

# Maintenance Study of County Roads in Minnesota

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●MINNESOTA counties have a uniform accounting system which has been in operation for about ten years. It was established primarily as a fiscal accounting procedure so that the public might know that our expenditures were legal and proper. Probably not enough consideration was given to cost accounting. Now, after a few years' experience with our uniform system, our expenditures are accounted for, and our books balance, but our cost accounting on maintenance expenditures has not fared that well.

At various times, since the establishment of this accounting system, engineers in their district meetings have attempted to compare maintenance costs. In each instance, large variations in the cost for similar work was encountered which did not appear reasonable.

During the needs appraisal completed in 1954, the maintenance expenditures as shown in the engineers' Annual Reports for 1953 were tabulated for each item of maintenance operation. This tabulation was also studied by grouping the counties and their costs into the eight construction districts which generally reflect like conditions. These tabulations again showed a lack of uniformity on similar maintenance operations between counties. The county engineers recognized that the existing variations were greater than the difference in the maintenance service provided and could result from: (1) failure to make similar accounting charges of the different maintenance functions in each county, (2) maintenance practices in the various counties not being related to a uniform standard of maintenance, and (3) differences in the economy, topography, climate, soils conditions and traffic volumes.

It was therefore agreed that a study should be made to determine what constitutes a reasonable standard of maintenance under various road and traffic conditions.

## Organization of the Study

During the December 1954 Annual Institute of County Engineers, the maintenance problem of the counties was discussed by the entire membership. As a result of this discussion and interest, the Executive Committee of the County Highway Engineers Association appointed a committee to make a study of county maintenance problems. It was the duty of the committee to determine the existing deficiencies in the present accounting system, suggest methods to correct both reporting and accounting procedure, and to explore methods of establishing standards for maintenance operations.

This committee arranged for meetings with about half of the county engineers in district groups. In these meetings we explored the variations in accounting by asking individual engineers how each item of routine maintenance was actually charged and recorded in their records. It was found that many different interpretations were being applied to the standard code, with the result that similar items were charged to entirely different accounts.

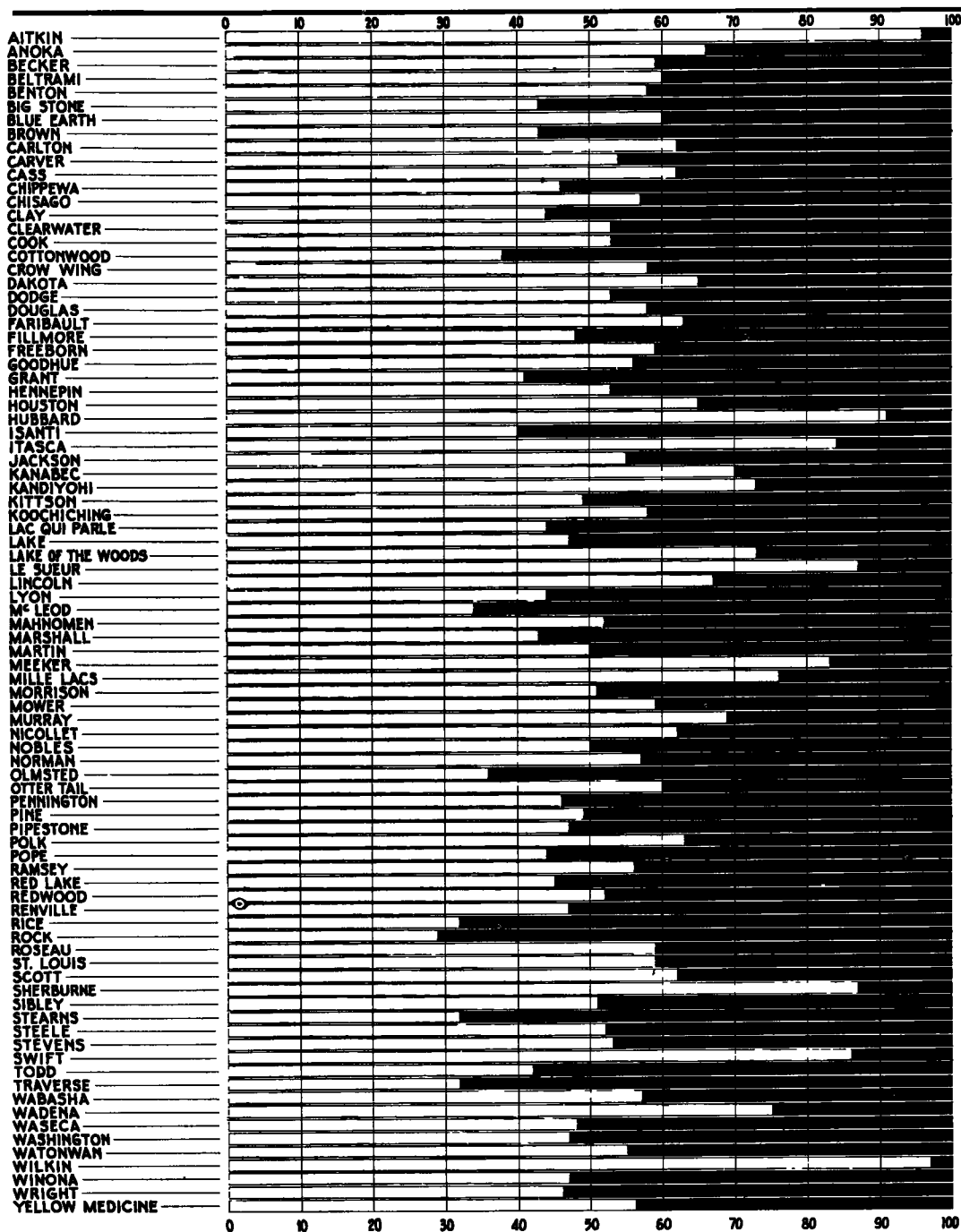
It was decided that although a good, uniform accounting system was in use in all the counties, individual interpretations of cost items were creating individual systems in many counties.

The following figures, compiled from the reported maintenance expenditures in Minnesota counties, show the present unrealistic variations in recorded maintenance charges.

Figure 1 shows the percentage of total budget expenditures for both maintenance and construction for each Minnesota county for the year 1954 and does not include any federal aid secondary funds. The open bars show the percentage spent for construction and the solid bars, the percentage charged as maintenance.

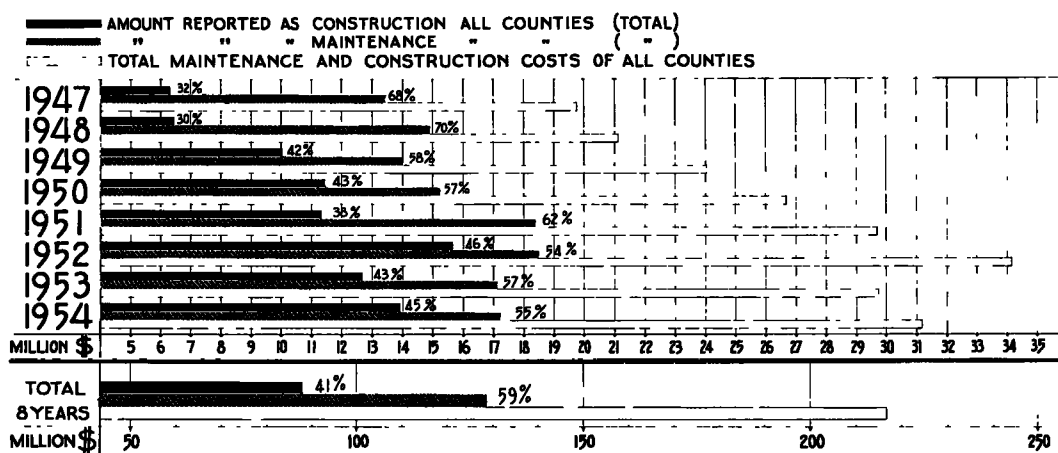
As Figure 1 indicates, one county reported 97 percent of its budget was spent for maintenance, and at the other extreme, one county reported only 28 percent for the same charge. There is little, if any, relation in the percentages reported to the wealth, traffic density, or general road conditions. This figure would lead one to believe that more variation exists because of accounting practices than because of operational differences.

% EXPENDED FOR MAINTENANCE PER COUNTY FOR 1954  
 % EXPENDED FOR CONSTRUCTION PER COUNTY FOR 1954



FEDERAL FUNDS USED ON COUNTY PROJECTS ARE NOT INCLUDED  
 COUNTY MATCHING FUNDS ARE INCLUDED

Figure 1.



FEDERAL AID USED ON COUNTY PROJECTS NOT INCLUDED  
 COUNTY MATCHING FUNDS ARE INCLUDED

Figure 2. Yearly expenditures showing breakdown of maintenance and construction costs.

Figure 2 shows the reported yearly expenditures, except for federal aid secondary funds, of all the counties in Minnesota from 1947 to 1954. The total expenditures for each year are shown by the open bars and the percentage spent for construction by the solid bars, with the percentage for maintenance represented by the hatched bars. The lower group of bars show the total statewide expenditures for the eight year period by the same symbols.

These two figures indicate that maintenance operations consume the largest part of the available highway funds. During the eight year period, out of a total budget of \$218 million, not including federal aid, 59 percent of this amount, or \$129 million, was charged as maintenance, while 41 percent, or \$89 million, was reported as construction. The 1954 reported cost of maintenance was 17.2 million dollars, and if even a 5 percent savings could be accomplished through the adoption of uniform standards of operation, the saving would pay the salaries of the 87 county engineers and their accountants.

Figure 3 shows the reported costs per mile for the routine maintenance of state aid gravel surfaced roads in 38 counties. These reported costs vary from \$104 to \$402 per mile. There exists no pattern to justify this variation either by location, resources, or the amount of road users in the counties.

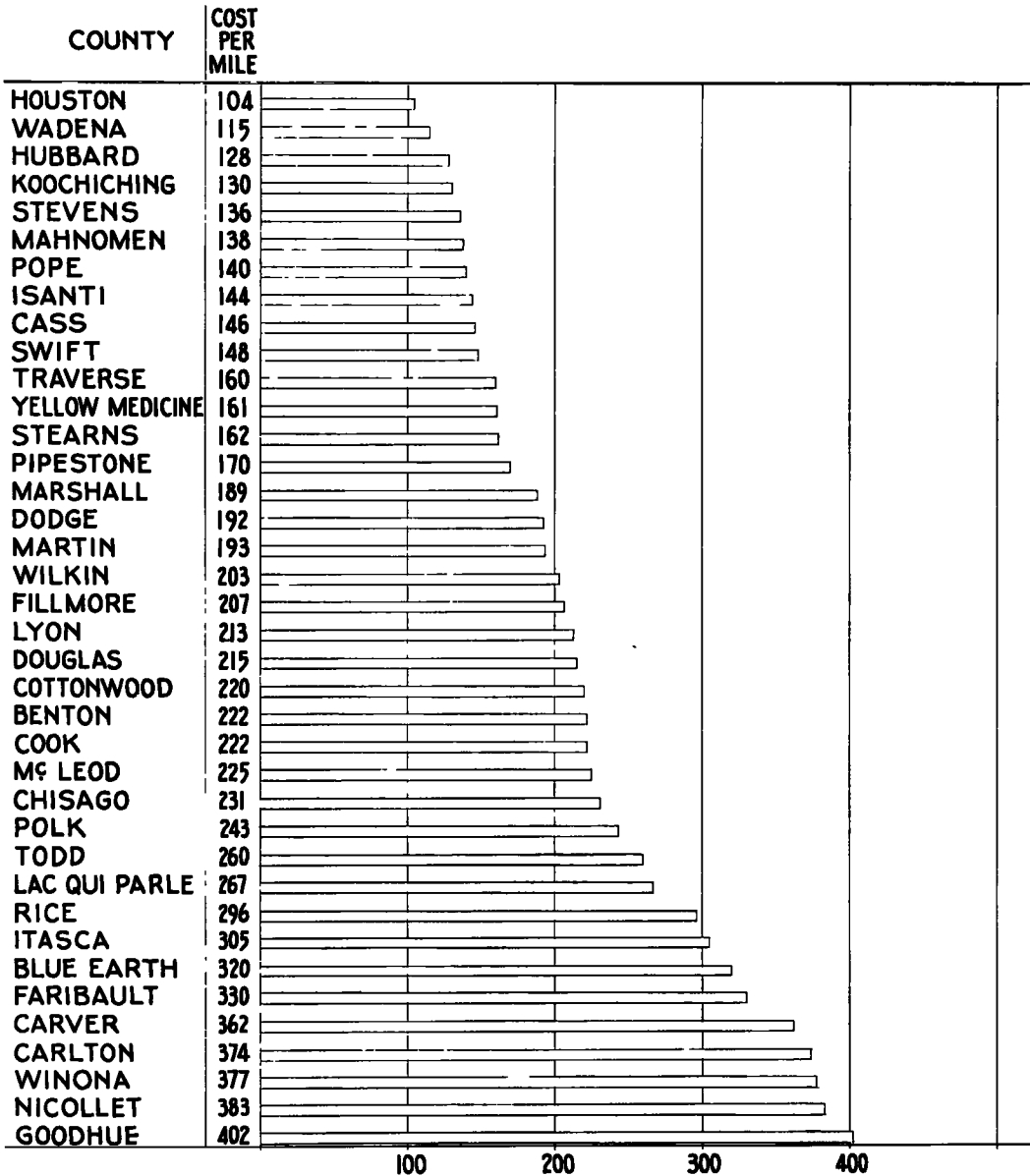
This figure does emphasize that variations do exist which cannot be explained or justified. If the reported expenditures are correct, it is apparent that some counties are spending too little for this function, or other counties are spending far too much.

Figure 4 is an analysis of routine maintenance costs on state aid gravel roads within one construction district. These counties are very similar regarding soil, wealth, topography and traffic volumes. Three counties in this district do not report separate routine items and no comparison of individual items of routine maintenance is possible. Total routine costs vary in this group of counties from a low of \$166 to a high of \$351 per mile, showing an extreme variation of \$185 per mile.

The variations between items of routine maintenance expenditures are such that they cannot be reconciled. The lower or hatched portion of the bars indicates the cost per mile of blading or smoothing gravel surfaces. The low cost for this item is \$72 per mile and the high cost is \$220 per mile. If the gravel roads on the state aid system in the county with the highest cost were bladed at the lower figure, a saving of \$40,000 would result. These are adjoining counties in which this item should be comparable.

With these facts in mind, the committee felt that the study would have to cover both the cost accounting and the extent of maintenance service provided. An outline was prepared for both of these investigations.

The first section attempts a refinement of the present reporting and accounting procedure. After investigation, it was decided that the present accounting system was adequate and if properly used and charges were made uniformly, this system would give accurate results. It was acknowledged that the major deficiency in using the system was the lack of a uniform interpretation of maintenance charges between the counties. In order to provide uniformity between all counties, instructions were sent to all



AVERAGE COST (38 COUNTIES SHOWN) \$ 222 PER MILE  
 MEDIAN COUNTY 207 TO 213

Figure 3. Variations in total routine costs of state aid (gravel surfaced) roads - 1953.

COST PER MILE

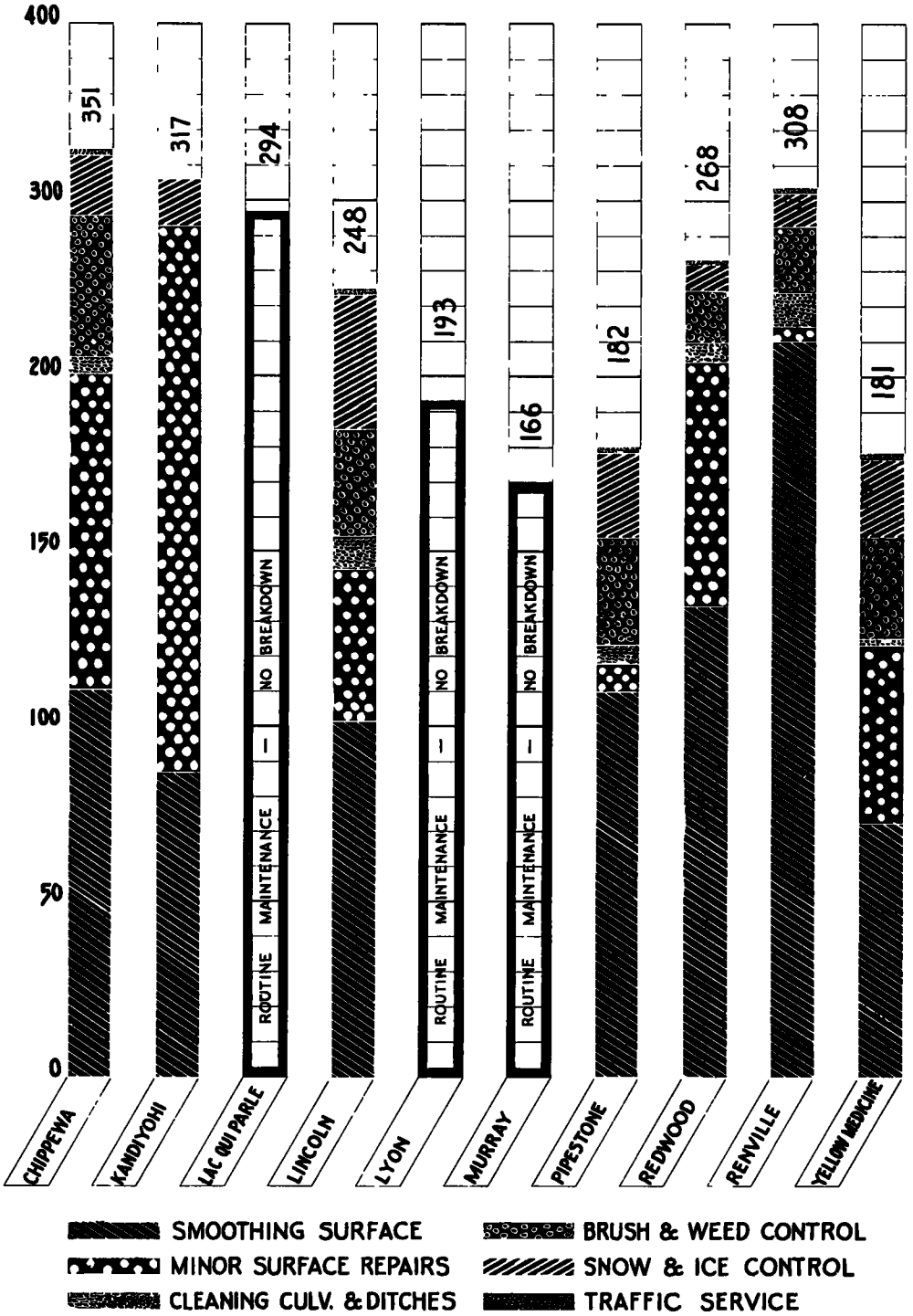


Figure 4. Analysis of routine maintenance on state aid roads within one district - 1954.

counties specifically describing the routine maintenance items and spelling out how charges should be made. As the study progresses, further instructions will be included, and eventually a complete accounting manual will be compiled. This manual is being written with the aid of the accountants so that the completed manual will be technically correct and readily understood by those who have the responsibility for this work.

The committee, aware of the importance of accurate reporting by operators in the field, has attempted to strengthen this part of the work by asking the engineers to take personal responsibility for all field reports, to carefully instruct the men and impress upon them the importance of their individual reports in the accounting procedure of the county.

The second section is designed to obtain the measurement of existing maintenance operations and permit the establishment of desirable standards of maintenance. Although it is known that some of the variations in maintenance costs between counties result from inaccurate accounting procedure, other variations are known to be the result of the extent of maintenance operations themselves. Different counties maintain roads to various standards, and no desirable standard exists that can be used as a guide. From the figures shown, it is apparent that if maintenance standards existed, more attention would be given to control these operations within reasonable limitations, and the variations would be less extreme between neighboring counties.

Test sections have been established in about half of the counties which will give an accurate measurement of present operations. Selection of the test sections was left to the local county engineer subject to the instructions set up by the committee. A test section data sheet is filed for each test section giving all the factual data required by the committee. Separate accounts are maintained by the county engineer for each test section, giving both labor and equipment time, in addition to the number of operations performed for each item of routine maintenance. Monthly reports for each test section will be sent to the central office where they will be tabulated for the committee, and from this data will be developed an initial set of standards for the major road types and traffic volumes. It may be necessary to develop standards by districts or areas to reflect the differences in cost due to topography, soils and economic considerations.

In 1957 these initial standards will be used on the test sections and operations or standards adjusted, where necessary, to provide adequate maintenance for each section. These standards can be used on other roads and by other county engineers as a measuring stick for their operations and expenditures.

Uniform reporting of maintenance charges by all Minnesota counties, and a standard by which to plan operations, should result in improved maintenance performance. Comparisons between counties will be realistic and possible. Better planning of operations by standards, will result in more uniform costs between counties and could result in a substantial reduction of maintenance expenditures.

## ESTABLISHMENT OF TEST SECTIONS

### How to Choose Your Test Section

You are asked to choose five test sections in your county. The following types of sections are suggested but will have to be adjusted to the conditions in your county. Each section should be at least five miles in length, except in incorporated areas, or for some other special reasons.

- A. Bituminous surface in a rural area.
- B. Bituminous surface in an incorporated area.
- C. Gravel or rock surface with high A. D. T. above 100.
- D. Gravel or rock surface with medium A. D. T. above 50.
- E. Gravel or rock surface with low A. D. T. 0 to 50

You are to choose from your own roads, sections that will meet these requirements and to furnish, for each section, a complete data sheet. In choosing these sections, several other requirements should be kept in mind. For gravel surfaced road sections you will probably want the section under an operator who can understand the purpose of the study and will submit accurate reports. The section should also be studied from an operational standpoint and should be a section over which you can obtain control of operations.

One of the facts we would like to obtain on gravel surfaced roads is the annual replacement of gravel. With this in mind, your section might possibly be chosen as a newly constructed road on which, under construction, you now have an adequate gravel surface, or on which you have records of the amount of gravel replacement since it was constructed.

A road should not be chosen as a test section if you anticipate a change in the surface type within a year or two.

The test sections should reflect average conditions rather than exceptional conditions.

Long test sections are more desirable than short ones.

In each county it is desirable to have one test section which will reflect maintenance costs on low traffic volume roads, below 25 A. D. T. Actual traffic count may not be available for these sections, but the engineer can reasonably estimate traffic for sections of this type.

**Special Sections.** It is desirable to have test sections on which the use of chemicals to consolidate gravel or crushed rock surfaces are employed. If you have roads on which you now use or plan to use calcium chloride, salt or other chemicals, it would be beneficial to include these roads as test sections.

#### DIRECTIONS FOR COMPLETING TEST DATA

- A. **County Name.** Location, show section on county map in color. Sections should be at least 5 miles in length. Except in incorporated areas. Give beginning and termination of section. Length of section in miles to the nearest tenth of a mile.
- B. **Classification.**  
Check existing system of section.  
If section is in an incorporated town, give the population.  
Check main use or uses of section.
- C. **Inventory.**
  1. Check terrain type.
  2. Give year when road was graded.
  3. Check design type of roadway—modern design type is streamlined section.
  4. Give soil classification of roadway (subbase).
  5. If roadway contains frost boil areas or unstable areas, indicate.
  6. Give roadway grade width and surface width.
  7. **Surface type.**  
PCC - Portland Cement Concrete  
PMB - Plant-Mixed Bituminous  
RMB - Road-Mixed Bituminous  
STB - Surface Treated Bituminous  
GR - CR - Gravel - Crushed Rock Untreated  
GRS - CRS - Gravel - Crushed Rock Stabilized with Soil  
GRSC - CRSC - Gravel or Crushed Rock Stabilized with Calcium Chloride  
GRSS - CRSS - Gravel or Crushed Rock Stabilized with Salt  
Gravel or crushed rock surface depths—depths of present surface measured in inches obtained by digging sufficient holes in the section to determine the average depth. Gravel or rock depths will be considered as the distinct point between the gravel and soil of the road.
  8. **Base type.**  
SC - Soil Cement  
GR - CR - Graded Gravel - Crushed Rock  
SA - Sand
  9. **Seal type.**  
Light seal 0.15 gallon or less of bituminous material per square yard.  
Heavy seal more than 0.15 gallon of bituminous material per square yard.
  10. **Surface age.** Applies to concrete, bituminous and chemical treated gravel or crushed rock.
  11. **Surface condition.** Seal condition. Indicate by good, fair, poor, existing con-

dition of both surface and seal condition for bituminous.

Surface condition only for concrete. Does not apply to gravel or crushed rock surfaces.

12. Give A. D. T. for 1955 and indicate if truck traffic is low, normal or high.
13. Give average summer traffic 1955 if section is classified as recreational.
14. For use on road sections below 25 A. D. T. check service functions.
15. Give spring load restrictions and indicate if restrictions are enforced.

**MINNESOTA MAINTENANCE STUDY**  
Test Section Data Sheet

**A. Identification**

County \_\_\_\_\_ Date \_\_\_\_\_ No. \_\_\_\_\_

Location \_\_\_\_\_

Length \_\_\_\_\_ miles

**B. Classification**

- |                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/> State Aid  | <input type="checkbox"/> Urban type not incorporated |
| <input type="checkbox"/> County Aid | <input type="checkbox"/> Incorporated                |
| <input type="checkbox"/> F. A. S.   | <input type="checkbox"/> Agricultural use            |
| <input type="checkbox"/> Township   | <input type="checkbox"/> Recreational use            |
| <input type="checkbox"/> Rural      | <input type="checkbox"/> Industrial use              |

\_\_\_\_\_ Population

**C. Inventory**

1. Terrain:  Flat       Rolling       Hilly
2. Year graded \_\_\_\_\_
3. Design type:  Modern       Old
4. Soil classification \_\_\_\_\_
5. Has frost boil areas  Yes       No
6. Grade width \_\_\_\_\_ ft.      Surface width \_\_\_\_\_ ft.
7. Surface type \_\_\_\_\_      Thickness \_\_\_\_\_ in.
8. Base type \_\_\_\_\_      Thickness \_\_\_\_\_ in.
9. Seal type \_\_\_\_\_
10. Surface age \_\_\_\_\_ yr.      Seal age \_\_\_\_\_ yr.
11. Surface condition \_\_\_\_\_      Seal condition \_\_\_\_\_
12. Traffic A. D. T. 1955 \_\_\_\_\_  
Truck traffic:  Low       Normal       High
13. Traffic avg. summer 1955 \_\_\_\_\_
14. Service function:  Mail Rte.       S. Bus       Milk Rte.
15. Spring load limits \_\_\_\_\_      Are they enforced? \_\_\_\_\_