration (1936) | 10,672,586 |
| Defense Highway Act | 1,626,662 |
| Emergency Flood Relief | 266,142 |
| TOTAL | $214,782,205 |

Of this amount the State has received approximately $168 million on the basis of completed construction through 1952. The lag of $46.8 million between total allotments and reimbursements represents encumbrances for construction projects under way and balances of funds not programmed for specific improvements.

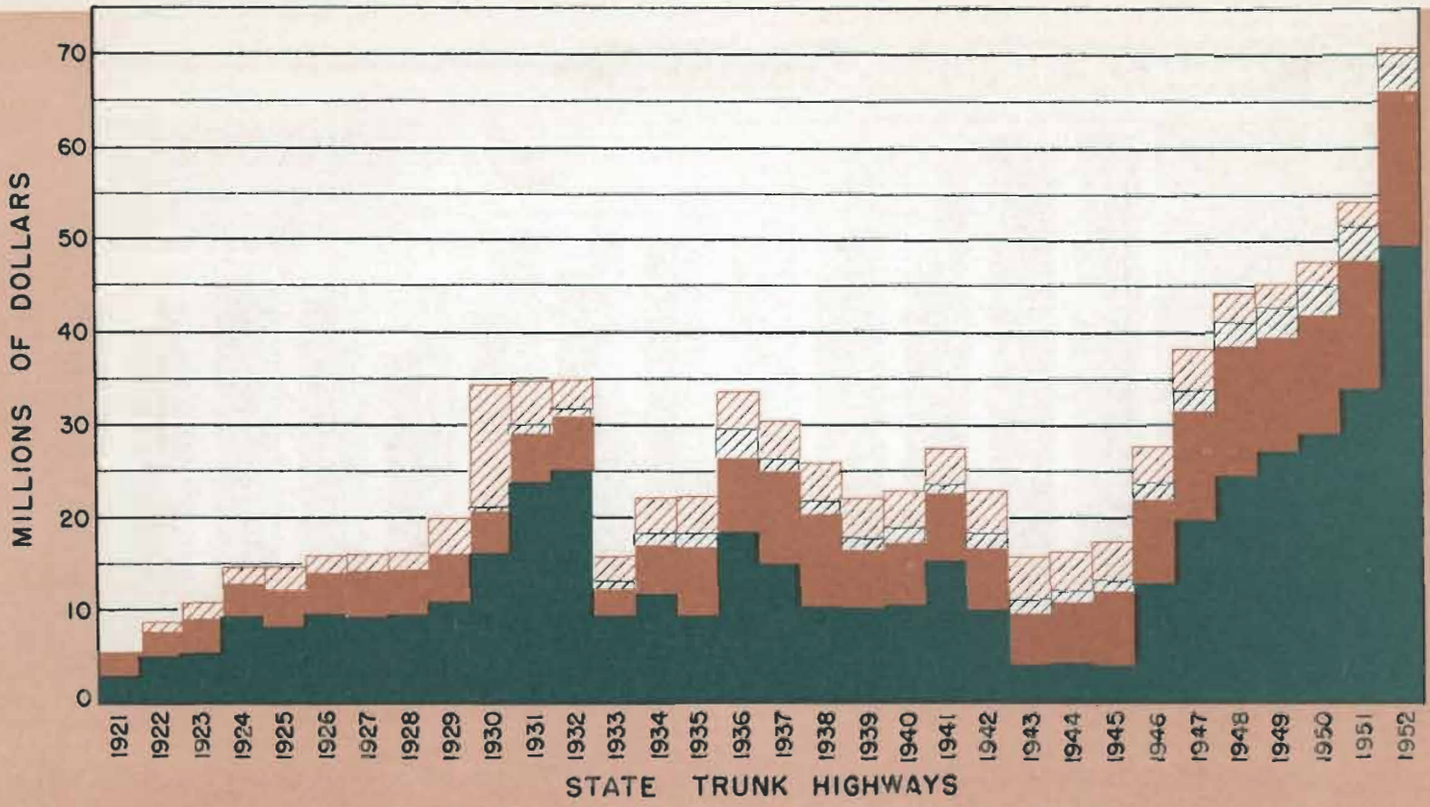
Currently Federal-aid funds provide about 13 per cent of total revenue for state highways,



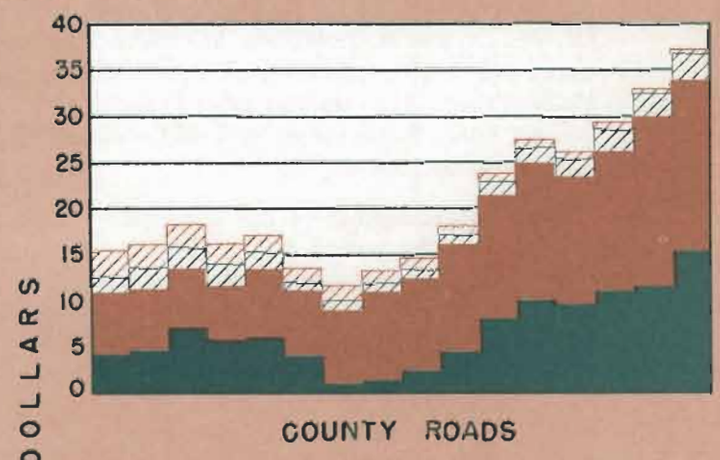

about 10 per cent of the total revenue for county roads and about three per cent of the total revenue for municipal streets.

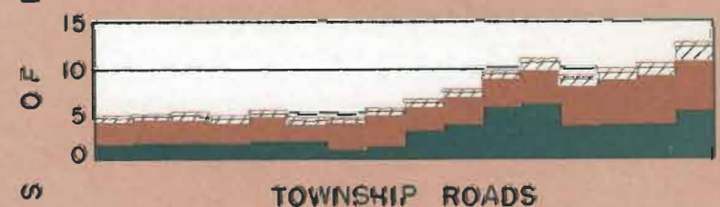
## Miscellaneous Receipts

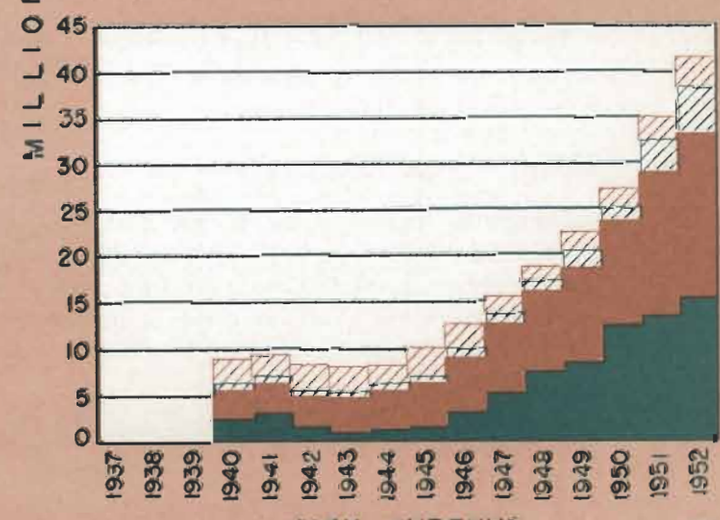
Receipts from all other sources for highway and street purposes from 1921 to 1952 totalled $100 million. Principal sources of this revenue were liquor and cigarette tax returns from State general funds and net profit of municipally owned utilities and enterprises. Other sources include earnings on investments, reimbursements for services, fines and parking meter revenues. Currently, miscellaneous revenues provide three per cent of total revenue for State trunk highways, about five per cent of total revenue for county roads, about 18 percent of total revenue for township roads and about 27 per cent of total revenue for municipal streets.




DEBT SERVICE
ADMINISTRATION & MISCELLANEOUS
MAINTENANCE
CONSTRUCTION




## Distribution of Revenue

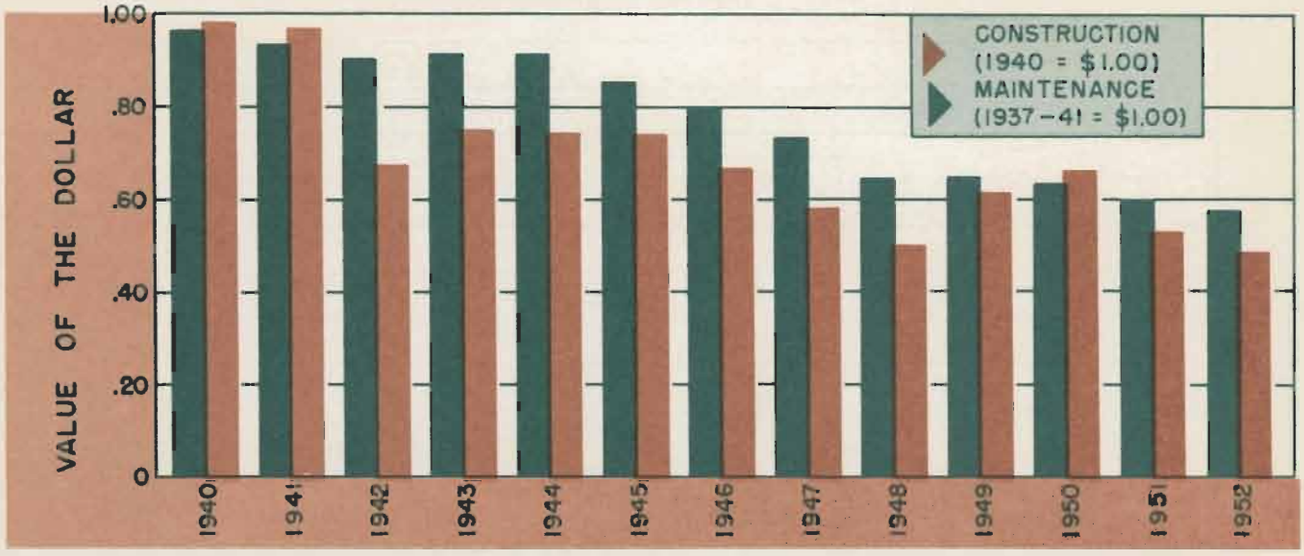
Of the approximately $2 billion of identifiable highway and street revenues collected during the period 1905 to 1952, State trunk highways received $916 million, county roads $587 million, township roads $245 million and city streets $266 million. The $916 million of State trunk highway revenue includes $26 million from Trunk Highway Reimbursement Bonds, the proceeds of which were returned to the counties to cover costs of improvement of county roads taken into the original Trunk Highway System.

### State Highway Revenue

Since creation of the State trunk system in 1921 revenues available to the State highway department have come from three principal sources: road user taxes, bond issues and Federal aid.

In the 31 year period, 1921 to 1952, total revenues available for State trunk highways, exclud-

## VALUE OF THE HIGHWAY DOLLAR




ing the Trunk Highway Reimbursement Bond Issue have been slightly in excess of $889 million. Of this amount $359 million has come from motor vehicle registration fees, $318 million from motor fuel taxes, $143 million from Federal aid, $48 million from bond issues and $21 million from miscellaneous sources.

With the exception of the depression years of the 30's and the period during the World War II total revenues available for State trunk highways have increased annually reflecting a steady growth in motor vehicle registration and in motor fuel consumption.

| Source | Total 1921-1952 |
|---|---|
| Motor Vehicle Registration Fees | $359,325,000 |
| Motor Fuel Taxes | 317,863,000 |
| Federal Aid | 143,305,000 |
| Bond Issues | 48,234,000* |
| Miscellaneous | 20,643,000 |
| Total | $889,370,000* |

* *Does not include $26 million Trunk Highway Reimbursement Bond Issue.*

Bonds have not been issued for State highway construction purposes since 1936. The last bonds were retired in 1952.

### County Road Revenue

Complete finance data is not available for county roads prior to 1937. Identifiable county road revenues from 1905 to 1937 total $251 million of which $223 million came from property taxes and $28 million from motor fuel taxes.

Since 1937, the records of the Highway Planning Survey contain a complete analysis of county road revenues, as shown below.

| Source | Total 1937-1952 |
|---|---|
| Property Taxes | $178,417,000 |
| Motor Fuel Taxes | 115,003,000 |
| Federal Aid | 20,607,000 |
| Bond and Note Issues | 5,881,000 |
| Miscellaneous | 16,157,000 |
| TOTAL | $336,065,000 |

The total outstanding debt for county roads at the close of 1952 amounted to $4.1 million.

### Township Road Revenue

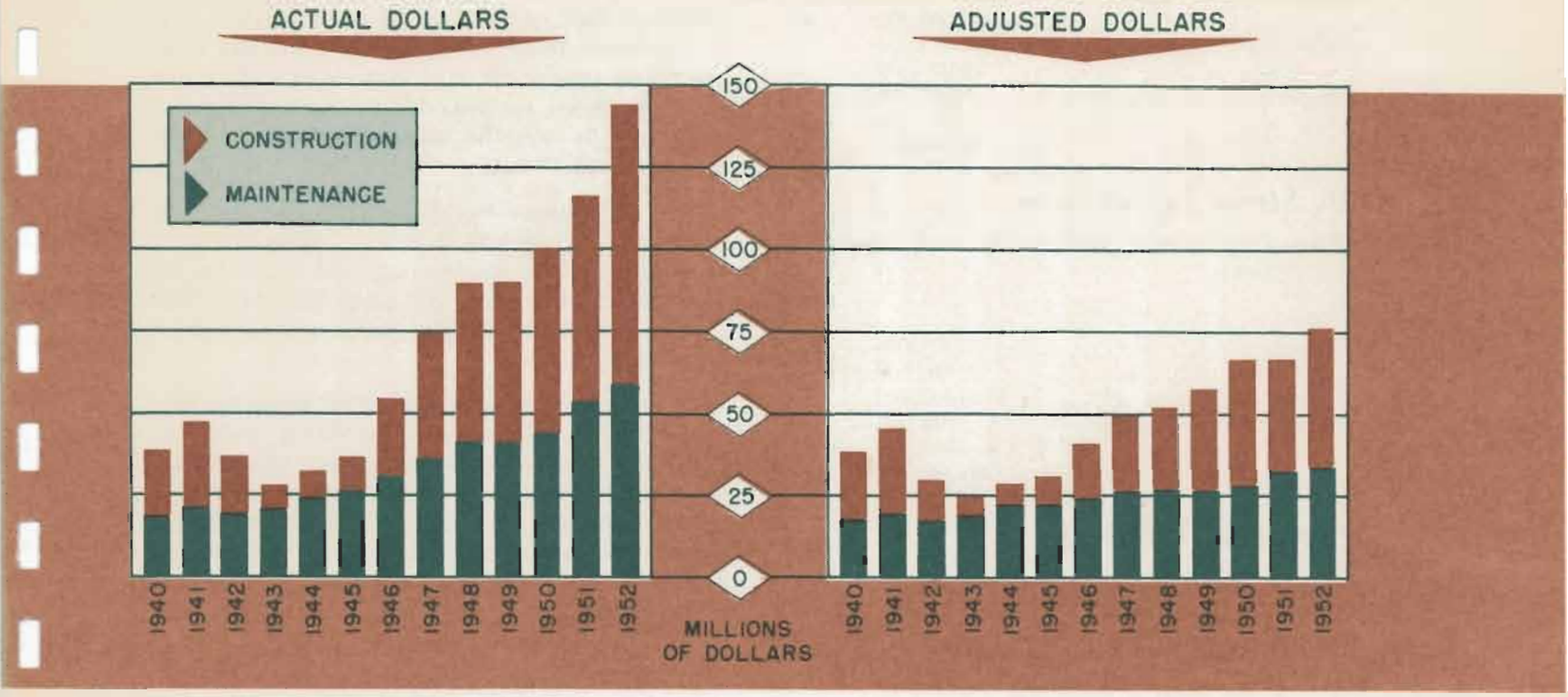
Township road revenue totalled $245 million from 1905 to 1952 of which $128 million came from property taxes prior to 1937. Revenues from 1937 through 1952 are as follows:

| Source | 1937-1952 |
|---|---|
| Property Taxes | $ 95,991,000 |
| Bond and Note Issues | 6,995,000 |
| Miscellaneous | 13,580,000 |
| TOTAL | $116,566,000 |

Miscellaneous revenues include aids from counties totalling $5.9 million. For the most part these aids came from the counties' share of the motor fuel tax. In addition, some counties furnish services, such as snow plowing to townships. The value of these services is not included in the above table.

The total outstanding debt for township roads at the close of 1952 amounted to $4.1 million.

# HIGHWAY CONSTRUCTION AND MAINTENANCE EXPENDITURES FOR ALL ROADS AND STREETS




## City Street Revenue

Complete finance data is not available for city streets prior to 1940. Identifiable revenues for city streets from 1905 to 1940 total $32 million all of which came from property tax levies.

Since 1940, the records of the Highway Planning Survey contain a complete analysis of city street revenues as shown in the following table:

| Source ..... | 1940-1952 |
|---|---|
| Property Taxes and Special Assessments ... | $140,418,000 |
| Federal Aid ..... | 4,292,000 |
| Bond and Note Issues ..... | 40,135,000 |
| Miscellaneous ..... | 49,451,000 |
| TOTAL ..... | $234,296,000 |

The total outstanding debt for city streets at the close of 1952 amounted to $28.5 million.

## Highway and Street Expenditures

State highway expenditures by purpose are available since establishment of the Trunk System in 1921. However, consolidated statements of expenditures on county and township roads are not available prior to 1937 nor for city streets prior to 1940.

## State Highway Expenditures

Expenditures on State trunk highways during the period 1921 to 1952 were approximately $853 million:

| Purpose ..... | | % |
|---|---|---|
| Construction ..... | $464,148,000 | 55 |
| Maintenance ..... | 234,938,000 | 27 |
| Debt Service ..... | 110,997,000* | 13 |
| Administration and Miscellaneous | 42,760,000 | 5 |
| TOTALS ..... | $852,843,000 | 100 |

** The $111 million for debt service includes costs of the $26 million of Trunk Highway Reimbursement Bonds for reimbursement to counties covering construction work performed on routes included in the original State Trunk System.*

## County Road Expenditures

During the period 1937 to 1952 county road expenditures totalled $332 million:

| Purpose ..... | | % |
|---|---|---|
| Construction ..... | $105,479,000 | 32 |
| Maintenance ..... | 175,125,000 | 53 |
| Debt Service ..... | 22,524,000 | 6 |
| Administration and Miscellaneous .. | 29,131,000 | 9 |
| TOTALS ..... | $332,259,000 | 100 |

## Township Road Expenditures

Expenditures on township roads from 1937 to 1952 totalled $116 million:

| Purpose | | % |
|---|---|---|
| Construction | $ 46,005,000 | 40 |
| Maintenance | 54,874,000 | 47 |
| Debt Service | 6,206,000 | 5 |
| Administration and Miscellaneous | 9,165,000 | 8 |
| TOTALS | $116,250,000 | 100 |

## City Street Expenditures

From 1940 to 1952, $230 million were expended on city streets:

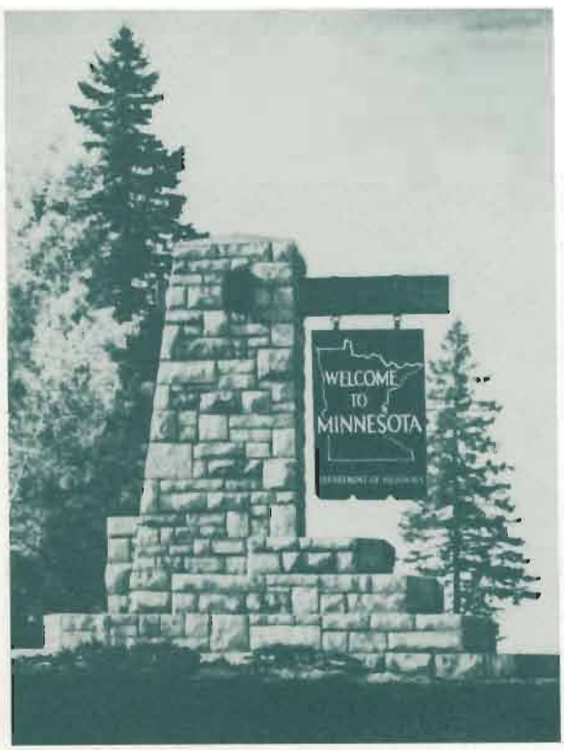
| Purpose | | % |
|---|---|---|
| Construction | $ 76,321,000 | 33 |
| Maintenance | 102,804,000 | 45 |
| Debt Service | 34,522,000 | 15 |
| Administration and Miscellaneous | 15,896,000 | 7 |
| TOTALS | $229,543,000 | 100 |

# Effects of Inflation

Increasing costs for construction and maintenance activities are a major factor in the present highway problem. The construction dollar, using 1940 as a base, was worth 49 cents in 1952. The maintenance dollar, based on 1937 to 1941 average prices, was worth only 58 cents in 1952. While there has been considerable variation in value from year to year the trend has been steadily downward since 1940.

This inflationary trend has had a pronounced effect on the highway program. While the total expenditures for construction and maintenance activities in 1952 were 3.7 times those for 1940 these expenditures actually purchased only twice the volume of work.

Preliminary information for 1953 indicates that the value of the maintenance dollar remained about the same as for 1952 but that there was a substantial increase in value of the construction dollar over 1952. This is attributed to easing of material shortages, particularly steel and cement, more competition for contracts and favorable construction weather during late summer and fall.




*Minnesota's recreational areas attract thousands of out-of-state visitors annually. In summer months alone, tourist trade produces an estimated revenue of $150 million.*

Chapter 10

# Economics

## WHAT MOTOR TRANSPORTATION MEANS TO MINNESOTA

Many of the important things we take for granted in our way of life depend upon rapid and relatively easy transportation. The transport system of modern America enables us to use much of our land for the purpose to which it is best suited. The people of any region with modern transport facilities can specialize in the economic activities they find they can perform best where they are, and they can ship their products to the places where those products are needed. With the same modern transport system they can bring in goods to meet their own varied demands from regions with other specialties.

Thus America is a nation of specialized regions. Every part of the country produces its specialties in abundance and consumes a bigger variety of goods than it makes, mines, or grows locally. The material level of living in any region of the United States, therefore, depends not only upon the effectiveness with which the region's people use their productive resources but also upon the efficiency with which they transport goods.

Minnesota is no exception. Its 84,000 square miles embrace perhaps the greatest geographic variety to be found in any state between the Appalachians and the Rockies. From its varied regions comes the surplus of many different kinds of production, and to all of them must move the goods to help meet the standards of living we can attain.

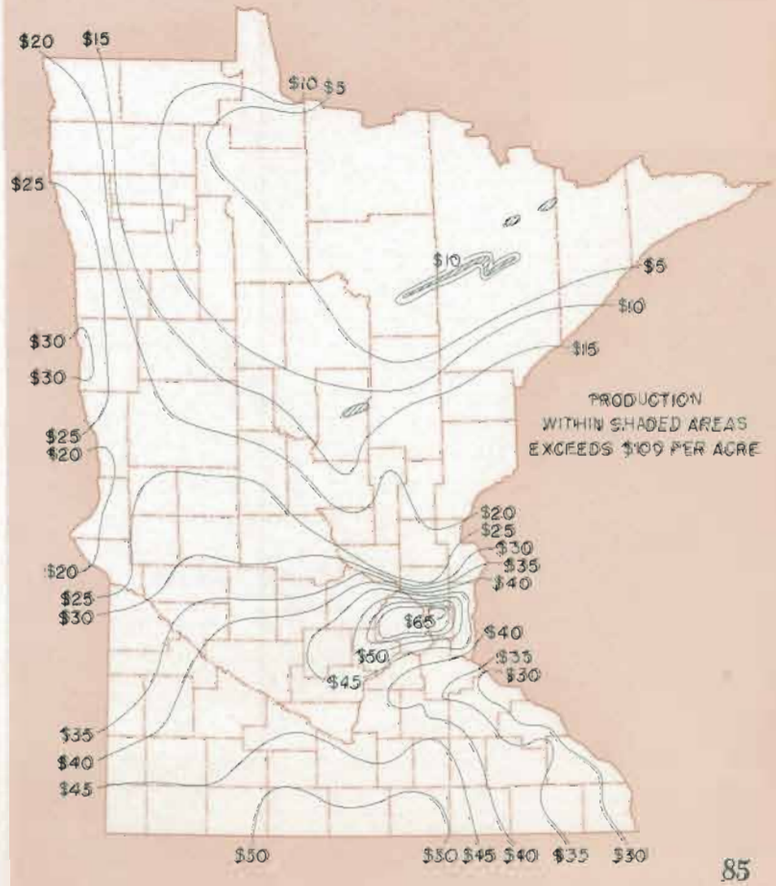
There are big differences in the land use and occupations in different sections of the state, different parts of each county, and different parts of each city. Hence regional specialization on the land of Minnesota generates interstate, intercounty, and local traffic; in the automotive age that, in turn, generates a need for roads to handle the traffic as efficiently and quickly as possible.

## The Productive Land and People

Two groups of activities generate the state's transport traffic. One group includes the basic production from the land—the output of the state's farms, forests, and mines. The other includes the non-farm, non-mining population's output of services and manufactured goods of all kinds. The first group of activities is distributed broadly over the land of the State; whereas the second group is concentrated in the towns and cities.

Value of the total production from the farms, forests, and mines of the State in 1950 was approximately $1.4 billion. More than two-thirds of this total represented the value of all products sold from the farms. As the map below shows, total productivity per acre from the state's farm land is highest adjoining the Twin Cities and in the counties immediately to the southwest, where dairy farms are close to the Northwest's major fluid milk market and there is the most intensive production for the metropolitan area. Productivity declines toward southeastern Minnesota, where steep slopes and a greater soil erosion risk keep half the farm land permanently out of cultivation. Productivity remains high across the southern and southwestern prairie section of the State, where a relatively long, warm growing season and level, rich prairie land produce the finest natural resource base for agriculture in the State. Moving northwestward, pro-

**DOLLAR VALUE, PER ACRE, OF TOTAL PRODUCTION FROM FARMS, FORESTS AND MINES**



ductivity declines in response to the gradually diminishing length and warmth of the growing season and consequent decrease in the production of grain corn. In the northeastern region various combinations of sandy, sour, wet, or stony land discourage cultivation in many districts and reduce average farm productivity per acre to the lowest values in the State. Furthermore, taxable farm land occupies less than half the land of the counties in the northeastern third of the State, less than one-twentieth of the land in the Arrowhead region.

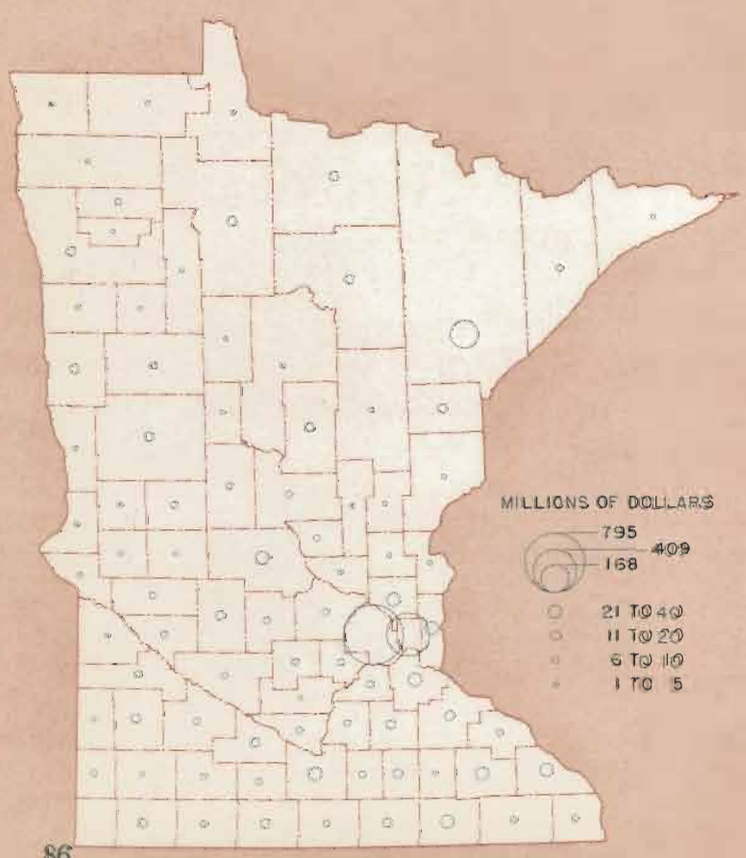
Wood is the principal product of much land of the northeastern counties. It comes in part from farms, in part from public and other forests. In total the yield of forests in 1952 was in excess of $40 million. But trees are a very extensive crop; their yield per acre is low in comparison with the farm crops on the richer land of southern and western Minnesota. Thus the total productivity per acre of land in the northeastern counties is far lower than that of the remainder of the State, even if we include the annual cut from all forests.

Mines accounted for another one-third billion dollars of the total production from the land in 1950. The bulk of this total, of course, represents the value of ore from the three ranges, mainly the Mesabi. Measured by value of product per acre, the iron ranges are by far the most productive land of the State as long as they contain saleable ore.

Total income of non-farm and non-mining population of Minnesota in 1950 was more than $2.5 billion—nearly twice the value of all products from the land. This income represents the value of manufactured products and services produced at the urban places in the State. The accompanying map shows that over most of the State the geographic pattern of urban income follows closely the pattern of farm productivity, suggesting the overwhelming degree to which urban activities depend, in the first place, upon agricultural production. The notable exceptions are at the Twin Cities and Duluth, the towns on the iron ranges, in the northeastern forests, and in the southeastern counties. In those various regions, commercial and manufacturing operations serve markets that range in both their complexity and their geographic extent far beyond the limits of Minnesota. Thus the distribution of cities in those parts of the State does not so closely follow the pattern of farm productivity.

This is the geographic pattern of Minnesota's gross surplus production and power to purchase. Hence it is also the regional pattern of Minnesota's capacity to generate traffic and to pay for the roads to accommodate it. A total road pattern must reach every corner of the State's productive land. But the greater part of the total production of goods and services is concentrated at a relatively few, widely spaced urban places which must be joined by trunk roads with one another and with principal urban centers of other states. This can be demonstrated from an examination of some of the maps of specific traffic-generating activities.

**DOLLAR VALUE OF MANUFACTURED PRODUCTS AND SERVICES PRODUCED IN URBAN AREAS**




## Generation of Local Rural Traffic

Some of Minnesota's productive activities are carried on at many hundreds or thousands of isolated points scattered across the entire State. Where the same type of materials or services are produced at many different points, the area served from each central point tends to be small, and most of the traffic generated around such points tends to be local. The average trip is far shorter than the distance across a county.

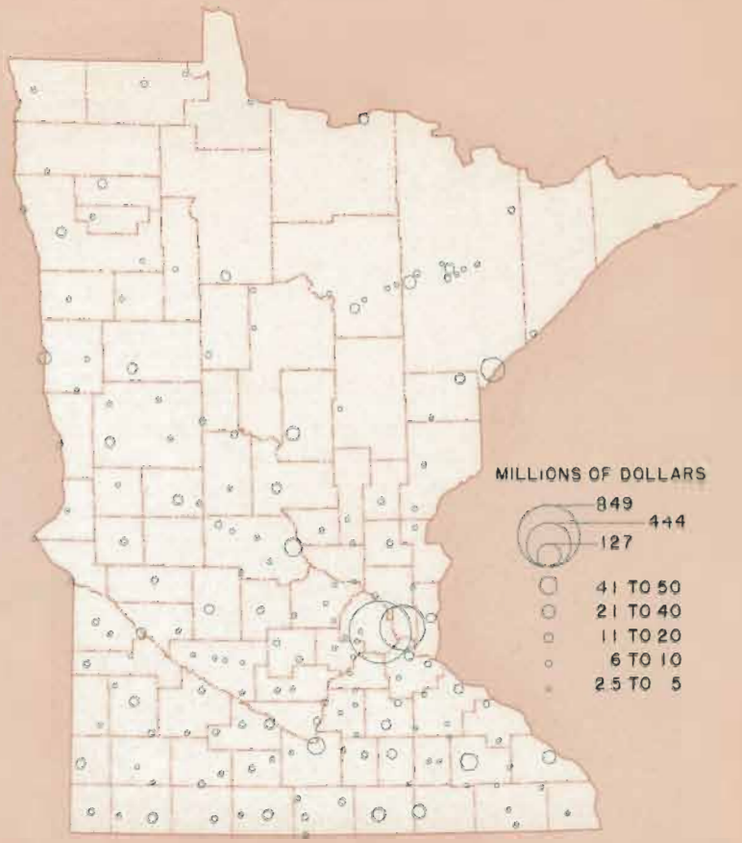
Thus there is local traffic generated between neighboring farms in the rural communities. On their local roads farmers commonly move feed, livestock, machinery, and other items that they exchange with neighbors. There is also traffic

between the farms and nearby hamlets or villages. Those small places contain many of the hundreds of creameries, line elevators, garages and filling stations, and community recreational and religious centers. They are local assembly points for milk and grain, retail distribution points for feed and petroleum products and a few services that are required most frequently on the farm.

Then there is the traffic between the farms and larger retail trade centers of each county. At those centers the population usually exceeds 1,000 and retail trade volume usually exceeded $2.5 million at the time of the last U. S. Census of trade in 1948. There are nearly 200 places in this class in Minnesota. The map to the right shows their location and dollar volume of trade. These larger county trade centers perform the functions of the hamlets and considerably more. They are the locations of most of the state's libraries, telephone exchanges and maintenance points, power and light offices, high schools, auditoriums, medical and legal offices, bulk oil depots, automotive and implement dealers; and they commonly have the shopping facilities symbolized by a large home-owned department store or the larger chain grocery, drug, hardware, and dry goods outlets. The largest of these centers in all but four counties is the county seat, with its governmental offices. Roads from these county trade centers carry the trucks that distribute to the surrounding farms and villages from the center's bakeries, feed dealers, bottling works, oil dealers, and others. They also carry the crews and trucks that service the state's communications and power transmission grids.

It is obvious from the accompanying map that the county trade centers follow closely the pattern of basic productivity from the land. Where that productivity is highest, the density of trade centers is greatest. That productivity must underpin the commercial activity at the trade centers and, hence, generate the traffic between them and their surrounding farms. But the basic production from the land is valued at about one-half

**DOLLAR VALUE OF RETAIL AND SERVICE TRADE**

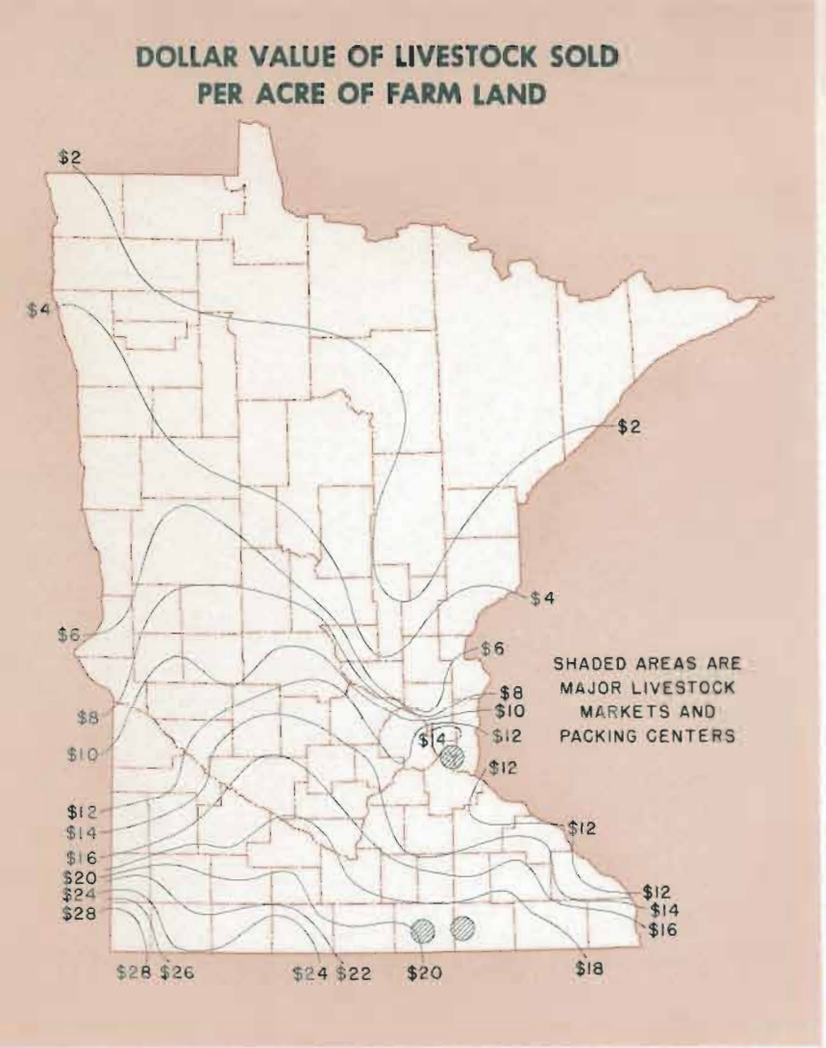



the income earned by individuals in commercial, industrial, and professional activities in the villages and cities—when the raw materials from our land reach the urban trade centers, urban people working with those materials and for one another generate additional buying power and goods. Hence they generate additional exchange of goods; and the traffic that moves between county trade centers reflects the specialized production and general needs of the cities, themselves, as well as the countryside they serve.

## Generation of Inter-County Traffic

Inter-county traffic is generated by a large number of vital productive activities concentrated at a relatively few places. Where the same type of production of goods or services is repeated at a small number of places, the territory those places serves tends to be large. Hence those activities generate regional, or inter-county, traffic. One major basis for Minnesota's inter-county traffic is the need to tie the state's farm livestock producers to the primary livestock markets. In a typical year 1.5 million cattle, 4.5 to 5 million hogs, and .5 million sheep are sold from the state's farms. The map on page 88 shows the value of livestock sold per acre of farm land in 1949. Ninety-five per cent of this production

*Value of production from mining in Minnesota is approximately one-third billion dollars annually.*




comes from the southwestern two-thirds of the State. Nearly 70 per cent comes from 40 counties in southern Minnesota where two-thirds of the state's crop of corn is produced. But most of the livestock sold for slaughter over this broad area must move to three points—South St. Paul, Austin, and Albert Lea; and more than four-fifths of the total moves by truck.

The need to move the increasing production of timber from forests to processing centers in northeastern Minnesota provides the basis for another important item of inter-county traffic. The biggest single user of locally-cut wood in the State is the paper industry. About .5 million tons of pulpwood move from forest to mill in Minnesota in a typical year. The forest spreads over a dozen northeastern counties, but the wood must be concentrated at half a dozen paper milling cities on the upper Mississippi, St. Louis, and Rainy Rivers. Trucks move the major part of this local pulpwood to the mills, and the importance of this regional highway traffic will grow with the state's growing forests and paper industries.

Some local retail and service centers are much more important than others. The cities whose volume of retail and service trade exceeded $10 million per year in 1948 are less numerous than the counties of the State. In fact, in the 87 counties of the State there are only 34 such centers, including metropolitan St. Paul, Minneapolis, and Duluth. Thus for certain purposes each of these cities serves as the urban focus for parts of several counties.

These cities are the locations of the state's major hospitals; their shopping facilities are more complete, and so is their array of professional and personal services. In general they provide services and facilities which cannot be sustained by a smaller or less productive trade area. The smaller cities of this group are exemplified in Fairmont, Worthington, Marshall, or Montevideo in southwestern Minnesota; Fergus Falls, Crookston, and Thief River Falls serving the Red River Valley and its eastern borderlands; Alexandria and Detroit Lakes in the central resort and dairying area; or Cloquet, Grand Rapids, Hibbing, Virginia or Bemidji in the mining-lumbering-paper milling-resort country of the northeast. There are others which obviously could be added to this list.

Some of these cities not only function as regional retail trade and service centers but also embrace important enterprises that serve interstate, national, or international markets. At those places retail and service trade in the last census year ranged between $20 and $50 million. Trade is bolstered by important local manufacturing payrolls at such places as Austin, Albert Lea, St. Cloud, and Winona, for example. Trade benefits from the activities of important wholesale enterprises at Winona, Rochester, Mankato, Albert Lea, St. Cloud, Moorhead, and Hibbing. At Rochester the volume of trade is further increased by the city's unique production of medical services for a world market. At the Twin Cities and Duluth, of course, there is the state's greatest development of manufacturing, wholesaling, and professional services whose markets extend far beyond the immediate inter-county retail trade area but whose activity boosts local trade.

Those 34 major centers account for two-thirds of the entire retail and service trade in the State.

*Four-fifths of the livestock sold annually in Minnesota moves to market by truck.*

If we exclude the Minneapolis, St. Paul, and Duluth metropolitan areas, the remaining 31 centers do nearly half the retail and service business of out-state Minnesota. Hence nearly half the volume of goods transported to the shops and stores of out-state Minnesota—or more than two-thirds of the goods for the State as a whole—must move to these few points on the map. Trucks are major servants of this trade. As the trade grows and trucking grows, it is obvious that the highways serving these major inter-county trade centers are vital arteries in the economy of Minnesota.

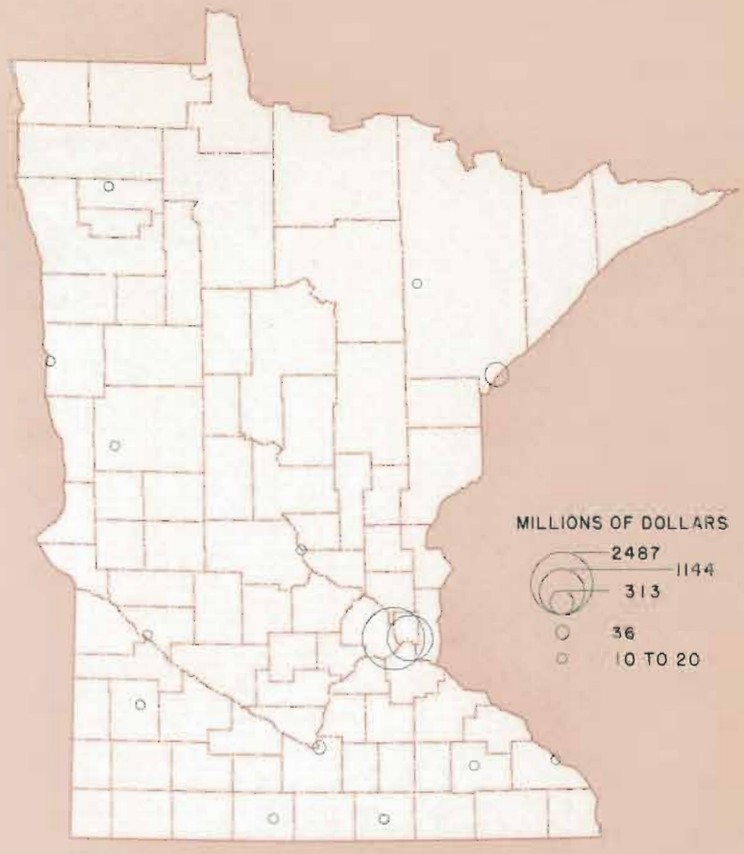
The Twin Cities, Duluth, and a dozen smaller cities function as regional wholesale centers for Minnesota. As shown on the map to the right the smaller centers include Winona, Rochester, Albert Lea, Fairmont, Marshall, Montevideo, St. Cloud, Fergus Falls, Moorhead, Thief River Falls, Hibbing, and Mankato. At all of the out-state centers wholesale trade exceeded $10 million in the last trade census year, and at Mankato it exceeded $40 million. In most of these trade centers wholesale trade is almost as great or greater than retail trade volume. It is obvious from the map that each of these centers wholesales to an inter-county block of retail centers. The great bulk of the distribution within these several-county wholesale territories is handled by truck. There is a trend toward increasing dispersal of food, general merchandise, and auto supply wholesaling, for instance, to these smaller trade centers.

It is worth emphasizing that all of the principal inter-county wholesale centers are also among the 34 top retail and service trade centers. So these centers not only receive the bulk of the goods shipped to the retail outlets, but they also receive and re-ship the bulk of the State's wholesale trade volume. Clearly, the inter-county roads that serve them are the roads most important to the State's urban trade.

Transfer of semi-finished goods and raw materials between integrated plants of a single manufacturer is a small but noteworthy generator of inter-county traffic in Minnesota. For example, an underwear manufacturer uses trucks to transfer between its parent plant at Minneapolis and branch plants at Albert Lea, Montgomery, Little Falls, Park Rapids, and Bemidji. Another large manufacturing company trucks over the road between its parent plant at St. Paul and branch plants at Hastings, Hutchinson, and Fairmont.

While most of Minnesota's industry does not yet show that dispersal, it will in the future. For

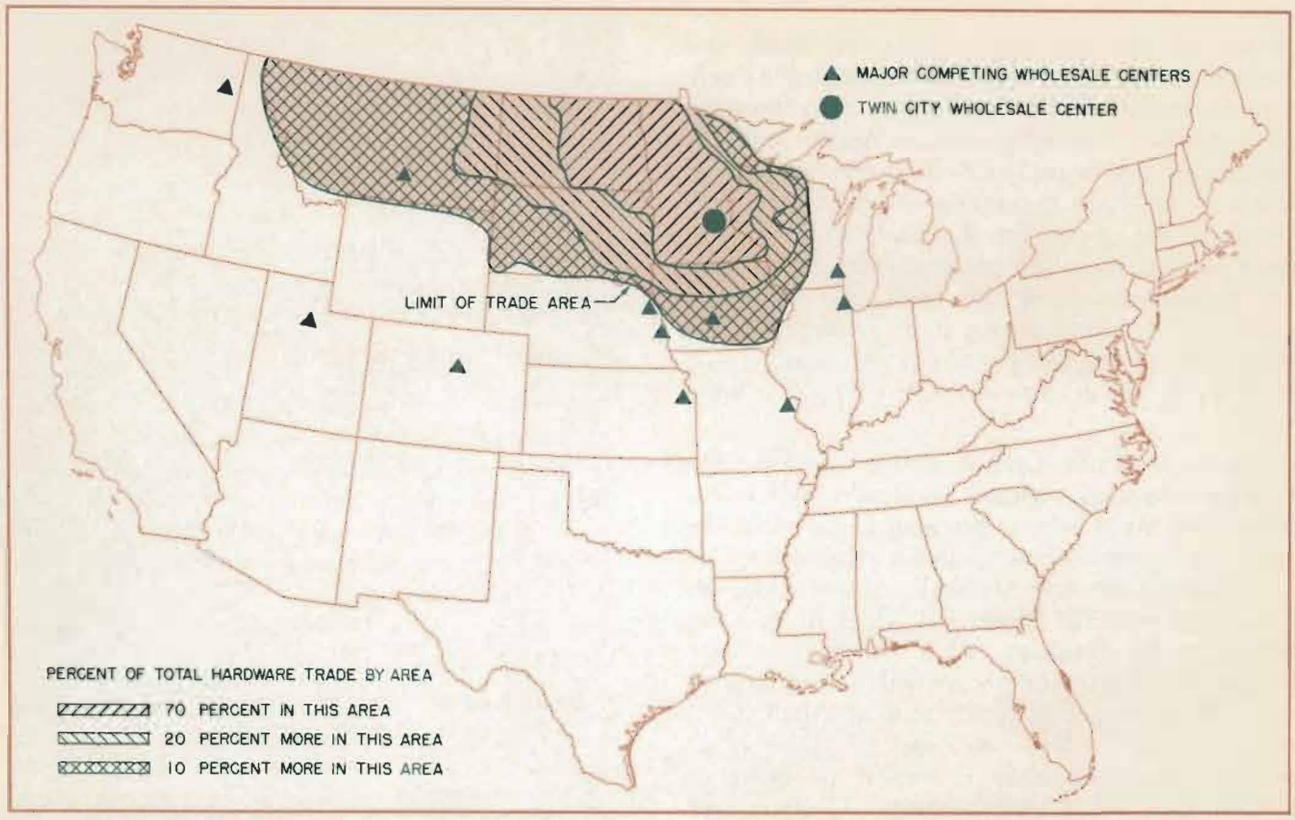
**VALUE OF WHOLESALE TRADE**




the advantages underlying the trend toward plant dispersal in many light industries are likely to persist; and light industry should continue to grow in Minnesota. The cities most likely to be the focal points for branch plant locations are the county trade centers, for they are the focal points for the local labor pool as well as for local retail and service trade. The highways that connect those centers with one another and with the major metropolitan centers should be expected to play an increasingly important role in integrating the operations of dispersed industrial plants.

The attraction provided by the state's recreational regions generates another important element of regional or inter-county traffic. The resort business of the State produces an estimated $150 million revenue in a typical summer. But that is far from being its fundamental importance to the state's livelihood. Aside from the production from its first-class agricultural land, the major industrial resource of Minnesota is its people—its reserve of dependable labor and skilled and effective managers and salesmen. Although there is no research to prove this, it seems likely that a major force keeping them here is the proximity of Minnesota's urban centers to abundant recreational opportunities in the lake and forest regions

## TWIN CITY WHOLESALE HARDWARE MARKET




of the State. It is probably of profound importance to Minnesota's industrial future as well as her commercial present to keep the recreational areas accessible as well as enjoyable. The regional highways that carry the truck and passenger traffic to and between trade and resort centers such as Alexandria, Detroit Lakes, Park Rapids, Bemidji, Brainerd, Grand Rapids, Ely, and Grand Marais serve several important transport needs.

### Generation of Interstate Traffic

The wholesale trade of the Twin Cities and Duluth is probably the biggest factor in Minnesota's interstate traffic picture. The Twin Cities and Duluth are more than retailers and wholesalers to important inter-county trade areas in their own sections of the State. In addition they perform merchandising functions that, because of their size and complexity, can be repeated only at a few places in the United States. Merchandising activities so distributed must generate interstate traffic. Total volume of wholesale trade through the Twin Cities exceeds $3 billion annually, and the volume at Duluth is nearly $.5 billion. Together these two centers collect manufactured goods from every state and distribute it to wholesale and retail outlets across the Northwest. They also collect agricultural produce and food products from the agricultural areas of Minnesota, the Dakotas, and Montana and sell it in the eastern markets.

The Twin Cities center is the nation's ninth largest wholesaler, the nation's fourth largest wholesaler of hardware. The scope of the Twin City wholesale hardware trade area is shown on the above map. Wholesaling is an unusually important aspect of the Twin Cities' livelihood in comparison with other major metropolitan areas. Among metropolitan centers of over one million people, only metropolitan New York has a higher ratio of wholesale to retail trade.

About one-third of the wholesale trade through Duluth and the Twin Cities is the tremendous volume of grain, dairy products, and other agricultural materials handled by merchant wholesalers, agents, and brokers. But the remainder represents a massive stream of food products, machinery and equipment, appliances and hardware, dry goods, paper, chemicals, and the multitude of other materials needed to run the economy of the Northwest.

Much of the goods moves by truck over the interstate highways that join the Twin Cities and Duluth to the nation's industrial regions and to the secondary distribution centers of a market that spreads over parts of seven states. For example, highways move the bulk of the electrical appliances and supplies, food and malt beverages, paint, floor coverings, textiles and apparel in Minnesota's interstate traffic. These are major

items in the wholesale trade. Likely the volume of this trade will continue to grow. The interstate highway is vital to the primary commerce of Minnesota's metropolitan centers now and in the future.

The state's manufacturing industries also generate interstate traffic. Highways are important to many industrial processors of raw materials from the farms and forests of Minnesota and the Northwest. For example, some of the livestock handled at the major meat packing centers comes from Iowa and South Dakota, for southern Minnesota is only part of the hog-and-beef-cattle-producing Corn Belt region of the Midwest. The greater part of the paper, sheathing, and insulation from the paper milling centers moves to the national market by truck, and highways bear an important part of the export of butter, cheese, and dried milk products.

Highway transport is even more important to the metal fabricating, machinery and apparatus, chemical, plastics, and garment industries. Those manufacturers account for two-thirds of Minnesota's manufacturing employees and pay total wages and salaries almost half as large as the income from sale of farm products. Hence they are important in stabilizing the State's economy. The flexibility of highway transport is especially important to those industries. For instance, the Northwest market for heavy machinery and fabricated steel products is the smallest among the nation's regional steel markets; yet it is diverse. As a result the state's metal-working industry demands a great variety of raw steel, much of it in relatively small consignments and special orders. The highway offers the solution to some of the transport requirements of these plants. Nearly half the tonnage of steel used by Minnesota industries in 1950 came from the Lower Lakes mills in trucks.

The fast-growing industries that manufacture for the national market in Minnesota make low-bulk, high-value products such as electronic equipment, tape and abrasives, or other specialty products. Those industries, too, demand a great variety of raw materials from industrial centers in all parts of the country. They also produce many relatively small consignments of finished goods that demand rapid delivery to far-flung customers. Trucks handle the greater part of Minnesota's outbound shipments of electrical goods, abrasives, and plastic products. The industries best suited to a Minnesota location appear to be those that can serve an extremely diverse but limited local market or produce light, high-value specialty products for the national market. Thus the Twin Cities, Duluth, and smaller out-state manufacturing cities will generate an increasing amount of interstate traffic vital to the industrial growth.

Another producer of interstate traffic is the resort industry in Minnesota's recreational regions. The forest and lake country, the cool nights, and the high frequency of clear, dustless air from the far North stand in sharp contrast with most of the remainder of the central United States during the summer months. Two-thirds of America's families who take vacations do so in the summer months from June through September. Hence the lakes, lodges, and camps of the Minnesota "north woods" are well-known to thousands of farmers and city people who come here from the lower Great Lakes and mid-continent regions. Practically all of these visitors come by motor on the interstate highways.

Other generators of interstate traffic affect Minnesota highways although they lie outside the State. For the State lies astride the routes between the populous Northeastern United States and the Pacific Northwest. Approximately one-third of the tourist travel to the Pacific Northwest and Northern Rocky Mountain region originates in the East North Central and Middle Atlantic states, east of Minnesota; and three-quarters of these transcontinental vacationers travel on the highways. Truck traffic follows the same paths between the northeast and Pacific Northwest. Here, then, is a stream of traffic that crosses Minnesota and helps to support motels and hotels, restaurants, truck forwarding depots, and other commercial establishments along certain trunk routes. But it is noteworthy that this traffic is more essential to other regions of the country than it is directly essential to Minnesota.

## Generation of City Traffic

Within each city, as within the whole State, land is used for different purposes in different areas. The result of this segregation of different parts of the urban mechanism within different regions is, of course, the generation of city traffic; a city does not have to become very large before the traffic takes to the road with trucks and passenger cars.

The outstanding and most fundamental geographical regions of our cities are the regions where people dwell and the regions where they work. Our standard of living compels us to differentiate these two functions if we can. Thus in the Twin Cities metropolitan area most of the

nearly half a million employed people go to work each day somewhere in one particular region. That is the region of commercial and industrial land that follows trackage for 23 miles down the river terrace of north, northeast, and downtown Minneapolis, through the Midway district, back to the river in downtown St. Paul, and down the river to Inver Grove and St. Paul Park. But to acquire or build their homes these same people have followed higher ground, lake frontage, cleaner air, and major lines of transport far from their places of work.

Great "spokes", dominantly residential in their land use, radiate from the Minneapolis loop eight miles northwest to Crystal, 20 miles southwest then west to Mound, 12 miles south into Bloomington. Similar spokes reach with little interruption from the St. Paul loop five miles southwest, 10 miles northwest to New Brighton, 11 miles northeast to White Bear Lake, and eight miles south to St. Paul Park. There are other functional regions of the metropolitan area, too—smaller outlying commercial centers and industrial districts, parks and other concentrations of recreational facilities, for example.

The total result is an ant-hill of half a million cars, delivery trucks, and buses where one-third of all Minnesotans live, work, and pay taxes. This same sort of geographic differentiation of land use generates urban traffic in all of the cities of the State. But certain special problems arise from the generation of urban traffic in the Twin Cities. It is obvious that the built-up, functional regions of the metropolitan area pay no attention to the boundaries of counties or municipalities. The thousands of trucks that shuttle daily up and down the axis of the metropolis between north Minneapolis and South St. Paul are as much intercounty traffic as the farmer who drives, say, from rural Clarkfield into Montevideo. The thousands of cars and trucks that shuttle daily between the Minneapolis loop and the Minnetonka suburbs are motivated basically by the simple pattern of urban regions. But the roads they travel cross more than half a dozen political units. This traffic is in a class by itself; it is metropolitan, and perhaps it should be recognized as such.

## Summary and Conclusions

We can visualize the land of Minnesota sprinkled with thousands of functional centers. There are the 175 thousand farms, several hundred lumber camps, and several hundred mines assembling the products of the land. There are approximately one thousand unincorporated hamlets and small villages, 200 larger county trade centers, 64 centers with over $5 million annual retail and service trade. As these functional centers become larger, their productive activities are more numerous and elaborate and the centers are more distant from similar centers. Hence the traffic generated by the larger centers is more voluminous and less local. Too, at the larger centers there are commercial and industrial activities that generate traffic with other large centers far beyond the boundaries of Minnesota. When we examine the urban centers on large maps they break down into many smaller areas between which traffic must flow. Thus there is intra-county, inter-county, interstate, and city and metropolitan traffic. All of it moves in response to commercial energy that results from geographic differences in the use of the land. Those differences are the geographic bases for highway needs.

This need to transport is nothing new in the world, and especially in the Midwest. Midwesterners have been perhaps the world's movingest people. In the development of America they have been outstanding builders of canals, buggies, wagons, railroads, interurban trolley lines, automobiles, and highways. Goods and people must be moved; and we will use whatever is available in the technology of our time to do the job best. Today for many purposes that is the automobile and truck.

Chapter 11

# Highway Use

CHARACTERISTICS OF TRAVEL

Among the many problems faced by highway administrators are locating highways and designing improvements which adequately serve the type and volume of travel. To accomplish those objectives the administrator must have knowledge of the numbers of vehicles, their types and the characteristics of the trips they make.

The first coordinated, broad effort to learn the why's and wherefore's of motor vehicle travel began with the organization of the Highway Planning Survey in 1936. This is a continuing joint effort of the U. S. Bureau of Public Roads and the Minnesota Department of Highways.

The numbers and types of vehicles using roads and streets have been counted periodically. Drivers have been questioned as to the origins, destinations and purposes of trips. Trucks have been measured and weighed. Vehicle owners have been questioned as to the uses and operating characteristics of their vehicles. Rural speeds have been measured and the accident history studied.

## Where People Travel

Minnesota residents and visitors from other states and Canada piled up to 10.6 billion vehicle miles of travel in 1952 and 10.9 billion miles in 1953. Indications are that this figure may reach 11.2 billion vehicle miles in 1954.

Traffic now is more than 12 times that generated in 1921 when the Department of Highways assumed responsibility for the Trunk Highway System. When considered that motor vehicle travel is expected to increase to 16 billion vehicle miles per year by 1975, the necessity for a detailed knowledge of travel patterns becomes apparent.

Not all this travel is distributed evenly over the 121,000 miles of roads and streets in Minnesota. Nor does it occur at an even rate over the hours of the day, the days of the week or the months of the year.

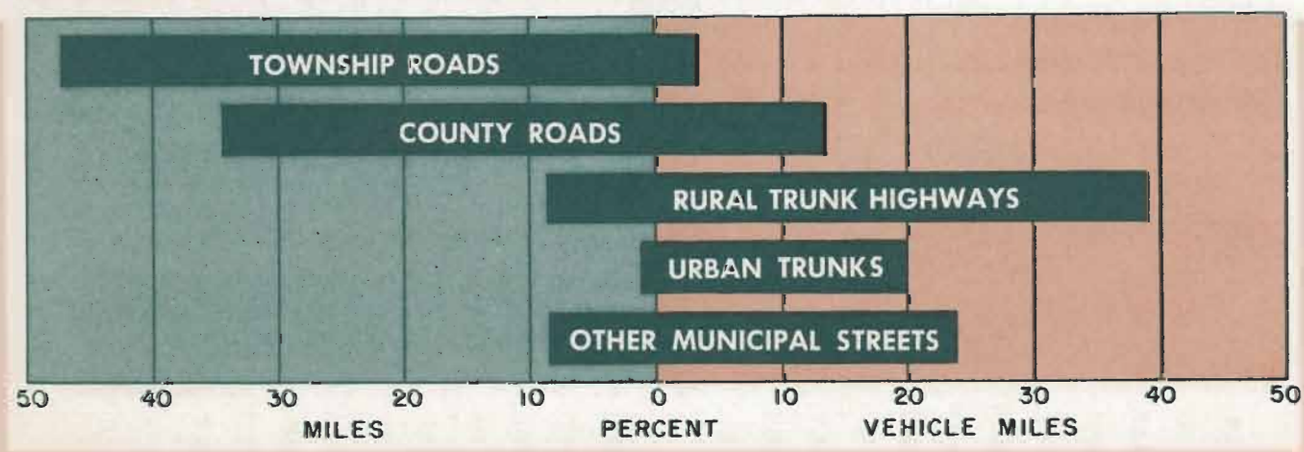
Fifty-six per cent of the travel occurs on rural roads and 44 per cent in cities. Heaviest travel is on the municipal extensions of the Trunk Highway System, which average 4,000 vehicles per day. The rural portions of the present Trunk Highway System carry an average of 1,100 vehicles per day, State-aid and county roads almost 100 vehicles per day, and township roads about 20 vehicles per day. City streets outside the Trunk Highway System average 700 vehicles per day.

## Travel on Trunk Highways

Almost 60 per cent of the total travel in the State is on the rural and urban trunk highways. Of this, two-thirds takes place on the rural portions of the system.

As shown on the accompanying traffic flow map, traffic volumes vary widely within the system. On sections of highway adjacent to St. Paul and Minneapolis, daily volumes of 15,000 vehicles are reached. Ninety-four miles have average daily volumes exceeding 5,000 vehicles and, in contrast, there are 267 miles in the system which have daily volumes of less than 100 vehicles.

## TRAVEL VARIATIONS BY SYSTEMS



*Rural traffic volumes depicted on this traffic flow map of the Trunk Highway System add up to 4.2 billion vehicle miles of travel per year. This is 40 per cent of the total travel in the State. Daily volumes range from less than 100 vehicles shown by the narrowest bands to 15,000 vehicles.*

The character of the services provided by the various routes of the rural trunk system is as different as the annual volumes of traffic. Routes which link the larger cities are traveled extensively by large combination trucks engaged in transportation of raw and manufactured products. Other routes, particularly those which extend across or terminate in the resort areas, serve large numbers of vacationists. On other sections of the rural system, usually those having low traffic volumes, the predominant travel is local in character.

## Time Variations in Travel

Travel also varies widely among months of the year, days of the week, and hours of the day.

### Seasonal Variations

On rural highways the variations in monthly traffic are so great that the average daily traffic in January is half the peak reached in August when the volume is 15 million vehicle miles per day. By comparison, the variations in monthly volumes of urban traffic are not as pronounced. On urban arteries, the average daily traffic in January is about three-quarters of the average volume in July, the month when urban routes serve the greatest number of motorists.

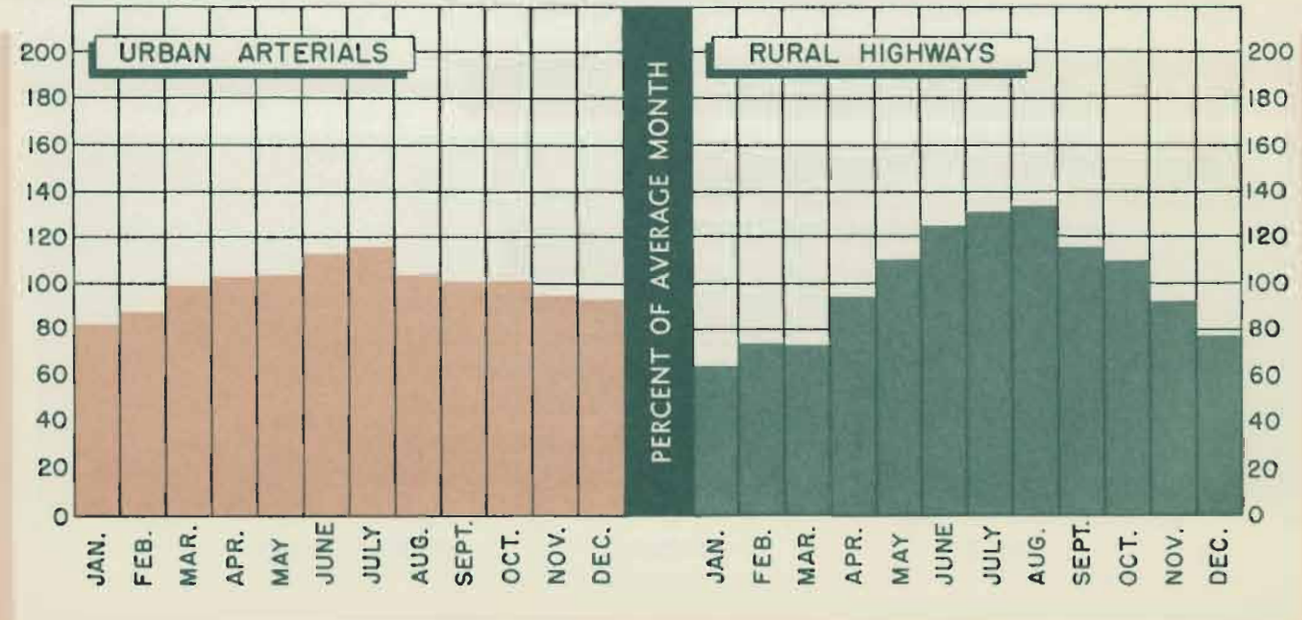
### Daily Variations

Travel on rural and urban systems also varies by day of the week. On rural systems, the peak daily volumes of travel occur on weekends when urban residents tour rural areas. In contrast, the travel on urban routes is low on weekends and high on weekdays when economic activities are resumed.

### Hourly Variations

In rural areas, the highest hourly volumes occur between 4 and 5 p.m. and then, with each succeeding hour, the volumes diminish at a uniform rate until 3 a.m. when the lowest hourly volume of traffic occurs.

## MONTHLY VARIATIONS IN TRAFFIC FLOW




*In urban areas peak traffic volume is reached during the 5 to 6 p.m. homeward bound rush hour.*

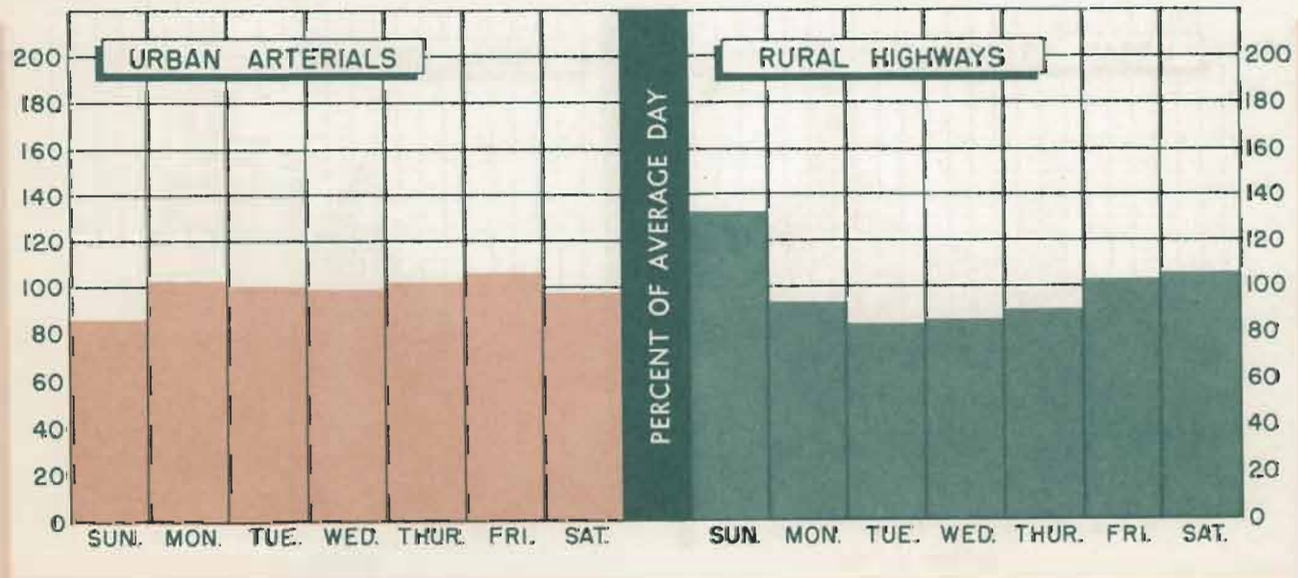
In urban areas, where industry and business have greater influence on travel, the pattern is quite different. Lowest hourly volumes occur between 4 and 5 a.m. From 8 a.m. to 4 p.m. the hourly volumes increase in proportion to business activities. The peak hour volume is reached during the 5 to 6 p.m. homeward bound rush hour. From this hour, the volumes again decrease rapidly.

The patterns of hourly traffic volumes are of special value in highway engineering because they isolate for detailed study the specific periods of congestion—the most irritating traffic condition encountered by motorists and by street and road administrators. Hourly patterns provide a sound basis for determining the frequency with which peak traffic volumes occur, and even more important, reveal the volumes which must be served. With such information available, the highway engineer can identify points of congestion on existing facilities and plan with confidence the remedial measures necessary for their relief.

## Who Travels Where

In 1936, the Highway Planning Survey conducted an extensive study to determine the extent to which various road systems were used by residents of rural and urban areas in the course of their annual travel. Data collected in this basic study has not been repeated. However, studies in North Dakota showed that these patterns of travel did not change between 1936 and 1952; only the volumes changed. These data provide the means for estimating the amount of annual 1952

## DAILY VARIATIONS IN TRAFFIC FLOW



*Today trucks are standard farm equipment, enabling the farmer to quickly obtain supplies or market produce.*

travel performed on each road system by the average rural or urban resident.

The greatest part of annual travel by the average rural resident is done on rural secondary roads, with travel on rural trunk highways a close second. For every 100 miles traveled by the rural resident, 43 miles are over secondary roads, 38 over rural trunk highways, 15 over urban trunk highways, and four over municipal streets. For every 100 miles traveled by the average urban resident 32 miles are traveled over municipal streets, 22 over urban trunk highways, 40 over rural trunk highways and only six over secondary rural roads.

From more recently collected basic data, it is estimated that 94 per cent of the 10.6 billion vehicle miles traveled on Minnesota streets and highways in 1952 was performed by residents of the State. The other six per cent was performed by residents of other states.

Travel by out-of-state vehicles is concentrated on the rural and urban Trunk Highway Systems, accounting for about 11 per cent of the total travel on rural trunk highways and three per cent of the travel on the other rural and urban systems.

## Reasons for Motor Vehicle Travel

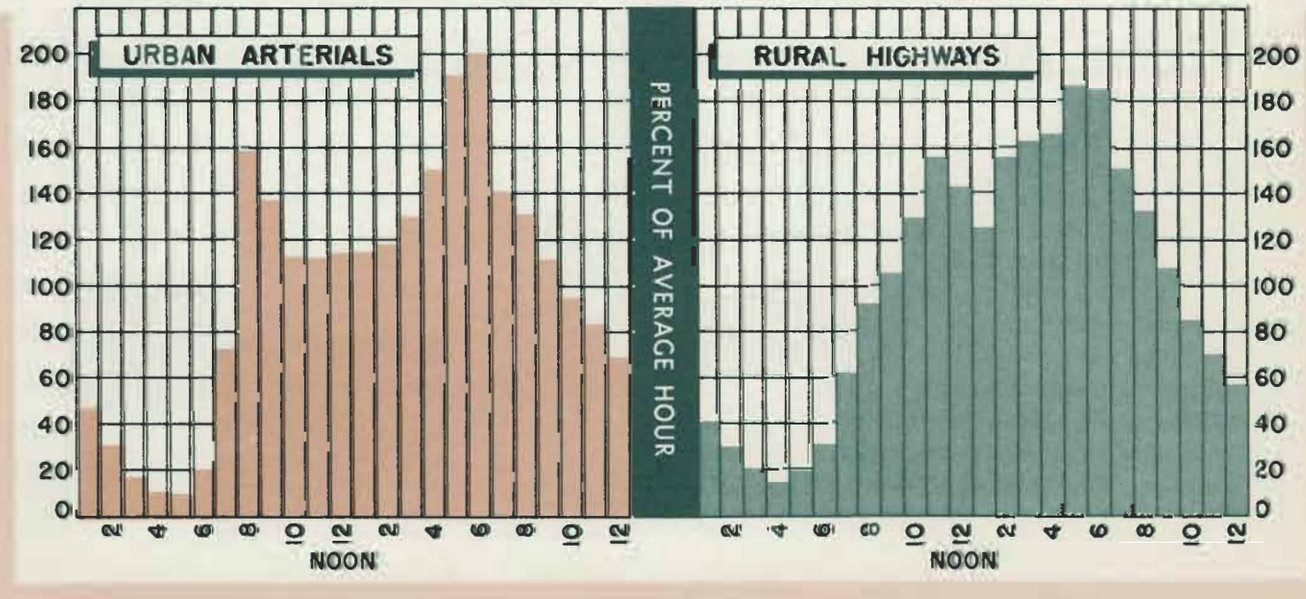
About half of all passenger car travel on all systems in the State is for business purposes, such as to and from work and for other activities directly associated with business and professional pursuits. Social and recreational travel varies from 18 per cent of the total in large cities to as much as 40 per cent on some rural trunk highways serving resort areas. Social and recreational travel on rural roads at points adjacent to some 14 cities, including Minneapolis, St. Paul and Duluth, averages about 35 per cent.

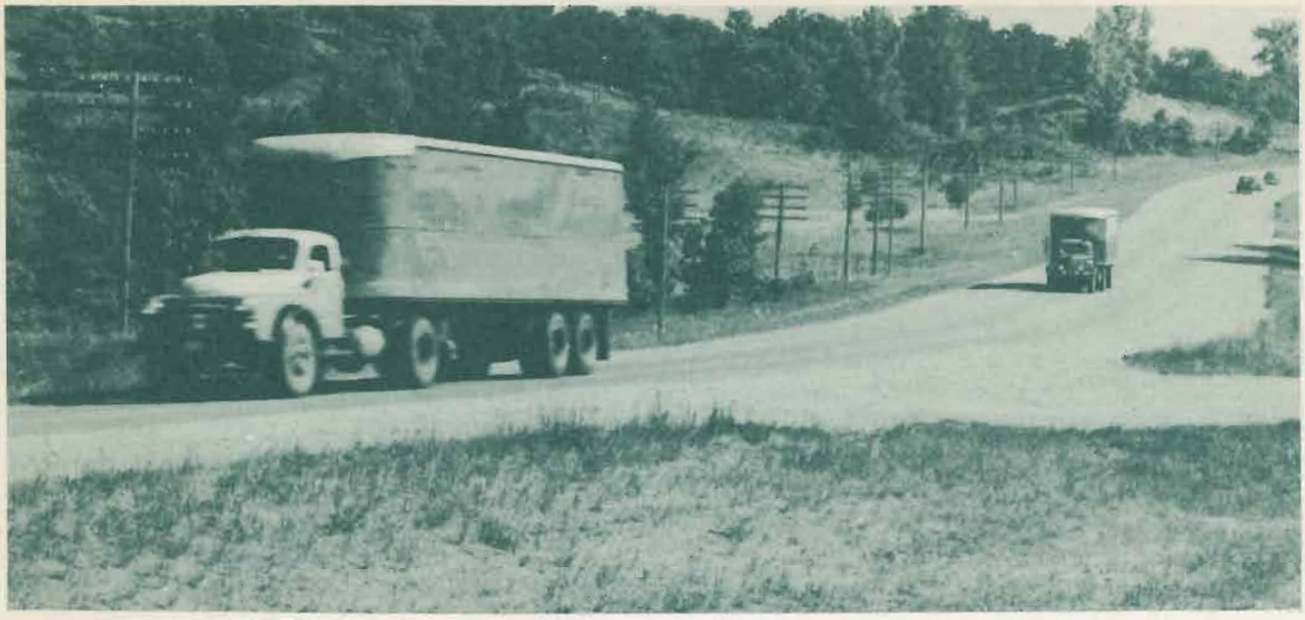
Remaining travel, ranging from 10 per cent to 32 per cent at various locations is for shopping, medical, school and other such purposes.

## Trends in Truck Travel

In meeting the demands for more rapid and efficient transportation of commodities, the number of commercial vehicles registered in the State increased from 114,516 in 1936 to 215,430 in 1953, including an increase in farm trucks from 40,000 to about 80,000. Annual travel by the average truck has remained at about 8,700 miles during this period.

## HOURLY VARIATIONS IN TRAFFIC FLOW





*There are almost twice as many trucks in use in Minnesota today as there were in 1936. Average loaded weight of large trucks increased by nearly two-thirds in the same period.*

About 87 per cent of all commercial vehicles observed on rural trunk highways in 1936 were single-unit trucks, with the remaining 13 per cent being tractor-semitrailers. By 1952, the single-unit trucks had dropped to 68 per cent of the commercial vehicles observed and tractor-semitrailers were up to 32 per cent.

## Loaded Weights

As to the weights of these two classes of commercial vehicles, further changes are noted. The average weight of a loaded single-unit truck increased from 9,900 pounds in 1936 to about 12,000 pounds in 1952. The increase in loaded weights of tractor-semitrailers was even more pronounced—from 26,000 pounds in 1936 to 42,000 in 1952.

Changes in axle arrangements paralleled the increase in loaded weights of tractor-semitrailers. In 1936, three-axled tractor-semitrailers predominated; in fact, they accounted for 97 per cent of all tractor-semitrailers. Five-axled tractor-semitrailers were seldom observed. Today, the three-axled unit accounts for 39 per cent of the tractor-semitrailers, four-axle units 47 per cent, and five-axled units 14 per cent.

## Truck Movements

The more heavily traveled routes linking the larger municipalities, in which major distribution centers are located, usually have the highest percentages of total vehicles in the tractor-semitrailer classes.

The increase in volumes of these vehicles and in their sizes has influenced the design of highways constructed in past years and will influence the designs of future highways. However, these increases reflect the already large and growing dependence on truck transportation to support the State's economy and the well-being of its citizens.

# Conclusions

In this study, usage of the various classes of highways has been considered in broad terms, with regard to trends in total travel, travel by rural and urban people, travel variations, time of travel, and sizes and weights of vehicles. These facts not only give knowledge of current usage but are basic to projecting future demands. Continuous collection of such data and periodic review are essential to properly developing highway facilities.

Chapter 12

# Standards

## HOW NEEDS ARE MEASURED

The engineering findings and recommendations, Part I of this report, required a vast amount of work to obtain facts, and to analyze and interpret them. This chapter describes the engineering processes used, with emphasis on development of standards applied in determining construction and other needs.

The engineering study of highway needs involved a comprehensive appraisal of the condition of all roads and streets in the State. To take full advantage of the knowledge of engineers experienced in Minnesota road and street problems, the study procedure was based on the fullest possible use of the engineering forces of state and local highway agencies. Determination of needs was accomplished through use of uniform procedures which set the target aimed at in the measurement process.

## The Engineering Study Procedure

The appraisal process involved the following steps:

1. Classification of roads and streets into systems.
2. Measurement of physical conditions.
3. Evaluation of traffic data.
4. Tolerable standards for determining tolerable facilities.
5. Construction standards for needed improvements.
6. Field appraisal of existing roads and structures.
7. Reports on conditions and needed improvements.
8. Initial screening of reports to check basic data.
9. Engineering review to appraise quality and results.
10. Field check to confirm or modify initial results.
11. Office correction and integration of field reports.
12. Tabulation of detailed data by systems.
13. Analysis and interpretation of results.
14. Program development.

With the counsel of the State, County and City Engineers Advisory Committees, the engineering staff prepared procedural manuals covering the first seven steps of the engineering process. These manuals, with standard reporting forms, served as a basis for the field appraisal and made possible a high degree of uniformity in reporting existing conditions of roads, streets and bridges and in determining needed improvements.

The manuals established specific principles and techniques for measuring deficiencies and determining needed improvements. Separate manuals were prepared for appraisal of rural State trunk highways, county and township roads, streets in municipalities of over 5,000 population, and streets in municipalities of under 5,000 population.

### The Field Appraisal

Appraisal of the Trunk Highway System, including the portions within municipalities, was

*Procedural manuals helped to produce a high degree of uniformity and accuracy in the appraisal of road and street needs.*

the responsibility of the district engineers of the Department of Highways.

County engineers were responsible for appraisal of the county roads in their respective counties. By agreement with the Minnesota County Highway Engineers Association and the Minnesota Association of Township Officials, county engineers were also responsible for appraisal of the needs on township roads within their counties.

City engineers appraised street needs except urban extensions of State trunk highways. Because most cities under 5,000 population in Minnesota do not have city engineers, county engineers provided valuable assistance to many of the small municipalities in making the city street appraisal.

Field engineers used much of the basic data available from the Highway Planning Survey in regard to road and bridge characteristics, traffic and accident data, and other special studies.

## Standards

State trunk highways, county and township roads and city streets, while having certain characteristics which are similar, serve traffic of widely varying volumes and composition. Highway standards are the basic element for measuring these differences and the engineering yardstick by which it is possible to evaluate what is needed to obtain safety and economy in an integrated highway transportation network.

Standards developed by the American Association of State Highway Officials, U. S. Bureau of Public Roads, Highway Research Board and other agencies, have been determined through years of experience and research. They have proved adequate for modern highway traffic service. The design standards in use by the Department of Highways and the highway departments of the counties of the State compare favorably with national accepted standards.

In developing standards for highways, consideration must be given to various factors influencing vehicle movement. These factors fall into two broad categories, those affecting the structural design or load carrying ability of a road and those affecting capacity or ability to carry the volume of traffic using a road safely without undue congestion. To establish economical standards, consistent with traffic needs, requires knowledge of present and future traffic volumes, composition and operating speeds.

Sharp curves and steep grades affect highway capacity and control operating speeds. Combined, they limit sight distances and restrict the amount of roadway available for safe passing maneuvers. Commercial vehicles have a greater effect on highway capacity for they occupy more road space and influence traffic over a larger area than do passenger cars. The width, height and length of commercial vehicles and the relatively higher speeds of passenger cars control many elements of standards. Loads carried by commercial vehicles also influence the thickness and type of road surface required and the design of bridges.

Capacity as a criteria for standards on local roads is not an important factor, as traffic volumes are generally low. Consideration must be given to safety and provisions made in the basic design for future improvement to a higher type when traffic warrants.

## The Engineering Study Standards

With the advice of the advisory committees, two sets of standards were developed for use in this study. First, a set of minimum or tolerable standards for comparison with existing road and street conditions to determine deficiencies. Second, a set of new construction standards for the preparation of cost estimates for needed improvements.

### Tolerable Standards

Tolerable standards are set by engineering judgment with the objective of defining the existing investment that can be continued in use with reasonable safety and without serious inconvenience to traffic.

Tolerable standards used are lower in all respects than the new construction standards. Existing roads and streets measuring up to the tolerable standards are reasonably adequate for today's traffic and can be used until they become obsolete, either for structural or

*A county road meeting tolerable standards.*

*This recently constructed State Trunk Highway meets new construction standards.*

capacity reasons. Existing roads and streets not measuring up to the tolerable standards are inadequate for today's traffic and represent a backlog of needed improvements. They are the facilities which should be given first consideration in the formulation of construction programs.

## New Construction Standards

Standards developed by the American Association of State Highway Officials reflect the type of highways that are desirable, economical, and most efficient in serving transportation needs. Where roads are improved to standards lower than those prescribed in the policies of American Association of State Highway Officials, some efficiency and safety is sacrificed.

The new construction standards used for estimating costs of needed improvements on State trunk highways and rural county and township roads conform to the recommendations of the A.A.S.H.O. with a few minor exceptions. They are also substantially in accordance with the standards currently used by the Department of Highways and the counties.

There are no national standards for municipal streets, nor are their uniform street standards in use by all Minnesota municipalities. The new construction standards developed for municipal streets agree with the best practices used in the State and in cities elsewhere in the nation.

The complete tables and instructions for both sets of standards are too voluminous to publish here. They are available in the files of the Highway Planning Survey and in the separately published manuals.

## Examples of Tolerable and Construction Standards

The following table shows a comparison of some of the essential features of the tolerable standards and new construction standards used for rural State trunk highways. The traffic volume groupings are identical for both sets of standards, but in their application an important difference exists. In the case of tolerable standards, the volumes refer to present traffic. In the case of new construction standards, the volumes refer to anticipated 1973 traffic. Road improvements last

**COMPARISON OF TOLERABLE AND NEW CONSTRUCTION STANDARDS**
**2-LANE RURAL STATE TRUNK HIGHWAYS**
**(ROLLING TERRAIN)**

| Item | Average Daily Traffic | | | | |
|---|---|---|---|---|---|
| | Over 2,400 | 1,000 to 2,400 | 400 to 1,000 | 200 to 400 | 100 to 200 |
| Surface Type | | | | | |
| Tolerable | Intermediate | Intermediate | Low | Low | Gravel |
| New Construction | High | High | Intermediate | Intermediate | Low |
| Surface Width | | | | | |
| Tolerable | 20′ | 18′-20′ | 18′ | 18′ | — |
| New Construction | 24′ | 22′-24′ | 22′-24′ | 22′-24′ | 22′-24′ |
| Roadway Width (Including Shoulders) | | | | | |
| Tolerable | 32′ | 30′-32′ | 26′ | 24′ | 22′ |
| New Construction | 44′-48′ | 34′-40′ | 30′-32′ | 28′-30′ | 28′-30′ |
| Curvature | | | | | |
| Tolerable | 6° | 11° | 11° | 14° | 18° |
| New Construction | 3° | 7° | 9° | 9° | 9° |
| Stopping Sight Distance | | | | | |
| Tolerable | 475′ | 315′ | 315′ | 275′ | 240′ |
| New Construction | 600′ | 350′ | 350′ | 350′ | 350′ |

*Planting of wind breaks is an effective method of snow control which pays dividends in the form of lower costs for snow removal.*

many years. It would be uneconomical to design and build a new facility for present traffic only. The new construction standards, therefore, must be based on the traffic growth expected during most of the life of the facility and traffic that may be attracted to it because of the improvement.

The tolerable surface types specified were considered adequate only if they were in good condition.

All two-lane roads carrying traffic above 2,400 vehicles per day were analyzed to determine whether divided four-lane construction would be required within the 20-year study period. Because of the several variables affecting capacity of two-lane roads, the point at which four-lane construction becomes necessary varies through a rather wide range. In a few cases, two-lane design was found adequate for traffic volumes of 5,000 vehicles per day. However, in some cases, capacity was reached at about 3,000 vehicles per day because of alignment.

Some of the elements of the tolerable and new construction standards for county and township roads are shown in the table below.

Tolerable standards for the various classes of city streets were based on physical condition and traffic adequacy. Intermediate type surfaces, in good condition, were required in developed areas. For streets in sparsely developed areas, gravel surfaces were considered tolerable. A minimum width of surfacing adequate for two moving lanes of traffic was required. The new construction standards for city streets called for high type pavements on arterials and business access streets and intermediate type surfaces in developed residential areas. Widening, to provide additional traffic lanes, was acceptable only when application of approved traffic engineering techniques would not provide the required capacity.

The above comparisons do not reflect many other elements of new construction standards given consideration, such as structure design, snow control, control of access, and elimination of hazards at railroad grade crossings and highway intersections. Typical examples and a brief discussion of each follows.

### Bridge Standards

The new construction standards provide that bridges shall in all cases be a minimum of four feet wider than the surface width of the pavement on approaches. For roads carrying in excess of

**COMPARISON OF TOLERABLE AND NEW CONSTRUCTION STANDARDS**
**COUNTY AND TOWNSHIP ROADS**
**(ROLLING TERRAIN)**

| Item | Average Daily Traffic | | | | |
|---|---|---|---|---|---|
| | 400 to 1,000 | 200 to 400 | 100 to 200 | 50 to 100 | 25 to 50 |
| Surface Type | | | | | |
| Tolerable | Low | Low | Gravel | Gravel | Gravel |
| New Construction | Intermediate | Intermediate | Low | Gravel | Gravel |
| Surface Width | | | | | |
| Tolerable | 18′ | 18′ | — | — | — |
| New Construction | 22′-24′ | 22′-24′ | 22′-24′ | — | — |
| Roadway Width (Including Shoulders) | | | | | |
| Tolerable | 26′ | 24′ | 22′ | 20′ | 18′ |
| New Construction | 30′ | 28′ | 26′-28′ | 24′ | 22′ |
| Curvature | | | | | |
| Tolerable | 11° | 14° | 18° | Safe for 30 m.p.h. | |
| New Construction | 9° | 9° | 9° | 14° | Safe for 30 m.p.h. |

2,400 vehicles per day, the new construction standards called for full roadway width on bridges less than 100 feet in length. For bridges over 100 feet in length, the standards provide for approach pavement width, plus six feet additional width. The load design capacities specified vary with the anticipated amount of heavy commercial traffic.

### Snow Control

Minnesota, along with other states in the snow belt, has the problem of keeping highways free from snow during winter months. Highway design can materially ease the winter maintenance problem. Raising grade lines above the natural ground, streamlining of slopes and ditches, and designed planting of wind breaks promotes self-clearing snow control through wind action. The standards for new construction include those features.

### Control of Access

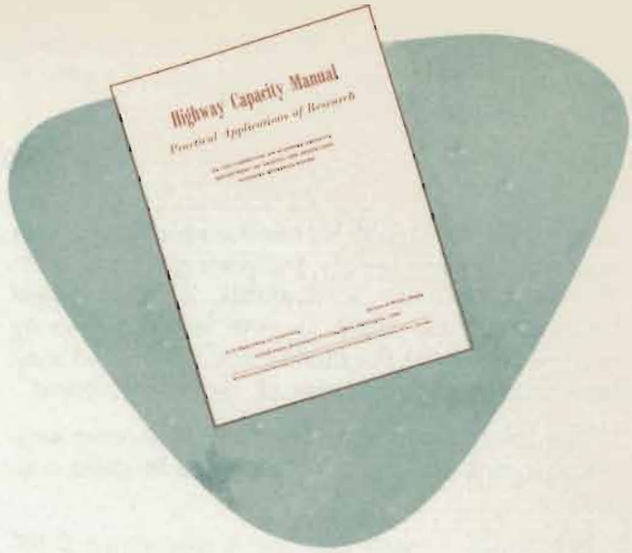
The safety, efficiency and mobility of vehicle operation depends greatly upon limitation of interference from the roadside and from traffic entering or leaving at driveways and crossroads. In most instances, traffic moves rapidly between cities in rural areas and then proceeds at a snail's pace when the suburban areas are reached. The efficiency of long distance travel decreases rapidly in and around urban areas.

To preserve and protect main highways as efficient means of transportation, access connections should remain at a practical minimum and their type and design should be commensurate with the importance of the highway.

Control of access may be accomplished by legal means through ownership or easements on strips adjacent to the highway, or physically by development of parallel frontage roads, or by any other type of control that will prevent indiscriminate access to the through roadway.

For new highway facilities carrying large traffic volumes, access rights of adjacent property should be acquired at the time the rights of way are obtained. This will prevent ribbon development which results in early obsolescense, decreased capacity, and increased numbers of accidents.

The new construction standards required control of access on all four-lane divided facilities on new location in rural areas and for expressway and freeway construction in urban areas. Control of access was also required on four-lane divided facilities constructed on existing locations in rural areas where its provision was economically feasible. Control of access was not required, but was indicated as desirable, on all two-lane roads carrying in excess of 2,400 vehicles per day.




### Railroad Crossings and Highway Intersections

Railroad grade crossing protection devices were called for by the new construction standards at all crossings where the product of highway traffic and number of trains per day exceeded 3,500.

Railroad separation structures were listed as needs in rural areas at main line crossings, on two-lane roads where the number of trains exceeded six per day, and on all four-lane divided highways.

In urban areas railroad separation structures were required at main line crossings on controlled access facilities and, where practical and economically feasible on other arterial streets carrying high traffic volumes.

Highway separation structures were shown as needs on two-lane roads in rural areas when total traffic at an intersection exceeded 6,000 vehicles per day. On four-lane divided roads, highway separation structures were specified when the total traffic exceeded 16,000 vehicles per day and cross-road traffic exceeded 1,000 vehicles per day.

## Determining Deficiencies

For all rural roads, report forms were prepared by the field engineers for each section of continuous roadway having uniform physical characteristics and about the same volume and type of traffic over its entire length. The report forms provided a description of the existing facility, that is, the type of surface, its condition, its width, the width of the shoulders, traffic data and other pertinent information necessary to an evaluation of current needs. The data for each road section was compared against tolerable standards for the traffic volumes served. Road sections failing to meet the tolerable standards were considered inadequate and in need of immediate improve-

ment. Costs of correcting deficiencies on sections found to be inadequate were based upon new construction standards for anticipated future traffic.

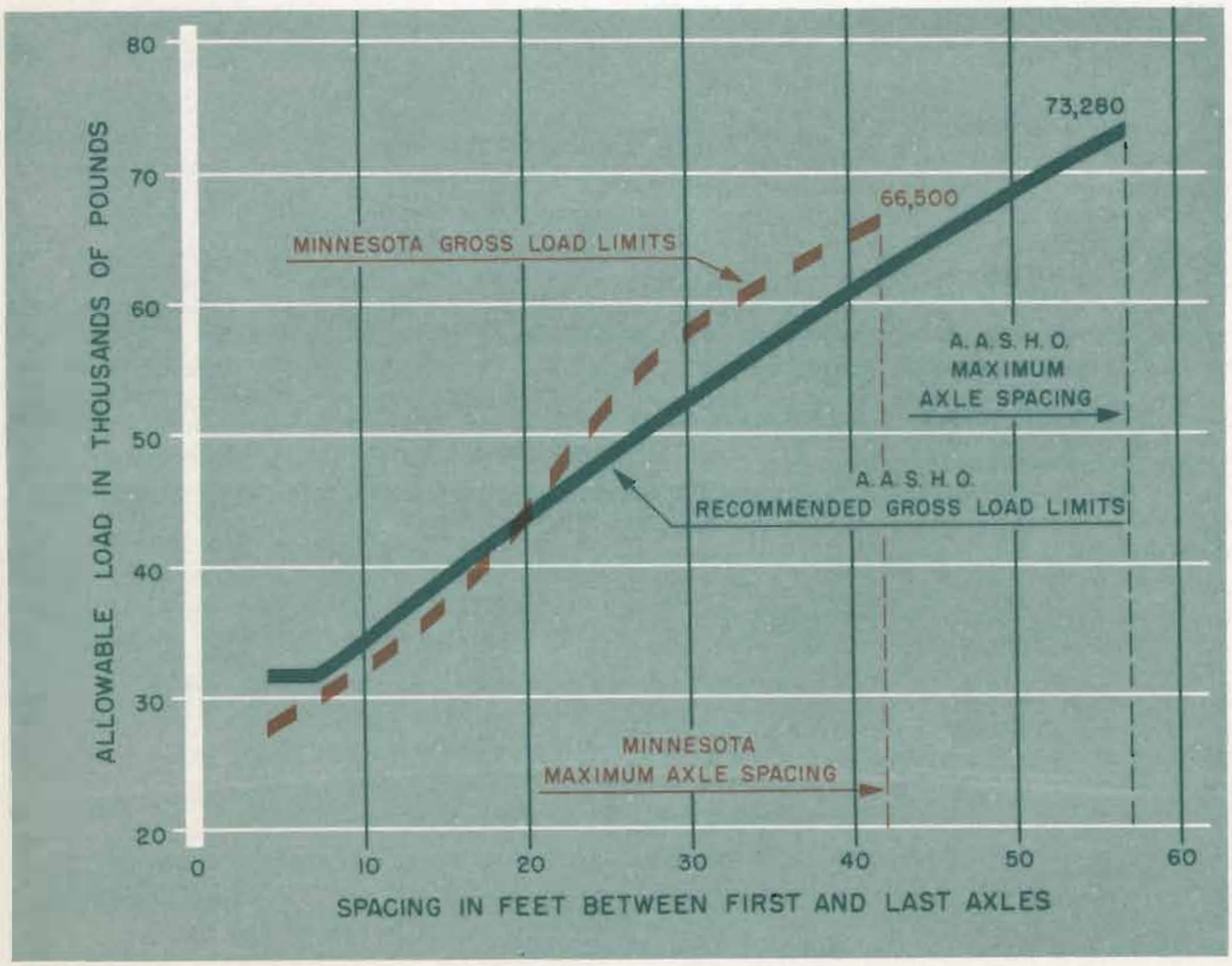
Those sections of the rural State Trunk System found to be adequate for today's traffic were given further consideration to determine whether they would become deficient, either structurally or from a capacity standpoint, within 20 years. For analysis purposes, the future needs were grouped into time periods of 1 to 5 years, 5 to 10 years, 10 to 15 years, and 15 to 20 years. Future deficiencies for structural reasons were based upon the estimated remaining life of the existing surface as determined from studies by the Highway Planning Survey of the rates at which Minnesota highways are wearing out and being replaced, confirmed by field inspection. Future deficiencies for capacity reasons were based upon projections of traffic growth as related to calculated practical capacity of existing facilities.

Future replacement needs on county and township roads found to be adequate in the field appraisal were estimated by the engineering staff. The estimates were based on analysis of the average life expectancy of various surface types found on local rural roads.

The procedures for appraisal of city streets including urban extensions of State trunk routes differed from the procedure for appraisal of the rural roads to the extent that reports were submitted only for sections found to be deficient. For those streets classified as residential or business access, only present deficiencies were reported. The future needs on access streets were estimated by the engineering staff. On urban portions of State trunk routes and on streets classified as arterials, future needs were estimated by the field engineers.

Staff engineers visited each State highway construction district during the field appraisal to review progress and offer assistance. Group meetings were held with the county engineers for the same purpose. In addition, as the study progressed, visits were made to those counties and cities where special problems arose requiring interpretation or modification of the procedures.

## MINNESOTA LEGAL AND A.A.S.H.O. RECOMMENDED GROSS LOAD LIMITS



## Engineering Review

As the field reports were received in the engineering study offices, they were given an initial screening by clerical personnel to see if the data were complete and extensions properly made. Then the staff engineers gave each and every field report a detailed review to determine if the appraisal procedures had been properly followed, if improvements proposed were reasonable and justified and accurately estimated as to cost. In cases of doubt, field checks were made to confirm or modify the initial appraisal.

As the review of the individual reports was completed, county by county and city by city, the data on the report forms were transcribed to numerical codes for punching on tabulating cards. These reports served as the basis for the estimates presented in Chapter 4 of capital investment requirements to meet present and future construction needs.

## Extent of Reporting

Reports were received covering the entire State Trunk System and for all rural county and township roads. Reports on street needs were received from all of the 54 cities of over 5,000 population. Of the 753 cities under 5,000 population, 584 reported, or approximately 78 per cent. Of the 169 smaller cities not reporting, 82 were in the population group 0 to 500; 29 in the population group 501 to 1,000; 47 in the population group 1,001 to 2,500; and 11 in the population group 2,501 to 5,000. All together, reports on city street needs were received from cities containing 92 per cent of the urban population of the State and representing 97 per cent of all urban needs.

Construction needs in the cities for which reports were not received were estimated by the engineering staff. This estimate was made by expansion of the reported needs in the smaller cities on the ratio of the population of the cities reporting to the total population of all cities in the under 5,000 population group.

# Standards of Vehicle Size and Weights

The increasing use of highways by heavily loaded vehicles, often fast moving, has created many problems concerning maximum size and weights of vehicles for which highways and bridges must be designed to prevent rapid deterioration. Extensive studies have been made taking into account the cost of building and maintaining highways in relation to service demands of motor transport.

The American Association of State Highway Officials issued a policy statement in 1946 concerning the size and weights of vehicles and urged uniform adoption by all states for the following reasons:

1. To establish one of the fundamental prerequisites of highway design.
2. To promote efficiency in interstate motor vehicle operation.
3. To promote the safety of highway transportation.
4. To establish a basis for regulating relationships between the dimensions and weights of motor vehicles and strengths and capacities of existing highways.

Minnesota laws concerning sizes and weights of vehicles vary to some degree with American Association of State Highway Officials standards. The following table and the chart on page 103 show comparisons between the two:

| | Minnesota | A.A.S.H.O. |
|---|---|---|
| Width | 8'-0" | 8'-0" |
| Height | 12'-6" | 12'-6" |
| Length | | |
| Truck–single unit | 40'-0" | 35'-0" |
| Truck–tractor and semi-trailer | 45'-0" | 50'-0" |
| Truck–combination | 45'-0" | 60'-0" |
| Maximum Axle Loads: | | |
| Single Axle | 18,000 lbs. | 18,000 lbs. |
| Tandem Axle | 28,000 lbs. | 32,000 lbs. |

As the table and chart reveal, the major differences between Minnesota law and American Association of State Highway Officials standards are found in the vehicle length restrictions, tandem axle, and gross load limitations. All of the bordering states permit tandem axle loads above that of Minnesota, three of which coincide with Association policy. Minnesota's limitations on gross loads for overall axle spacing in excess of 19 feet are somewhat greater than those recommended at the present time by the Association. The differences, while not materially increasing the cost of new structures, do adversely affect older structures because of the higher gross loads permitted.

Recommendations covering amendments to size and weight laws are contained in Chapter 6, Management.

# APPENDIX

## COST OF IMMEDIATE NEEDS ON RURAL ROADS
### (AS OF NOVEMBER 1, 1953)

| COUNTY | TOTAL | | STATE TRUNK HIGHWAY | | | | STATE-AID | | | | COUNTY-AID AND COUNTY | | | | TOWNSHIP ROADS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Miles | Cost ($1,000) | Miles | Road Cost ($1,000) | Structure Cost ($1,000) | Total Cost ($1,000) | Miles | Road Cost ($1,000) | Structure Cost ($1,000) | Total Cost ($1,000) | Miles | Road Cost ($1,000) | Structure Cost ($1,000) | Total Cost ($1,000) | Miles | Road Cost ($1,000) | Structure Cost ($1,000) | Total Cost ($1,000) |
| AITKIN | 531 | 4,904 | 56 | 1,092 | 110 | 1,202 | 124 | 995 | 247 | 1,242 | 196 | 1,529 | 256 | 1,785 | 155 | 654 | 21 | 675 |
| ANOKA | 386 | 6,247 | 31 | 3,787 | | 3,787 | 77 | 950 | 125 | 1,075 | 104 | 958 | | 958 | 174 | 419 | 8 | 427 |
| BECKER | 537 | 4,802 | 28 | 1,844 | 85 | 1,929 | 82 | 636 | 12 | 648 | 261 | 1,527 | 7 | 1,534 | 166 | 676 | 15 | 691 |
| BELTRAMI | 499 | 3,766 | 17 | 647 | 56 | 703 | 112 | 722 | 110 | 832 | 196 | 1,279 | 78 | 1,357 | 174 | 807 | 67 | 874 |
| BENTON | 406 | 4,734 | 35 | 1,803 | 193 | 1,996 | 135 | 1,243 | 173 | 1,416 | 130 | 859 | 77 | 936 | 106 | 351 | 35 | 386 |
| BIG STONE | 362 | 2,127 | 18 | 399 | | 399 | 39 | 253 | 9 | 262 | 209 | 1,099 | | 1,099 | 96 | 367 | | 367 |
| BLUE EARTH | 601 | 9,247 | 57 | 2,817 | 876 | 3,693 | 208 | 2,200 | 841 | 3,041 | 212 | 1,327 | 433 | 1,760 | 124 | 511 | 242 | 753 |
| BROWN | 467 | 5,341 | 25 | 683 | 293 | 976 | 148 | 1,504 | 958 | 2,462 | 39 | 430 | 10 | 440 | 255 | 1,006 | 457 | 1,463 |
| CARLTON | 265 | 2,755 | 14 | 447 | 175 | 622 | 73 | 976 | 78 | 1,054 | 76 | 624 | 47 | 671 | 102 | 383 | 25 | 408 |
| CARVER | 263 | 6,806 | 47 | 3,507 | 1,111 | 4,618 | 68 | 794 | 98 | 892 | 43 | 448 | 63 | 511 | 105 | 609 | 176 | 785 |
| CASS | 749 | 5,915 | 57 | 1,825 | 116 | 1,941 | 75 | 783 | 66 | 849 | 352 | 1,895 | 229 | 2,124 | 265 | 947 | 54 | 1,001 |
| CHIPPEWA | 326 | 3,769 | 53 | 2,006 | | 2,006 | 83 | 676 | 40 | 716 | 73 | 505 | 6 | 511 | 117 | 317 | 219 | 536 |
| CHISAGO | 367 | 4,086 | 23 | 1,769 | | 1,769 | 88 | 904 | 71 | 975 | 111 | 761 | 16 | 767 | 145 | 569 | 6 | 575 |
| CLAY | 480 | 5,724 | 41 | 2,149 | 265 | 2,414 | 119 | 910 | 293 | 1,203 | 131 | 769 | 510 | 1,279 | 189 | 665 | 163 | 828 |
| CLEARWATER | 325 | 1,816 | | | 25 | 25 | 68 | 504 | 24 | 528 | 182 | 827 | 112 | 939 | 75 | 306 | 18 | 324 |
| COOK | 239 | 3,215 | 13 | 972 | 204 | 1,176 | 35 | 986 | | 986 | 60 | 750 | 16 | 766 | 131 | 287 | | 287 |
| COTTONWOOD | 628 | 4,487 | 19 | 552 | 327 | 879 | 131 | 1,329 | 28 | 1,357 | 128 | 869 | 253 | 1,122 | 350 | 844 | 285 | 1,129 |
| CROW WING | 456 | 4,241 | 53 | 1,764 | 52 | 1,816 | 71 | 421 | 60 | 481 | 128 | 1,137 | 207 | 1,344 | 204 | 566 | 34 | 600 |
| DAKOTA | 366 | 7,593 | 41 | 3,549 | 478 | 4,027 | 105 | 1,410 | 206 | 1,616 | 96 | 1,055 | 47 | 1,102 | 124 | 817 | 31 | 848 |
| DODGE | 193 | 2,180 | 14 | 306 | 77 | 383 | 57 | 746 | 60 | 806 | 26 | 289 | 115 | 404 | 96 | 393 | 194 | 587 |
| DOUGLAS | 436 | 3,270 | 20 | 593 | 32 | 625 | 185 | 1,351 | 54 | 1,405 | 146 | 848 | 44 | 892 | 85 | 348 | | 348 |
| FARIBAULT | 473 | 5,044 | | | 65 | 65 | 75 | 1,251 | 83 | 1,334 | 92 | 948 | 535 | 1,483 | 306 | 1,427 | 735 | 2,162 |
| FILLMORE | 359 | 7,094 | 47 | 1,676 | 820 | 2,496 | 50 | 653 | 785 | 1,438 | 48 | 534 | 459 | 993 | 214 | 1,361 | 806 | 2,167 |
| FREEBORN | 369 | 5,358 | 22 | 1,911 | 118 | 2,029 | 110 | 1,293 | 102 | 1,395 | 88 | 888 | 231 | 1,119 | 149 | 590 | 225 | 815 |
| GOODHUE | 424 | 10,041 | 76 | 6,389 | 700 | 7,089 | 110 | 1,450 | 103 | 1,553 | 8 | 88 | 26 | 114 | 230 | 1,275 | 10 | 1,285 |
| GRANT | 167 | 910 | 2 | 29 | | 29 | 29 | 251 | | 251 | 92 | 461 | | 461 | 44 | 169 | | 169 |
| HENNEPIN | 333 | 13,195 | 75 | 8,475 | 2,292 | 10,767 | 98 | 1,398 | | 1,398 | 32 | 344 | 70 | 414 | 128 | 596 | 20 | 616 |
| HOUSTON | 213 | 4,520 | 25 | 1,050 | 763 | 1,813 | 77 | 962 | 241 | 1,203 | 9 | 59 | 313 | 372 | 102 | 721 | 411 | 1,132 |
| HUBBARD | 427 | 3,098 | 22 | 1,006 | | 1,006 | 29 | 166 | 32 | 198 | 244 | 1,389 | 54 | 1,443 | 132 | 451 | | 451 |
| ISANTI | 421 | 3,019 | 9 | 394 | 277 | 671 | 77 | 563 | 19 | 582 | 136 | 910 | 90 | 1,000 | 199 | 761 | 5 | 766 |
| ITASCA | 976 | 11,681 | 144 | 3,510 | 728 | 4,238 | 82 | 870 | 85 | 955 | 402 | 3,803 | 700 | 4,503 | 348 | 1,953 | 32 | 1,985 |
| JACKSON | 323 | 3,922 | 20 | 888 | 132 | 1,020 | 108 | 1,218 | 522 | 1,740 | 22 | 240 | 178 | 418 | 173 | 691 | 53 | 744 |
| KANABEC | 285 | 3,052 | 56 | 1,474 | 104 | 1,578 | 33 | 265 | 132 | 397 | 117 | 687 | 61 | 748 | 79 | 322 | 7 | 329 |
| KANDIYOHI | 522 | 5,341 | 35 | 1,778 | 23 | 1,801 | 142 | 1,472 | 52 | 1,524 | 228 | 1,665 | 14 | 1,679 | 117 | 332 | 5 | 337 |
| KITTSON | 559 | 4,174 | 32 | 1,572 | 209 | 1,781 | 85 | 714 | 76 | 790 | 87 | 414 | 64 | 478 | 355 | 1,096 | 29 | 1,125 |
| KOOCHICHING | 260 | 4,462 | 64 | 1,861 | 687 | 2,548 | 30 | 281 | | 281 | 119 | 1,065 | 285 | 1,350 | 47 | 242 | 41 | 283 |
| LAC QUI PARLE | 435 | 4,258 | 43 | 1,791 | 171 | 1,962 | 84 | 650 | 148 | 798 | 211 | 1,161 | 15 | 1,176 | 97 | 279 | 43 | 322 |
| LAKE | 312 | 6,835 | 74 | 3,520 | 1,028 | 4,548 | 9 | 167 | 18 | 185 | 125 | 1,463 | 147 | 1,610 | 104 | 449 | 43 | 492 |
| LAKE OF THE WOODS | 165 | 1,796 | | | 448 | 448 | 14 | 149 | 98 | 247 | 125 | 853 | 138 | 991 | 26 | 96 | 14 | 110 |
| LE SUEUR | 254 | 4,873 | 50 | 2,549 | 412 | 2,961 | 137 | 1,446 | 53 | 1,499 | 15 | 101 | 20 | 121 | 52 | 265 | 27 | 292 |
| LINCOLN | 275 | 1,869 | 3 | 94 | 27 | 121 | 111 | 1,062 | 28 | 1,090 | 85 | 447 | 26 | 473 | 76 | 156 | 29 | 185 |
| LYON | 332 | 2,355 | 27 | 635 | 42 | 677 | 37 | 241 | 100 | 341 | 119 | 603 | 197 | 800 | 149 | 318 | 219 | 537 |
| McLEOD | 216 | 2,318 | 10 | 445 | 5 | 450 | 67 | 750 | 132 | 882 | 61 | 537 | 67 | 604 | 78 | 244 | 138 | 382 |
| MAHNOMEN | 243 | 1,430 | 5 | 125 | 4 | 129 | 37 | 257 | 46 | 303 | 105 | 652 | 51 | 703 | 96 | 291 | 4 | 295 |
| MARSHALL | 1,221 | 5,830 | 12 | 75 | 226 | 301 | 124 | 1,473 | 73 | 1,546 | 155 | 1,228 | 128 | 1,356 | 930 | 2,303 | 324 | 2,627 |
| MARTIN | 387 | 4,597 | 18 | 1,257 | 30 | 1,287 | 83 | 850 | 140 | 990 | 147 | 965 | 263 | 1,228 | 139 | 611 | 481 | 1,092 |
| MEEKER | 649 | 4,975 | 37 | 1,269 | 70 | 1,339 | 117 | 1,125 | 52 | 1,177 | 486 | 2,018 | 396 | 2,414 | 9 | 45 | | 45 |
| MILLE LACS | 526 | 8,071 | 57 | 4,513 | 415 | 4,928 | 91 | 749 | 113 | 862 | 196 | 1,313 | 70 | 1,383 | 182 | 889 | 9 | 898 |
| MORRISON | 787 | 6,441 | 23 | 1,180 | 119 | 1,299 | 142 | 1,507 | 153 | 1,660 | 268 | 1,736 | 87 | 1,823 | 354 | 1,621 | 38 | 1,659 |
| MOWER | 216 | 5,825 | 16 | 1,660 | 1,200 | 2,860 | 61 | 782 | 522 | 1,304 | 35 | 459 | 331 | 790 | 104 | 526 | 345 | 871 |
| MURRAY | 488 | 2,975 | 46 | 1,081 | 4 | 1,085 | 71 | 591 | 27 | 618 | 149 | 672 | 26 | 698 | 222 | 455 | 119 | 574 |
| NICOLLET | 380 | 4,438 | 13 | 1,854 | 315 | 2,169 | 105 | 1,272 | 28 | 1,300 | 86 | 568 | 31 | 599 | 96 | 360 | 10 | 370 |
| NOBLES | 501 | 4,089 | 32 | 987 | 22 | 1,009 | 129 | 1,315 | 41 | 1,356 | 71 | 488 | | 488 | 269 | 1,064 | 172 | 1,236 |
| NORMAN | 454 | 5,398 | 27 | 1,609 | 149 | 1,758 | 45 | 443 | 131 | 574 | 297 | 2,134 | 476 | 2,610 | 85 | 362 | 94 | 456 |
| OLMSTED | 490 | 8,672 | 42 | 2,232 | 847 | 3,079 | 120 | 1,987 | 759 | 2,746 | 20 | 158 | 113 | 271 | 308 | 1,938 | 638 | 2,576 |
| OTTER TAIL | 706 | 6,923 | 33 | 1,103 | 12 | 1,115 | 170 | 2,460 | 67 | 2,527 | 340 | 2,396 | 182 | 2,578 | 163 | 695 | 8 | 703 |
| PENNINGTON | 317 | 2,449 | 3 | 48 | 103 | 151 | 110 | 906 | 260 | 1,166 | 104 | 556 | 214 | 770 | 100 | 358 | 4 | 362 |
| PINE | 652 | 6,779 | 46 | 1,578 | 188 | 1,766 | 115 | 1,171 | 368 | 1,539 | 264 | 2,302 | 197 | 2,499 | 227 | 950 | 25 | 975 |
| PIPESTONE | 326 | 2,177 | | | 31 | 31 | 122 | 751 | 69 | 820 | 112 | 631 | 145 | 776 | 92 | 354 | 196 | 550 |
| POLK | 1,011 | 7,535 | 23 | 1,297 | 31 | 1,328 | 125 | 1,533 | 769 | 2,302 | 218 | 1,701 | 615 | 2,316 | 645 | 1,750 | 439 | 1,389 |
| POPE | 441 | 2,769 | 6 | 124 | | 124 | 74 | 720 | 85 | 805 | 120 | 755 | | 755 | 241 | 1,008 | 77 | 1,085 |
| RAMSEY | 55 | 6,347 | 30 | 3,640 | 1,385 | 5,025 | 14 | 801 | 215 | 1,016 | 6 | 120 | 120 | 240 | 5 | 66 | | 66 |
| RED LAKE | 181 | 2,049 | 14 | 316 | | 316 | 75 | 804 | 253 | 1,057 | 67 | 369 | 163 | 532 | 25 | 99 | 45 | 144 |
| REDWOOD | 451 | 4,729 | 38 | 519 | 7 | 526 | 76 | 734 | 707 | 1,441 | 124 | 808 | 517 | 1,325 | 213 | 964 | 473 | 1,437 |
| RENVILLE | 258 | 1,922 | 10 | 166 | 77 | 243 | 114 | 890 | 80 | 970 | 56 | 261 | 90 | 351 | 78 | 236 | 122 | 358 |
| RICE | 398 | 6,494 | 30 | 2,258 | 342 | 2,600 | 117 | 1,654 | 144 | 1,798 | 107 | 1,054 | 161 | 1,215 | 144 | 647 | 234 | 881 |
| ROCK | 376 | 3,959 | 25 | 394 | 100 | 494 | 91 | 1,007 | 307 | 1,314 | 109 | 931 | 201 | 1,132 | 151 | 624 | 395 | 1,019 |
| ROSEAU | 308 | 1,917 | 12 | 260 | 15 | 275 | 25 | 169 | 50 | 219 | 91 | 572 | 228 | 800 | 180 | 555 | 68 | 623 |
| ST. LOUIS | 938 | 15,335 | 93 | 3,437 | 980 | 4,417 | 142 | 1,506 | 361 | 1,867 | 564 | 6,103 | 2,026 | 8,129 | 139 | 834 | 88 | 922 |
| SCOTT | 236 | 6,743 | 57 | 4,817 | 47 | 4,864 | 114 | 1,380 | 7 | 1,387 | 72 | 252 | 20 | 272 | 33 | 197 | 23 | 220 |
| SHERBURNE | 240 | 3,917 | 38 | 1,814 | 667 | 2,481 | 55 | 438 | 234 | 672 | 87 | 412 | 131 | 543 | 60 | 221 | | 221 |
| SIBLEY | 485 | 4,525 | 35 | 988 | 57 | 1,045 | 134 | 1,686 | 59 | 1,745 | 104 | 668 | 70 | 738 | 212 | 844 | 153 | 997 |
| STEARNS | 697 | 11,787 | 66 | 4,987 | 722 | 5,709 | 151 | 1,674 | 761 | 2,435 | 288 | 2,277 | 280 | 2,557 | 192 | 871 | 215 | 1,086 |
| STEELE | 131 | 2,931 | 11 | 1,076 | 464 | 1,540 | 53 | 590 | 57 | 647 | 20 | 184 | 14 | 198 | 47 | 191 | 355 | 546 |
| STEVENS | 383 | 1,651 | | | | | 78 | 552 | | 552 | 137 | 624 | 10 | 634 | 168 | 460 | 5 | 465 |
| SWIFT | 524 | 3,195 | 8 | 299 | 138 | 437 | 148 | 1,178 | | 1,178 | 171 | 1,040 | 26 | 1,066 | 197 | 483 | 31 | 514 |
| TODD | 637 | 7,672 | 57 | 2,420 | 36 | 2,456 | 215 | 2,374 | 377 | 2,751 | 168 | 1,348 | 234 | 1,582 | 197 | 842 | 41 | 883 |
| TRAVERSE | 284 | 2,150 | 4 | 92 | | 92 | 106 | 869 | 44 | 913 | 115 | 724 | 158 | 882 | 59 | 195 | 68 | 263 |
| WABASHA | 289 | 10,711 | 38 | 5,061 | 2,626 | 7,687 | 62 | 913 | 557 | 1,470 | 55 | 523 | 121 | 644 | 134 | 725 | 185 | 910 |
| WADENA | 502 | 3,579 | 10 | 785 | 154 | 939 | 90 | 582 | 276 | 858 | 266 | 1,233 | 144 | 1,377 | 136 | 361 | 44 | 405 |
| WASECA | 367 | 2,593 | | | 4 | 4 | 163 | 1,590 | 75 | 1,665 | 77 | 326 | 78 | 404 | 127 | 424 | 96 | 520 |
| WASHINGTON | 401 | 10,728 | 73 | 7,801 | 695 | 8,496 | 41 | 451 | 61 | 512 | 93 | 751 | | 751 | 194 | 946 | 23 | 969 |
| WATONWAN | 154 | 1,211 | 8 | 145 | 8 | 153 | 35 | 316 | 89 | 405 | 14 | 122 | 12 | 134 | 97 | 332 | 187 | 519 |
| WILKIN | 322 | 2,330 | 18 | 303 | 87 | 390 | 93 | 664 | 328 | 992 | 117 | 595 | 122 | 717 | 94 | 188 | 43 | 231 |
| WINONA | 352 | 17,918 | 43 | 13,149 | 685 | 13,834 | 71 | 1,065 | 248 | 1,313 | 107 | 1,365 | 323 | 1,688 | 131 | 818 | 265 | 1,083 |
| WRIGHT | 521 | 6,912 | 72 | 3,621 | 219 | 3,840 | 114 | 1,142 | 71 | 1,213 | 53 | 538 | | 538 | 282 | 1,154 | 167 | 1,321 |
| YELLOW MEDICINE | 185 | 1,846 | 19 | 580 | 146 | 726 | 55 | 382 | 75 | 457 | 43 | 209 | 23 | 232 | 68 | 198 | 233 | 431 |
| Total | 36,372 | 442,364 | 2,746 | 154,478 | 26,953 | 181,431 | 7,950 | 82,868 | 15,501 | 98,369 | 11,808 | 82,576 | 14,813 | 97,389 | 14,068 | 54,091 | 11,484 | 65,575 |

# COST OF IMMEDIATE NEEDS ON MUNICIPAL STREETS

## (AS OF NOVEMBER 1, 1953)

| POPULATION GROUP | TOTAL | | | STATE TRUNK HIGHWAYS | | | | ARTERIALS | | | | OTHER CITY STREETS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number Of Places | Miles | Cost ($1000) | Miles | Road Cost ($1000) | Structure Cost ($1000) | Total Cost ($1000) | Miles | Road Cost ($1000) | Structure Cost ($1000) | Total Cost ($1000) | Miles | Road Cost ($1000) | Structure Cost ($1000) | Total Cost ($1000) |
| 0- -500 | 435 | 673 | 15,759 | 82 | 5,844 | 1,332 | 7,176 | 174 | 2,255 | 830 | 3,085 | 417 | 5,313 | 185 | 5,498 |
| 501 - 1,000 | 146 | 413 | 8,867 | 38 | 3,225 | 578 | 3,803 | 52 | 649 | 301 | 950 | 323 | 4,092 | 22 | 4,114 |
| 1,001 - 2,500 | 133 | 507 | 15,550 | 56 | 6,523 | 1,576 | 8,099 | 44 | 900 | 210 | 1,110 | 407 | 5,762 | 579 | 6,341 |
| 2,501 - 5,000 | 39 | 320 | 12,157 | 41 | 5,336 | 1,529 | 6,865 | 44 | 720 | 386 | 1,106 | 235 | 4,067 | 119 | 4,186 |
| 5,001 - 10,000 | 31 | 342 | 17,816 | 24 | 4,003 | 1,790 | 5,793 | 50 | 1,826 | 1,515 | 3,341 | 268 | 8,028 | 654 | 8,682 |
| 10,001 - 30,000 | 20 | 611 | 35,153 | 47 | 7,297 | 4,498 | 11,795 | 132 | 7,526 | 2,936 | 10,462 | 432 | 12,041 | 855 | 12,896 |
| DULUTH | 1 | 228 | 12,007 | 3 | 3,846 | 32 | 3,878 | 41 | 1,095 | 565 | 1,660 | 184 | 5,489 | 980 | 6,469 |
| ST. PAUL | 1 | 157 | 51,745 | 46 | 29,199 | 7,919 | 37,118 | 13 | 2,347 | 360 | 2,707 | 98 | 11,270 | 650 | 11,920 |
| MINNEAPOLIS | 1 | 150 | 69,564 | 48 | 44,900 | 9,960 | 54,860 | 24 | 3,193 | 4,880 | 8,073 | 78 | 6,613 | 18 | 6,631 |
| TOTAL | 807 | 3,401 | 238,618 | 385 | 110,173 | 29,214 | 139,387 | 574 | 20,511 | 11,983 | 32,494 | 2,442 | 62,675 | 4,062 | 66,737 |